GYAN VIGYAN SARITA:शिक्षा

A non-remunerative, non-commercial and non-political initiative to Democratize Education as a Personal Social Responsibility (PSR)

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72nd Independence Day : 15th August

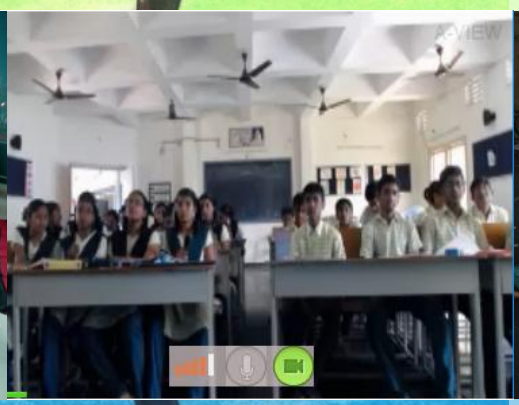
THROUGH INTERACTIVE ONLINE MENTORING SESSIONS (IOMS)

WITH A SENSE OF PERSONAL SOCIAL RESPONSIBILITY (PSR)

AMONG UNPRIVILEGED CHILDREN

IN GROOMING COMPETENCE TO COMPETE

BY COLLECTIVELY COMPLEMENTING OF EFFORTS



WE COMMEMORATE SACRIFICES OF OUR MARTYRS


LET'S SPREAD COLOURS
OF KNOWLEDGE & HAPPINESS
THIS INDEPENDENCE DAY

Swadesh Mantra - एक आह्वान.

Swami Vivekananda

O India! With this mere echoing of others, with this base imitation
of others, with this dependence on others, this slavish weakness,
this vile detestable cruelty -- wouldst thou, with these provisions
only, scale the highest pinnacle of civilisation and greatness?
Wouldst thou attain, by means of thy disgraceful cowardice, that
freedom deserved only by the brave and the heroic?
--
O India! Forget not that the ideal of thy womanhood is Sita, Savitri, Damayanti;
forget not that the God thou worshippest is the great Ascetic of ascetics, the all- renouncing Shankara, the Lord of Uma;
forget not that thy marriage, thy wealth, thy life
are not for sense-pleasure, are not for thy individual personal happiness;

forget not that thou art born as a sacrifice to the Mother's altar;
forget not that thy social order is but the reflex of the Infinite
Universal Motherhood;

forget not that the lower classes, the ignorant, the poor, the illiterate, the cobbler, the sweeper, are thy flesh and blood, thy brothers.

Thou brave one, be bold, take courage, be proud that thou art an Indian, and proudly proclaim, " *I am an Indian, every Indian is mybrother.* " Say, " *The ignorant Indian, the poor and destitute Indian, the Brahmin Indian, the Pariah Indian, is my brother.* "

Thou, too, clad with but a rag round thy loins proudly proclaim at the top of thy voice: " *The Indian is my brother, the Indian is my life, India's gods and goddesses are my God. India's society is the cradle of my infancy, the pleasure-garden of my youth, the sacred heaven, the Varanasi of my old age.* "

Say, brother; " *The soil of India is my highest heaven, the good of India is my good,* " and repeat and pray day and night, " *O Lord of Gauri, O Thou Mother of the Universe, vouchsafe manliness unto me!*

O Mother of Strength, take away my weakness, take away my unmanliness, and make me a Man! "

ऐ भारत ! क्या दूसरों की ही हां में हां मिला कर, दूसरों की ही नकल कर,

परमुखापेक्षी होकर इस दासों की सी दुर्बलता,

इस घृणित जघन्य निष्ठुरता से ही

तुम बड़े-बड़े अधिकार प्राप्त करोगे?

क्या इसी लज्जास्पद कापुरुषता से तुम

वीरभोग्यास्वाधीनता प्राप्त करोगे?

--

ऐ भारत ! तुम मत भूलना कि तुम्हारी स्त्रियों का आदर्श
सीता,सावित्री,दमयन्ती है;

तुम मत भूलना कि तुम्हारे उपास्थ सर्वत्यागी उमानाथ शंकर हैं;

मत भूलना कि तुम्हारा विवाह, धन और तुम्हारा जीवन

इन्द्रिय सुख के लिए, अपने व्यक्तिगत सुख के लिए नहीं है;

मत भूलना कि तुम जन्म से ही माता के लिए बलिदान स्वरूप रखे गए हो;

मत भूलना की तुम्हारा समाज उस विराट महामाया की छाया मात्र है,

मत भूलना कि निम्न,अज्ञानी, दरिद्र, मेहतर तुम्हारा रक्त और तुम्हारे भाई हैं;

ऐ वीर, साहस का साथ लो, गर्व से बोलो कि "मैं भारतवासी हूं और प्रत्येक भारतवासी, मेरा भाई है"

बोलो कि "अज्ञानी भारतवासी, दरिद्र भारतवासी, ब्राह्मण भारतवासी, चांडाल भारतवासी, सब मेरे भाई हैं" ;

तुम भी कटिमात्र वस्त्रावृत्त होकर गर्व से पुकार कर कहो कि "भारतवासी मेरा भाई है,

भारतवासी मेरे प्राण हैं, भारत के देव-देवियाँ मेरे ईश्वर हैं;

भारत का समाज मेरी शिशुसज्जा,मेरे यौवन का उपवन और मेरे वृद्धावस्था की वाराणसी है"

भाई, बोलो कि "भारत की मिट्टी मेरा स्वर्ग है, भारत के कल्याण में मेरा कल्याण है,

और दिन-रात कहते रहो कि हे गौरीनाथ,हे जगदम्बे, मुझे मनुष्यत्व दो !

पुष्प की अभिलाषा

माखनलाल चतुर्वेदी

चाह नहीं मैं सुरबाला के
गहनों में गूँथा जाऊँ,
चाह नहीं, प्रेमी-माला में
बिंध प्यारी को ललचाऊँ,
चाह नहीं, सम्राटों के शव
पर, हे हरि डाला जाऊँ,
चाह नहीं, देवों के सिर पर
चढ़ूँ, भाग्य पर इठलाऊँ।
मुझे तोड़ लेना वनमाली !
उस पथ पर देना तुम फेंक
मातृभूमि पर शीश चढ़ाने
जिस पर जावें वीर अनेक

—00—

Dishita Class 7th,
Khaitan Public School, NOIDA

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Aim at the Best, but...

... start, without loosing time, with whatever is available.

Infrastructural requirement for Centers in Interactive Online Mentoring Sessions (IOMS)

Learning Center (if asked for by Mentor)		Mentoring Center (if asked for by Mentor)	
Estimated Capital Cost (One Time)			
Particulars	**Cost (in Rs)**	**Particulars**	**Cost (in Rs)**
Desktop (without monitor)	20,000	Laptop	25,000
Projector	15,000	Projector	-
Web camera	10,000	Web camera	-
Mixer cum amplifier with Speaker and Wireless microphones	15,000	Headset with Microphone	3,000
Wireless Surface Writing device	15,000	Wireless Surface Writing device	15,000
Total	75,000		43,000
Estimated Recurring Cost			
Internet charges, based on estimated monthly data transfer which depends upon choice of cloud platform, and tariffs of ISP		Internet charges, based on estimated monthly data transfer which depends upon choice of cloud platform, and tariffs of ISP	
Cloud platform : a. Subscription whether it annual as in WebEx or One time with AMC like in as in UTP+. b. Cloud platform is a shared resource across Learning Centers benefitting from IOMS. c. The IOMS envisages session for more than one centre together, these charges may be shared across, or one centre bears total cost sequentially. It is purely in mutual agreement between Learning Centers. d. Benefit of sharing of charges of cloud platform can be optimized with offset of schedule of sessions of IOMS.		IOMS is since an initiative driven with Personal Social Responsibility (PSR) operating n Zero-Fund-&-Zero-Asset (ZFZA) basis, the Cloud Platform has to provided by Learning Centers benefitting from IOMS. Gyan Vigyan Sarita will be pleased to connect Learning Centers for collectively complementing the cost of Cloud Platform for arriving at a mutual agreement on financial sharing. So also IT Infrastructure with Dr Joshi has been in use and is working. But, at any stage if upgradation becomes essential, extended hand by learning centers is gratefully welcomed on ZFZA basis. The same is true for any other mentor joining IOMS	

Specification: These were practiced independently, based on ground level operating experience and need of optimizing the cost on the initiative. This is essential to utilize financial resources, considered scarce, for benefitting more number of students at more number of centers and mentoring centers.

These specifications have been updated by deriving motivation from **VIVEKDISHA, Belur Math**, which has been engaged in Online Teaching to about 22 Centers, since last 10 years. The only difference that IOMS has is in extensive use of Whiteboard.

Web Camera: Logitech HD 1080p, with a tripod or wall mounting

Projector: Portronics LED Projector Beam 100", 100 Lumen, 130" Screen size, 800x480px resolution

Mixer-cum-Amplifier: Ahuja Make PA Mixer Amplifier Model DPA-370, 30 W Max/37W Max, with Two Cordless Mikes and Speakers. This device offers echoless input/output communication with base computer and Mikes and Speakers in the Class.

Cloud Platform: A-VIEW (Amrita Virtual E-Learning World) developed by Amrita University in association with IIT Bombay, an MHRD, GOI sponsored project.. Problems with Whiteboard functionality of A-VIEW are being circumvented with OneNote app of MS Office for IOMS. This has many features of minimizing bandwidth requirements.

Surface Writing Device: HUION make Model WH1409, or Wacom Intuos with wireless device makes it suitable for communication with base computer in class like environment.

UPS: An additional accessory, for uninterrupted continuity of session, based on power availability to be decided by Learning Center, **not included in above cost estimates.**

Furniture and Lighting: At Learning Center, as deemed fit by local administration of Learning Center, **not included in above cost estimates.**

संपादकीय

स्वतंत्र भारत और राष्ट्रीय नेतृत्व

भारत विविधताओं का देश है। यहां भिन्न-भिन्न प्रकार की वेशभूषा, बोलियां और रहन-सहन प्रचलित हैं। यह सब की सब यहां के लोगों की धरोहर हैं, या यूं कहें कि यही विविधता भारत है, यही भारत की सांस्कृतिक पहचान है, और यही यहां के लोगों की खुशहाली का कारण है। जितनी अधिक भिन्नता यहां दीखती है, उतना ही अधिक अपनापन भी एक दूसरे के बीच में मिलता है।

हमारी विविधता में एक कमी हमेशा से रही। यहां राजाओं की अधिकता रही। सभी एक दूसरे से लड़ते रहे और जनता पिसती रही। विदेशी आक्रांताओं ने इसका फायदा उठाया और हम पर शासन करने के लिये आते रहे। हमारे राजाओं ने इससे कोई सबक नहीं लिया। वर्तमान में राजाओं की जगह नेताओं ने ले ली है। काम कम, बोलना अधिक-इनका ध्येय वाक्य बन गया है। क्या बोलते हैं, क्यों बोलते हैं, किसके लिये बोलते हैं, उस बोलने से किसका फायदा होता है, किसका नुकसान होता है, उनका बोलना देश के हित में है, अथवा देश को तोड़ने वाला है, इससे उनका कोई लेना देना नहीं होता है। बनाने में पीढ़ियां गुजर जाती हैं-ये क्षण भर में सब तार-तार कर देते हैं, और तो और, इनका कुछ बिगड़ता भी नहीं है।

हम भारतवासी सोने की चिड़िया तब तक रहे, जब तक हमने धर्म, कर्म, अलग-अलग रखते हुये भी विदेशी आक्रांताओं के सामने एक जुट बने रहे। जब जब हम बिखरे, दूसरों ने हम पर राज किया। हमने अपनी अस्मिता उन्हें सौंप दी। याद होगी, बड़ी मुश्किल से मिली है, एक बार फिर से आजादी। चलो, इसे संवारें और अबकी इसे अपनी जीवन-शैली में ले आयें।

आजादी हमें कुछ सीख देती है-जितना कम बोलेंगे, उतना अधिक सोचेंगे। जितना कम देश के विरोध में रहेंगे, देश के विकास के बारे में उतना अधिक सोचेंगे और एक दूसरे की खुशहाली में ज्यादा शरीक होंगे।

किसी भी राष्ट्र की पहचान, उसके धर्म, ध्वज, संस्कृति और विरासत के साथ साथ, उसे आगे लेकर चलने वाले नेतृत्व से होती है। नेतृत्व वह होता है जो केवल देश के बारे में सोचे। खून से लथपथ पोरस जब अपनी सेना की हार के बाद आत्मसमर्पण के लिये युद्धस्थल में सिकंदर के सामने पहुंचता है, और सिकंदर उससे पूछता है कि तुम्हारे साथ कैसा सलूक किया जाये, उस समय पोरस का यह कहना कि जैसा एक राजा, दूसरे राजा के साथ करता है-यह सुन सिकंदर का भारत को जीतने का मंसूबा चूर-चूर हो जाता है और वह वीर पोरस की हिम्मत और नेतृत्व की क्षमता के सामने नतमस्तक हो जाता है, अपनी जीत भूल जाता है, पोरस को मित्र बना लेता है, और उसका राज्य उसे वापस कर देता है। यह होती है - वीर पुरूष की पहचान, कठिन परिस्थिति में भी देश के बारे में सोचना न कि अपने जीवन की रक्षा के बारे में चिंतित होना और अपने लिये जीवनदान की भीख मांगना।

आज आवश्यकता है हमें ऐसे नेतृत्व की, जो देश के बारे में सोचे, और ऐसे लोगों को आम जनता के जीवन से दूर करे जो जनता को बरगलाते ज्यादा हैं और उसकी जरूरत के समय खड़े कम होते हैं।

नेतृत्व हमें अपनी सेना से सीखना चाहिये जहां लड़ाई के समय उनका नेतृत्व करने वाला अपने सैनिकों के साथ कंधे से कंधा मिलाकर खड़ा रहता है, और उनको हौसला देता रहता है कि सब साथ-साथ हैं।

देश की अस्मिता हमेशा उसने नेतृत्व में समाहित रहती है। जैसा कर्मठ नेतृत्व होता है, वैसा ही कर्मशील देश होता है। जैसा निकम्मा राजनेता होता है, वैसा ही अकर्मण्य जनसमुदाय बनता है। दूसरे देशों में देश नहीं जाता है, वहां उसका नेतृत्व जाता है। दूसरे देशों में किसी देश का धन-धान्य नहीं जाता है, वहां सजग नेतृत्व की हुंकारमय वाणी जाती है। यदि नेतृत्व सजग, सफल और ईमानदार है तो हर जगह देश की छवि जागरूक, आगे बढ़नेवाला और ईमानदार राष्ट्र की होती है। नेतृत्व जितना देश के प्रति समर्पित और आस्थावान रहता है, कठिन समय में जितनी देर तक वह देश के साथ खड़ा रहता है, जितनी सहजता से अपने नागरिकों, सैनिकों, किसानों, व्यापारियों को भरोसा दिलाता है, जितनी आसानी से लोग उसकी एक आवाज पर उठ खड़े होते हैं, उसका वर्तमान जितना उसके भूतकाल से मेलखाता है, उतना ही देश तरक्की करता है, दूसरे देशों में उसका उतना ही भय रहता है, और उतनी ही उसकी इज्जत रहती है। देश का सम्मान ओज पूर्ण वाणी और ईमानदार शासन-प्रणाली से बढ़ता है।

स्वतंत्रता अनमोल होती है। स्वतंत्रता एक जीवन-शैली होती है। कभी कोई सिक्ख कहीं भी भीख मांगता नजर नहीं आयेगा क्योंकि कर्मठता उनके खून के हर बूंद में भरी पड़ी है, मेहनत करना और दूसरों की मदद में सबसे पहले आ खड़ा होना उनकी जीवनशैली है। उनका निडर होना उनकी ताकत है।

जब लोग बदलाव के विचार से डरते नहीं हैं, तभी स्वतंत्रता मिलती है। स्वतंत्रता उस समाज को मिलती है जो सदैव अपना जीवन खोने के लिये तैयार रहता है। स्वतंत्रता कुछ नहीं, बस बेहतर होने का एक अवसरभर है। स्वतंत्रता का अर्थ यह नहीं होता है कि हमारी जंजीरें कट गयी हैं, बल्कि स्वतंत्रता का अर्थ यह होता है कि हमारी वजह से कितने और लोग सम्मानजनक जीवन जीने लगे हैं। साहस से स्वतंत्रता आती है, और साहस से ही स्वतंत्रता सुरक्षित रहती है।

स्वतंत्र जीवन प्रकृति का उपहार है। स्वतंत्र वृक्ष आकाश से बातें करते हैं। स्वतंत्र पुष्प अपनी महक चारों दिशाओं में बिखेरते हैं। स्वतत्र मनुष्य चहुंमुखी विकास करते हैं। पराधीनता में विकास नहीं हो पाता है। मनुष्य जीवन का मतलब है-विकासमय जीवन। यदि विकास नहीं है तो फिर जीवन व्यर्थ है। स्वतंत्रता हर व्यक्ति का जन्मसिद्ध अधिकार है।

भारत सदियों की गुलामी के बाद 15 अगस्त 1947 को स्वतंत्र हुआ था। भारत का सांस्कृतिक इतिहास हजारों वर्षो का है। विदेशी आक्रामक आये, यहां घुलमिल गये। कुछ ने भारतीय संस्कृति को अपनाया, कुछ ने अपनी संस्कृति इसके अनुकूल की और फिर यहीं बस गये। यह घुलने मिलने का क्रम जबतक चलता रहा, यहां के लोगों को यह महसूस ही नहीं हुआ कि वे विदेशी आक्रांताओं के पराधीन थे। लेकिन जब अंग्रेजों ने अठारहवीं शताव्दी में हम पर राज्य करना शुरू किया तब यहां के लोगों को आभास हुआ कि वे तो गुलाम हो गये हैं, परतंत्र हो गये हैं और अपना अस्तित्व खो चुके हैं क्योंकि अंग्रेजों ने भारत को अपना देश समझ कर शासन नहीं किया बल्कि इस देश के धन धान्य, संपन्नता को देश के बाहर इंगलैंड भेजना शुरू कर दिया और देश को लूटना शुरू कर दिया।

बस क्या था, आजादी की मांग की शुरूआत हो गयी। भारतीय युवकों ने आजादी का बिगुल 19वीं शताब्दी में बजा दी। अपना सर्वस्व न्यौछावर कर दिया। कुछ शहीद हुये। मंगल पांडे, महारानी लक्ष्मीबाई, तात्यांटोपे, रामप्रसादविस्मिल, सुभाषचंद्रबोस, भगतसिंह, चंद्रशेखरआजाद, खुदीरामबोस, आदि के त्याग ने अंग्रेजों की नींद हराम कर दी।

स्वतंत्रता की ज्योति जगाने वालों का एक ही नारा था कि लोगों को अपने देश के लिये एकजुट होना चाहिये, और देश को टुकड़े टुकड़े करने वालों के प्रति सचेत रहना चाहिये।

इतिहास याद दिलाता है कि सत्रहवीं शताब्दी के मध्यकाल में डच, पुर्तगाल, ब्रिटेन, फ्रांस, आदि अनेक यूरोपीय देश भारत से व्यापार करने के इच्छुक थे। मुगल सल्तनत कमजोर हो गयी थी। भारतीय राजवंश आपसी मतभेदों में उलझा हुआ था और आपस में युद्ध करने में व्यस्त था। इसका लाभ उठाकर अंग्रेजों ने 1840 ई तक समस्त भारत को अपने कब्जे में ले लिया।

1857 में ईस्ट इंडिया कंपनी के विरोध में लोगों ने पहली बार विद्रोह किया। इस विद्रोह को प्रथम असफल स्वतंत्रता संग्राम कहा गया। बीसवीं शताब्दी के प्रारंभ में अंग्रेजो से स्वतंत्रता प्राप्ति का संघर्ष चला।

15 अगस्त 1947 को भारत अंग्रेजों की दासता से मुक्त हुआ, पर अंग्रेज जाते जाते भारत को दो भागों - पाकिस्तान और हिंदुस्तान में बांट गये और हमारे राजनेता खुशी खुशी इसे स्वीकार भी कर लिये। वर्तमान का इंडियन इंस्टीटयूट आफ एडवांस स्टडीज शिमला जो पहले वाइसरीगल हाउस अथवा राष्ट्रपति निवास हुआ करता था, की फोटो गैलरी हर देशवासी को एकबार अवश्य देखनी चाहिये, जो देश के बंटवारे की आज भी गवाही देती है।

देर से ही सही, आज की 21वीं सदी का स्वतंत्र भारत दुनिया में राजनीतिक ही नहीं बल्कि आर्थिक ताकत के रूप में भी उभर रहा है। भारतीय युवक अपनी प्रतिभा और क्षमता को हर देश में विखेर रहे हैं। हर गांव विकास कर रहा है। महिलायें पुरूषों की बराबरी में विकास कर रही हैं। हर क्षेत्र में महिलायें बिना भेदभाव काम कर रही हैं।

स्वतंत्रता को अक्षुण्य रखने के लिये, आज आवश्यकता है कि हम देश की स्वतंत्रतता को नुकसान पहुंचाने वाले लोगों को पहचानें, उनकी कुटिल चालों को समझें, उनके स्वार्थीपन को उनसे छीनें, और उन्हें ताकतवर होने से रोकें ताकि हमारा देश तरक्की करके संसार के विकसित देशों की बराबरी कर सके।

जो देश संगठित रहता है उसे न तो कोई तोड़ सकता है और न ही कोई उसका कुछ बिगाड़ सकता है। वह हमेशा सामूहिक प्रयास से उन्नति करता जाता है।

सरदार बल्लभ भाई पटेल एक ऐसे राजनेता थे, जो बोलते कम थे और काम ज्यादा करने में विश्वास करते थे। उन्होंने 565 रियासतों को भारत में विलय किया। इंदिरा गांधी एक ऐसी महिला थीं, जो अपने निर्णयों पर अडिग रहती थीं। उन्हें आयरन लेडी भी कहा जाता है। उन्होंने आतंकी पाकिस्तान का नक्शा ही बदल डाला। पूर्वी पाकिस्तान को हमेशा हमेशा के लिये खत्म कर बांगलादेश में परिवर्तित कर दिया। अटलबिहारी बाजपेयी एक ऐसे नेता हुये जिन्होंने governance and development को राजनीतिक एजेंडा बनाया, जिसे आज भी हर कोई अपनाना चाहता है। सबको साथ लेकर चलना उन्होंने सिखाया।

वर्तमान प्रधानमंत्री मोदी ने देश के युवाओं की आर्थिक सूझबूझ, कम्प्यूटर जगत में उनकी दूरदर्शिता, एकजुट होने की कला को समझा है और विश्व को यह बताया है कि भारत अपने युवाओं के बल पर विश्व को नेतृत्व देने में सक्षम है। भारत आज विश्व में उनके माध्यम से वह स्थान पा रहा है जिसे आजतक किसी ने नहीं किया था। आज भारत विश्व के बड़े बड़े देशों के साथ खड़ा नजर आता है न कि उनका पिछलग्गू बना दीखता है। विश्व का हर देश भारत को साथ लेकर चलना चाहता है, उसके साथ खड़ा रहना चाहता है और उसे पहली पंक्ति में स्थान देने के लिये राजी है।

सच कहा है - जब व्यक्ति की सोच ईमानदारी भरी हो, और निःस्वार्थ कार्य करने की नियत हो, तब उसे आगे बढ़ने से कोई रोक नहीं सकता है। आज यही वह समय है जिसके लिये भारत उठ खड़ा हुआ है। आज विश्व का हर देश जान गया है कि भारतीय ईमानदार, कर्मठ, दूर तक सोचने वाला और उज्ज्वल भविष्य की ओर देखने वाला होता है।

जय भारत !!

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OUR MENTORING PHILOSOPHY: Mentoring is not teaching, neither tuition nor coaching. It is an activity driven by passion, and commerce has no place in it. In this effort is to caution students that -

- This place is not where they will be taught how to score marks and get higher ranks, but to conceptualize and visualize subject matter in their real life so that it becomes intuitive.
- This place is not to aim at solutions but inculcate competence to analyze a problem and evolve solution.
- This place does not extend selective and personalized attention, rather an opportunity to become a part of which is focused on learning and problem solving ability collectively.
- This place provides an opportunity to find students above and below one's own level of learning. Thus students develop not in isolation but learn from better ones and associate in problem solving to those who need help. This group dynamics while create a team spirit, an essential attribute of personality, while one learns more by teaching others.
- This place has strategically chosen Online Mentoring, so that those who are unprivileged can gather at one point and those who can facilitate learning of such students by creating, necessary IT setup. Aseperate **Mentor's Manual** is being developed to support the cause.

We are implementing this philosophy through **Online Mentoring**

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I have been impressed with the urgency of doing.

Knowing is not enough; we must apply.

Being willing is not enough; we must do.

- Leonardo da Vinci

Appeal: Gyan Vigyan Sarita

A Non-organizational Initiative of a Small Set of Co-passionate Persons

Philosophy: Personal Social Responsibility (PSR)

Objective: Groom competence to Compete among unprivileged children from 9th-12th in Maths and Physics, leading to IIT-JEE.

Financial Model:*Zero-&-Fund-Zero-Asset (ZFZA).* It calls for promoters and facilitators to provide infrastructure for use to the extent they feel it is neither abused nor there is a breach of trust. And, reimbursement of operational expenses to the participators

Operation:

a. **Mode:** Online since July'16, using Google Hangouts, a free we-conferencing S/w, with connectivity upto 15 nodes.
b. **Participation:** Voluntary and Non-remunerative, Non-Commercial and Non-Political

Involvement:

a. **As Promote**r –
   i. Initiate a Learning Center,
   ii. Sponsor a Mentor who is willing to join on certain terms,
   iii. sponsor cost of operation and up-gradation of infrastructure to voluntary mentors,
   iv. Sponsor Website.
b. **As Facilitator** –
   i. Provide space and infrastructure for **Online Mentoring Sessions (OMS)**, which is generally available, with a marginal add-on,
   ii. Garner support of elite persons to act as coordinators at a Learning Centre.
c. **As Participator** –
   i. As a Mentor,
   ii. As Coordinator,
   iii. As Editor and or contributor of thought provoking articles for e-Bulletin, which are relevant to the initiative, and make it more purposeful and reachable to the target audience.
   iv. As author of Chapters for Mentors' Manual, being uploaded as a Free Web Resource,
   v. Anything else that you feel can add value to the mission and make it more purposeful.
   vi. *Anything else that you consider to make this initiative to become more effective.*

Background: *The initiative had its offing in May'12, when its coordinator, a power engineer by profession, soonafter submission of Ph.D. Thesis in April'12, at IIT Roorkee, at the age of 61 years, decided to mentor unprivileged students.*

SARTHAK PRAYASH, a Ghaziabad based NGO, warmly accepted the proposition and created a facility to mentor students from 8+ to prepare in mathematics and physics and prepare them for engineering entrance tests. They warmly reciprocated and created a class room.

*Experience in this selfless social work were used to navigate across without losing focus. He was associated with SUBODH FOUNDATION from Sept'15 to Sept'16 during which he published a monthly e-Bulletin **SUBODH-पत्रिका** to create visibility across persons who could make a difference.*

*In Sept'16, post transition, the mission has been continued as a non-organizational entity **Gyan Vigyan Sarita**, with a set of Four persons, including retired **Prof. SB Dhar**, Alumnus-IIT Kanpur, a middle aged **Shri Shailendra Parolkar**, Alumnus-IIT Kharagpur, settled at Texas, US and **Smt. Kumud Bala**, Retired Principal, Govt. School Haryana. Earlier, they were complementing the OMS. While, the initiative survived transition, a website: http://gyanvigyansarita.inhas been launched. It contains under its**Menu: Publication>e-Bulletins,** and>**Mentors' Manual.** You may like to read them.*

Actions Requested: May please like to ponder upon this initiative. **Queries**, *if any, are heartily welcome.* We would welcome your collective complementing in any of the areas listed at **Involvement**, above, to make the mission more purposeful and reachable to target children.

Coordinator's Views

Positivity - Negativity

Every accomplished person, preacher, leader and head of a family insists upon positivity on descendents. There is either visible or a latent tug-of-war descendents and preacher, each of them claiming to be positive. In pursuit of this initiative we came across many cross-roads to discriminate positivity and negativity. This discrimination in situations, expectations, roles, responsibilities is a very complex dilemma. This column is taken as an opportunity to share across the state of predicament to elite readers and look forward for a thought process which is rational, purposeful and fulfilling the larger good.

Growth of human learning is based on consequential experiences. In 4th century BC, Socrates made a considered choice to build his scholastic order by nurturing dissent to evolve reasoning. In 19th Century G.W.F. Hegel laid Dialectical Materialism, a way for evolution of thoughts, out of contradictory arguments for a better understanding of a given situation, process or a problem.

Evolution of knowledge is a result of contradictions as and when they discomforted a thinker. But, these contradictions are seen as a challenge to the authoritarian paradigm. Order in a family, society or state, at large, is a result of linkages in authority. This flow of authority demands a specific role from each person in the matrix. In process, it becomes a static order and suffers from staleness and lacks innovation. But, situations, processes and problems are inevitably time variant. This makes it essential to reason out the prevalent order to evolve suitable actions and parameters so as to regulate inevitable change for a larger good. It has to cater to emergent needs in a sustainable manner.

Prevalent situations conditions in the country are paradoxical where people at large find that political mood is generated by mass communication and it is left to the test of time that is positive or otherwise. But, damage done can be undone only with positivity, not only in words, but in intentions and actions. This involves firstly owning responsibility of prevalent circumstances and getting inspired to play a proactive role by every individual. This leads to collective wisdom.

Thus at individual level it needs to be reasoned out that- is positivity only playing consensual role in each and every situation? Answering this question is extremely crucial. It collectivism of individuals which forms family, society and state. It would be incorrect to ignore individual positivity on account of its minuscule impact on society and state.

Thought process in every individual is highly discriminate and continues to evolve out of human experiences in life. If it were not so, utterances of an illiterate person like Saint Kabeer, in fifteenth century, would not have remained time relevant.

Biologically actions and thoughts of a person create electrical pulses in human body which apart from controlling muscular actions affects physiology and biochemistry of the individual. Influence of thoughts is manifested in facial and eyes expressions. This is where meditation, ancient Indian practice, has acquired international recognition as Yogic cure for mental peace and happiness and prescribed by leading medical practitioners. It regulates thought process and thus, reflexes generated by a person; as a result evaluation of reflexes has become a tool for interpreting personality of an individual.

Getting back to social order it acts like a container which holds fluid. In this process, there is continuous action and reaction between fluid and container. At any point when fluid encounter a weak spot in the container or fluid pressure increases beyond container's capacity there is a rupture, and energy stored in fluid is set into flow. There are numerous applications of this concept to regulate flow of energy. At this point it is just a way of looking at the situation and a matter of perception as to which is positive; energy of the fluid or its regulation by container.

But, in case of human behavior discriminating positivity and negativity is as complex as judging objectivity and subjectivity in a world regulated by intricate means of information and intelligence. This is where new terms in dishonesty got coined viz. intellectual dishonesty, professional dishonesty and moral dishonesty. Menace of these dishonesties is not perceivable. Financial dishonesty is perceivable and localized while the other forms of dishonesty grows cancerous.

One saint justified lie in misguiding a butcher who is chasing a cow. The other story of a snake quoted by Swami Ramakrishna Paramahansa is a good example of discriminating positivity and negativity. It is based on the larger good initiated out of self-protection.

Momentary positivity can be stimulated, but sustaining positivity needs perseverance and pursuance with continuity, consistency and commitment. This is the only way to perpetuate positivity. A worldly person, living in real-time necessity of survival finds sustaining positivity a real challenge. But, one cannot remain complacent in perceivable negativity, just on the pretext of compulsions.

At this point it is necessary to appreciate that positivity is not mathematical, it does not mean countering negativity with negativity. Rather, it is proactive mindset to convert negativity of a situation, perception and/or a person into positive orientation and consequence. Genesis of negativity lies in situations which are not fulfilling expectation. These expectations in turn have roots in context and upbringing of a person. Primarily it requires a great deal of effort to evaluate negativity. Eradicating negativity requires to get into its root cause and evolving a remedial strategy. These efforts are worth putting in as long as situation does not command an emergency. In emergency situation managing negativity mathematically is not wrong. This judgment of emergency and courage to act impatiently comes only from within. Intensity of such actions is cumulative effect of positivity that one has lived along. It just cannot be an abrupt eruption.

Such impulsive actions are seen as a result of anger, while the two are completely different. Impulsive actions are result of a considered decision with calculated or perceived risk. But, anger is a result of one's helplessness to protect self-interest. Anger is manifestation of negativity and weakness. There are persons who have excelled in regulating suppression of expression of their anger. This regulation is based on their assessment of profit/loss. This is moral dishonesty and is a way of commercialization of anger. Plain anger without camouflage is child like innocent. A child is and has to be innocent, while a person as grows in life should not and cannot remain innocent. Wisdom has got to come into play in every thought and action and lead to inspiring positivity for the larger and sustainable good.

Complacence is reflection of negativity and leads to tranquility through gradual decay in desperation to act or react. Positivity demands a high degree of proactive mindset which exists in inspired persons.

'Forgive and Forget' a benevolent policy is often sermonized, but in practice every state and organization, including spiritual centers, have their own rule of law. It provides for grant of punishment to a person, when proven to be guilty. The pronouncement of judgment is based on context of the crime and history of the criminal. It raises a question why do the finest brains framing laws ignore the benevolent policy? Past is history, future is a mystery and hence one must know history. It is not for the purpose of creating biases but, take lessons from history. This is the only way to make sure that judgment of situations does not becomes counterproductive on the pretext on lack of awareness of history. It doesn't counter proposition of forgiveness but, it guides a sense of caution to avert an inadvertent or circumstantial error.

There are circumstances when some act or situation comes up in an unpleasant or unwarranted manner. In such situations unless there is a history of recurrence, positivity demands to patiently judge good of it. This good has to be compared with bad part of it and disseminated across stake holders. This is based on the fact that nothing in this world is either completely good or bad; it always exists in mixed texture. It is relative, situational and contextual and a matter of individual perspective.

Thus wisdom, patience and consideration with time relevance are the essential virtues in positivity. They radiate in the form of firm conviction and inspiration.. It leads to win-win situation. On the contrary stubbornness blinds wisdom of a person. Such a notion leads to lack of compassion and reflects negativity. It makes a person introvert and ill-tolerant and is self deceptive proposition.

Positivity demands cause above individual, an attribute of an inspired person, unless need is felt essential to moderate the cause. Commitment of such an inspired person if exploited abused, sensibility demands a correction initiation, without subverting the cause.

Preserving objectivity in positivity is most difficult, and makes one vulnerable to sabotage by prevalent negativity. Nevertheless, positivity is a considered choice and grows into an attribute of personality assimilated over a long period. But, negativity is an inherent weakness.

अंदाज ए बयां

चाय की गरमागरम चुस्की के नाम

समीर लाल 'समीर'

भारत में जब रहा करते थे तब अक्सर पंखे के ऊपर और रोशनदान आदि में लगभग हर ही जगह चिड़िया का घोसला देख पाना एक आम सी बात थी. अक्सर घोसले से उड़ कर घास और तिनके जमीन पर, बाल्टी में और कभी किसी बरतन में गिरे देख पाना भी एकदम सामान्य सी घटना होती थी.

उस रोज एक मित्र के कार्यालय पहुँचा तो एकाएक उनकी टेबल पर एक कप में गरम पानी पर वैसे ही तिनके और घास फूस गिरे दिखे. अनायास ही नजर छत की तरफ उठ गई. न पंखा और न ही घोसला. सुन्दर सी साफ सुथरी छत. पूरे कमरे में एयर कन्डिशन और काँच की दीवारें. समझ नहीं आया कि फिर ये तिनके कप में कैसे गिरे? जब तक मैं कुछ सोचता और पूछता, तब तक मित्र ने कप उठाया और उसमें से एक घूँट पी लिया जैसे की चाय हो. मैं एकाएक बोल उठा कि भई, देख तो ले पीने से पहले? कचरा गिरा है उसमें.

वो कहने लगा कि अरे, ये कचरा नहीं है, हर्बस हैं और यह है हर्बल टी. हमारे जमाने में तो बस एक ही चाय होती थी वो काली वाली. चाय की पत्ती को पानी, दूध और शक्कर में मिला कर खौला कर बनाई जाती थी. उसी का जो वेरीयेशन कर लो. कोई मसाले वाली बना लेता था तो कोई अदरक वाली. एक खास वर्ग के नफासत वाले लोग चाय, दूध और शक्कर अलग अलग परोस कर खुद अपने हिसाब से मिलाया करते थे. कितने चम्मच शक्कर डालें, वो सिर्फ इसी वर्ग में पूछने का रिवाज़ था. फिर एक वर्ग ऐसा आया जो ब्लैक टी पीने लगा. न दूध न शक्कर. समाज में अपने आपको कुछ अलग सा दिखाने की होड़ वाला वर्ग जैसे आजकल लिव ईन रिलेशन वाले. अलग टाईप के कि हम थोड़ा बोल्ड हैं. कुछ डाक्टर के मारे, डायब्टीज़ वाले बेचारे उसी काली चाय में नींबू डालकर ऐसे पीते थे जैसे कि दवाई हो.

फिर एकाएक न जाने किस खुराफाती को यह सूझा होगा कि चाय की पत्ती को प्रोसेसिंग करके सुखाने में कहीं इसके गुण उड़ तो नहीं जाते तो उसने हरी पत्ती ही उबाल कर पीकर देखा होगा. स्वाद न भी आया हो तो कड़वा तो नहीं लगा अतः हल्ला मचा ग्रीन टी ..ग्रीन टी..सब भागे ..हां हां..ग्रीन टी. हेल्दी टी. हेल्दी के नाम पर आजकल लोग बाँस का ज्यूस पी ले रहे हैं. लौकी का ज्यूस भी एक समय में हर घर में तबीयत से पिया ही गया. फिर बंद हो गया. अब फैशन से बाहर है.

हालत ये हो गये कि ठेले से लेकर मेले तक हर कोई ग्रीन टी पीने लगा. अब अलग कैसे दिखें? यह ग्रीन टी तो सब पी रहे हैं. तो घाँस, फूस, पत्ती, फूल, डंठल जो भी यह समझ आया कि जहरीला और कड़वा नहीं है, अपने अपने नाम की हर्बल टी के नाम से अपनी जगह बना कर बाजार में छाने लगे. ऐसा नहीं कि असली काली वाली चाय अब बिकती नहीं, मगर एक बड़ा वर्ग इन हर्बल चायों की तरफ चल पड़ा है.

बदलाव का जमाना है. नये नये प्रयोग होते हैं. खिचड़ी भी फाईव स्टार में जिस नाम और विवरण के साथ बिकती है कि लगता है न जाने कौन सा अदभुत व्यंजन परोसा जाने वाला है और जब प्लेट आती है तो पता चलता है कि खिचड़ी है. चाय की बढ़ती किस्मों और उसको पसंद करने वालों की तादाद देखकर मुझे आने वाले समय से चाय के बाजार से बहुत उम्मीदें है. अभी ही हजारों किस्मों की मंहगी मंहगी चाय बिक रही हैं.

हो सकता है कल को बाजार में लोग कुछ अलग सा हो जाने के चक्कर में मेनु में पायें बर्ड नेस्ट टी - चिड़िया के

घोसले के तिनकों से बनाई हुई चाय. एसार्टेड स्ट्रा बीक पिक्ड बाई बर्ड फॉर यू याने कि चिड़िया द्वारा चुने हुए घोसले के तिनके अपनी चोंच से खास तौर पर आपके लिए. इस चाय में चींटियों द्वारा पर्सनली दाने दाने ढ़ोकर लाई गई चीनी का इस्तेमाल हुआ है.

अब जब ऐसी चाय होगी तो बिकेगी कितनी मँहगी. क्या पता कितने लोग अफोर्ड कर पायें इसे. मुश्किल से कुछ गिने चुने और यही वजह बनेगी इसके फेमस और हेल्दी होने की.

गरीब की थाली में खिचड़ी किसी तरह पेट भरने का जरिया होती है और रईस की थाली में वही खिचड़ी हेल्दी फूड कहलाता है, यह बात बाजार समझता है.

बस डर इतना सा है कि चाय के बढ़ते बाजार का कोई हिस्सा हमारा कोई नेता न संभाल ले वरना बहुत संभव है कि सबसे मंहगी चाय होगी- नो लीफ नेचुरल टी. बिना पत्ती की प्राकृतिक चाय और चाय के नाम पर आप पी रहे होंगे नगर निगम के नल से निकला सूर्य देव का आशीर्वाद प्राप्त गरमा गरम पानी.

लोकप्रिय चिट्ठाकार समीर लाल व्यवसाय से चार्टर्ड एकाउंटैंट हैं। आजकल वे कैनैडा में रहते हैं। उन्होंने कहानी लिखना पाँचवीं कक्षा में ही शुरु कर दिया था। आप कविता, गज़ल, व्यंग्य, कहानी, लघु कथा आदि अनेकों विधाओं में दखल रखते हैं| भारत के अलावा कनाडा और अमेरिका में मंच से कई बार अपनी प्रस्तुति कर चुके हैं। आपका ब्लॉग "उड़नतश्तरी" हिन्दी ब्लॉगजगत में एक लोकप्रिय नाम है। ई-मेल: sameer.lal@gmail.com

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GROWING WITH CONCEPTS

Concepts of an expert are not like a static foundation of a huge structure; rather it is like blood flowing in a vibrant mind.

During growing into an expert, each one must have used best of the books available on subject and received guidance of best of the teachers. Authors might have had limitations to take every concept thread bare from first principle and so also must be the constraint of teacher while mentoring a class with a diversity of inquisitiveness and focus. As a result, there are instances when on a certain concept a discomfort remains. The only remedy is to live with the conceptual problem and continue to visualize it thread bare till it goes to bottom of heart and that is an ***ingenious illustration****.*

In this column an effort is being made to take one topic on Mathematics, Physics and Chemistry in each e-Bulletin and provide its illustration from First Principle. We invite all experts in these subjects to please mail us their ingenious illustrations and it would be our pleasure to include it in the column.

We hope this repository of ingenious illustrations, built over a period of time, would be helpful to ignite minds of children, particularly to aspiring unprivileged students, that we target in this initiative, and in general to all, as a free educational web resource.

This e-Bulletin covers – a) Mathematics, b) Physics , and c) Chemistry. This is just a beginning in this direction. These articles are not replacement of text books and reference books. These books provide a large number of solved examples, problems and objective questions, necessary to make the concepts intuitive, a journey of educational enlightenment.

Looking forward, these articles are being integrated into Mentors' Manual. After completion of series of such articles on Physics it is contemplated to come up representative problems from contemporary text books and Question papers from various competitive examinationsand a guide to theirsolutions in a structured manner, as a dynamic exercise to catalyse the conceptual thought process.

Ayurveda : Healthy Life

DINCHARYA - ***दिनचर्या***

Dr. Sangeeta Pahuja

Ayurveda has described Dincharya for a healthy life.By following it we can keep ourselves healthy.

What is Dincharya? The word Dincharya is made up of two words -Dina means day and Charya means activity. Ayurvedic daily routine is called Dincharya. When we begin the day with a routine and in a planned way, it sets up for a stress free day by helping us to keep Tridosha's in balance. Daily routine is necessary for maintaining a healthy mind, body and spirit. It helps in establishing a balanced constitution. It aids in digestion and absorption of food. A disciplined life leads to peace, happiness and longivity.

A day consists of two cycles -Sun cycle and Moon cycle.

For each cycle,there are four periods dominated by Vat, Pitt and Kapha energies. Similarly we have Vata, Pitta, Kapha energies with in our body in various strength and combinations. Hence it is beneficial if we can prevent activities that aggravate the cycle of Vata, Pitta and Kapha.

First cycle is the period from 6am-6pm pertains to Sunrise till sunset. In this period 6am-10am is Kapha Pradhan, 10am-2pm is Pitta Pradhan and 2pm-6pm is Vata Pradhan.

Wake up time - we should try to wake up two hours before sunrise. This is the Vata Pradhan time and Satva pradhan time. Quality of air is also good at this time. This period is called Brahnamuhurat. This is the best period to learn anything new. This time is beneficial for the students to learn something and for reading as they can grasp easily in this period in comparison to the rest of day. Exception for this rule includes sick people or small kids and very old person.

Drink two glasses of lukewatm water and evacuate your bowl. Evacuation of bowls in the morning, soonafter you wake up, is strongly recommended in Ayurveda. As waiting longer could increase the Aama or toxins in the body and leads to imbalance of Tridoshas and causes diseases.

Cleanse your sensory organs - Wash your eyes, vbrush your teeth and clean your tongue. Coating on tongue is the sign of Aama according to Ayurveda. Nasya or Neti is also recommended to clear your nose and respiratory channels. Massage oil on the scalp, forehead, temples,hands,feet and the rest of the body for your organs to function well. Daily massage makes your body strong and prevent you from premature ageing.

Indulge in Vyayam or some sort of physical activity like light exercise, Yoga, breathing exercises etc. Early morning is appropriate Vata time, it is good for flexible morning exercise, and it helps to remove the stagnation in the body and helps to rejuvenate your body and mind for a productive day.

Bath after a while after finishing the exercise with lukewarm water. Do meditation for some time. Meditation is an important part of Ayurvedic Dincharya. As it helps to increase self awareness and awaken consciousness..

Have fresh, warm and nutritious wholesome breakfast. As we have long fasting since yesterday night, our body wll be depleted of all nutrients. So a healthy breakfast is necessary to energize ourselves. It's a myth that some people skip breakfast to loose weight. Skipping the breakfast in the morning will leave us depleated of energy and lethargic. Now you can continue with your work, daily chores, be it work, study or performing other activities.

Noon Time – it should be taken between 12pm -2pm. The sun is strongest at this time and so is our digestive fire or Agni. Lunch at this time helps to digest the food properly. Skipping lunch or having late or irregular timings of lunch is the primary reason for many metabolic disorders.

After every meal we should walk a bit, it is better for digestion. Avoid day sleeping, it slower the process of digestion.

Second cycle pertains to Moon cycle is the period from 6pm-6am. This is divided in periods - 6pm-

10pm Kapha time, 10pm-2am Pitta time, and 2am-6am Vata time.

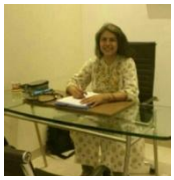
Sunset time is considered another satvik time of the day. We should finish our all planned work by this time and do meditation for few minutes, try to stay calm and enjoy the nature by a calm walk or looking at the beauty or splendour of the nature. This is an important time to relax and disconnect yourself from the rest of the world atleast for a short period.

Dinner Time in Ayurveda is recommend atleast 3 hours before bedtime. Dinner should be lighter than lunch. Having dinner by 7pm is ideal to have a better digestion. It helps to prevent the accumulation of Aama(toxins) in the body. Undigested food is what turns into Aama and hence it is strongly recommended to have an early dinner.

Sleeping Time -Ayurveda strongly recommends that we should sleep by 10pm at night. It's Kapha time of the day and our body naturally feels heavy and demands sleep. If we miss the time and still awake then we move into Pitta time or the time of intense activity, and it will be difficult to sleep. People suffering from Insomnia are the ones who stay awake late night. 6-7 hours sleep is mandatory to stay healthy and to cope up with our daily chores.

Keep yourself healthy by following this Ayurvedic Dincharya.And you can keep yourself away from all lifestyle disorders.

Know Ayurveda, Follow Ayurveda and Stay Healthy.



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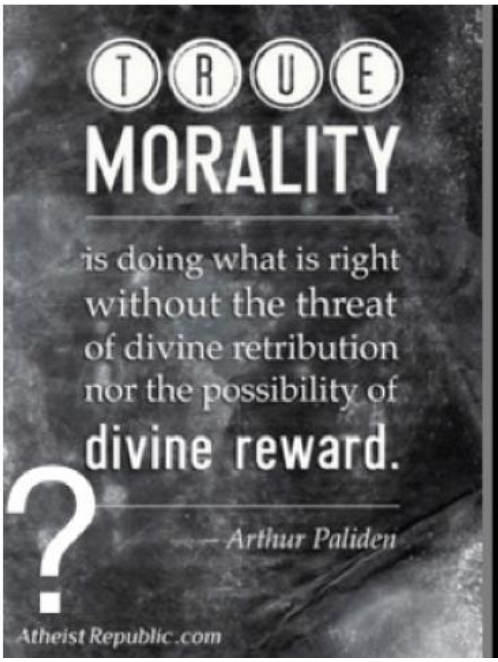

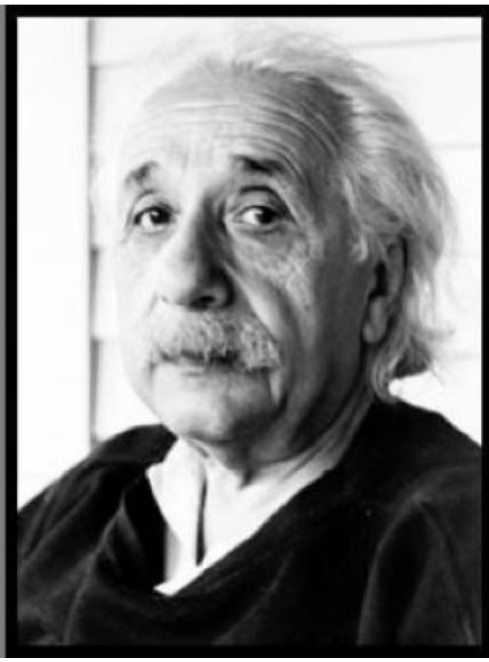

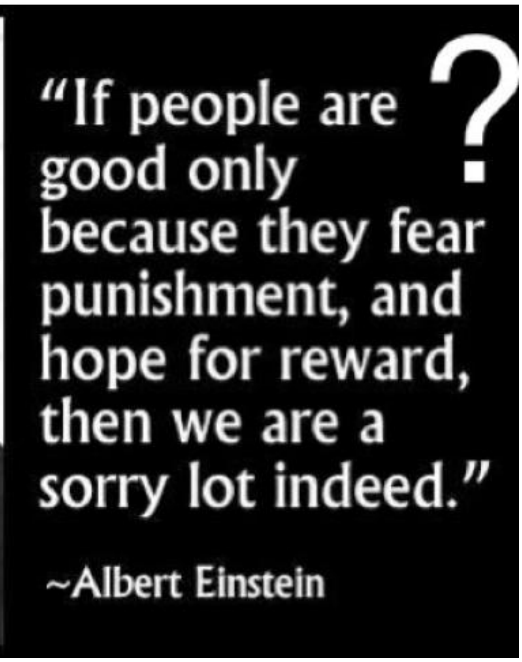

Students' Domain

Save Water

N. Kamlesh

There are three things (oxygen, water and food) without which we cannot live on the earth. But the most precious thing is oxygen, then water and food because we cannot live without oxygen even for a second. Clean water is also a most important thing as we need it in our all the daily routine activities and especially to drink. Already the percentage of clean water was less but due to the industrial activities our clean water under the ground is getting dirty and polluted. Because of the lack of fresh mineral water everywhere, it has been started selling on the local shops for many years. And, people are ready to buy it worth 30 to 35 Rs because they know that simple tap water may not be clean especially at the public places.

Increasing rate of people's carelessness (regarding water saving and safety) and population, it is sure that our future generations must suffer the shortage of clean water. Very less percentage of earth's water is suitable for drinking and many people (at the place of water shortage) survive on very less water per day.

Percentage of Clean Water - Three-fourth of the earth is covered by water from which 97% water is ocean water means salt water and completely unfit for our consumption. Left percentage (about 2.7 percent) is fresh drinking water however around 70 percent of this is available as ice sheets and glaciers in Antarctica. So, we only have one percent of fresh water which is fit for human use. We need to practice water conservation on urgent basis in order to make the presence of this precious resource in our life. We also need to stop contaminating the drinking water resources through direct passage of sewage, toxic chemicals and other wastes into it. Increasing rate of population, deforestation and rapid urbanization is increasing the need of clean water and leading to the water pollution and scarcity.

Sources making Clean Water Dirty: The sources which are polluting the underground water are land runoff, drainage, seepage, sewage, atmospheric deposition, precipitation, industrial waste, etc. Such wastes get deposited into lakes, rivers, coastal waters, wetlands, etc and meet to the large water bodies and ground water too. Other water spoiling sources are use of excess fertilizers, insecticides, herbicides, detergents, soaps, etc from agricultural lands and residential areas. Acid drainage from abandoned mines and industries involved in making oil, grease and toxic chemicals are also involved in making water dirty and polluted. Such nonpoint sources are the leading cause of water quality problems.

Simple Ways to Save Water: There are various simple ways which we can use on daily basis and save gallons of water daily. Following are save water techniques which we must use to save water at home and other places:

- We should use shower heads with low-flow (also called as energy-efficient shower heads), low-flush toilets and composting toilets (instead of conventional western toilets as they use large volumes of water) or dual flush toilets (it uses very less water than others).
- Keep the tap close while doing hand wash, tooth brush, face wash, washing dishes, etc.
- Collect rain water during rainy season to use in toilet flush, watering plants, sprinkle in garden, etc. Using raw water like sea water or non-purified water in toilet is also good.
- We should be habitual of reusing or recycling waste water.
- We should promote rainwater harvesting, using high-efficiency clothes washers, weather-based irrigation controllers, garden hose nozzles, low flow taps in wash basins, swimming pool covers, automatic faucet, etc for water conservation.

- Water saving techniques should also be given priority in the commercial areas as it is a big area where gallons of water can be saved on daily basis.
- Water saving techniques in the business areas are like waterless urinals, waterless car washes, infrared or foot-operated taps, pressurized water brooms, cooling tower conductivity controllers, water-saving steam sterilizers (in hospitals and health care units), rain water harvesting, water to water heat exchangers, etc.
- Agriculture field is also a vast area where we can save more water on daily basis if we follow water saving techniques. We can use overhead irrigation for crop irrigation (using center-pivot or lateral-moving sprinklers), minimize evaporation, runoff or subsurface drainage, etc.
- Use of green manures, recycling of crop residues, mulching, animal manure, etc in the field improves the soil organic matter which again increases the water holding capacity and ability to absorb water (during torrential rains) of the soil.
- Water saving techniques is also promoted at the social and community level by the municipal water utilities or regional governments through the use of common strategies like public outreach campaigns pay higher price for increasing water use, restrictions on use of clean water for outdoor activities like lawn watering, floor cleaning, car washing, etc.

Conclusion: Water saving techniques should be promoted among people living in the societies, communities, villages including business sections as they are the main water users in rough manner. Farmers, children, and women should be taught properly about how to use and save water in efficient manner. They must understand the value of water in their life. Clean water scarcity is not a problem of one country or continent; it is a global issue which needs to be solved globally by increasing awareness about it among people worldwide.

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Experience Sharing

Rohit

I had an opportunity of getting mentored by Gyan Vigyan Sarita (GVS) Group in Maths and Physics right in class 9th. I could not make it to get into IIT. Finally with my constraints I got into a private RD Engineering College, Ghaziabad. The college faculty and teachers are much supporting. After giving first and second semester exams, I realized that securing 80% marks is not a the big task, if we do study each day in regularly and consistently, and weekly tests help us in self assessment and regulate our efforts as much as revision of previous topic. I feel that revision, mental revision , thought process and time management are the key of success in exam and develop a disciplined personality. I started working in all these areas soon after association with GVS. It helped me to develop ability to solve problems easily and in different ways. It is helpful to me in all subjects. [e-Mail ID: rohit.kumar70906@gmail.com]

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Students' Domain

POLLUTION

G.V. Sai Meghana

Pollution is a process of making the environment dirty, unhealthy and unsuitable for humans and animals to live. It is caused due to the release of both tangible and intangible contaminants. These can be released naturally or by humans themselves accidentally or deliberately.

More than 200 million people are affected due to toxic pollutants. Due to pollution, there are few countries that have faced defected child birth and increase in mortality rate. Humans are regularly exposed to pollution when they inhale toxic air inside them.

Pollution can be controlled, if not eliminated. Efforts such as promoting green environment, proper disposal of waste, etc are simple steps that lead to great emphasis on maintaining the order of environment.

Preventive measures:

- Plant trees/cultivate garden to curb polluted air and release more oxygen.
- Switch off electricity-based equipments when not in use: lights, fans, machines, etc.
- Make high use of natural energy than electric energy: dry the clothes naturally.
- Use recyclable products, wherever possible.
- Avoid plastic bags and use paper bags.
- Avoid wastage of paper and use both the sides.
- Restrict usage of hazardous chemicals.
- Don't overuse heaters and air conditioners.
- Use public transport to reduce noise, air and light pollution.
- Protect Mother Earth by not spilling oil, garbage, sewage water, etc at undesirable places.
- Stop burning of crackers during marriages, Diwali, etc.
- Don't dispose off eatables, packaging in oceans, rivers, etc.

Pollution disturbs our ecosystem and the balance in the environment. By following the above simple points, we all can restrict pollution at our own level.

Each year millions of people die due to various diseases caused by pollution. The key to live a healthy life is to protect the environment from pollution.

The increase in the pollution level over the years by human and natural causes has caused severe damage to the earth's ecosystem. Lifestyle, habitat, etc everything is being adversely affected. Though natural causes cannot be stopped, but human beings' accidental and deliberate actions can easily be stopped which surely will result in the control of pollution generation.

Types of Pollution: Major pollutions and their causes are -

- *Land Pollution* – Wastes collated at Earth's surface, garbage on roads, industrial debris, pesticides, insecticides, etc. Unwanted wastes lying and being decomposed release harmful gases and lead to pollution.
- *Water Pollution* – Wastes disposed of in rivers, oceans act as pollutant in water bodies. Raw sewage, oil spills, chemical refuse, etc create poisonous water and hence lead to water pollution.
- *Air pollution* – Burning of fossil fuels, release of gases from vehicles release mono-oxide, carbon-di-oxide, industrial pollution, nuclear radiations etc lead to air pollution.
- *Noise Pollution* – Vehicle horns, loud music, construction machinery sounds, and other human activities create noise. This affects humans and animals, their natural vegetation and create Noise Pollution.
- *Thermal Pollution* – Manufacturing activities lead to rise in the temperature of water and land. This affects marine and plant life. Such activities lead to thermal pollution.

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Students' Domain

Dreadful

Tarika Sodhi

What comes to your mind when you hear the word "book"? If it's the title, which in most cases, it might be, read along.

Books. We all have at least once in our lives have heard it from our parents, teachers, or in fact any random elderly person - "Beta, books are very important in life, you should read them. It makes you wise". If you haven't then you might hear it in future, because the odds of elder people not advising our generation to read and study are very, very rare.

So why exactly do we need to read books? Is the only point of reading to make you smart and get you a job? Or do adults get a salary for nagging us to read everyday?

Well, I think the answer is no. Books don't just make you cramp Emperor Akbar's laurels or ask you to solve for x. There's more to them than just studies. Books can also give you pleasure if you spend enough time reading them, understanding them. A book is an entirely different world in itself, and like just imagine, a world of our own imagination, far away from the real one, where things you dislike don't necessarily exist and everything is your way, I'm so up for it!

Books can make you laugh hysterically, cry melancholically and love or hate characters that don't even exist! They don't just teach you vocabulary, but values too. They teach you how to love, because if you can love a non-existing character, how hard can it be to love and care for real people?

I'm intrigued by the fact that some authors changed the world using only a pen, while others struggled with nuclear weapons, and yet couldn't match an authors influence.

Books are basically a portal for people who want to escape reality. Books create world, not gods. And that couldn't be dreadful, could it?

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Beautiful Intricacy of Flaws

'*Uitiosam colit, est pulchre applicant vitae*.' This Latin sentence simply means life is beautifully flawed.

Such a simple, comprehensible sentence yet such a deep and underrated meaning.

We often don't realise how beautiful life is. We often don't realise how flawed it is either. Because everything eventually is made up of this world itself. We think we're individual selves, one person different from another, one thing different from the other, but, in actuality, are we really that different?

Eventually everything is made up of the earth and the earth is made up of everything that thrives on it.

It's all connected and joined and just like the food chain in the nature, where if one animal gets extinct the whole web starts to falter, if one thing goes wrong in life, all of our life in that particular moment falls apart. But, animals adapt again, they find new prey and new predators.

Just like humans adapt again and find new purposes.

It's flawed, for sure. But it's beautiful. The intricacy of the flaws is what makes them so beautiful.

Author is an ardent student of Class 9th in Lotus Valley International School, Noida. She is a voracious reader of renowned authors and their books. She enjoys travelling, listening music and eating good food Her favourite subjects are literature, maths and biology. She is taking training in Hindustani vocal music. She actively participates in school activities like theatre, debates, public speaking and MUNS. .
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विचार-मंथन

गुरु- दक्षिणा

सुरेन्द्र कुमार मिश्र

ग्रामीण जीवन में शहरों जैसी सुविधाएं उपलब्ध नहीं थीं। शिक्षा से जीवन के स्तर में सुधार होता है। प्रायः यह देखा गया है कि पढ़ने के लिए गांव से बच्चे शहरों में जाते थे, क्योंकि ग्रामीण जीवन में उच्च शिक्षा की सुविधाएं नहीं थीं । जिन परिवारों में शिक्षा के प्रति जागरूकता नहीं थी अथवा उसका अभाव था, उनके बच्चे प्रायःशिक्षा से वंचित रह जाते थे। कुछ बच्चे पढ़ाई को बंधन समझकर शिक्षा से दूर भागते थे। वे प्रायः खेतो में काम करने अथवा पशुओं को चराने में खुश रहते थे। उनमें से प्रायःग्वालों के बच्चे गाय-भैसों को चराते थे। गड़ेरियों के बच्चे भेड़ बकरियां चराते थे। कुछ अछूत बच्चे थे जो जमींदारों की गाय-भैसों को चराते थे क्योंकि उनके पास न अपने खेत होते थे न पशु। वे चरवाहे की नौकरी करना पसंद करते थे। अशिक्षा का प्रभाव पारिवारिक वातावरण में ऐसा था कि मेहनत मजदूरी तक अपने बच्चों को सीमित रख कर ही अभिभावक सन्तुष्ट रहा करते थे। गर्मी के दिनों में खेतों में फसलें नहीं होती थीं। मेड़ों पर घास की हरियाली देखने को मिलती थी।पशु दूर -दूर तक घूम-घूम कर घास चरते थे और शाम को गंगा के किनारे जाकर जल पीते थे। चरवाहे बच्चे दिनभर बगीचे में खेलते और पके-पके आम ओर जामुन खाते रहते थे। शाम होने पर पशुओं को गंगा-घाट पर पानी पिलाते तथा उन्हें धोकर घर वापस आते थे। यही उनका दैनिक कार्य था। किसान अपने काम-धंधे में लगे रहते थे। औरतें घर के काम में लगी रहती थीं। बच्चे दिन भर बाहर रह कर खेलते-कूदते रहते थे। इस प्रकार बच्चे भी स्वस्थ एवं प्रसन रहते थे और घर में भी शांति बनी रहती थी। उनके खाने-पीने की चिन्ता घरवालों को सुबह और शाम की ही रहती थी।

ग्रामीण छात्रों में शिक्षा के क्षेत्र में जागरूकता लाने वाली प्रथम महिला महाश्वेता जी थीं। महाश्वेताजी विदुषी थीं। शिक्षा को दूर-दूर तक फैलाने का संकल्प उन्होंने ले रखा था। उनका मानना था कि शिक्षा से ही जन-जागृति लाई जा सकती है। उन्होंने देखा था कि शहरी छात्रों में बच्चों को शिक्षित करना आसान है किंतु ग्रामीण क्षेत्रों में बहुत कठिन है। सच पूछा जाए तो ग्रामीण क्षेत्रों में आज भी यह अभाव बना हुआ है। वहां के लोगों में न शिक्षा के प्रति जागरूकता है न ही सुविधाएं उपलब्ध हैं । महाश्वेता जब गाँव के बच्चों को खेलते, पशु चराते देखती थीं तो उन्हें तरस आता था। वे चाहती थीं कि उन्हें भी शिक्षित किया जाए जिससे उनके जीवन की दिशा बदल जाए। इसे क्रियांन्वित करने के लिए यह उपाय सोचा कि शाम को चार बजे से छह बजे तक कि उनकी नियमित कक्षाएं लगाई जाएँ क्योंकि दोपहर तक खेतों में काम करने वाले बच्चे भी खाली हो जाएंगे। इसके लिए उन्होंने बड़े बच्चों से बात की और यह भी कहा कि इसके लिए कोई फीस नहीं लगेगी बल्कि छुट्टी के समय उन्हें कुछ नाश्ता भी दिया जाएगा। यह सुनकर कुछ बच्चे तैयार हो गए और कुछ बच्चे अपने घर पूछ कर पढ़ने आने की बात कह कर चले गए।

अगले दिन कुल आठ विद्यार्थी पढ़ने के लिए उपस्थित हुए। महाश्वेता जी ने पढ़ाई का श्री गणेश किया। रोचक कहानियों के माध्यम से उन्होंने पढ़ाना आरंभ किया। उम्र अधिक होने से परिपक्वता आ जाने के कारण बच्चे सवाल तथा हिंदी भाषा का ज्ञान जल्दी ग्रहण कर लिए। यह देखकर महाश्वेता जी का उत्साह बढ़ गया। छुट्टी के समय उन्होंने खाने के लिए बच्चों को जलेबियां दीं। बच्चे खुश होकर जलेबी खाते घर चले गए और अगले दिन दूसरे बच्चों को लाने के लिए कह गए।अगले दिन पढ़ने वालों की संख्या सचमुच दो गुनी हो गई। उस दिन हर बच्चे को दो-दो समोसे मिले। बच्चे खुश हो गए। असल में ग्रामीण जन-जीवन में अभाव था, बच्चों को कई-कई दिन तक मिठाई देखने को भी नहीं मिलती थी। इस तरह खेलने- खाने की सुविधाओं सहित ग्रीष्मकाल के दो माह तक लगातार उनकी अनौपचारिक शिक्षा चलती रही। बच्चों की रुचि जगाए रखने के लिए उन्हें कभी मिठाईयाँ, कभी कचौड़िया, कभी सेब, कभी केला आदि खाने के लिए दिए जाते थे। बच्चे भी रूचि लेकर आते और पढ़ते थे।

एक दिन एक अत्यंत काला लड़का बच्चों के पीछे आकर खड़ा हो गया। पूछने पर उसने अपना परिचय दिया कि वह अछूत है

किन्तु पढ़ना चाहता है। क्या उसे पढ़ने की अनुमति मिलेगी? महाश्वेता जी अभी बातें कर ही रही थीं कि आगे बैठे बच्चे आपस में बातें करने लगे कि यह कहाँ से आ गया। यह तो इधर आता भी नहीं था। असल में अछूतों की बस्ती अलग ही दिशा में होती थी। महाश्वेता जी ने उसे पढ़ने की स्वीकृति दे दी और उसे सबसे आगे बैठाया। इसके बाद जब उन्होंने उसका नाम पूंछा तो उसने अपना नाम 'घसीटाराम' बताया। नाम सुनकर कुछ बच्चे मुस्कुराने लगे। महाश्वेता जी उसे 'राम' कहकर पुकारती थीं। वह पाठशाला छायादार पेड़ों के नीचे लगती थी। दो घंटे का समय कैसे बीत जाता था यह पता भी नहीं चलता था। छुट्टी होने पर सभी बच्चे नाश्ता लेकर उछलते-कूदते घर जाते थे। शिक्षा के प्रभाव से धीरे- धीरे उनमें मेल-जोल बढ़ता गया। अब घसीटाराम भी उनके बीच रहकर सहजता से पढ़ाई करने लगा। वह समय से पढ़ने आता और साथियों के बुलाने पर साथ खेलने जाता। बच्चों में अब विजातीय दुर्भावना समाप्त हो गई। सभी एक साथ पढ़ते, खेलते, खाते तथा पशु चराते थे। गर्मी के लंबे दिन बिताने के लिए बच्चों को एक दूसरे का साथ मिलना महत्व की बात थी। अब खेल-खेल में शिक्षा वाली कहावत चरितार्थ होने लगी।

जून का अंतिम सप्ताह था। किसान वर्षा की कामना कर रहे थे जिससे खेती का कार्य आरंभ किया जाए। बच्चे भी सोच रहे थे कि अब तो गर्मी की छुट्टी समाप्त होने वाली है। बाद में यह पाठशाला भी बंद हो जाएगी और हमें पूरी तरह से स्वतंत्र रहकर खेलने- कूदने का मौका मिलेगा क्योंकि कुछ बच्चे इसे भी बंधन समझ रहे थे। कुछ बच्चों को पढ़ाई अच्छी लगती थी। वे सोचने लगे कि पढ़ाई का मौका आगे भी मिलता तो नौकरी अच्छी मिल जाती फिर तो खूब पैस मिलते। उससे अच्छे कपड़े, जूते, टोपी पहनकर गाँव में आते।लोग हमें देखकर आश्चर्य करते। अभी गाँव में जो लोग कोट, टाई, पैंट पहनकर आते हैं वे नौकरी के कारण ही तो ऐसे सज-धज कर रहते हैं। नौकरी भी तो पढ़ाई-लिखाई के बाद ही मिलती होगी। उन्होंने जितनी ऊँची पढ़ाई की होगी, उतनी ऊँची नौकरी मिली होगी और उसी के अनुसार वेतन मिलता होगा। सरकारी नौकरी में अधिक पैसे मिलते है किंतु कम पढ़ाई से तो सरकारी नौकरी मिलती भी नहीं है। इस प्रकार विचार कर के दो-चार वच्चे अपने माता-पिता, दादा-दादी के सामने आगे पढ़ने की इच्छा प्रकट करने लगे। इस आधार पर कहा जा सकता है कि महाश्वेता जी ने अपने सार्थक प्रयास से शिक्षा के बारे में अभिभावकों को कुछ सोचने के लिए मजबूर कर दिया। बच्चे भला किसे प्रिय नहीं लगते हैं। जब बच्चे खुद ही आगे पढ़ने की इक्छा प्रकट कर रहे है तो माता-पिता उन्हें कैसे मना कर देगें। इस प्रकार धीरे-धीरे कुछ बच्चों के आगे-आने से उनसे छोटे भाई बहनों को भी पढ़ने की प्रेरणा मिली। महाश्वेता जी ने उन्हें आगे पढ़ने में सहयोग करने का वायदा किया।

एक दिन बालक घसीटाराम नई सफेद चमकदार कमीज पहनकर बगीचे की पाठशाला में आया उसके सांवले शरीर पर सफेद कमीज अधिक सुंदर लग रही थी। बच्चे उससे बार-बार प्रश्न कर रहे थे कि ऐसी कमीज तुम्हें किसने दी। घसीटा यही उत्तर देता था कि "मुझे मेरी माँ ने दी थी, "मैं नहीं जानता कि वह कहाँ से लाई "। बाद में महाश्वेता जी के आते ही उनकी नज़र घसीटा पर पड़ी। वे भी चौंक गई और प्रसन्न होकर बोलीं कि "राम, यह कमीज तो बहुत अच्छी है लेकिन यह थोड़ी सी बड़ी है ।तुम्हारे साइज की नहीं है।इसे कहाँ सिलवाया था?" घसीटा ने उन्हें सही-सही बात बता दी कि गुरुजी मेरी माँ किसी न किसी के घर में या खेत में काम करती है। उनमें से कुछ लोग दयालु हैं। वे ही मेरे पहनने के कपड़े दे देते हैं। उससे ही मेरा काम चल जाता हैं, मुझे बनवाना नहीं पड़ता। महाश्वेता जी के पूछने पर उसने बताया कि उसका कोई भाई या बहन नहीं है। उसके जन्म के सात दिन बाद ही पिता का निधन हो गया। फूस की झोपड़ी में गाँव के दक्षिण में वह अपनी माँ के साथ रहता है। अगले दिन महाश्वेता जी ने उसकी माँ को बुलाकर कहा कि "कल के बाद विद्यालय बंद हो जाएगा। जुलाई के प्रथम सप्ताह में स्कूल खुलेंगे । तुम्हारा लड़का पढ़ने में होशियार है। इसे आगे पढ़ाना। पढ़ाई का पूरा खर्च मैं दूँगी"। विधवा ने घूँघट से सिर हिलाकर "हाँ" कहा और बोली कि "आपकी कृपा हो जाए तो रोटी का सहारा मिल जाएगा। भगवान आपका भला करे बहनजी"।

बगीचे की पाठशाला का अंतिम दिन था। बच्चे अन्य दिनों की अपेक्षा उस दिन अधिक उत्साहित थे। इसका कारण था कि अब वे स्वतंत्र होकर खेल-कूद करेंगे, घूमेंगे। समापन के दिन बच्चों के मनपसंद ढेर सारी जलेबियाँ और समोसे लाये गए थे। नैतिक शिक्षा की बातें बताकर महाश्वेता जी ने सभी बच्चों को

शिक्षा का महत्व समझाया और कामयाब होने वाले शिक्षित लोगों के अनेक उदाहरण दिये। इसके बाद हर एक बच्चे को कुछ जलेबियाँ और दो-दो समोसे दिए। काफी देर बाद प्रतीक्षा करने पर भी जब घसीटाराम नहीं आया तो महाश्वेता जी ने कहा कि मेरा राम नहीं आया, न जाने कहाँ रह गया। अंत में उन्होंने कुछ जलेबियाँ तथा दो समोसे एक लड़के को देकर कहा कि यह राम को दे देना। जब सभी बच्चे चले गए तब महाश्वेता जी गाँव से बाहर जाने लगीं। अभी रिक्शे पर बैठी ही थीं कि आवाज़ आई "गुरुजी रुक जाइए"। महाश्वेता जी ने आवाज़ पहचान ली कि यह तो मेरे राम की आवाज़ है। थोड़ी देर बाद कमर के ऊपर नंगे बदन दौड़ता हुआ सिर पर टोकरी सी कोई चीज रखकर राम आता हुआ दिखाई पड़ा। जैसे-जैसे वह निकट आता गया, वैसे-वैसे उसकी आकृति स्पष्ट से स्पष्टतर होती गई। अंत में हाँफता हुआ, पसीने से तर शरीर घसीटा अखबार में लिपटा तरबूज सिर से उतारकर गुरुजी के चरणों जे पास रख दिया और कंधे से उतार कर कोमल ककड़ियों का बंडल भी सामने रख दिया। इसके बाद हाथ जोड़कर बोला कि "गुरुजी यही मुझ गरीब की ओर से दक्षिणा है, इसे स्वीकार कर लीजिए"। महाश्वेता जी ने सोचा कि इसके पास पैसे कहाँ से आए, कहीं चोरी करके खेत से तरबूज तो नहीं तोड़ लाया अथवा चोरी के पैसे से ककड़ी और तरबूज तो नहीं खरीद लाया। उन्होंने अपनी कसम दिला कर पूछा तो राम ने साफ कह दिया कि "अभी तो बहुत गर्मी पड़ रही है। इतनी गर्मी में कपड़े कौन पहनेगा, सर्दी आने तक कोई न कोई कपड़े, चद्दर दे ही देगा। मैंने अपनी कमीज खेत वाले को दे दी और उसने तरबूज तथा कुछ कोमल ककड़ियाँ, ककड़ियों के डन्ठल से रस्सी बनाकर बाँधकर दे दीं "। यह कहकर वह चुप हो गया। महाश्वेता जी ने आंखों में आंसू भरकर गुरु-दक्षिणा स्वीकार कर ली तथा अपने काँपते हाथों से उसका सिर पकड़कर अपने सीने से लगा लिया। इसके बाद अपने प्रिय-शिष्य घसीटाराम को पढ़ा-लिखाकर वकील बनाया।

इस प्रकार महाश्वेता जी ने अपने पिता पं० दीनानाथ जी के बताए हुए मार्ग पर चलकर शिक्षा द्वारा जाति-पाँति, ऊँच-नीच का भेद-भाव मिटाकर समाज को संगठित करने का कार्य आजीवन किया। वास्तव में जाति, धर्म, सम्प्रदाय से बड़ा मानव है। मानवता से बढ़कर न कोई जाति-धर्म है, न भाषा। अतः मानवता के विकास से समाज एवं राष्ट्र को सुदृढ़ बनाना हर नागरिक का नैतिक कर्त्तव्य है। यह शिक्षा से ही संभव है। राष्ट्रीय एकता और अखंडता को बनाये रखने के लिए उत्तम-शिक्षा, नैतिक-शिक्षा की आवश्यकता है।

उत्तमशिक्षा ! उत्तमनागरिक ! उत्तमराष्ट्र !

लेखक शिक्षा जगत में सक्रीय रहे। वे हरियाणा राज्य के शिक्षा वि भाग में हिंदी के विभागाध्यक्ष के पद से सेवा-निवृत्त हुए। सामजिक एवं नैतिक मूल्यों पर चिंतन, लेखन एवं परिचर्चा आपकी विशेष रूचि है

e-Mail: surendraayan.mishra@gmail.com

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Let us not pary to be shelted from dangers

but

to be fearless when facing them

\-

\- ***Rabindranath tagore***

अपनी पहचान -

मृणालिनी घुळे

अपना प्यारा देश है जिसका , नाम है हिंदुस्तान
इस पर प्राण निछावर करता, देश का हर जवान।

हिंदू मुस्लिम सिख ईसाई, पूरे जग में होते
पर भारत में सबसे पहले, हम तो एक इंसान।

आजादी पाने की धून में, कितने हुए शहीद
आज भी आतंकियों से लड़ते, कितने हैं कुर्बान।

खड़े हुए हैं सीना ताने, सीमा पर प्रहरी बन
उनके लिये पूजा मंदिर में, मस्जिद में है अजान।

अंतरिक्ष से लेकर पूरे, जग में धाक जमाई
प्रगति के इस देश के आगे, नित्य नये सोपान।

खेल विज्ञान अर्थशास्त्र में, नये गढे हैं स्तंभ
संस्कृति और साहित्य क्षेत्र में, अपना देश महान।

एक लक्ष्य है एक ध्येय है, एक ध्वजा हम सबकी
तीन रंग की विजय पताका, है अपनी पहचान।

गुरू सानिध्य सुधा समान -

गुरू का सदा बढ़ाओ मान, गुरू को सदा मिले सम्मान
गुरू ही सदा मार्ग दिखलाता, गुरू ज्ञान का मधु छिाता
गुरू प्रकाश की राह दिखाता, वही दूर करता अज्ञान
गुरू की पूजा, पूजा प्रभु की, सदा वंदना करना गुरू की
गुरू से मिले बुद्धि और शक्ति,गुरू सानिध्य सुधा समान।

कवियत्री एक सामाजिक चिंतक एवं विचारक हैं | आपकी कविताएँ वर्तमान पर्यवेक्ष्य में बुद्धि-जीवियों को उनके सामाजिक उत्तरदायित्व के प्रति उन्हें चिंतन के लिए प्रेरित करती हैं | आपकी लेखनी प्रादेशिक एवं राष्ट्रीय स्तर पर प्रकाशित है|
E-mail: mrinalinighule46@gmail.com

मासूमियत -

डॉ. संगीता पाहुजा

क्या होती है मासूमियत
सतयुग के अनुसार
न सुन्दरता है मासूमियत
न गौरवर्ण है मासूमियत।

छल कपट से रहित होती है मासूमियत
प्यार से सराबोर होती है मासूमियत
जिसे देखते ही हृदय खुशी से फूला न समाए,
जो तन मन के अवसाद को हर
ले जाए, वह होती है मासूमियत।

जिससे बार-बार मिलने को जी चाहे
वह होती है मासूमियत।
बच्चा हो या बड़ा, जो है छल-कपट से रहित,वही है मासूम
जो रख सके स्वयं को निष्कपट तमाम उम्र,वही है मासूमियत।

परंतु विज्ञान के इस युग में नही दिखती कहीं मासूमियत
समय से पूर्व सब परिपक्व हो गए
ज्ञान-विज्ञान की इस चकाचौंध में कहीं लुप्त हो गए।

मासूमियत का न रहा कोई नामोनिशां
सब ज्ञान का भंडार हो गए,,
ज्ञान-विज्ञान की इस चकाचौंध में कहीं लुप्त हो गए।

कवियत्री आयुर्वेदिक चिकित्सक हैं | आपने B.A.M.S. की उपाधि M.D. University, रोहतक से प्राप्त की | आपके दिल्ली एवं नॉएडा में परामर्श केंद्र है | धार्मिक, नारी एवं समाज उत्थान कार्यों में आपकी विशेष रूचि है |
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Jharkhand Government MSME Tool Room Ranchi

Mangal Toppo

Introduction : The Jharkhand Government Mini Tool Room & Training Centre (JGMTRTC), Ranchi is an strategic endeavor towards fulfillment of the goals set by the Government of Jharkhand in its industrial policy. The Tool room have been setup by the Government of Jharkhand with Central Assistance from Ministry of MSME, Government of India and is registered is registered under Societies Registration act, 1860. The centre has separate training and

production wings equipped with comprehensive range of machine tools having the latest controls, procured from the global market, including CAD/CAM and sophisticated CNC machines, CNC Turning, CMM, CNC machining centre, CNC EDM, CNC Wire cut, The Tool Room have the latest design software like Auto CAD, DELCAM, Pro Engineer, CATIA, etc.It also has ultra modern class rooms with latest teaching aids, hostel facilities inside the campus for boys and girls, recreational facilities, playgrounds etc.

The Jharkhand Government Mini Tool Room & Training Centre (JGMTRTC), Ranchi is under direct control of Department of Industries, Government of Jharkhand. A Governing Council having Secretary Industries as its Chairman and Director Industries as Vice Chairman, and also having members from DC (MSME), Government of India, renowned technical institutions of Jharkhand such as XLRI, Jamshedpur; BIT, Mesra, Ranchi; BIT- Sindri; NIT, Jamshedpur; NIFFT, Ranchi; and various financial bodies of the state such as IDBI, Ranchi Branch; SIDBI, Ranchi Branch etc.The academic activities of the centre are governed by an Academic Council in which representatives from renowned institutes like BIT, Mesra, Ranchi; NIFFT, Ranchi; and industry representatives from JSPL, Usha Martin Industries.

The Tool Room is located nearly 15 kilometers from Ranchi Railway station on Ranchi-Muri Road, opposite Usha Martin Ltd and just behind the Tatisilwai railway station. The location is strategically chosen in the Tatisilwai Industrial area, in front of the Usha Martin Limited to facilitate the trainees to learn the work culture prevalent in industrial environment, during their training at the centre.

The training methodology in the Tool room is through prolonged working hours on the shop floor, compiled with class room teaching. The tool room uses an exceptional blend of theoretical and practical training to produce highly skilled technical hands.

The objectives of the Centre;

- To manufacture jig, fixtures, cutting tools, gauges, press tools, forgings dies, pressure casting dies and other tooling for small scale & other industries. Advanced tool making process using CAD/CAM techniques are to be adopted.
- Provide training facility in Tool manufacturing and tool design in order to generate work force of

skilled workers, supervisors, engineers/designers etc.

- To work as nucleus centre for providing consultancy, information services, documentation etc. for solving the problems related to tooling of industries in the region.
- To act as common facility centre for small-scale industries and to assist them in product and prototype development.

Courses Conducted : It is conducting "4 Years Diploma in Tool and Die Making Course". This course has been designed to fulfill the demands of the manufacturing sector. It has been conferred equivalence to "Diploma in Mechanical Engineering" by the department of Technical and higher Education Government of Jharkhand. This course is practical oriented and more emphasis is given on workshop training. Training on conventional machines like Lathe, Milling, Surface Grinding, Cylindrical Grinding and CNC machines are provided to the trainees. The institute has indigenous as well as imported machines for the training. Training on various Design Software's is also given.

This course contains subjects like Press Tools Design,

Mould Design, Cutting Tools and Jigs & fixtures Design, Die Casting Technology, Engineering Design, Production Technology, Engineering Metrology, Material Technology, Basics of Mechanical Engineering, Engineering Mechanics, Metal Forming Technology, Strength of Materials, Mechatronics Engineering, CAD/CAM, CNC Technology & FMS, Industrial Management, Hydraulics & Pneumatics, and Non-Conventional Machining Process etc. Personality development classes are also conducted to improve the personality of the trainees so that they may be able to face the interviews, group discussions etc during the campus recruitment. The students are encouraged to work on various innovative projects. Some of the projects made by the students include the Electric Bicycle, Solar powered vehicle for Differently Abled Person, Engine running on Hydrogen, Automatic Seed feeder, Hydraulic Crane, Hand Moulding Machine etc.

The institute has a very good placement record till date for this course. The students have been placed in industries like Tata Motors, TRF Ltd, Tata Cummins, TML Drivelines, Timken India Ltd, Tata Hitachi Ltd, Heavy Engineering Corporation, Jindal Power & Steel, Simplex Engg, Motherson Moulds, Alcast, Metalsa, Wabco India, Mangalam Plastics & Moulds.

The tool room is also conducting various skill development courses for the students who have done their B.E/Diploma/ITI in Mech/Prod/Auto or equivalent. These courses are bridging courses which fill the gap between technological industry and technical institutes. These courses make the students industry ready.

Vocational courses on welder, electrician, fitter, plumber, carpenter, machinist, turner, etc are also conducted for the 8th/10th passed or drop out students. Free polytechnic coaching is being conducted by the institute for the students of 10th (appearing/passed). One month Basic computer and internet course is being conducted by the institute at a nominal fee of Rs 300/- only.

Interactive Online Mentoring : Jharkhand

Government MSME Tool Room is the first institute which has started imparting training through the Interactive Online Mentoring Sessions (IOMS),

involving experts from outside. It uses available IT Infrastructure, with marginal add-on. It provides an environment where the students have interactive online access to the mentor, which enables them to discuss their doubts and learn the core fundamentals of the subjects. This is a very unique way of facilitating the best learning experience to the students from any part of the globe. Guidance from the best experts from various fields in now possible with this new methodology of study. The first initiative as part of the IOMS program at our centre has been started at behest of Gyan Vigyan Sarita, a non-organizational, non-remunerative, non-commercial and non-political initiative of a Four passionate individuals, This initiative is driven with a sense of Personal Social Responsibility (PSR) to groom competence to compete among unprivileged students on Zero-Fund-&Zero-Asset (ZFZA) basis. In first go first year students of Diploma in the subject of Applied Mathematics and Physics. This is intended to be carried forward to impart clear understanding of these subjects form basics concepts that go into every activity of skill related to engineering. It is a a pro-active step towards SKILL-INDIA and create a competent human resource among the less privilege section of the society.

Author is Training –Incharge, at Jharkhand Government MSME Tool Room, Tatisilwai Industrial Arae, Ranchi. He is BE (Mechanical) from Delhi College of Engineering (DCE). He has 13 years of experience in industry and training, which includes 11 years at this institute.

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INVITATION FOR CONTRIBUTION OF ARTICLES

Your contribution in the form of an article, story poem or a narration of real life experience is of immense value to our students, the target audience, and elite readers of this Quarterly monthly e-Bulletin ***Gyan-Vigyan Sarita: शिक्षा,*** *and thus create a visibility of the concerns of this initiative. It gives target students a feel that you care for them, and they are anxiously awaiting to get benefitted by your contributions. We request you to please feel free to send your creation, by* ***20th of each month*** *to enable us to incorporate your contribution in next bulletin, subhashjoshi2107@gmail.com.*

We will be pleased have your association in taking forward path our plans as under-

- ***With the start of Second year of operation, we have reached to 8th Quarterly e-Bulletin Gyan-Vigyan Sarita: शिक्षा.***
- ***Theme of the 2nd Supplement of 8th Quarterly e-Bulletin dt 1st September'18 is 72th Teachers' Day to commemorate birth day of a great Teacher, philosopher and statesman Dr. Sarvepalli Radhakrishnan who was the first Vice President of India and the second President of India of our country.***
- ***And this cycle of monthly supplement sandwitching consecutive Quarterly e-Bulletin Gyan-Vigyan Sarita: शिक्षा is aimed to continue endlessly***

We believe that this monthly supplements to quarterly periodicity of e-Bulletins shall make it possible for our esteemed contributors to make contribution rich in content, diversity and based on their ground level work and/or experiences.

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APPENDIX III - LIST OF STANDARD FORMULAE

Prof. SB Dhar

This article is the last part of the **Important Formulae Of Mathematics**. In this part, the formulae are related to **and Vector Algebra and Calculus.**

Vector Algebra:

1. Scalar quantity: The quantity that has only magnitude.
2. Vector quantity: The quantity that has magnitude as well as direction.
3. Vector quantity has two end points: (a) the originating and (b) the terminating
4. The Originating is written in general as O and the terminating as A, B etc.
5. The vector is represented by $O\vec{A}$ or $O\vec{B}$
6. Sum of the vectors is given by $O\vec{A}+A\vec{B}+B\vec{C}=O\vec{C}$.
7. If the point A is represented by $O\vec{A}$ and the point B by $O\vec{B}$ then $\overrightarrow{AB}$ is represented by $\overrightarrow{AB}=\overrightarrow{OB}-\overrightarrow{OA}$= Position vector of B – Position vector of A=Position vector of terminating point- Position vector of originating point.
8. Vectors ***a, b ,c*** are said to be **linearly dependent** iff there exist real scalars **x, y, z** not all zero such that $x\bar{a}+y\bar{b}+z\bar{c}=0$.
9. Vectors ***a, b, c*** are said to be linearly independent iff there exist real scalars x, y, z all zero such that $x\bar{a}+y\bar{b}+z\bar{c}=0$.
10. Three points with possible vectors ***a, b, c*** are said to be collinear iff there exist scalars x, y, z not all zero such that $x\bar{a}+y\bar{b}+z\bar{c}=0$ where x+y+z=0.
11. Three vectors ***a, b, c*** are said to be coplanar iff any one of them can be represented as the linear combination of the other twos.
12. Four points with position vectors ***a,b,c,d*** are said to be coplanar iff there exists scalars x,y,z, u such that $x\bar{a}+y\bar{b}+z\bar{c}+u\bar{d}=0$ where x+y+z+u=0.
13. Two vectors are called collinear if one can be expressed in terms of the other. i.e. a and b are collinear if $\bar{a}=\lambda\bar{b}$ where λ is an arbitrary constant.
14. Two vectors ***a*** and ***b*** are said to be non-collinear if $\lambda\bar{a}+\mu\bar{b}=\bar{0}$ such that λ=μ=0 .
15. Two are more vectors are said to be coplanar or linearly dependent if they are parallel to the same plane or lie in the same plane or mathematically a,b,c are coplanar if $x\bar{a}+y\bar{b}+z\bar{c}=0$ where x, y, z are not necessarily zero.
16. ***a,b,c*** are called non-coplanar or linearly independent if they form a relation mathematically such that $x\bar{a}+y\bar{b}+z\bar{c}=0$ where x=y=z=0.
17. Three points A.B,C with position vectors ***a,b,c*** are called collinear if a relation in a,b,c is such that $x\bar{a}+y\bar{b}+z\bar{c}=0$ where x+y+z=0 and all of x,y,z are not zero and if such relation does not exist then these are called non-collinear.
18. The Position vector of a point R dividing a line segment joining P and Q whose position vectors are ***a*** and *b* respectively in the ratio m and n by $\overrightarrow{OR}=\frac{n\bar{a}+m\bar{b}}{m+n}$ (intermally) and $\overrightarrow{OR}=\frac{n\bar{a}-m\bar{b}}{n-m}$ (externally).
19. $\left|\bar{a}+\bar{b}\right|\le\left|\bar{a}\right|+\left|\bar{b}\right|$
20. $\left|\bar{a}-\bar{b}\right|\ge\left|\bar{a}\right|-\left|\bar{b}\right|$
21. $\left|\bar{a}+\bar{b}\right|=\left|\bar{a}\right|+\left|\bar{b}\right|$ iff vectors a and b have the same direction.
22. Product of a vector and a scalar is a vector of same direction but of scalar times magnitude.
23. If the Product of two vectors is a scalar then this is called a scalar product or dot (.) product is is written as $\bar{a}.\bar{b}$.

24. If the product of two vectors is again a vector, this is called vector product or crossproduct and is written as $\bar{a}\times\bar{b}$.
25. Scalar Product is the Product of two vectors a and b is defined as $\bar{a}.\bar{b}=ab\cos\theta$ where θ is the angle between vectors a and b.
26. This can also be written as $\bar{a}.\bar{b}=ab\cos\theta$ = a (b cos θ) = (Length of a)(Length of projection of b on a)
27. $\bar{a}.\bar{b}=\bar{b}.\bar{a}$
28. $\hat{i}.\hat{i}=\hat{j}.\hat{j}=\hat{k}.\hat{k}=1$
29. $\hat{i}.\hat{j}=\hat{j}.\hat{k}=\hat{k}.\hat{i}=0$
30. Work= $\bar{F}.\bar{d}$
31. Projection of $\bar{a}$ in the direction of $\bar{b}$ = $\dfrac{\bar{a}.\bar{b}}{|\bar{b}|}$
32. If $\bar{a}$ and $\bar{b}$ are parallel and $\bar{a}\neq 0$ and $\bar{b}\neq 0$ then $\bar{a}.\bar{b}=0$
33. $|\bar{a}+\bar{b}|=|\bar{a}-\bar{b}|$, if $\bar{a}$ and $\bar{b}$ are perpendicular to each other.
34. $|\bar{a}.\bar{b}|\leq|\bar{a}||\bar{b}|$
35. Component of vector $\bar{r}$ in the direction of $\bar{a}$ = $\dfrac{(\bar{r}.\bar{a})\bar{a}}{|\bar{a}|^2}$
36. Component of vector $\bar{r}$ in the direction perpendicular to $\bar{a}$ = $\bar{r}-\dfrac{(\bar{r}.\bar{a})\bar{a}}{|\bar{a}|^2}$
37. Vector product of $\bar{a}$ and $\bar{b}$ is defined as $\bar{a}$ x $\bar{b}$ = (ab sinθ) $\hat{n}$ where $\hat{n}$ is a unit vectorperpendicular to both $\bar{a}$ and $\bar{b}$.
38. $\bar{a}$ x $\bar{b}$ =- $\bar{b}$ x $\bar{a}$
39. $\bar{a}\times(\bar{b}+\bar{c})=\bar{a}\times\bar{b}+\bar{a}\times\bar{c}$
40. If $\bar{a}=a_1\hat{i}+a_2\hat{j}+a_3\hat{k}$ and $\bar{b}=b_1\hat{i}+b_2\hat{j}+b_3\hat{k}$ then a and b are said to be parallel iff $\dfrac{a_1}{b_1}=\dfrac{a_2}{b_2}=\dfrac{a_3}{b_3}$ or a x b =0.
41. Unit vector perpendicular to both a and b = $\dfrac{\bar{a}\times\bar{b}}{|\bar{a}\times\bar{b}|}$
42. $\hat{i}\times\hat{i}=\hat{j}\times\hat{j}=\hat{k}\times\hat{k}=0$
43. $\hat{i}\times\hat{j}=\hat{k},\hat{j}\times\hat{k}=\hat{i},\hat{k}\times\hat{i}=\hat{j}$
44. $\bar{a}\times\bar{b}=\begin{vmatrix}\hat{i}&\hat{j}&\hat{k}\\a_1&a_2&a_3\\b_1&b_2&b_3\end{vmatrix}$
45. $|\bar{a}\times\bar{b}|$ represents area of a parallelogram whose adjacent sides are a and b.
46. $\frac{1}{2}|\bar{a}\times\bar{b}|$ represents area of a triangle whose sides are a and b.
47. $\frac{1}{2}|\bar{a}\times\bar{b}|$ represents area of a parallelogram if the diagonal are a and b.
48. $\frac{1}{2}|\bar{a}\times\bar{b}+\bar{b}\times\bar{c}+\bar{c}\times\bar{a}|$ represents area of a triangle if the vertices are a ,b and c.
49. Moment of force : r x F
50. $(\bar{a}.\bar{b})^2=(\bar{a}\times\bar{b})^2=a^2b^2$.
51. $(\bar{a}.\bar{b})^2\leq a^2b^2$
52. Formula for scalar triple product where $a=a_1i+a_2j+a_3k$, $b=b_1i+b_2j+b_3k$, $c=c_1i+c_2j+c_3k$, $[abc]=\begin{vmatrix}a_1&a_2&a_3\\b_1&b_2&b_3\\c_1&c_2&c_3\end{vmatrix}$
53. For any three vectors a,b,c
    (a) [a+b b+c c+a]= 2 [a b c]
    (b) [a-b b-c c-a]=0
    (c) [a x b b x c c x a] = [a b c]^2
    (d) [a b c] = [b c a = [c a b]
    (e) [a a b] =0
    (f) [a b c] = 0 if a , b , c are coplanar.

(g) For any vector a, b, c, d ; [a+b c d] = [a c d] + [b c d]
(h) Volume of a parallelepiped=[a b c]
(i) Volume of a tetrahedron OABC where O is the origin and a, b , c are the positon vectors of A, B, C is given by (1/6)[a b c]
(j) If a, b , c , d are the position vectors of A, B, C, D then the volume of tetrahedron ABCD is given by (1/6)[b-a c-a d-a]
(k) For any three vectors a, b,c ; the vector triple product is given by a x (b x c) = (a.c)b-(a.b)c

54. If **a** and **b** are two vectors, their internal bisector is given by ***a+b*** and external bisector by ***a-b***.
55. Bisectors of the angle between the lines **r** = t **a** and **r**= s**b** are given by **r** = u (**a** +**b**) where u is a scalar.
56. Equation of a plane passing through a point ***a*** and parallel to the plane containg ***b*** and ***c*** is given by **r** = **a** + t **b** + s**c** or [**r-a, b, c**]=0
57. The equation of a plane through three points ***a, b, c*** is given by **r** = **a** + t (**b-a**) + s(**c-a**) or **r**.[**b** x **c** + **c** x **a** + **a** x **b**]=[**abc**]
58. Equation of a plane at distance p from the origin **r.n**=p
59. Length of perpendicular from the origin through ***a,b,c*** is given by [**abc**]/ I bxc + cxa+ axbI
60. Reciprocal system of vectors $\bar{a}'=\frac{\bar{b}\times\bar{c}}{[abc]}$., $\bar{b}'=\frac{\bar{c}\times\bar{a}}{[abc]}$, $\bar{c}'=\frac{\bar{a}\times\bar{b}}{[abc]}$
61. Product of four vectors: (***a*** x ***b***).(***c*** x ***d***)= $\begin{vmatrix} a.c & a.d \\ b.c & b.d \end{vmatrix}$

3-dimensional coordinate geometry:

1. Origin (0,0,0)
2. Equation of x-axis y=0, z=0
3. Equation of y-axis x=0, z=0
4. Equation of z-axis x=0, y=0
5. Equation of XOY plane z=0
6. Equation of YOZ plane x=0
7. Equation of XOZ plane y=0
8. Distance between two points A(x_1,y_1,z_1) and B(x_2,y_2,z_2) is $\sqrt{(x_1-x_2)^2+(y_1-y_2)^2+(z_1-z_2)^2}$
9. Distance of a Point P(x,y,z) from the Coordinate axes X, Y and Z are given respectively by $\sqrt{y^2+z^2},\sqrt{x^2+z^2},\sqrt{x^2+y^2}$.
10. Section formula: if A(x_1,y_1,z_1) and B(x_2,y_2,z_2) and P(x,y,z) divides the line joining AB into the ratio m:n then the coordinates of P is given by $\left(\frac{nx_1+mx_2}{m+n},\frac{ny_1+my_2}{m+n},\frac{nz_1+mz_2}{m+n}\right)$. This is also called formulae for internal division.
    For external division one of m and n becomes – negative as below:
    $\left(\frac{nx_1-mx_2}{n-m},\frac{ny_1-my_2}{n-m},\frac{nz_1-mz_2}{n-m}\right)$
11. Coordinates of mid-point of AB are $=\left(\frac{x_1+x_2}{2},\frac{y_1+y_2}{2},\frac{z_1+z_2}{2}\right)$
12. Coordinates of centroid of the triangle are $\left(\frac{x_1+x_2+x_3}{3},\frac{y_1+y_2+y_3}{3},\frac{z_1+z_2+z_3}{3}\right)$
13. Coordinates of centroid of the tetrahedron are $\left(\frac{x_1+x_2+x_3+x_4}{4},\frac{y_1+y_2+y_3+y_4}{4},\frac{z_1+z_2+z_3+z_4}{4}\right)$
14. The X-Y plane divides the line segment joining (x_1, y_1,z_1) and (x_2, y_2, z_2) in the ratio – z_1/z_2 . The Y-Z plane divides in the ratio – x_1/x_2 and the Z-X plane divides in – y_1/y_2 ratio.
15. *l,m,n* are direction cosines if $l^2 + m^2 + n^2 = 1$ otherwise they are called direction ratios.i.e. $\cos^2\alpha+\cos^2\beta+\cos^2\gamma=1$ and $\sin^2\alpha+\sin^2\beta+\sin^2\gamma=2$.
16. If a,b,c are direction ratios or direction numbers i.e. $a^2+b^2+c^2 \neq 1$ then the direction ratios are given by $l=\pm\frac{a}{\sqrt{a^2+b^2+c^2}},m=\pm\frac{b}{\sqrt{a^2+b^2+c^2}},n=\pm\frac{c}{\sqrt{a^2+b^2+c^2}}$
17. If $\overrightarrow{OP}=x\hat{i}+y\hat{j}+z\hat{k}$ then $\left|\overrightarrow{OP}\right|=\sqrt{x^2+y^2+z^2}$ is called modulus of vector OP and is represented by r.

18. Area of the triangle ABC whose vertices are $A(x_1,y_1,z_1)$, $B(x_2,y_2,z_2)$ and $C(x_3,y_3,z_3)$ is given by $\Delta = \sqrt{\Delta_x^{\,2} + \Delta_y^{\,2} + \Delta_z^{\,2}}$ where $\Delta_x = \frac{1}{2}\begin{vmatrix} y_1 & y_2 & y_3 \\ z_1 & z_2 & z_3 \\ 1 & 1 & 1 \end{vmatrix}$,

$\Delta_y = \frac{1}{2}\begin{vmatrix} x_1 & x_2 & x_3 \\ z_1 & z_2 & z_3 \\ 1 & 1 & 1 \end{vmatrix}$ $\Delta_z = \frac{1}{2}\begin{vmatrix} x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \\ 1 & 1 & 1 \end{vmatrix}$

19. Condition for collinearity of three points $A(x_1,y_1,z_1)$, $B(x_2,y_2,z_2)$ and $C(x_3,y_3,z_3)$ is given by $\frac{x_1-x_2}{x_2-x_3} = \frac{y_1-y_2}{y_2-y_3} = \frac{z_1-z_2}{z_2-z_3}$.

20. **Direction cosines** are the cosines of the angles made with the axes and is given by $l = \cos\alpha = \frac{x}{r}, m = \cos\beta = \frac{y}{r}, n = \cos\gamma = \frac{z}{r}$

21. Direction cosines of x-axis are < 1, 0, 0 >.
22. Direction cosines of y-axis are < 0, 1, 0 >.
23. Direction cosines of z-axis are < 0, 0, 1 > .
24. Direction cosines of a line are unique but direction ratios are not unique and can be infinite.
25. Angle between two lines with direction cosines < l_1,m_1,n_1 > and < l_2,m_2,n_2 > is given by cos $\theta = l_1l_2+m_1m_2+n_1n_2$
26. Angle between two lines with direction ratios < a_1,b_1,c_1 > and < a_2,b_2,c_2 > is given by cos $\theta =$ $\frac{a_1a_2+b_1b_2+c_1c_2}{\sqrt{a_1^{\,2}+b_1^{\,2}+c_1^{\,2}}\sqrt{a_2^{\,2}+b_2^{\,2}+c_2^{\,2}}}$
27. Lines are parallel if $l_1=l_2$; $m_1=m_2$; $n_1=n_2$
28. Lines are parallel if $a_1/a_2 = b_1/b_2 = c_1/c_2$
29. Lines are perpendicular if $l_1l_2+m_1m_2+n_1n_2=0$
30. Lines are perpendicular if $a_1a_2+b_1b_2+c_1c_2=0$
31. Length of projection of PQ on AB if $P(x_1,y_1,z_1)$, $Q(x_2,y_2,z_2)$ and direction cosines of AB are l,m,n is given by $(x_2-x_1)l + (y_2-y_1)m + (z_2-z_1)n$.
32. The direction cosines of a line joining $P(x_1,y_1,z_1)$ and $Q(x_2,y_2,z_2)$ are $\frac{x_2-x_1}{PQ}, \frac{y_2-y_1}{PQ}, \frac{z_2-z_1}{PQ}$ where

$$PQ = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2}$$

Straight Lines

1. Equation of a straight line with direction cosines <l,m,n> and passing through point (x_1,y_1,z_1) is given by $\frac{x-x_1}{l} = \frac{y-y_1}{m} = \frac{z-z_1}{n}$
2. Equation of a straight line with direction ratios < a, b, c > and passing through point (x_1,y_1,z_1) is given by $\frac{x-x_1}{a} = \frac{y-y_1}{b} = \frac{z-z_1}{c}$
3. Coordinates of any point on the line $\frac{x-x_1}{l} = \frac{y-y_1}{m} = \frac{z-z_1}{n}$ = k (say) is given by $(x_1+kl , y_1+km, z_1+kn)$.
4. Equation of x axis is given by $\frac{x-0}{1} = \frac{y-0}{0} = \frac{z-0}{0}$ as it passes through (0,0,0) and the direction cosines of x-axis are < 1, 0, 0 > or it can be written as y=0 and z=0.
5. Equation of y-axis is given by $\frac{x-0}{0} = \frac{y-0}{1} = \frac{z-0}{0}$ as it passes through (0,0,0) and the direction cosines of y axis are < 0, 1, 0 > or it can be written as x=0 and z=0.
6. Equation of z-axis is given by $\frac{x-0}{0} = \frac{y-0}{0} = \frac{z-0}{1}$ as it passes through (0,0,0) and the direction cosines of z axis are < 0, 0, 1 > or it can be written as x=0 and y=0.
7. Vector equation of a line passing through a point A(**a**) and parallel to line **b** is given by **r**=**a**+ t**b**.
8. Vector equation of a line passing through two points A(**a**) and B(**b**) is given by **r**=**a** + t(**b**-**a**).
9. Equation of a line passing through two points $P(x_1,y_1,z_1)$, $Q(x_2,y_2,z_2)$ is given by $\frac{x-x_1}{x_2-x_1} = \frac{y-y_1}{y_2-y_1} = \frac{z-z_1}{z_2-z_1}$
10. Intersection of two lines:
    (a) If the lines are on the same plane and not parallel, then they will cut in a point.
    (b) If the lines are on the same plane and are parallel then they will not intersect each other.

(c) If the lines are on the different planes then thay may neither be parallel nor intersect each other. These lines are called skew lines.

11. Perpendicular distance of a point P(x_1, y_1, z_1) from a line:
    (a) if the line is $\frac{x-a}{l}=\frac{y-b}{m}=\frac{z-c}{n}=k(say)$,
    (b) the general point on the line will be M(lk+a, mk+b, nk+c)
    (c) the perpendicular distance from P to M is the required distance= $\sqrt{(lk+a-x_1)^2+(mk+b-y_1)^2+(nk+c-z_1)^2}$ if PM is perpendicular to the given line i.e.(lk+a-x_1)l+(mk+b-y_1)m+(nk+c-z_1)n=0.
    (d) The equation of the perpendicular line can be written using the two point form i.e. $\frac{x-a}{lk+a-x_1}=\frac{y-b}{mk+b-y_1}=\frac{z-c}{nk+c-z_1}$
    (e) if the line is **r**=**a**+ t**b** , the perpendicular distance from a point P($\mathbf{r_1}$) is given by $\frac{\left|(\bar{a}-\bar{r}_1)\times\bar{b}\right|}{\left|\bar{b}\right|}$
12. Shortest distance between two lines r=a_1 + tb and r = a_2 + sb is given by $d=\frac{\left|(\bar{a}_2-\bar{a}_1)\times\bar{b}\right|}{\left|\bar{b}\right|}$
13. Shortest distance between two lines r=a_1 + tb_1 and r= a_2 + sb_2 is given by $d=\frac{\left|(\bar{a}_2-\bar{a}_1).(\bar{b}_1\times b_2)\right|}{\left|\bar{b}_1\times b_2\right|}$
14. The condition for two lines r=a_1 + tb_1 and r= a_2 + sb_2 to intersect is $d=\frac{\left|(\bar{a}_2-\bar{a}_1).(\bar{b}_1\times b_2)\right|}{\left|\bar{b}_1\times b_2\right|}$ =0 i.e. $\left|(\bar{a}_2-\bar{a}_1).(\bar{b}_1\times b_2)\right|=0$.
15. The shortest distance between two parallel lines r=a_1 + tb and r= a_2 + sb to intersect is $d=\frac{\left|(\bar{a}_2-\bar{a}_1)\times\bar{b}\right|}{\left|\bar{b}\right|}$.
16. Shortest distance between two lines in Cartesian form $\frac{x-x_1}{l_1}=\frac{y-y_1}{m_1}=\frac{z-z_1}{n_1}$, $\frac{x-x_2}{l_2}=\frac{y-y_2}{m_2}=\frac{z-z_2}{n_2}$ is given by $d=\frac{\begin{vmatrix}x_2-x_1 & y_2-y_1 & z_2-z_1\\ l_1 & m_1 & n_1\\ l_2 & m_2 & n_2\end{vmatrix}}{\sqrt{(m_1n_2-m_2n_1)^2+(n_1l_2-l_1n_2)^2+(l_1m_2-m_1l_2)^2}}$.
17. Shortest distance between two skew lines is such a line that is perpendicular to both the skew lines.
18. Condition for two lines to intersect $\frac{x-x_1}{l_1}=\frac{y-y_1}{m_1}=\frac{z-z_1}{n_1}$, $\frac{x-x_2}{l_2}=\frac{y-y_2}{m_2}=\frac{z-z_2}{n_2}$ is given by $d=\frac{\begin{vmatrix}x_2-x_1 & y_2-y_1 & z_2-z_1\\ l_1 & m_1 & n_1\\ l_2 & m_2 & n_2\end{vmatrix}}{\sqrt{(m_1n_2-m_2n_1)^2+(n_1l_2-l_1n_2)^2+(l_1m_2-m_1l_2)^2}}$ = 0 i.e. $\begin{vmatrix}x_2-x_1 & y_2-y_1 & z_2-z_1\\ l_1 & m_1 & n_1\\ l_2 & m_2 & n_2\end{vmatrix}=0$.
19. Two lines r=a_1 + tb_1 and r=a_2 + sb_2 that are coplanar intersect if (a_2-a_1).(b_1x b_2)=0
20. Bisectors of angle between two lines r = a+ tb and r = a + sb are given by r= a + λ (c+b) and r = a + λ (c-b).
21. The numbers of lines that are equally inclined to the axes are 4.
22. The direction cosines of the line equally inclined to the coordinate axes are < ±1/√3, ±1/√3 , ±1/√3 >
23. The maximum value of lmn= 1/(3√3) where l,m,n are the direction cosines.
24. Skew lines are lines in space which are neither parallel nor intersecting. They lie in different planes i.e. skew lines are non-coplanar lines.
25. Angle between skew lines is the angle between two intersecting lines drawn from any point (preferably through origin) parallel to each of the skew lines.
26. Intersection of two planes forms a straight line.
27. Joint equation of a line is represented by two planes: $a_1x+b_1y+c_1z+d_1=0$ and $a_2x+b_2y+c_2z+d_2=0$.
28. Angle between a line r = a + tb and a plane r.n = p is given by sin $\sin\theta=\frac{b.n}{|b||n|}$ = if the line is parallel to the plane b.n=0 and if the line is perpendicular to the plane b x n =0

29. Point of intersection of a line and a plane is a point. If the line is $\frac{x-x_1}{l}=\frac{y-y_1}{m}=\frac{z-z_1}{n}$ =r and the plane is ax+by+cz+d=0 then the point on the line will be given by (r l + x_1, mr +y_1, nr + z_1). This point will lie on the plane. So put the value of x,y,z and get the value of r. and hence the point of intersection.
30. Condition to lie a line in a plane; if the line is $\frac{x-x_1}{l}=\frac{y-y_1}{m}=\frac{z-z_1}{n}$ and the plane is ax + by +c z +d =0 then al + bm +cn =0 and $ax_1 + by_1 + cz_1 + d=0$
31. Condition for the lines to be coplanar; if the lines are r = $a_1 + tb_1$ and r= a_2+ s b_2 then $[ab_1b_2]=[a_2b_1b_2]$
32. Equation of the plane containing two lines will be $[rb_1b_2]=[a_2b_1b_2]$

Fundamental Theorem in Space

If ***a, b, c*** are non-zero, non-coplanar vectors in space, then there exists unique x,y, z ∈R such that ***r*** = x ***a*** + y***b*** + z***c***.

A **surface** is called a plane if every point of the line joining any two random points on it also lies on it.

Equation of a plane

1. Equation of XOY-plane is given by z=0.
2. Equation of YOZ plane is given by x=0.
3. Equation of XOZ plane is given by y=0.
4. Equation of any plane parallel to XOY plane is given by z= c, the positive or negative sign of c will determine the exact state of plane as c is the distance from the z-axis.
5. Equation of any plane parallel to YOZ plane is given by x= c, the positive or negative sign of c will determine the exact state of plane as c is the distance from the x-axis.
6. Equation of any plane parallel to XOZ plane is given by y= c, the positive or negative sign of c will determine the exact state of plane as c is the distance from the y-axis.
7. Equation of a plane is calculated under three conditions.
8. Equation of a plane is of the form ax+by+cz+d=0 where a,b,c are the direction ratios of the normal to the given plane.
9. Equation of a plane passing through Origin(0,0,0) is given by ax+by+cz=0.
10. Equation of a plane perpendicular to XOY plane or parallel to z-axis is ax+by+d=0.
11. Equation of a plane perpendicular to YOZ plane or parallel to x-axis is by+cz+d=0.
12. Equation of a plane perpendicular to XOZ plane or parallel to y-axis is ax+cz+d=0.
13. Equation of a plane passing through the intersection of two planes ax+by+cz+d=0 and a'x+b'y+c'z+d'=0 is given by (ax+by+cz+d)+ λ(a'x+b'y+c'z+d')=0 where λ is a parameter whose value can be evaluated under given condition.
14. Equation of plane ax+by+cz+d=0 represents a system of planes perpendicular to the line x/a=y/b=z/c.
15. Normal form of the vector equation of the plane is given by **r**.**n**=p where n is the unit vector normal to the plane and p is the perpendicular distance from the origin to the plane.
16. Equation of a plane passing through one point (x_1,y_1,z_1) is given by $a(x-x_1)+b(y-y_1)+c(z-z_1)=0$, where a,b,c are the direction ratios of the normal to the plane.
17. Equation of a plane passing through three points(x_1,y_1,z_1) , (x_2,y_2,z_2) , (x_3,y_3,z_3) is given by $\begin{vmatrix} x & y & z & 1 \\ x_1 & y_1 & z_1 & 1 \\ x_2 & y_2 & z_2 & 1 \\ x_3 & y_3 & z_3 & 1 \end{vmatrix}=0$
18. Vector equation of a plane passing through a point (**a**) and perpendicular to the vector **n** is given by (**r**-**a**).**n**=0.
19. Vector equation a plane passing through three points **a,b,c** is given by[**r-a r-b r-c**]=0.
20. Angle between two planes in case of Cartesian equations: $a_1x+ b_1y + c_1z + d_1=0$ and $a_2x + b_2y +c_2z + d_2$ =0 is defined as the angle between their normals and is given by $\cos\theta=\frac{a_1a_2+b_1b_2+c_1c_2}{\sqrt{a_1^2+b_1^2+c_1^2}\sqrt{a_2^2+b_2^2+c_2^2}}$.
21. If planes are perpendicular to each other then $a_1a_2+b_1b_2+c_1c_2$
22. If planes are parallel to each other then $a_1/a_2=b_1/b_2=c_1/c_2$
23. Intercepts of the plane **r**.**n**=p upon the axes is p/(**i**.**n**), p/(**j**.**n**), p/(**k**.**n**).
24. Intercept form of a plane is given by x/a + y/b + z/c =1

25. Angle between two planes in case of vector equations: $\mathbf{r.n_1}=p$ and $\mathbf{r.n_2}=q$, is given by $\cos\theta=\frac{n_1.n_2}{|n_1||n_2|}$
26. Any plane parallel to a given plane ax+by+cz+d=0 is given by ax+by+cz+λ =0 where λ is calculated under some given conditions i.e. only constant term is changed.
27. Perpendicular distance of a point (x_1, y_1 , z_1) from a plane ax+by +cz +d=0 is given by $\frac{|ax_1+by_1+cz_1+d|}{\sqrt{a^2+b^2+c^2}}$
28. Perpendicular distance of a point whose position vector is $\boldsymbol{a}$, in case of the vector form of the equation of the plane **r.n** = p, is given by $\frac{|\bar{a}.\bar{n}-p|}{|\bar{n}|}$.
29. Distance between two parallel planes: ax+by+cz+d_1=0 is given by ax+by+cz+d_2 =0 is given by $\frac{|d_1-d_2|}{\sqrt{a^2+b^2+c^2}}$.
30. If a plane meets coordinate axes A,B,C in such a way that the centroid is (p,q,r) then the equation of the plane will be x/p + y/q + z/r =3.
31. The distance between the parallel planes **r.n**=p and **r.n**=q is given by |p-q|/|**n**|.
32. The equation of the plane lx+my+nz=p represents a plane whose distance from the origin is p and the direction cosines of the normal to the plane are <*l,m,n*>.
33. Equations of planes bisecting angles between two planes
    (a) in case of vector form of planes $\mathbf{r.n_1}=p_1$ and $\mathbf{r.n_2}=p_2$: $\frac{|\bar{r}.\bar{n}_1-p_1|}{|\bar{n}_1|}=\frac{|\bar{r}.\bar{n}_2-p_2|}{|\bar{n}_2|}$
    (b) in case of Cartesian form of planes $a_1x+b_1y+c_1z+d_1=0$ and $a_2x+b_2y+c_2z+d_2=0$: $\frac{a_1x+b_1y+c_1z+d_1}{\sqrt{a_1^2+b_1^2+c_1^2}}=\pm\frac{a_2x+b_2y+c_2z+d_2}{\sqrt{a_2^2+b_2^2+c_2^2}}$.
34. Angle bisector is an acute angle bisector if the angle between the bisector plane and one of the plane is less than 45^0 , otherwise it is an obtuse angle bisector.
35. Origin lies in the acute angle between the planes if $a_1a_2+b_1b_2+c_1c_2$ is (+)positive and it lies in the obtuse angle if it is (-)negative if both d_1 and d_2 are positive or of same sign.

Plane and Line

1. Equation of a plane through a line (if the equation of the line is in general form $a_1x+b_1y+c_1z+d_1=0$, $a_2x+b_2y+c_2z+d_2=0$): $(a_1x+b_1y+c_1z+d_1)+\lambda(a_2x+b_2y+c_2z+d_2)=0$ where is a parameter whose value may be found under given condition.
2. Equation of a plane through a line (if the line is in symmetrical form $\frac{x-x_1}{l}=\frac{y-y_1}{m}=\frac{z-z_1}{n}$): $a(x-x_1)+b(y-y_1)+c(z-z_1)=0$ where a,b,c are given by al+bm+cn=0.
3. Equation of a plane (with direction ratios of the normal to the plane < a, b, c >) through a line (with direction cosines < l_1, m_1, n_1>) and parallel to another line (with direction cosines < l_2, m_2, n_2 >): $al_2+bm_2+cn_2=0$ as the normal will be perpendicular to the parallel line and $\begin{vmatrix} x-x_1 & y-y_1 & z-z_1 \\ l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix}=0$.
4. Condition for a line **r**= **a** + t**b** to lie in a plane **r.n** = d (the equations in Vector form): **b.n**=0 and **a.n**=d.
5. Condition for a line $\frac{x-x_1}{l}=\frac{y-y_1}{m}=\frac{z-z_1}{n}$ to lie in a plane ax+by+cz+d=0 (the equations in Cartesian form): $ax_1+by_1+cz_1+d=0$, al+bm+cn=0.
6. Angle between a line and a plane is defined as "the complement of the angle between the line and the normal to the plane".
7. In Vector form if the line is **r**=**a**+t**b** and the plane is **r.n**=p then the angle between the line and plane θ will be given by $\sin\theta=\frac{\bar{b}.\bar{n}}{|\bar{b}||\bar{n}|}$.
8. If the line is parallel to the plane (i.e. line is perpendicular to the normal to the plane) : **b.n**=0 .
9. If the line is perpendicular to the plane (i.e. line is parallel to the normal to the plane): **bxn**=0 or **b** = λ **n**.
10. In Cartesian form if the line is $\frac{x-x_1}{l}=\frac{y-y_1}{m}=\frac{z-z_1}{n}$ and the plane is ax+by+cz+d=0 and θ is the angle between the line and

the plane then it is given by $\sin\theta = \frac{al+bm+cn}{\sqrt{a^2+b^2+c^2}\sqrt{l^2+m^2+n^2}}$.

11. If the line is parallel to the plane then al+bm+cn=0.
12. If the line is pependicular to the plane then a/l=b/m=c/n.
13. If the lines $\mathbf{r} = \mathbf{a}_1 + t\mathbf{b}_1$, $\mathbf{r} = \mathbf{a}_2 + s\mathbf{b}_2$ are coplanar (i.e. intersecting) then $[\mathbf{a_1}\ \mathbf{b_1}\ \mathbf{b_2}] = [\mathbf{a_2}\ \mathbf{b_1}\ \mathbf{b_2}]$ and the equation of the plane containing the two lines: $[\mathbf{r}\ \mathbf{b_1}\ \mathbf{b_2}] = [\mathbf{a_1}\ \mathbf{b_1}\ \mathbf{b_2}]$ or $[\mathbf{r}\ \mathbf{b_1}\ \mathbf{b_2}] = [\mathbf{a_2}\ \mathbf{b_1}\ \mathbf{b_2}]$.
14. If the lines $\frac{x-x_1}{l_1} = \frac{y-y_1}{m_1} = \frac{z-z_1}{n_1}$, $\frac{x-x_2}{l_2} = \frac{y-y_2}{m_2} = \frac{z-z_2}{n_2}$ are coplanar (i.e. intersecting) then $\begin{vmatrix} x_2-x_1 & y_2-y_1 & z_2-z_1 \\ l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix} = 0$ and the equation of the plane containing two lines: $\begin{vmatrix} x-x_1 & y-y_1 & z-z_1 \\ l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix} = 0$ or $\begin{vmatrix} x-x_2 & y-y_2 & z-z_2 \\ l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix} = 0$.

Sphere

1. Sphere is the locus of a point that moves in space such that its distance from a fixed point called centre is always constant.
2. The constant distance is called the radius of the sphere.
3. Vector equation of the sphere is denoted by $|r-c| = a$ where c is the Position vector of centre and a is the radius of the sphere.
4. Cartesian form of the sphere is $(x-a)^2 + (y-b)^2 + (z-c)^2 = r^2$ where (a,b,c) is the centre and r is the radius.
5. If the centre is (0,0,0) and radius is r then the equation becomes $x^2 + y^2 + z^2 = r^2$
6. Diameter form of a sphere is in Vetor form $(\bar{r}-\bar{r}_1).(\bar{r}-\bar{r}_2)=0$. In the Cartesian form it is given by $(x-x_1)(x-x_2)+(y-y_1)(y-y_2)+(z-z_1)(z-z_2)=0$. Its center will be $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}, \frac{z_1+z_2}{2}\right)$ and radius will be $\frac{1}{2}\sqrt{(x_1-x_2)^2+(y_1-y_2)^2+(z_1-z_2)^2}$.
7. General equation of the sphere is of the type $x^2 + y^2 + z^2 + 2gx + 2fy + 2hz + c=0$. The centre is given by $(-g, -f, -h)$ and radius = $(g^2 + f^2 + h^2 - c)^{1/2}$.
8. The plane $ax + by + cz = p$ touches the sphere $x^2 + y^2 + z^2 + 2gx + 2fy + 2hz + c=0$ if $(ag+bf+ch-p)^2 = (a^2+b^2+c^2)(g^2+f^2+h^2-c)$

Indeterminate Form

When a unique value of an expression f(x) at x=a is not possible, it is said that it is indeterminate. For example the expression f(x)= $\frac{x^2-4}{x-2}$ at x=2 becomes (0/0) which will give no unique value at x=2 hence it will be of Indeterminate form.

Note: $\log_a 0$ is not defined but $\log_a 0 \to -\infty$ for a > 1 and $+\infty$ for 0 < a < 1.

Note: in case of $1^\infty, 0^0, \infty^0$ take logarithm and then use the appropriate method to evaluate the limit.

Continuity

1. A function is said to be continuous at a point x=c if f(c)= $\lim_{x\to c+} f(x) = \lim_{x\to c-} f(x)$
2. If RHLimit=LHLimit=value of the function, the function is continuous otherwise discontinuous.
3. If f(x) and g(x) are continuous then c f(x) is also continuous.
4. f(x) ±g(x) , f(x).g(x), f(x)/g(x) are also continuous.
5. If f(x) is defined on [a,b] then f(x) is said to be continuous at end points at x=a if $f(a) = \lim_{x\to a^+} f(x)$ and at x=b if $f(b) = \lim_{x\to b^-} f(x)$. At x=a, LHL and at x=b, RHL cannot be checked.
6. A function is said to be continuous on its domain if it is continuous at the end points and at all points lying between a and b.

7. If f(x) is defined on (a,b) then the function cannot be checked for continuity at end points as they are not included in the domain at all. In this case only at the interior point, the continuity may be checked.
8. If f(x) is continuous on [a,b] such that f(a) and f(b) are of opposite signs, then there exists atleast one solution of f(x)=0 in the open interval (a,b).
9. Every polynomial is continuous at every point of the real line. For example $f(x)=a_0x^n + a_1x^{n-1}+a_2 x^{n-2} +....+ a_n$ is continuous on R.
10. Every Rational function is continuous at every point where the denominator is not zero.
11. Logarithmic, Exponential, Trigonometric, Inverse Trigonometric, Modulus functions are continuous in their domain of definition.
12. Point Function (i.e. domain and range containing only one point) is a discontinuous function.
13. **Cauchy's Definition of Continuity**: A real valued function f defined on an open interval I is said to be continuous at a∈ I iff for any arbitrarily chosen positive number ε, however small, we get a corresponding number $\delta > 0$ such that $|f(x) - f(a)| < \varepsilon$ for all values of x for which $|x - a| < \delta$.
14. **Heine's Definition of Continuity**: let a function f be defined on some neighbourhood of a point a, then f is said to be continuous at a iff for every sequence $a_1, a_2, a_3,...., a_n,...$of real numbers for which $\lim_{n\to\infty} a_n = a$, we have $\lim_{n\to\infty} f(a_n) = \lim f(a)$

Discontinuity

1. The function is said to be discontinuous if either the limit does not exist or value is not equal to its limit.
2. The discontinuity is said to be of first kind if both the limits (Right Hand Limit and Left Hand Limit) exist and are not equal. This is also called non-removable discontinuity of first kind.
3. The discontinuity is said to be removable if $\lim_{x\to c+} f(x) = \lim_{x\to c-} f(x) \neq f(c)$
4. The discontinuity is said to be of second kind if atleast one of the limit does not exist. Remember, the limits are said to be existing if they are finite and definite. This is also called infinite discontinuity.
5. The difference between RHL and LHL is called the jump discontinuity.

Limits

1. If $\lim_{x\to a} f(x) = l, \lim_{x\to a} g(x) = m,$ then $\lim_{x\to a}\{f(x) \pm g(x)\} = l \pm m$ if l and m exist
2. $\lim_{x\to a}\{f(x).g(x)\} = l.m$
3. $\lim_{x\to a}\{f(x)\}^{g(x)} = l^m$
4. $\lim_{x\to a}\{fog(x)\} = f\left(\lim_{x\to a} g(x)\right) = f(m)$
5. In particular, $\lim_{x\to a} \log\{f(x)\} = \log\left(\lim_{x\to a} f(x)\right) = \log l$
6. In particular, $\lim_{x\to a} e^{f(x)} = e^{\lim_{x\to a} f(x)} = e^l$
7. $\lim_{x\to a} \frac{1}{f(x)} = 0$ if $\lim_{x\to a} f(x) = +\infty ...or... -\infty$
8. $\lim_{x\to 0^+} \left[\frac{\tan x}{x}\right] = 1^+$
9. $\lim_{x\to 0^+} \left[\frac{\sin x}{x}\right] = 0$, as (sinx/x)<1
10. $\lim_{x\to 0^-} \left[\frac{\sin x}{x}\right] = 0$, as (sinx/x)<1
11. $\lim_{x\to 0^+} \frac{\{x\}}{\tan\{x\}} = 1$, as $\{x\} \to 0$ when $x \to 0$.
12. $\lim_{x\to\infty} x.\sin\frac{1}{x} = \lim_{x\to\infty} \frac{\sin\frac{1}{x}}{\frac{1}{x}} = 1$
13. $\lim_{x\to\infty} \cos\frac{1}{x} = 1$
14. $\lim_{x\to\infty} x.\tan\frac{1}{x} = 1$
15. If $\lim_{x\to a} f(x) = \lim_{x\to a} g(x) = 0$ then $\lim_{x\to a}(1 + f(x))^{\frac{1}{g(x)}} = e^{\lim_{x\to a}\frac{f(x)}{g(x)}}$
16. If $\lim_{x\to a} f(x) = 1, \lim_{x\to a} g(x) = \infty$ then $\lim_{x\to a}(f(x))^{g(x)} = \lim_{x\to a}(1 + (f(x) - 1))^{g(x)} = e^{\lim_{x\to a}(f(x)-1)g(x)}$

17. Particularly: $\lim_{x\to 0}(1+x)^{\frac{1}{x}} = e; \lim_{x\to 0}(1+\lambda x)^{\frac{1}{x}} = e^{\lambda}$

L'Hospital Rule

This is applied if the function is differentiable and is of the form (0/0) or (∞/∞).

If $\lim_{x\to a} f(x) = \lim_{x\to a} g(x) = 0$ then

$$\lim_{x\to a}\frac{f(x)}{g(x)} = \lim_{x\to a}\frac{f'(x)}{g'(x)}; g'(x)\neq 0$$

Example: $\lim_{x\to 0}\left(\frac{1}{x} - \frac{1}{\sin x}\right)$. This is of the form $\infty - \infty$.

Let us change to (0/0) form by simplifying as $\lim_{x\to 0}\left(\frac{\sin x - x}{x\sin x}\right)$

Apply L'Hospital Rule i.e. differentiate Numerator and Denominator separately equal number of times and when it is not of 0/0 form , put x=0 to find the limit = 0.

Very Important:

Sometime the evaluation of the limit appears of no form. Then the exponential form of rewriting it helps in its evaluation. For example:

$\lim_{x\to 0}|\cot x|^{\sin x} = e^{\lim_{x\to 0}\sin x \log_e|\cot x|}$,as it is obvious that the use of exponential writing helps and changes one of the known forms as $e^{\log_e z} = z$

Limits that do not exist

1. $\lim_{x\to 0}\left(\frac{1}{x}\right)$
2. $\lim_{x\to 0}\cos\left(\frac{1}{x}\right)$
3. $\lim_{x\to 0}\left(\frac{1}{x}\right)$
4. $\lim_{x\to 0} e^{\frac{1}{x}}$
5. $\lim_{x\to\infty}\cos x$
6. $\lim_{x\to\infty}\sec x$
7. $\lim_{x\to 0} x^{1/x}$
8. $\lim_{x\to a}\frac{|x-a|}{x-a}$
9. $\lim_{x\to\infty}\sin x$
10. $\lim_{x\to\infty}\csc x$ **cosec** is written also written as **csc**
11. $\lim_{x\to\infty}\tan x$
12. $\lim_{x\to\infty}\cot x$

DIFFERENTIATION

A function f(x) is said to be differentiable if RH derivative = LH derivative otherwise it is said to be not differentiable or,

$$\lim_{h\to 0}\frac{f(x+h)-f(x)}{h} = \lim_{h\to 0}\frac{f(x-h)-f(x)}{-h}$$

The Right hand derivative is also called Progressive derivative and the Left hand derivative is called the Regressive derivative

1. The derivatives should be finite.
2. A function defined on open interval (a, b) is said to be differentiable in an open interval (a, b) if it is differentiable at each point of (a,b).
3. A function defined on closed interval [a, b] is said to be differentiable at end points a and b if it is differentiable from the right at a i.e. $Lim_{x\to a^+}\frac{f(x)-f(a)}{x-a}$ exists and is finite and is differentiable from the left at b i.e. $Lim_{x\to b^-}\frac{f(x)-f(b)}{x-b}$ exists and is finite.

4. A function is said to be differentiable function if it is differentiable at every point of its domain.
5. If A function is differentiable in the open interval (a, b) and also at the end points a and b then it said to be differentiable in the closed interval [a, b].
6. If a function is differentiable at a point, then it is necessarily continuous at that point but the converse is not true i.e. if it is continuous then it may or may not be differentiable at that point.
7. If f(x) and g(x) are differentiable, then f(x)$\pm$ g(x) or f(x).g(x) are also differentiable.
8. If f(x) is differentiable and g(x) is not differentiable then f(x) g(x) may be differentiable.
9. If f(x) is not differentiable and g(x) is also not differentiable then f(x) g(x) may be differentiable.
10. A function is not differentiable at ***kink (corner)*** as a unique tangent cannot be drawn at that point i.e. a function is derivable iff its graph is always smooth i.e. there exists no break or corner.
11. The derivative of a Periodic Function is also a periodic function having the same fundamental period.
12. The derivative of an even function is an odd function and the derivative of an odd function is an even function.
13. Differentiability of a function at a point implies the continuity at that point only.
14. $\frac{dy}{dx}$ represents the derivative of y w.r.t. x and is also the rate of change of y with respect to x. This also represents the slope of the tangent to the curve at (x, y).
15. If tangent is parallel to x-axis then $\frac{dy}{dx}$ =0 and if it is perpendicular to the x-axis then $\frac{dy}{dx}=\frac{1}{0}$. The value 1/0 should not be written as ∞, as it is not a number but an assumption.
16. A function is said to be increasing if f'(x) > 0 for all x in its domain.
17. A function is said to be decreasing if f'(x) < 0 for all x in its domain.
18. For comparison of two functions f(x) and g(x), we should check whether h(x)= f(x)-g(x) is increasing or decreasing.
19. If a function is strictly increasing in closed interval [a, b] then f(a) is local minimum and f(b) is local maximum.
20. If a function is strictly decreasing in closed interval [a, b] then f(a) is local maximum and f(b) is local minimum.
21. In second derivative test for maximum and minimum values, one must note that this method cannot be applied at the points where f'(x) is undefined.
22. For global maximum and minimum values in the closed interval [a,b] all values including at a and b of f(x) should be evaluated and then noted for maximum and minimum.
23. Leibnitz formula for successive differentiation of explicit functions:

$$(uv)^{(n)}=u^{(n)}v+{}^nC_1u^{(n-1)}v'+{}^nC_2u^{(n-2)}v''+....+{}^nC_nuv^{(n)}$$

24. $\frac{d}{dx}(cons\tan t)=0$
25. $\frac{d}{dx}(|x|)=\frac{x}{|x|},x\neq 0$
26. $\frac{d}{dx}([x])=0$
27. $\frac{d}{dx}(x^n)=nx^{n-1}$ where x is a variable and n is a constant.
28. $\frac{d}{dx}(e^x)=e^x$
29. $\frac{d}{dx}(\sin x)=\cos x$
30. $\frac{d}{dx}(\cos x)=-\sin x$
31. $\frac{d}{dx}(\tan x)=\sec^2 x$
32. $\frac{d}{dx}(\cot x)=-\cos ec^2 x$
33. $\frac{d}{dx}(\sec x)=\sec x\tan x$
34. $\frac{d}{dx}(\cos ecx)=-\cos ecx\cot x$
35. $\frac{d}{dx}(\log x)=\frac{1}{x}$
36. $\frac{d}{dx}(\log_a x)=\frac{1}{x}\log_a e$

37. $\frac{d}{dx}(a^x) = a^x \log_e a$

38. $\frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}}$

39. $\frac{d}{dx}(\cos^{-1} x) = -\frac{1}{\sqrt{1-x^2}}$

40. $\frac{d}{dx}(\tan^{-1} x) = \frac{1}{1+x^2}$

41. $\frac{d}{dx}(\cot^{-1} x) = -\frac{1}{1+x^2}$

42. $\frac{d}{dx}(\sec^{-1} x) = \frac{1}{x\sqrt{x^2-1}}$

43. $\frac{d}{dx}(\operatorname{cosec}^{-1} x) = -\frac{1}{x\sqrt{x^2-1}}$

44. $\frac{d}{dx}\left(vers^{-1}\left(\frac{x}{a}\right)\right) = \frac{1}{\sqrt{2ax-x^2}}$ where vers x = 1-cosx and 1-sinx = covers x.

45. $\frac{d}{dx}\{f(x) \pm g(x)\} = \frac{d}{dx}\{f(x)\} \pm \frac{d}{dx}\{g(x)\}$

46. $\frac{d}{dx}\{f(x).g(x)\} = g(x).\frac{d}{dx}\{f(x)\} + f(x)\frac{d}{dx}\{g(x)\}$

47. $\frac{d}{dx}\left\{\frac{f(x)}{g(x)}\right\} = \frac{\left(\frac{d}{dx}Nr\right)Dr - \left(\frac{d}{dx}Dr\right)Nr}{Dr^2}$

48. In differentiation of inverse Trigonometric functions if no branch is mentioned then, then the Principal branch should be taken in consideration.

49. $\frac{d}{dx}\begin{vmatrix} f(x) & g(x) & h(x) \\ g(x) & h(x) & g(x) \\ h(x) & f(x) & f(x) \end{vmatrix} = \begin{vmatrix} f'(x) & g'(x) & h'(x) \\ g(x) & h(x) & g(x) \\ h(x) & f(x) & f(x) \end{vmatrix}$

$$+\begin{vmatrix} f(x) & g(x) & h(x) \\ g'(x) & h'(x) & g'(x) \\ h(x) & f(x) & f(x) \end{vmatrix} + \begin{vmatrix} f(x) & g(x) & h(x) \\ g(x) & h(x) & g(x) \\ h'(x) & f'(x) & f'(x) \end{vmatrix}$$

50. $\frac{d}{dx}\begin{pmatrix} f(x) & g(x) & h(x) \\ g(x) & h(x) & g(x) \\ h(x) & f(x) & f(x) \end{pmatrix} = \begin{pmatrix} f'(x) & g'(x) & h'(x) \\ g'(x) & h'(x) & g'(x) \\ h'(x) & f'(x) & f'(x) \end{pmatrix}$

51. The chain rule is expressed as: $\frac{dy}{dx} = \frac{dy}{ds}.\frac{ds}{dt}.\frac{dt}{dx}$

52. n[th] derivatives of functions:

(a) $D^n x^m = \frac{d^n}{dx^n} x^m$

$= m(m-1)(m-2)..(m-n+1)x^{m-n}$

(b) $D^n (ax+b)^m = \frac{d^n}{dx^n}(ax+b)^m$

$= a^n.m(m-1)(m-2)..(m-n+1)(ax+b)^{m-n}$

(c) $D^n \log(ax+b)$

$= \frac{d^n}{dx^n}\log(ax+b) = \frac{(-1)^{n-1}.a^n.(n-1)!}{(ax+b)^n}$

(d) $D^n e^{ax} = \frac{d^n}{dx^n} e^{ax} = a^n e^{ax}$ Gg

(e) $D^n a^{bx} = \frac{d^n}{dx^n} a^{bx} = b^n a^{bx} (\log_e a)^n$.

(f) $D^n \sin(ax+b)$

$= \frac{d^n}{dx^n}\sin(ax+b) = a^n \sin\left(ax+b+\frac{n\pi}{2}\right)$

(g) $D^n \cos(ax+b)$

$= \frac{d^n}{dx^n}\cos(ax+b) = a^n \cos\left(ax+b+\frac{n\pi}{2}\right)$

(h) $D^n e^{ax}\cos(bx+c) = \frac{d^n}{dx^n} e^{ax}\cos(bx+c)$

$= \left(a^2+b^2\right)^{\frac{n}{2}} e^{ax}\cos\left(bx+c+n\phi\right)$

where $\tan\phi = \frac{b}{a}$

(i) $D^n e^{ax}\sin(bx+c) = \frac{d^n}{dx^n} e^{ax}\sin(bx+c)$

$= \left(a^2+b^2\right)^{\frac{n}{2}} e^{ax}\sin\left(bx+c+n\phi\right)$ $\tan\phi = \frac{b}{a}$

53. The ***slope*** of the tangent for the function y=f(x) at point (x_1,y_1) is given by $\tan\psi = \left(\frac{dy}{dx}\right)_{(x_1,y_1)}$ = tangent of the

angle between the positive direction of x-axis and the tangent.

54. The slope of the normal is given by $-\frac{1}{\left(\frac{dy}{dx}\right)_{(x_1,y_1)}}$

55. ***Tangent*** at (x_1, y_1) is written as $y-y_1=(dy/dx)(x-x_1)$

56. ***Normal*** at (x_1, y_1) is written as $y-y_1=-(dx/dy)(x-x_1)$

57. If the line is parallel to x-axis dy/dx=0

58. If the line is perpendicular to x-axis dy/dx= 1/0

59. ***Length of tangent*** $= \frac{y\sqrt{1+\left(\frac{dy}{dx}\right)^2}}{\frac{dy}{dx}}$

60. ***Length of normal*** $= y\sqrt{1+\left(\frac{dy}{dx}\right)^2}$

61. ***Length of sub-tangent*** $= \frac{y}{\left(\frac{dy}{dx}\right)}$

62. Length of ***sub-normal =*** $y.\frac{dy}{dx}$

63. Intercept of tangent on x-axis= $\left|x-y.\left(\frac{dy}{dx}\right)\right|$

64. Intercept of tangent on y-axis= $\left|y-x.\left(\frac{dy}{dx}\right)\right|$

65. Two curves touch each other if at the point of contact $m_1 = m_2$

66. Two curves cut each other orthogonally if $m_1 m_2 = -1$

67. If function f(x) is continuous on [a,b] such that $f'(c) \geq 0$, or $f'(c)>0$ for each $c \in (a,b)$ then f(x) is said to be monotonically (strictly)increasing function on [a,b]

68. If function f(x) is continuous on [a,b] such that $f'(c) \leq 0$, or $f'(c)<0$ for each $c \in (a,b)$ then f(x) is said to be monotonically (strictly) decreasing function on [a,b]

69. If f(x) and g(x) are monotonically (or strictly) increasing (or decreasing) functions on [a,b] then gof (x) is a monotonically (strictly) increasing function on [a,b]

70. If one of the function f(x) and g(x) is montonically (or strictly) increasing and other amonotically (or strictly) decreasing , then gof(x) is monotonically (or strictly) decreasing on (a,b)

71. If f(x) is an ***increasing function***[1] on (a,b) then tangent makes an acute angle with +ive direction of x-axis ie dy/dx > 0.

72. If f(x) is ***decreasing function***[2] on (a,b) then tangent makes an obtuse angle with the +ive direction of x-axis ie dy/dx<0.

73. The sign of the derivative gives a **sufficient condition** for the function to be increasing or decreasing but this condition is by means **necessary** . The function $f(x)=x^3$ produces a counter example as this is differentiable and increasing on (-1,1) and everywhere else except at x=0 where it is 0.

74. Fermat Theorem
Let a function y=f(x) be defined on a certain interval and have a maximum or a minimum value at an interior point x_0 of the interval. If there exists a derivative $f'(x_0)$ at the point x_0 then $f'(x_0) =0$.

75. Rolle's Theorem
f(x) is continuous on [a,b], derivable in (a,b) and f(a) = f(b) then there exists atleast one point $c \in (a,b)$ such that $f'(c)=0$.

76. Lagrange's Mean Value Theorem
If f(x) is continuous on [a,b], derivable in (a,b) then there exists atleast one point $c \in (a,b)$ such that $f'(c) = \frac{f(b)-f(a)}{b-a}$

77. Cauchy's Theorem
Let f(x) and g(x) be two functions continuous in the interval [a,b] and have finite derivatives at all interior points of the interval. If these derivatives do not vanish simultaneously and $g(a) \neq g(b)$, then there exists $\varepsilon \in (a,b)$ such that $\frac{f(b)-f(a)}{g(b)-g(a)} = \frac{f'(\varepsilon)}{g'(\varepsilon)}$

78. Sandwich Theorem (Squeeze Theorem): This is sometimes also called Pinching Theorem. It states that if g(x) is squeezed between f(x) and h(x) at x=a i.e. if $f(x) \leq g(x) \leq h(x), \forall x \in (a-\delta, a+\delta)$ and $\lim_{x\to a} f(x) = \lim_{x\to a} h(x) = l$ | then $\lim_{x\to a} g(x) = l$

79. If δx is an error in the variable then $\frac{\delta x}{x}.100$ is called the percentage error in x.

80. Local maxima

A function f(x) is said to have a local maximum value at x=a if there exists a nbd (a-δ,a+δ) of **a** such that f(x)<f(a) for all x∈ (a-δ, a+δ), [x≠ a] or f(x)-f(a) <0 for all x∈ (a-δ,a+δ), [x ≠a]. f(a) is called the local maximum value of f(x) at x=a.

81. Local minimum

A function f(x) is said to have a local minimum value at x=a if there exists a nbd (a-δ,a+δ) of **a** such that f(x)>f(a) for all x∈ (a-δ, a+δ), [x≠ a] or f(x)-f(a) >0 for all x∈ (a-δ,a+δ), [x ≠a]. f(a) is called the local minimum value of f(x) at x=a.

82. The points at which the function has either the local maxima or minima are called extreme values of f(x).

83. The values of x for which f'(x)=0 are called stationary values or critical values of x and the corresponding values of f(x) are called the stationary or turning values of f(x). The points at which f'(x) does not exist are also called critical points.

In nutshell the ***critical*** points are the values of x for which **f(x) is undefined**, **f'(x)=0** and/or **f'(x) does not exist**.

84. Point of ***Inflexion*** is a point where $d^2y/dx^2=0$ but d^3y/dx^3 is not zero.

85. First derivative test

(a) If f(x) is differentiable at x=a and f'(a)=0 and f'(x) changes sign from + to – as x passes through then f(x) is said to have the local ***maximum*** value at x=a.

(b) If f(x) is differentiable at x=a and f'(a)=0 and f'(x) changes sign from - to + as x passes through then f(x) is said to have the local ***minimum*** value at x=a.

86. If y is maximum or minimum then log y is also maximum or minimum provided y >0.

87. n^{th} derivative test for Relative Extrema

Find the critical number for $x=x_0$.

Also $f''(x_0)$.

If $f''(x_0)>0$, f(x) is minimum at $x=x_0$

If $f''(x_0)<0$, f(x) is maximum at $x=x_0$

If $f''(x_0)=0$, neither maxima nor minima but this point is called the point of inflexion if $f'''(x_0)\neq 0$.

Repeat this process till we obtain $f^n(x_0)\neq 0$.

If n is odd f(x) has neither maxima nor minima.

If n is even and $f^n(x_0)>0$, f(x) is minimum at $x=x_0$

If n is even and $f^n(x_0)<0$, f(x) is maximum at $x=x_0$.

88. A ***maximum*** value of f(x) at $x=x_0$ in an interval [a,b] does not mean that it is the greatest value of f(x) in that interval. There may be a value of the function greater than a maxi mum value. As a matter of fact there may exist a minimum value of the function which is greater than or equal to some maximum value of the function in [a,b].

89. L'Hospital Rule

If the function f(x) and g(x) are differentiable in the certain neighborhood of the point **a** , except, may be, at the point **a** itself, and g'(x) ≠0 and if $\lim_{x\to a} f(x)=\lim_{x\to a} g(x)=0..or..\infty$ then

$\lim_{x\to a}\frac{f(x)}{g(x)}=\lim_{x\to a}\frac{f'(x)}{g'(x)}$ provided $\lim_{x\to a}\frac{f'(x)}{g'(x)}$ exists. The point ***a*** may be either finite or improper i.e. +∞ or -∞.

90. Taylor's Formula

It is used for approximate calculations. If a function f(x) is continuous and has continuous derivatives through order (n-1) on the interval [a,b] and has a finite derivative of the n^{th} order at every interior point of the interval then at x∈ [a,b] the following formula holds true:

$$f(x)=f(a)+\frac{(x-a)f'(a)}{1!}++\frac{(x-a)^2 f''(a)}{2!}+...$$

$$+\frac{(x-a)^{n-1}f^{n-1}(a)}{(n-1)!}+\frac{(x-a)^n f^n(\varepsilon)}{n!}$$ where ε=a+θ(x-a) and 0<θ<1

91. Maclaurin's formula

When a=0 in Taylor's formula, it becomes Maclaurin's Formula ie

$$f(x)=f(0)+\frac{xf'(0)}{1!}++\frac{x^2 f''(0)}{2!}+...$$

$$+\frac{x^{n-1}f^{n-1}(0)}{(n-1)!}+\frac{x^n f^n(\varepsilon)}{n!}$$ where ε=θx and 0<θ<1

92. If a function is defined and continuous in some interval, and if this interval is not a closed one then it can have neither the greatest nor the least value.

Integrals

1. If g'(x) = f(x) then g(x) is called anti-derivative or primitive of f(x) and is written as $\int f(x)dx=g(x)$
2. If two primitives f1 and f2 exist, then they differ by a constant.

3. Geometrically indefinite integral refers to family of curves parallel to a curve upward or downward.
4. Derivative of a function is unique but anti-derivative is not unique.
5. Function is differentiable at a point but can be integrated on an interval.
6. $\int x^n dx = \frac{x^{n+1}}{n+1}, n \neq -1$
7. $\int dx = x$
8. $\int \frac{dx}{x} = \log_e x$
9. $\int a^x dx = a^x \log_a e$
10. $\int e^x dx = e^x$
11. $\int \sin x dx = -\cos x$
12. $\int \cos x dx = \sin x$
13. $\int \tan x dx = \log_e \sec x$
14. $\int \cot x dx = -\log_e \cos ecx$
15. $\int \sec x \tan x dx = \sec x$
16. $\int \cos ecx \cot x dx = -\cos ecx$
17. $\int \sec^2 x dx = \tan x$
18. $\int \cos ec^2 x dx = -\cot x$
19. $\int \frac{dx}{\sqrt{1-x^2}} = \sin^{-1} x = -\cos^{-1} x$
20. $\int \frac{dx}{1+x^2} = \tan^{-1} x = -\cot^{-1} x$
21. $\int \frac{dx}{x\sqrt{x^2-1}} = \sec^{-1} x = -\cos ec^{-1} x$
22. $\int \frac{dx}{\sqrt{a^2-x^2}} = \sin^{-1} \frac{x}{a} = -\cos^{-1} \frac{x}{a}$
23. $\int \frac{dx}{\sqrt{x^2-a^2}} = \log\left|x+\sqrt{x^2-a^2}\right|$
24. $\int \frac{dx}{\sqrt{x^2+a^2}} = \log\left|x+\sqrt{x^2+a^2}\right|$
25. $\int \frac{dx}{x^2+a^2} = \frac{1}{a}\tan^{-1}\frac{x}{a} = -\frac{1}{a}\cot^{-1}\frac{x}{a}$
26. $\int \frac{dx}{x\sqrt{x^2-a^2}} = \frac{1}{a}\sec^{-1}\frac{x}{a} = -\frac{1}{a}\cos ec^{-1}\frac{x}{a}$
27. $\int \sec x dx = \log(\sec x + \tan x) = \log\tan\left(\frac{\pi}{4}+\frac{x}{2}\right)$
28. $\int \cos ecx dx = \log(\cos ecx - \cot x) = \log\tan\frac{x}{2}$
29. $\int \frac{dx}{x^2-a^2} = \frac{1}{2a}\log\frac{x-a}{x+a}$
30. $\int \frac{dx}{a^2-x^2} = \frac{1}{2a}\log\frac{a+x}{a-x}$
31. $\int \sqrt{a^2-x^2}dx = \frac{x}{2}\sqrt{a^2-x^2} + \frac{a^2}{2}\sin^{-1}\frac{x}{a}$
32. $\int \sqrt{x^2-a^2}dx = \frac{x}{2}\sqrt{x^2-a^2} - \frac{a^2}{2}\log\left(x+\sqrt{x^2-a^2}\right)$
33. $\int \sqrt{x^2+a^2}dx = \frac{x}{2}\sqrt{x^2+a^2} + \frac{a^2}{2}\log\left(x+\sqrt{x^2+a^2}\right)$
34. $\int |x| dx = \frac{1}{2}x|x|$
35. $\int uvdx = u\int vdx - \int\left(\frac{du}{dx}\int vdx\right)dx$. u is named the first function and v the second function. The First function is selected through ILATE (order should be Inverse, Logarithmic, Algebraic, Trigonometric, Exponential.)
36. General formulae for Integration by parts

$$\int uvdx = uv_1 - u'v_2 + u''v_3 - \ldots + (-1)^{n-1}u^{n-1}v_n - (-1)^{n-1}\int u^n v_n dx$$

37. In the integrals of Type $\int \frac{dx}{a+b\sin x}$, $\int \frac{dx}{a+b\cos x}$, $\int \frac{dx}{a\sin x + b\cos x}$, $\int \frac{dx}{a+b\sin x+c\cos x}$, the proper way is to use $\sin x = \frac{2\tan\frac{x}{2}}{1+\tan^2\frac{x}{2}}, \cos x = \frac{1-\tan^2\frac{x}{2}}{1+\tan^2\frac{x}{2}}$ and after putting tan x/2 = t the sum can be done.
38. In the integral of the Type $\int \frac{(p\sin x + q\cos x + r)dx}{(a\sin x + b\cos x + c)}$, the proper substitution is to put Numerator= λ+ μ(differential coefficient of denominator)+ν. And then after finding the numeric values for the assumed arbitrary constants, the Integrals can be done.

39. In the integral of Type $\int \frac{Q(x)dx}{P(x)}$, the Numerator should be first made of lesser degree than the Denominator and then if the Denominator is decomposable to factors, the method of partial fractions should be used to split into different fractions and then one of the proper methods can be used to start for Integration.

40. In the integral of Type $\int \frac{dx}{(a+bx)\sqrt{cx+d}}$, put $cx+d=t^2$ and proceed using the method as required.

41. In the integral of Type $\int \frac{dx}{(a+bx+cx^2)\sqrt{px+q}}$, put $px+q=t^2$ and proceed using the method as required.

42. In the integral of Type $\int \frac{dx}{(a+bx)\sqrt{px^2+qx+r}}$, put $a+bx=\frac{1}{t}$ and proceed using the method as required.

43. In the integral of Type $\int \frac{dx}{(a+bx^2)\sqrt{cx^2+d}}$, put $x=\frac{1}{t}$ and proceed using the method as required.

Definite integrals Properties

44. $\int_a^b f(x)dx=\int_a^b f(t)dt$

45. $\int_a^b f(x)dx=-\int_b^a f(x)dx$

46. $\int_a^b f(x)dx=\int_a^c f(x)dx+\int_c^b f(x)dx, a<c<b$

47. $\int_0^a f(x)dx=\int_0^{a/2} f(x)dx+\int_0^{a/2} f(a-x)dx$

48. $\int_a^b f(x)dx=0, if\ ..\ f(a+x)=-f(b-x)$

49. $\int_a^b f(x)dx=2\int_a^{\frac{a+b}{2}} f(x)dx, if\ ..\ f(a+x)=f(b-x)$

50. $\int_0^a f(x)dx=\int_0^a f(a-x)dx$

51. $\int_{-a}^a f(x)dx=0, if\ ..\ f(-x)=-f(x)$

52. $\int_{-a}^a f(x)dx=2\int_0^a f(x)dx, if\ ..\ f(-x)=f(x)$

53. $\int_0^{2a} f(x)dx=0, if\ ..\ f(2a-x)=-f(x)$

54. $\int_0^{2a} f(x)dx=2\int_0^a f(x)dx, if\ ..\ f(2a-x)=f(x)$

55. $\int_a^b f(x)dx=\int_a^b f(a+b-x)dx$

56. $\int_0^{nT} f(x)dx=n\int_0^T f(x)dx$ if f(x+T) = f(x)

57. $\int_a^{a+nT} f(x)dx=n\int_0^T f(x)dx$ if n is an Integer

58. $\int_0^{a+T} f(x)dx=\int_0^T f(x)dx$ if n=1.

59. $\int_{mT}^{nT} f(x)dx=(n-m)\int_0^T f(x)dx$

60. $\int_{a+nT}^{b+nT} f(x)dx=\int_a^b f(x)dx$ where n is an Integer.

61. $\int_a^{a+T} f(x)dx$ is independent of a.

62. **Mean value theorem of Integral Calculus**

If a function f is continuous on [a,b], it assumes its mean value in [a,b], that is $\frac{1}{b-a}\int_a^b f(x)dx=f(c)$ for some c such that $a\le c\le b$.

63. If f(x) ≥ g(x) on [a, b] then $\int_a^b f(x)dx\ge\int_a^b g(x)dx$

64. If f(x) is increasing and has a concave graph in [a,b] then
$$(b-a)f(a)<\int_a^b f(x)dx<(b-a)\frac{f(a)+f(b)}{2}.$$

65. If f(x) is increasing and has a convex graph in [a,b] then

$$(b-a)\frac{f(a)+f(b)}{2} < \int_a^b f(x)dx < (b-a)f(b)$$

66. If m and M be global minimum and global maximum of f(x) respectively in [a,b] then m(b-a) ≤ $\int_a^b f(x)dx \le$ M(b-a)

67. $\left|\int_a^b f(x)dx\right| \le \int_a^b |f(x)|dx$.

68. If f(t) is an odd function then $\phi(x)=\int_a^x f(t)dt$ is an even function.

69. If f(t) is an even function then $\phi(x)=\int_a^x f(t)dt$ is an odd function.

70. Definite integral as the limit of a sum:

$$\int_a^b f(x)dx = \lim_{h\to 0, n\to\infty} h[f(a)+f(a+h)+f(a+2h)+\ldots + f(a+(n-1)h)]$$ where b-a=nh

71. Find the r^{th} term and write it as $\lim_{n\to\infty}\sum\frac{1}{n}f\left(\frac{r}{n}\right)=\int_0^1 f(x)dx$

72. ***Gamma function***: $\int_0^\infty e^{-x}x^{n-1}dx = \Gamma n$ where x ∈ Q^+ and n is a positive number. This is also called the Eulerian Integral of 2nd Kind.

73. Γn is pronunciated as Gamma n, and, it is denoted as Γn = (n-1)Γ(n-1).

74. If n is a natural number then Γ(n+1) =n! and $\Gamma(1/2)=\sqrt{\pi}$.

75. $\int_0^{\frac{\pi}{2}} \sin^m x.\cos^n x\,dx = \frac{\Gamma\frac{m+1}{2}\Gamma\frac{n+1}{2}}{2\Gamma\frac{m+n+2}{2}}$ for all m> -1 and n > -1.

76. ***Beta Function***: $\int_0^1 x^{m-1}.(1-x)^{n-1}dx$, where m,n>0 is called the Beta Function and is denoted by B(m,n). This is also called ***Eulerian integral of Ist kind***.

77. B(m,n)=B(n,m)

78. B(m,1)= 1/m

79. $\frac{B(m+1,n)}{B(m,n)}=\frac{m}{m+n}$.

80. B(m,n)= $\frac{n-1}{m}B(m+1,n-1)$, n > 1

81. B(m,n)= $\frac{(m-1)!}{n(n+1)(n+2)\ldots(n+m-1)}$ if m is a positive integer.

82. If m,n are positive integer then B(m,n)= $\frac{(m-1)!(n-1)!}{(m+n-1)!}$.

83. Another form of Beta Function is given by B(m,n)= $\int_0^\infty \frac{x^{m-1}}{(1+x)^{m+n}}dx$ where m,n>0. This form is obtained by replacing x=1/(1+y) in the original format.

84. Relation between Gamma and Beta Function:

(a) B(m,n)= $\frac{\Gamma m\,\Gamma n}{\Gamma(m+n)}$, m,n>0

(b) $\Gamma n\,\Gamma(1-n)=\frac{\pi}{\sin n\pi}$, where 0<n<1

(c) $\int_0^\infty \frac{x^{n-1}}{(1+x)}dx=\frac{\pi}{\sin n\pi}$.

(d) $\int_0^\infty e^{-x^2}dx=\frac{\sqrt{\pi}}{2}$.

85. $\int_a^b f(x)dx=[F(x)]_a^b=F(b)-F(a)$ where F(x) is one of the anti-derivative of f(x). This is called as ***Newton-Leibnitz formula***.

Dr S.B. Dhar, is **Editor of this Quartrerly e-Bulletin**. He is an eminent mentor, analyst and connoisseur of Mathematics from IIT for preparing aspirants of Competitive Examinations for Services & Admissions to different streams of study at Undergraduate and Graduate levels using formal methods of teaching shared with technological aids to keep learning at par with escalating standards of scholars and learners. He has authored numerous books of excellence.
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Answers to Science Quiz : July'18

Kumud Bala

1. (b)	2. (a)	3. (d)	4. (c)	5. (a)	6. (a)	7. (b)	8. (d)	9. (d)	10. (c)
11. (d)	12. (a)	13. (b)	14. (a)	15. (a)	16. (d)	17. (a)	18. (a)	19. (d)	20. a()
21. (a)	22. (c)	23. (a)	24. c()	25. (b)					

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ANSWER: CROSSWORD PUZZLE July'18: BC ROY- A DOCTOR FOR THE NATION

Prof. S.B. Dhar

													2P															
												1U	R			3U												
4B												N	A			N												
5C	A	L	C	6U	T	T	A					I	F			I												
R				T					7G			V	F			8V	O	L	T	A	I	R	E					
O				T					A			E	U			E												
Y				A					N			R	L			R				9P								
				R		10P			G			S	L			S				E								
				P		A			A			I	A			I		11D		O								
				R		T			S			T	C			T		U		P								
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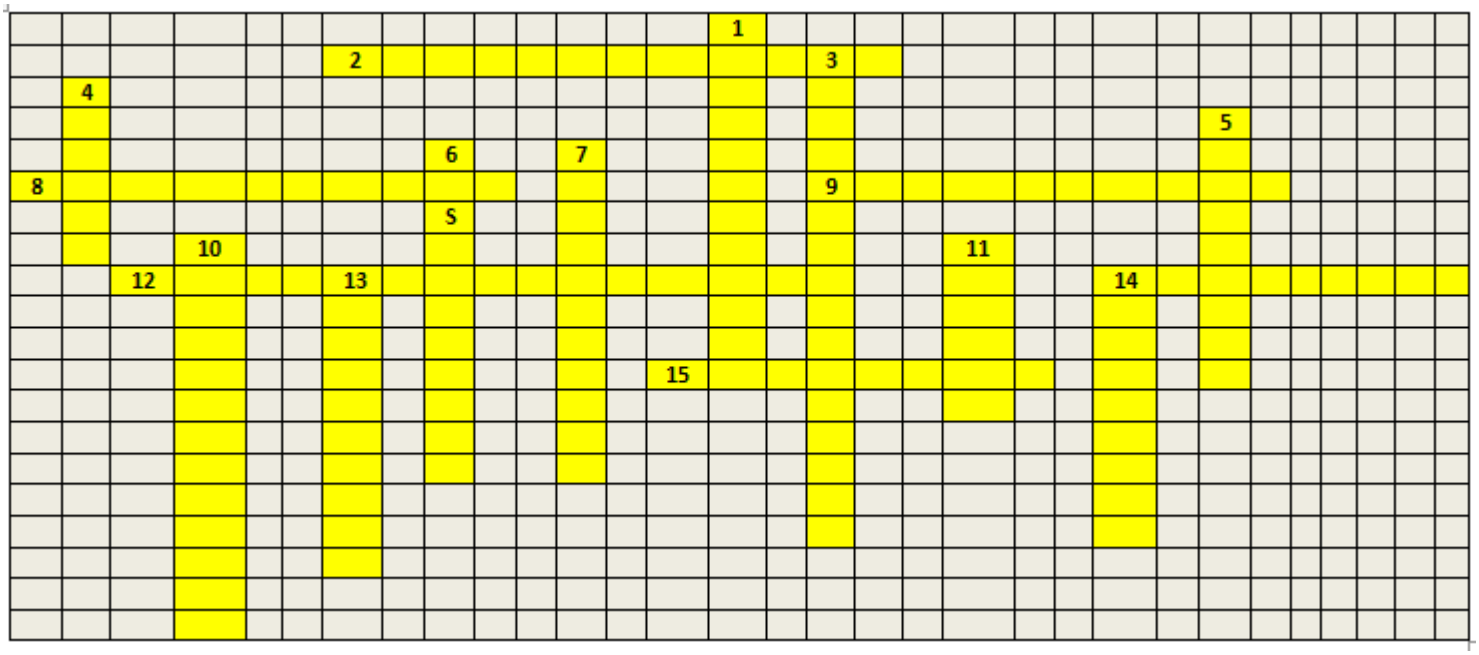
CROSSWORD PUZZLE August'18: INDIA FIGHTS FOR FREEDOM

Prof. SB Dhar



ACROSS

2 King who was throned in 313 BC

8 An Empire established in South in 1336

9 Ratio of Width to Length of Indian flag

12 Battle of 1526 where in Babar defeated Ibrahim Lodi

14 A Dharma established by Akbar in 1582

15 General who was defeated by Chandra Gupta In 305 BC

DOWN

1 Empire after which East India Company ruled India

3 Name of Nehru's speech of freedom

4 Chinese traveler who visited India in 405-411

5 Foreigner who invaded India in 327-326BC

6 Traveler who came to India through sea route in 1497

7 Two cities of India between which the First Rail ran

10 Great Indian leader born in 1869

11 City where first Independence Struggle started

13 Bengal was partitioned by the order of

14 Tibetan leader who formed a government in exile in Dharmshala

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Growing with Concepts : Physics

Code: Phy/NLM-II/S/001

Subjective Problems Solving: Newton's Laws of Motion-II

Newton's Laws of Motion is a matter of most common experience while performing any action or seeing an action being performed. Therefore, every action whether in equilibrium, uniform motion or acceleration will involve the Laws of Motion in one or the other way. Therefore, possibility of encountering a problem or situation never encountered earlier is infinite. In view of this while attempting solution of problems one must be ready to analyze it with pure ingenuity. Nevertheless, typical questions have been drawn to inculcate practice of handling problems with basic concepts and their application, and accordingly illustrations to the answers have been developed.

It is essential to iterate that typical question may, at times, contain certain information, not needed in solution. Likewise, one might make a start applying concepts in apparently identical situation. But, where to proceed with it for the solution or drop it is an important decision to avoid solution either becoming complex or incorrect. Likewise, values of universal constants like g, π etc. are generally given in examinations, but in case it is not there choose a value as per your wisdom and calculations with principles of significant figures and rounding of numbers will be a good enough to write correct answer. It may be observed that certain figures or details are too minimized. But, handling this document give us liberty to manage the space by adjusting size of figures and reader to zoom them as per requirement of clarity. Despite best efforts by authors, one may find it difficult to match the answer arrived at with the one given. It might be an inadvertent typographical despite meticulous efforts. In such a situation remain open to fix the answer by reviewing solution, consultation with colleagues and your teachers. In case considered necessary readers are welcome to scan question and related solution with answer and write us through *Contact Us*.

Analyzing problems by splitting it into different situations given or inbuilt, drawing diagram and writing equations for each case is essential at practice stage. Going forward many of these steps become intuitive. Despite, meticulous and stepwise analysis helps to avoid chances of errors. This is essential to buit comprehension, accuracy and speed necessary for success in competitive examinations.

Last-but-not-the-least understanding concepts from best of the best teachers, books and videos would not help to attain a proficiency in problem solving, unless it is practiced with variety of problems from different sources and discussing them with colleagues or solving their difficulties. This is nothing but imbibing a proficiency in group dynamics involving caring-and-sharing not a sermon on morality but a necessity of improving performance in times ahead.

Education is just not collection of facts. It is ability to observe, think, analyze and apply it in evolving a sustainable solution, on a pedestal of coexistence.

Going forward effort is being made to cover complete scope of physics upto 12^{th} standard and give more practice questions in Online Test and Self Assessment Mode involving topic-wise, section-wise, level-wise and type of questions.

Inputs on any typographical error in question, answer, illustration and/or diversity of scope of the resource material would be gratefully welcomed, in the spirit of Personal Social Responsibility (PSR). All this is being made available as free web-resource in an effort to complement that already available or accessible.

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Code: Phy/NLM-II/S/001

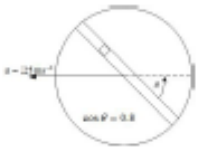
Newton's Laws of Motion : Objective Questions (Typical)

No of Questions:10 **Time Allotted: 1 Hours**

All questions are compulsory

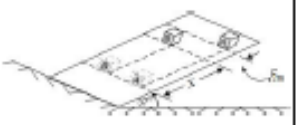
Q-01

A circular disc with a grove along its diameter is placed horizontally. A block of mass 1 kg is placed as shown in Figure. The coefficient of friction between block and all surfaces of groove in contact is $\mu = 0.4$. The disc has an acceleration of $25 m.s^{-2}$.[Given $g = 10 m.s^{-2}$]. Find acceleration of the block w.r.t. the disc.



Q-02

Two identical blocks A and B are placed on a rough inclined plane at an inclination of 45°. The coefficient of friction between block A and plane is 0.2 and that between block B and the plane is 0.3. The initial separation between the blocks is $\sqrt{2}$ m. The blocks are released from rest. $g = 10 m.s^{-2}$. Find -

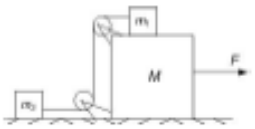


(a) Time after which front when both blocks come in line.

(b) Distance moved by each block for attaining position at (a) above

Q-03

In the given figure masses m_1, m_2 and M are 20 kg, 5 kg and 50 kg respectively. The coefficient of friction between m_1 and M, and between m_2. and ground is 0.3. The pulleys and the string are mass-less. The string is perfectly horizontal between m_1 and pulley P_1, and between m_2 and P_2. Whereas string is perfectly vertical between P_1 and P_2. An external force F is applied horizontally on mass M. Take $g = 10 m.s^{-2}$.



(a) Draw a free body diagram for mass M, clearly showing all forces.

(b) Let the magnitude of the force of friction between m_1 and M be f_1 and m_2 and ground be f_2. For a particular force F it is found that $f_1 = 2 \times f_2$. Find f_1 and f_2. Write equation of motion of all masses. Find F, tension in the string and acceleration of masses.

Q-04

Two blocks of mass $m_1 = 10$ kg and $m_2 = 5$ kg connected to each other by a massless in-extensible string of 0.3 m, are placed along diameter of a turn-table. The coefficient of friction between the table and m_1 is 0.5 while there is no friction between m_2 and the table. The table is rotating with an angular velocity of 10 rad/sec about its vertical axis passing through its centre. Masses are so placed that they are on either side of centre with m_1 at a distance 0.124 m from the centre. The masses are observed to be at rest w.r.t. an observer on the turntable.

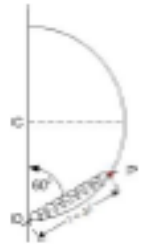
(a) Calculate the frictional force on m_1

(b) What should be the minimum angular speed of the turn table so that masses will start slipping from their positions?

(c) How should the masses be placed with the string remaining taut, so that there is no frictional force acting on the mass m_1?

Q-05

A smooth semicircular wire-track of radius R is fixed in a vertical plane. One end of a massless spring of natural length $\frac{3R}{4}$ and spring constant $K = \frac{mg}{R}$ is attached to the lowest point O of the wire-track. A small ring of mass m, which can freely slide on the track, is attached to other end of the spring.The ring is held stationary at point P such that the spring makes an angle of 60° with the vertical. The instant when spring is released from point P -



(a) Draw free body diagram of the ring

(b) Find tangential acceleration of the ring and the normal reaction

Q-06

A hemispherical bowl, with frictionless inner surface, of radius $r = 0.1$ m is placed with its axis vertical. The bowl is set in rotation with an angular velocity ω. A particle of mass 10^{-2} kg is. placed on inner surface of the bowl and it is stationary w.r.t. bowl. Find -

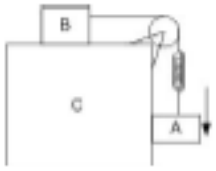
(a) Height h of the particle as function of ω.

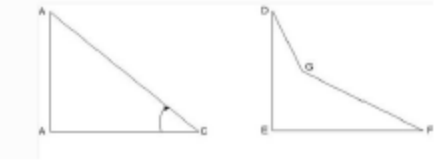
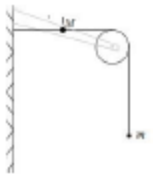
(b) What is the minimum value of ω in order to have h a non-zero value?

(c) It is desired to measure g (acceleration due to gravity) using this experimental set-up, by measuring h; assuming that r and ω are known. The least-count in measurement of h is 10^{-4}. What is the minimum possible error in measured value of g, i.e. Δg

Q-07

Two blocks A and B are connected to each other by massless string, spring and pulley as shown in the figure. Block B slides over the horizontal top surface of a stationary block C, and block A slides along the vertical side of block C. Both blocks A and B are sliding with uniform speed. Coefficient of friction between surfaces of the blocks is 0.2. Force constant of spring is $K = 1960$ N/m. If mass of the block A is 2 kg, calculate - **a** mass of the block B and **b** energy stored in the spring, [Given that $g = 9.8$ m·s^{-2}]



Q-08	In figure (a)and (b) AC, DG and GF are fixed inclined planes. Further, BC=EF=x and AB=DE=y. A small block of mass M is released from point A and reaches C with a speed V_C. The same block is released from D at a state of rest and reaches point F with speed V_F. Coefficient of friction between the block and both the surfaces AC and DGF are μ. Calculate V_C and V_F.-  Figure-(a) Figure(b)
Q-09	A bullet of mass M is fired up with a velocity of 50 m· s^{-1} at an angle θ with horizontal. At the highest point of its path, it collides with a bomb of mass $3M$ suspended from a massless string of length $\frac{10}{3}$ m and gets embedded in the bob. After collision, the bob moves through an angle of 120°. , until string remains stretched, after which it starts collapsing. [Given that $g = 10$ m.s^{-2}] (a) The angle θ. (b) Horizontal and Vertical coordinates of the initial position of the bob w.r.t. the point of firing of bullet.
Q-10	An in-extensible string with one end fixed on a rigid wall, passing over a fixed frictionless pulley at a distance of 2 m from the wall, has a point mass $M = 2$ kg attached to it at a distance 1 m from the fixed end. A mass $m = 0.5$ kg at the free end of the string attached at free end of the string is held such that that string is horizontal between wall and pulley. What will be the speed with the mass M will hit the wall when mass m will be released? [Given $g = 9.8$M·s^{-2}] 

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बुद्ध ने कहा है.....!

जीवन नदी जैसा है, यहां प्रतिपल सब बह रहा है।

ऐसा ही जीवन का प्रवाह है

जो आये उसे अंगीकार करो

जो जाये उसे अलविदा करो

कुछ पकड़ के मत रखो

ऐसा आदमी कभी दुखी नहीं होता।

- ओशो

Code: Phy/NLM-II/S/001

Answers: Newton's Laws of Motions (Part-II)– Subjective Questions

A-01	$10 m/s^2$
A-02	(a) 2 sec (b)$7\sqrt{2}$m, $8\sqrt{2}$m
A-03	$F = 60N, T = 18N$ and $a = \frac{3}{5}$ m.s^{-2}
A-04	(a) 36N (b) 11.75rad.s^{-1} (c) 0.1m 0.2m
A-05	(a) FBD is shown in illustration (b)$\frac{5\sqrt{3}}{8}g$ m · s^{-2} $\frac{3}{8}mg$ N
A-06	(a) $h = (r - \frac{g}{\omega^2})$ m (b) $\omega > \sqrt{\frac{g}{r}} = 9.89$ rad.s^{-1}
A-07	(a) $m = 10$ kg (b) 0.098 J
A-08	$V_C = V_P = \sqrt{2g(y - \mu x)}$
A-09	(a) $\theta = 30°$ (b) 108.25 m, 31.25 m
A-10	Answer is 3.4 m-s^{-1}

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"A hundred times every day I remind myself that my inner and outer life are based on the labors of other men, living and dead, and that I must exert myself in order to give in the same measure as I have received and am still receiving."

- Albert Einstein

Growing with Concepts: Chemistry

MOLECULAR ORBITAL THEORY-Part II

Kumud Bala

Energy level diagram for molecular orbitals:- The relative energies of molecular orbitals depend upon the following two factors: (i) The energies of the atomic orbitals combining to form molecular orbitals. (ii) The extent of overlapping between the atomic orbitals.

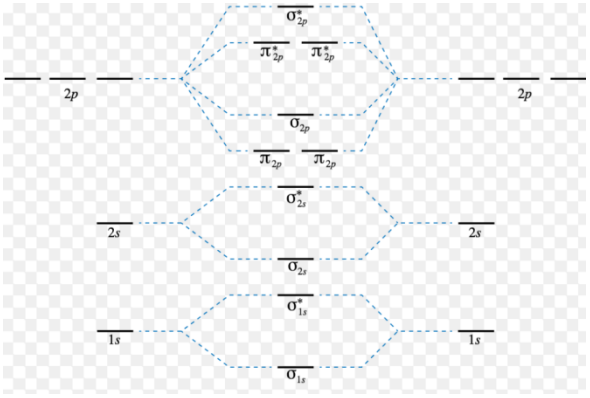
The greater the overlap, more the bonding orbital is lowered and the antibonding orbital is raised in energy relative to atomic orbitals. For example, the extent of overlapping in case of σ- orbital is more than that of π-orbital. Consequently, the energy of $\sigma 2p_z$ is lower than the energy of bonding $\pi 2p_x$ or $\pi 2p_y$ molecular orbitals. Now, 1s atomic orbital of two atoms form two molecular orbitals designated as σ1s and σ^*1s. The energies 2s and 2p orbitals (eight AOs on two atoms) form four bonding molecular orbitals and four antibonding molecular orbitals as: Bonding Molecular Orbitals: - $\sigma 2s$, $\sigma 2p_z$, $\pi 2p_x$, $\pi 2p_y$, Antibonding Molecular Orbitals: - σ^*2s, σ^*2p_z, π^*2p_x, π^*2p_y. The energy levels of these molecular orbitals have been determined experimentally by spectroscopic methods. The order of increasing energy of molecular orbitals obtained by the combination of 1s, 2s and 2p- orbitals of two atoms is:

$\sigma 1s<\sigma^*1s<\sigma 2s<\sigma^*2s<\sigma 2p_z<\pi 2p_x=\pi 2p_y<\pi^*2p_x=\pi^*2p_y<\sigma^*2p_z$ (1) (energy increases)

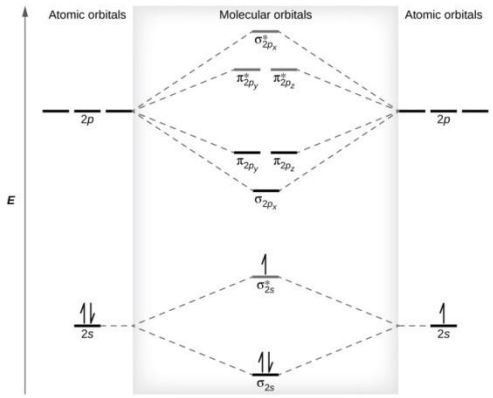
However, experimental evidence for some diatomic molecules has shown that above sequence energy levels of molecular orbitals is not correct for all molecules. For example, for homonuclear diatomic molecules of second row elements of periodic table such as Li_2, Be_2, B_2, C_2, N_2, the $\sigma 2p_z$ molecular orbital is higher in energy than $\pi 2p_x$ and $\pi 2p_y$ molecular orbitals. The order of Molecular Orbitals (MOs) for these molecules is:

$\sigma 1s<\sigma^*1s<\sigma 2s<\sigma^*2s<\pi 2p_x=\pi 2p_y<\sigma 2p_z<\pi^*2p_x=\pi^*2p_y<\sigma^*2p_z$ ----------(2)

But for molecules O_2 onward (F_2 and Ne_2) the first order of energies of MOs is correct. Thus, for diatomic molecules of second period (Li_2 to Ne_2), there are two types of energy levels of molecular orbitals.



(Molecular orbital energy level diagram for Li_2, Be_2, B_2, C_2, N_2 molecules)



(Molecular orbital energy level diagram for O_2, F_2, Ne_2 molecules)

Why molecular orbital energy level diagrams are different?

The main reason for the difference in sequences is the interaction of 2s and $2p_x$ Atomic Orbitals(AOs). For the

molecules Li_2, Be_2, B_2, C_2, and N_2, the difference in energies of 2s and $2p_x$ orbitals is small and therefore, they can interact. While the energies of 2s and $2p_x$ AOs for O_2, F_2 and Ne_2 is large and therefore, they cannot interact.

Difference in energy splitting of σ2p and π2p orbitals: The energy splitting between bonding and antibonding orbitals is larger for σ2p orbitals than it is for π2p orbitals. This is so because the overlap of p-orbital is greater when they are oriented along the axis to form σ- orbitals than when they are oriented to overlap sideways to form π- orbitals.

Relationship between electronic configuration and molecular behavior: Before we take up the actual electronic configuration of molecules or molecular ions, it is important to know the rules relating the molecular behavior with the electronic configuration. The important rules are as follows:

(i) **Stability of molecules in terms bonding and antibonding electrons**: Suppose the number of electrons present in the bonding orbitals is represented by N_b and the number of electrons present in the antibonding orbitals by N_a. Then (a) if $N_b > N_a$, the molecule is stable. This is evident because greater numbers of bonding orbitals are occupied than antibonding orbitals, resulting in a net force of attraction. (b) If $N_b = N_a$, the molecule is unstable. This is because even if the numbers of electrons are equal, the antibonding molecular orbitals are greater than the bonding influence of the electrons in the bonding molecular orbitals. (c) If $N_b < N_a$, the molecule is again unstable. This is again obvious because here, the antibonding influence is greater than the bonding influence, resulting in a net force of repulsion.

(ii) **Stability of molecules in terms of bond order**: Bond order is defined as half of the difference between the number of electrons present in the bonding and the antibonding orbitals, i.e., bond order (B.O) = $\frac{1}{2}(N_b - N_a)$. The molecule is stable if $N_b > N_a$, i.e., if bond order is positive. The molecule is unstable if $N_b < N_a$ or $N_b = N_a$, i.e., if the bond order is negative or zero.

(iii) Relative stability of molecules in terms of bond order: Stability of a molecule is measured by its bond dissociation energy. But the bond dissociation energy is directly proportional to the bond order. Greater the bond order, greater is the bond dissociation energy. For example, nitrogen molecule with bond order equal to 3 has larger bond dissociation energy (945 kJ/mol) than oxygen molecule with a bond order equal to 2 (495kJ/mol).

(iv) Nature of bond in terms of bond order: Bond order 1,2 and 3 means single, double and triple bond respectively as studied in the classical concept. However, the difference between a chemical bond and bond order lies in the fact that a chemical bond id always integral but bond order can be fractional also.

(v) Bond length in terms of bond order: Bond order is inversely proportional to the bond length. The higher the bond order value, smaller is the bond length. For example, the bond length in N_2 molecule is shorter than oxygen molecule as shown below:

Molecule	Bond order	Bond dissociation energy	Bond length
Oxygen	2	495 kJ/mol	121pm
Nitrogen	3	945 kJ/mol	110pm

(vi) Magnetic character: If all the electrons in the molecule of a substance are paired, the substance is diamagnetic in nature (repelled by the magnetic field). On the other hand, if there are unpaired electrons in the molecule, the substance is paramagnetic in nature (attracted by the magnetic field). It is expressed in terms of magnetic moment according to the expression: Magnetic moment = $\sqrt{n(n+2)}$ B.M (Bohr Magneton), where n is the number of unpaired electrons present in the molecule or the ion.

Electronic configuration of homo nuclear diatomic molecules and molecular ions of first and second row elements:- The following rules are followed for filling up molecular orbitals with electrons in order to write molecular configuration:

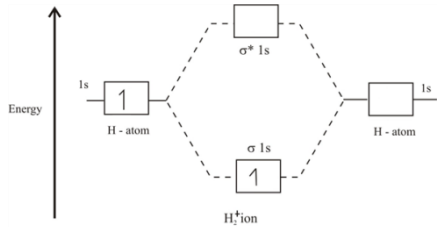
(i) Aufbau Principle- In accordance with this principle, the molecular orbital having the lowest energy is filled first .

(ii) Pauli Exclusion Principle- Each molecular orbital can accommodate maximum of two electrons having opposite spins.

(iii) Hund's rule- If there are two molecular orbitals of the same energy, the pairing of electrons will occur only after each orbital of same energy has one electron. This is in accordance with Hund's rule.

Let us discuss bonding in some homonuclear diatomic molecules of the elements of first and second rows of the periodic table.

1. **Hydrogen molecular positive ion (H_2^+)** - This is the simplest molecular species containing one electron only. Its existence has been detected spectroscopically when an electric discharge is passed through a discharge tube containing hydrogen gas at low pressure. The only electron present in H_2^+ ion enters the σ1s molecular orbital which has the lowest energy. Thus, electronic configuration of the molecule is : $H_2^+ = (\sigma 1s)^1$ (molecular orbital energy level diagram).



Energy level diagram

Here, $N_b = 1$, $N_a = 0$ so that bond order = ½ ($N_b - N_a$) = ½ (1–0) = ½ , resulting in the following:

(a) Stability: The bond order is positive. Hence, H_2^+ ion should be stable. The low value indicates that the stability is not very high.

(b) Paramagnetic character: One unpaired electron is present. Hence, H_2^+ ion should be paramagnetic. Both the above results have been found to be correct experimentally.

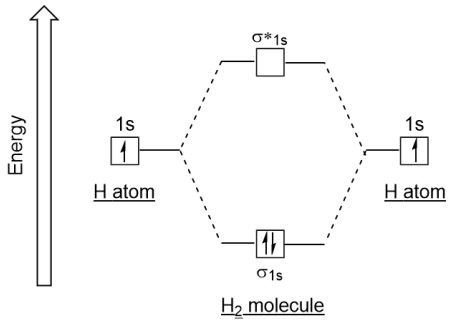
2. Hydrogen molecule (H_2): It is formed by the combination of two hydrogen atoms. Each hydrogen atom has one electron in 1s-orbital and therefore, there are two electrons in hydrogen molecule. Both these electrons are to be accommodated in the lowest energy molecular orbital. According to Pauli's exclusion principle, these two electrons should have opposite spins. The molecular orbital electronic configuration of hydrogen molecule is thus $(\sigma 1s)^2$, bond order in H_2 = ½(N_b–N_a) = ½ (2–0) = 1

(a) Stability: Positive value of bond order indicates that the H_2 molecule is stable. Bond dissociation energy has been found to be 438kJ/ mol.

(b) Nature of bond: Bond order is one. This means that two hydrogen atoms are connected by a single bond. Bond length of H_2 is 74pm.

(c) Bond strength and bond length: Bond order for H_2 molecule is greater than for H_2+ ion. This shows that H_2molecule is more stable than H_2^+ ion, i.e., bond in H_2 is stronger than that of H_2^+ ion. Further, it shows that the bond length in H_2 is smaller than that of H_2^+ ion.

(d) Diamagnetic character: As no unpaired electron is present, the H_2 molecule should be diamagnetic in nature.



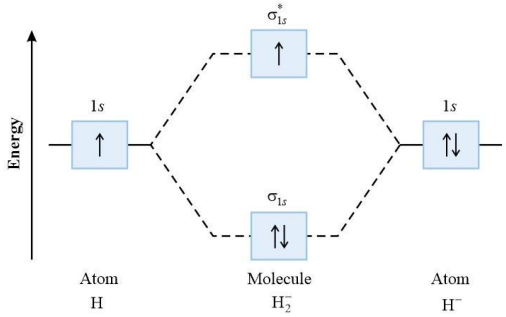
H_2 molecule

3. Hydrogen molecular negative ion (H_2^-): This molecular negative ion is formed by combination of one hydrogen atom having one electron in 1s-orbital with a hydrogen ion (H^-) having two electrons in 1s-orbital. Thus, H_2^- ion has three electrons. The two electrons will enter the bonding σ1s molecular orbital and the third electron will enter the antibonding σ*1s molecular orbital according to aufbau and Pauli's exclusion principles. Electronic configuration of H_2^- ion = $[\sigma 1s]^2[\sigma^* 1s]^1$, bond order= ½ ($N_b$–$N_a$)= ½ (2-1) =1/2

(a) Stability: Smaller positive value of bond order indicates that it is somewhat stable.

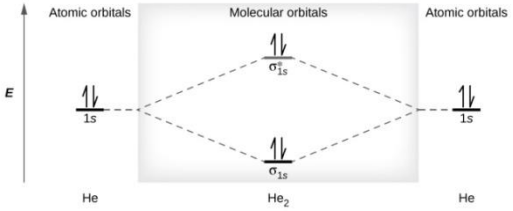
(b) Paramagnetic character: Since it has one electron in σ^*1s^1 orbital, it is paramagnetic. It may be noted that though H_2^+ and H_2^- have same bond order i.e., ½, yet H_2^- is slightly less stable than H_2^+. This is because H_2^- contains one electron in the antibonding orbital which results in repulsion and decreases the stability. On the other hand, H_2^+ does not contain any electron in the antibonding molecular orbital.

Species	Bond order	Stability	Magnetic character
H_2^+	1/2	Somewhat stable	Paramagnetic
H_2	1	Quite stable	Diamagnetic
H_2^-	1/2	Somewhat stable	Paramagnetic

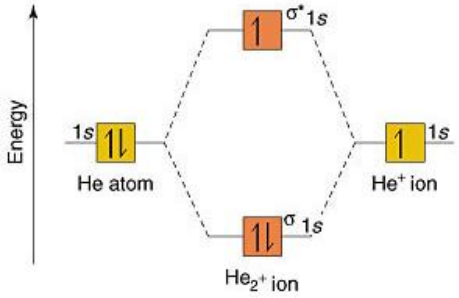


(Energy level diagram for H_2^- ion)

4. Helium molecule (He_2): Each helium atom has two electrons in 1s-orbital, therefore, there are four electrons in He_2 molecule. These electrons will be accommodated in σ1s and σ*1s molecular orbitals. Electronic configuration for helium molecule (He_2) is : $(\sigma 1s)^2\ (\sigma^*1s)^2$, bond order = ½ (N_b– N_a) = ½ (2-2)=0 . No bond is formed between two helium atoms. He_2 does not exist, which is actually so.

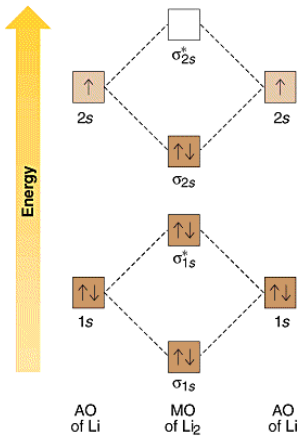


5. He_2^+ ion (Helium molecule ion): This molecule contains three electrons, two from one helium atom and one from the other (He^+ion). The molecular orbital electronic configuration of the molecule (He_2^+) is: $(\sigma 1s)^2\ (\sigma^*1s)^1$, bond order = ½ (N_b–N_a) = ½ (2–1) = ½.



He_2^+ ion has the same bond order as H_2^- ion and both have the same number of electrons in the antibonding orbitals. Thus, they will have similar stability, similar bond dissociation energy, similar bond lengths and paramagnetic in nature. The experiments support all these predictions.

6. Lithium molecule (Li_2): The electronic configuration of lithium atom is $1s^2\ 2s^1$. There are six electrons in lithium molecule. The electronic configuration of Li_2 molecule may be written as: $(\sigma 1s)^2\ (\sigma^*1s)^2\ (\sigma 2s)^2$ or KK $(\sigma 2s)^2$. KK represents full filled inner K-shells in two atoms i.e., $(\sigma 1s)^2\ (\sigma^*1s)^2$. As the closed K-shells do not take part in bonding, therefore, they are called non-bonding orbitals.



A Li_2 bond order = 1

From the electronic configuration of Li_2 molecule, it is clear that there are 4 electrons in bonding MOs and 2 electrons in antibonding MO. Bond order = ½ (N_b–N_a) = ½ (4-2) = 1 , thus, there is one Li-Li sigma bond. This shows that Li_2 is a stable molecule. Further, as it has no unpaired electron, it should be diamagnetic. Li_2 molecules are found to exist in the vapour phase.

7. Be_2, B_2 and C_2 molecules: The molecular orbital configurations along with their bond orders and magnetic properties are given in table:

Molecules	Molecular orbital configuration	Bond order	Magnetic character
Be_2	KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$	½ (2-2)= 0	Be_2 does not exist
B_2	KK $(\sigma 2s)^2$ $(\sigma^*2s)^2(\pi 2p_x)^1$ $(\pi 2p_y)^1$	½ (4-2) = 1	Paramagnetic
C_2	KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\pi 2p_x)^2$ $(\pi 2p_Y)^2$	½ (6-2) = 2	Diamagnetic

It has been observed that Li_2, C_2 molecules also exist in the vapour phase. Further, it is important to point out here that double bond in C_2 consists of both Pi bonds because the four electrons are present in the two pi molecular orbitals. Generally, in most of the molecules, the double bond consists of one sigma bond and one pi bond. Similarly, B_2 molecule has a weak pi bond.

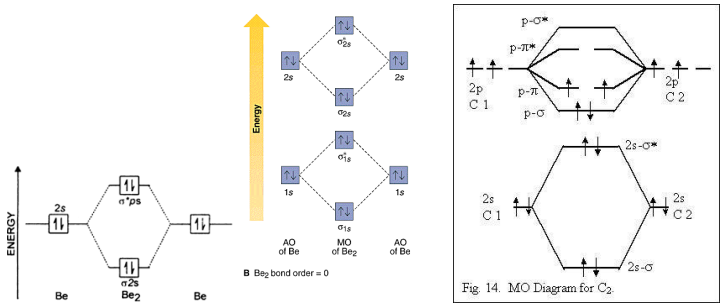
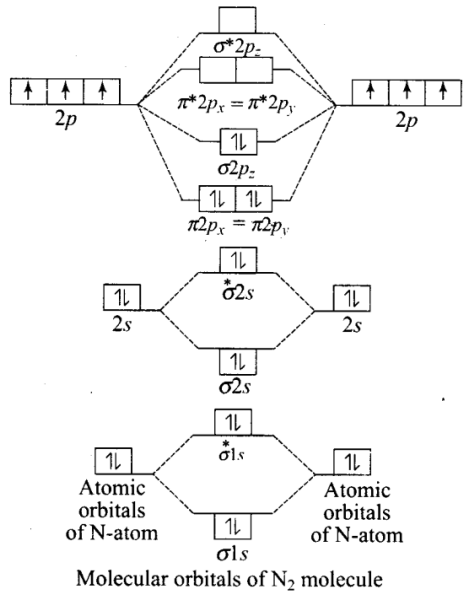


Fig. 14. MO Diagram for C_2.

Comparison of stability of H_2, Li_2 and B_2 : Though all the three molecules,viz., H_2, Li_2, and B_2, have the same bond order (i.e., 1), yet they are not equally stable. This may be explained as follows:

Li-atom is much larger in size than H-atom. Hence, Li-Li bond length (265pm) is much larger than H-H bond length(74pm). Moreover, Li_2 molecule has two electrons in the antibonding σ*1s while H_2 has no electron in the antibonding orbital. Because of these reasons, Li_2 is less stable than H_2. Bond energy of Li_2 is 110kJ/mol while that of H_2 is 438kJ/mol. Boron atom is smaller in size than Li –atom but larger than H-atom. Hence, bond length of B_2 is 159pm. B_2 molecule has two electrons more in the bonding molecular orbitals $(\pi 2p_x)^1$ and $(\pi 2p_y)^1$ than Li_2. Hence, B_2 is more stable than Li_2 but less stable than H_2, bond energy of B_2 is 290kJ/mol. Thus, the order of stability is H_2> B_2 > Li_2.

8. Nitrogen molecule (N_2): The electronic configuration of nitrogen atom (Z=7) is $1s^2$ $2s^2$ $2p_x^1$ $2p_y^1$ $2p_z^1$ and N_2 molecule has 14 electrons. The molecular orbital electronic configuration of theN_2 molecule is: KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\sigma 2p_z)^2$, bond order= ½ (N_b–N_a) = ½ (8-2) = 3 , thus, nitrogen molecule has three bonds, one sigma and two π bonds. This is in accordance with very high bond dissociation energy (945kJ/mol) and small bond length (110pm) of the molecule. The molecule is diamagnetic because there are no unpaired electrons.



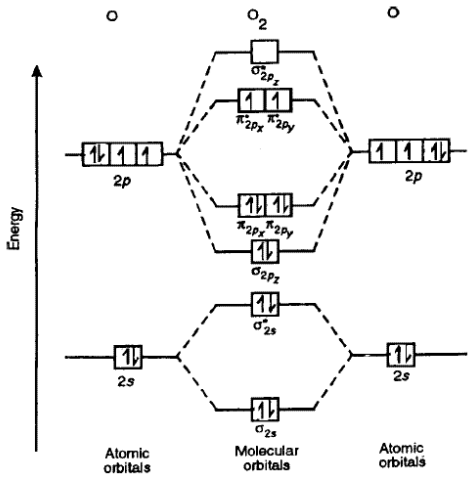
Molecular orbitals of N_2 molecule

Comparison of N_2, N_2^+, N_2^- and N_2^{2-}

Species	Molecular orbital configuration	Bond order	Stability	Magnetic character
N_2	KK$(\sigma 2s)^2(\sigma^*2s)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\sigma 2p_z)^2$	3	Most stable	Diamagnetic
N_2^+	KK$(\sigma 2s)^2(\sigma^*2s)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\sigma 2p_z)^1$	2 ½	Less stable	Paramagnetic
N_2^-	KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\sigma 2p_z)^2$ $(\pi^*2p_x)^1$	2 ½	Less stable	Paramagnetic
N_2^{2-}	KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\sigma\ 2p_z)^2$ $(\pi^*2p_x)^1$ $(\pi^*2p_y)^1$	2	Least stable	Paramagnetic

The bond orders of these species are: $N_2 = 3$, $N_2^+ = 2$ ½, $N_2^- = 2$ ½, $N_2^{2-} = 2$. As bond dissociation energies are directly proportional to the bond order, therefore, the dissociation energies of these molecular species are in the order: $N_2 > N_2^+ = N_2^- > N_2^{2-}$. As greater the bond dissociation energy, greater is the stability, the stability of these species is also in the above order. As bond length is inversely proportional to the bond order, therefore, their bond lengths will be in the order: $N_2^{2-} > N_2^- = N_2^+ > N_2$.

9. Oxygen molecule (O_2): One of the greatest achievements of molecular orbital approach was that it could explain the paramagnetic nature of oxygen molecule which could not be explained by valence bond approach. Electronic configuration of O-atom (Z=8) is $1s^2$ $2s^2$ $2p_x^2$ $2p_y^1$ $2p_z^1$. Therefore, oxygen molecule has 16 electrons. The electronic configuration of the O_2 molecule is: KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\pi^*2p_x)^1$ $(\pi^*2p_y)^1$, bond order = ½(8-4) = 2 , thus, oxygen molecule has two bonds (one σ and one π). Further, in accordance with Hund's rule, the last two electrons in π^*2p_x and π^*2p_y orbitals will remain unpaired. Therefore, the molecule has paramagnetic character due to the presence of two unpaired electrons. The bond dissociation energy in O_2 molecule has been found to be 498kJ/mol and bond length 121pm.



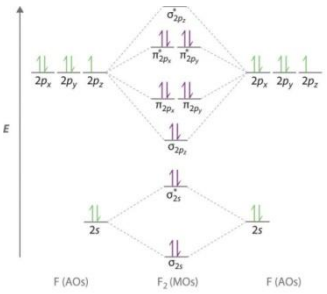
Comparison of O_2, O_2^+, O_2^- and O_2^{-2} species:-

Species	Molecular orbital configuration	Bond order	Bond dissociation	Bond length	Magnetic character
O_2	KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\pi^*2p_x)^1$ $(\pi^*2p_y)^1$	2	498kJ/mol	121pm	Paramagnetic
O_2^+ ($O_2 \rightarrow O_2^+ + e^-$)	KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\pi^*2p_x)^1$	2.5	625kJ/mol	112pm	Paramagnetic
O_2^- (superoxide ion)	KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2(\pi^*2p_x)^2$ $(\pi^*2p_y)^1$	1.5	395kJ/mol	130 pm	Paramagnetic
O_2^{-2} (peroxide ion)	KK $(\sigma 2s)^2$ $(\sigma^*2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\pi^*2p_x)^2$ $(\pi^*2p_y)^2$	1			Diamagnetic

Since bond order of O_2^{-2} ion is less than that of O_2 molecule, therefore, the bond O_2^{-2} will be weaker than

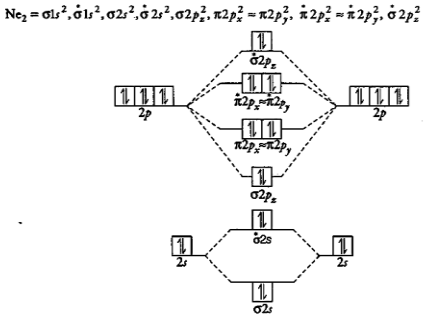
in O_2 and bond length of O_2^{-2} will be larger than that of O_2 molecule. The species O_2, O_2^+, O_2^- and O_2^{-2} can be arranged as; bond dissociation energy : $O_2^+ > O_2 > O_2^- > O_2^{-2}$ and bond length : $O_2^{-2} > O_2^- > O_2 > O_2^+$.

10. Fluorine molecule (F_2): The electronic configuration of fluorine atom is $1s^2\ 2s^2\ 2p^5$ and therefore, there are 18 electrons in the F_2 molecule. The molecular orbital electronic configuration of the F_2 molecule is: KK $(\sigma 2s)^2$ $(\sigma^* 2s)^2$ $(\sigma 2p_z)^2$ [$(\pi 2p_x)^2 = (\pi 2p_y)^2$]$(\pi^* 2p_x)^2$ $(\pi^* 2p_y)^2$, bond order= ½ (8-6) = 1, thus, there is one σ-bond in the molecule. Since all the electrons in the molecular orbital are paired, it is diamanetic. The single bond in the molecule is also in agreement with bond dissociation energy of 159kJ/mol and bond length is 143 pm.



(Molecular orbitals of F_2 molecule)

11. Hypothetical neon molecule:- The electronic configuration of neon atom (Z= 10) is $1s^2\ 2s^2\ 2p^6$ and the molecular orbital electronic configuration of neon molecule is: KK $(\sigma 2s)^2$ $(\sigma^* 2s)^2$ $(\sigma 2p_z)^2$ $[(\pi 2p_x)^2 = (\pi 2p_y)^2]$ $[(\pi^* 2p_x)^2 = (\pi^* 2p_y)^2]$ $(\sigma^* 2p_z)^2$. Bond order = ½ $(N_b - N_a)$ = ½ (8-8) = 0 , thus, Ne_2 does not exist.



Molecular orbital electronic configuration of some common hetronuclear molecules:- The configuration of heteronuclear molecules(containing different atoms) can be written in a similar manner as in case of homonuclear molecules.

Species	Total No. of electrons	Valence electrons	Molecular orbital electronic configuration	Bond order	Bond dissociation energy	Bond length
NO	7+8= 15	11	KK $(\sigma 2s)^2$ $(\sigma^* 2s)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\sigma 2p_z)^2$ $(\pi^* 2p_x)^1$	½ $(N_b - N_a)$ =1/2 (8-3) =2.5	667kJ/mol	115 pm
NO^+	7+7 = 14	10	KK $(\sigma 2s)^2$ $(\sigma^* 2s)^2$ $(\pi 2p_x)^2(\pi 2p_y)^2(\sigma 2p_z)^2$	½ (8-2) =3		106 pm
CN	6+7 =13	9	KK $(\sigma 2s)^2$ $(\sigma^* 2s)^2$ $(\pi 2p_x)^2(\pi 2p_y)^2(\sigma 2p_z)^1$	½ (7-2)= 2.5	786 kJ/mol	117 pm
CN^-	6+8= 14	10	KK $(\sigma 2s)^2$ $(\sigma^* 2s)^2$ $(\pi 2p_x)^2(\pi 2p_y)^2(\sigma 2p_z)^2$	½ (8-2) =3		
CO	6+8 = 14	10	KK $(\sigma 2s)^2$ $(\pi 2p_x)^2(\pi 2p_y)^2(\sigma 2p_z)^2$ $(\sigma^* 2s)^2$	½ (8-2) =3	1067kJ /mol	113 pm
CO^+	6+7 = 13	9	KK $(\sigma 2s)^2$ $(\pi 2p_x)^2(\pi 2p_y)^2(\sigma 2p_z)^1$ $(\sigma^* 2s)^2$	½ (7-2)= 2.5		111pm
BN	5+7= 12	8	KK $(\sigma 2s)^2$ $(\sigma^* 2s)^2$ $(\pi 2p_x)^2(\pi 2p_y)^2$	½ (6-2)=2	385kJ/mol	128 pm
BO	5+8= 13	9	KK $(\sigma 2s)^2$ $(\sigma^* 2s)^2$ $(\pi 2p_x)^2(\pi 2p_y)^2(\sigma 2p_z)^1$	½ (7-2)= 2.5	773 kJ/mol	120 pm

It may be noted that in CO and CO^+, σ*2s MO is higher in energy than $\pi 2p_x$, $\pi 2p_y$ and $\sigma 2p_z$ molecular orbitals.

Species	Molecular orbital configuration	Bond order	Stability	Magnetic character
N_2	KK$(\sigma 2s)^2(\sigma^* 2s)^2$ $(\pi 2p_x)^2$ $(\pi 2p_y)^2$ $(\sigma 2p_z)^2$	3	Most stable	Diamagnetic

N_2^+	KK(σ2s)^2(σ^*2s)^2 (π2p$_x$)^2 (π2p$_y$)^2 (σ2p$_z$)^1	2 ½	Less stable	Paramagn etic
N_2^-	KK (σ2s)^2 (σ^*2s)^2 (π2p$_x$)^2 (π2p$_y$)^2 (σ2p$_z$)^2 (π^*2p$_x$)^1	2 ½	Less stable	Paramagn etic
N_2^{2-}	KK (σ2s)^2 (σ^*2s)^2	2	Least	Paramagn
	(π2p$_x$)^2 (π2p$_y$)^2 (σ 2p$_z$)^2 (π^*2p$_x$)^1 (π^*2p$_y$)^1		stable	etic

Assignment

1. The calculated bond order in O_2^- ion is:
(a) 1 (b) 1 ½ (c) 2 (d) 2 ½

2. The bond order in the species O_2, O_2^+, and O_2^- follows the order:
(a) $O_2 > O_2^+ > O_2^-$ (b) $O_2^+ > O_2 > O_2^-$
(c) $O_2^- > O_2 > O_2^+$ (d)) $O_2^+ > O_2^- > O_2$

3. If z-axis is considered as molecular axis, which of the following combinations is not possible for homonuclear diatomic molecules?
(a) $2p_z + 2s$ (b) $2p_y - 2p_y$
(c) $2p_x + 2p_x$ (d) $2p_x + 2p_y$

4. Which of the following is paramagnetic?
(a) O_2^- (b) CN^-
(c) CO (d) NO^+

5. Which of the following molecules/ ions do not contain unpaired electrons?
(a) B_2 (b) N_2^+ (c) O_2 (d) O_2^{2-}

6. Which one of the following pairs consists of only paramagnetic species?
(a) O_2, NO (b) O_2^+, O_2^{-2} (c) CO , NO (d) NO, NO^+

7. The species having bond order different from that in CO is –
a) NO^- (b) NO^+ (c) CN^- (d) N_2

8. Which of the following species exhibits the diamagnetic behavior?
(a) O_2^+ (b) O_2 (c) NO (d) O_2^{2-}

9. According to molecular orbital theory, which of the lists ranks the nitrogen species in terms of increasing bond order?
(a) $N_2^{2-} < N_2^- < N_2$ (b) $N_2 < N_2^{2-} < N_2^-$
(c) $N_2^- < N_2^{2-} < N_2$ (d) $N_2^- < N_2 < N_2^{2-}$

10. Assuming Hund's rule is violated, the bond order and magnetic nature of the diatomic molecule B_2 is –
(a) 1 and diamagnetic (b) 0 and diamagnetic
(c) 1 and paramagnetic (d) 0 and paramagnetic

11. In which of the following pairs of molecules/ions, both the species are not likely to exist?
(a) H_2^-, He_2^{2+} (b) H_2^+, He_2^{2-}
(c) H_2^- He_2^{2-} (d) H_2^{2+}, He_2

12. Stability of the species Li_2 , Li_2^- and Li_2^+ increases in the order of –
(a) $Li_2^- < Li_2 < Li_2^+$ (b) $Li_2 < Li_2^+ < Li_2^-$
(c) $Li_2^- < Li_2^+ < Li_2$ (d) $Li_2 < Li_2^- < Li_2^+$

Answer: 1. (b) 2. (b) 3. (d) 4. (a) 5. (d) 6. (a) 7. (a) 8. (d) 9. (a) 10. (e) 11. (d) 12. (c)

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SCIENCE QUIZ AUGUST 2018

Kumud Bala

1. In which of the following metals, when left free in the air, the process of corrosion doesn't take place in:
(a) Iron (b) Copper (c) Gold (d) Silver

2. Which of these diseases is not caused by improper disposal of sewage?
(a) Cholera (b) Heart attack
(c) Jaundice (d) Typhoid

3. What are the products of anaerobic respiration in yeast?
(a) Alcohol and CO_2 (b) CO_2 and glucose
(c) Oxygen and alcohol (d) Glucose and oxygen

4. On what factor loudness of the sounds depends on:
(a) Amplitude (b) Frequency
(c) Time period (d) Speed.

5. Which mirror is used in headlights of the car?
(a) Concave (b) Convex
(c) Plane (d) None of these.

6. In fireworks, the green flame is produced because of:
(a) Barium (b) Sodium
(c) Mercury (d) Potassium.

7. Potassium permanganate is used for purifying drinking water because it:
(a) Dissolves the impurity of water
(b) Reeducing agent
(c) Ooxidizing agent
(d) Sterilizing agent

8. The radioactive element which is most commonly detected in humans is:
(a) Cobalt-60 (b) Iodine-131
(c) Potassium-40 (d) Plutonium-238

9. What is the chemical name of vitamin-D?
(a) Alpha tocopherol (b) Retinol
(c) Calciferol (d) Thiamine

10. Accumulation of which chemical leads to kidney stones –
(a) Calcium oxalate (b) Cadmium
(c) Sulphur (d) Diethyl ether

11. Which element is excreted through human sweat?
(a) sodium (b) mercury (c) sulphur (d) calcium

12. In L.P.G the main component is:
(a) Methane (b) Carbon dioxide
(c) Butane (d) Sulphur dioxide

13. Which of the following would produce minimum environmental pollution?
(a) diesel (b) coal
(c) hydrogen (d) kerosene

14. The radio isotope used to control the disease like blood cancer (leukemia) is:
(a) Phosphurs-32 (b) Cobalt-60
(c) Iodine-131 (d) Sodium-24

15. How will you define the process of vulcanization?
(a) Sample of butane mixed with sulphur and litharge
(b) Sample of propane mixed with sulphur and litharge
(c) Sample of plastic formed carbon mixed with sulphur and litharge
(d) Sample of rubber mixed with sulphur and litharge

16. What is the composition of soap?
(a) Sodium salt with fatty acids
(b) Potassium salt with fatty acids
(c) Both a and b
(d) Sodium potassium salt mixed with chemicals.

17. Which of the following parts of the Sun is easily visible only during a total solar eclipse?
(a) Photosphere (b) Sunspots
(c) Corona (d) Core

18. What do we celebrate every 15th August?
(a) Indian Independence Day
(b) Civil Disobedience Movement
(c) Quit India Movement
(d) Jalianwala Bagh Tragedy

19. From which country, India got the independence.
(a) Russia (b) Britain
(c) America (d) Africa

20. How many years Britain ruled India?
(a) About 100 years (b) About 150 years
(c) About 200 years (d) About 250 years

21. Who created Indian National Army for Indian Independence?
(a) Netaji Subhash Chandra Bose
(b) Gandhji
(c) Mangal Pandy
(d) Rani Laxmi Bai

22. When was the first uprising against the British East India Company's rule?
(a) 1857 in Meerut, North India
(b) Gwalior on 17 June 1858
(c) April13, 1919
(d) April 6, 1930

23. Who led Quit India movement?
(a) Netaji Subhash Chandra Bose
(b) Mohandas Karamchand Gandhi
(c) Rani Laxmi Bai
(d) Mangal Pandy

24. Whose famous motto was: Give me blood and I will give you freedom.
(a) Gandhiji
(b) Subhash Chandra Bose
(c) Bal Gangadhar Tilak
(d) Lala Lajpat Rai

25. When Jallianwala Bagh massacre took place?
(a) 6 April, 1930 (b) September 1920
(c) 13 April, 1919 (d) 11 March 1930

26. Who announced partition of India?
(a) Gandhiji
(b) Viscount Louis Mountbatten
(c) Brigadier-General Reginald Dyer
(d) Muhammad Ali Jinnah

27. Who was the Governor- General of India at the time of Independence?
(a) Viscount Louis Mountbatten
(b) Brigadier- General Reginald Dyer
(c) Dr. Rajendra Prashad
(d) Mughal emperor, Bahadur Shah II

28. Who is the author of the National Anthem of India?
(a) Bal Gangadhar Tilak (b) Lala Lajpat Rai
(c) Rabindranath Tagore (d) Capt. Mohan Singh

29. What does the blue wheel that appears in the Indian National Flag stand for?
(a) The wheel of law of justice (b) Sacrifice
(c) Peace (d) Prosperity

30. Who was the key-factor in uniting self-governed princely states post- independence?
(a) Sardar Vallabh Bhai Patel
(b) Mahatma Gandhi
(c) Jawaharlal Nehru
(d) Dr. Rajendra Prashad

(Answers to this Science Quiz June'18 shall be provided in 1st Supplement to 8th Quarterly e-Bulletin dt. 1st Sept'18)

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Code: Phy/NLM-II/S/001

Newton's Laws of Motion-II: Illustrations Subjective Questions (Typical)

I-01

Given that mass of the block is 1 kg. Translation acceleration of the horizontally placed disc is $a = 25\text{m.s}^{-2}$ towards left. Since the block is free to move in the groove, acceleration on the block along the groove shall be $a\cos\theta$ as is the figure. Therefore, frictional forces shall be acting against the acceleration on the block. There are Two frictional forces one on account of weight of the block $-\mu \times mg$. The second is due normal reaction $N = ma\cos\theta$ by the edge of groove, caused by pseudo-force (ma).

Thus second frictional force shall be $\mu ma\sin\theta$ Thus total Frictional force is $-\mu \times mg + \mu \times ma\sin\theta$. And this frictional force is equivalent to a retardation $= \mu \times (g + a \times \sin\theta)$

Accordingly, net acceleration shall be $a\cos\theta - \mu(g + a\sin\theta) \rightarrow 25 \times 0.8 - 0.4(10 + 25 \times 0.6) \rightarrow 20 - 0.4(10 + 15) \rightarrow 20 - 10 = 10\text{m.s}^{-2}$

I-02

Normal reaction for a plane inclined at 45° would be $\frac{mg}{\sqrt{2}}$ and hence frictional force for block A shall be $0.2\frac{mg}{\sqrt{2}}$ and for Block B shall be $0.3\frac{mg}{\sqrt{2}}$. Thus net force on Block A prompting it slide down would be $\frac{mg}{\sqrt{2}}(1-0.2) = 0.8\frac{mg}{\sqrt{2}}$ and on block B shall be Block A prompting it slide down would be $\frac{mg}{\sqrt{2}}(1-0.3) = 0.7\frac{mg}{\sqrt{2}}$.

And as per NSLM acceleration experienced by Block A is $0.8\frac{g}{\sqrt{2}}$ and by Block B is $0.7\frac{g}{\sqrt{2}}$. Let distance covered by Block B when it is in line with block B is x m, then distance covered by block B shall be $x + \sqrt{2}$ m. Since both blocks start moving from rest at same instance and hence from Second Eqn. of Motion for block A, $x + \sqrt{2} = 0 \times t + \frac{1}{2}(0.8\frac{g}{\sqrt{2}}t^2)$, here t is time taken to cover distance $x + \sqrt{2}$. Likewise for block B, $x = 0 \times t + \frac{1}{2}(0.7\frac{g}{\sqrt{2}}t^2)$.

Accordingly, answers for Two parts are -

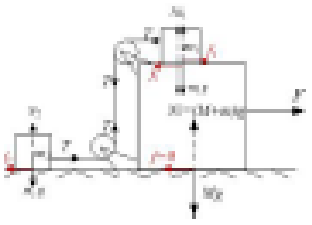
(a) Subtracting 1st Eqn. for block B from the Eqn. for block A and using given value of g it leads to $\sqrt{2} = \frac{1}{2}(0.1\frac{g}{\sqrt{2}}t^2) \rightarrow \sqrt{2} = \frac{1}{2}(\frac{1}{\sqrt{2}}t^2) \rightarrow t^2 = 4\ t = 2$ sec.

(b) Now to determine distance traveled by Two Blocks is

(i) Block B: Use the equation for it with value of v and g, it leads to $x = \frac{1}{2}(0.7\frac{10}{\sqrt{2}}2^2) = 7\sqrt{2}\text{m}$.

(ii) Block A: And distance covered by block A is $x + \sqrt{2} = 7\sqrt{2} + \sqrt{2} = 8\sqrt{2}$ m

I-03



[Note: This case involves consideration of frictional force on mass m_1 and m_2 in the range Zero to their maximum values. And this needs to be decided first. This makes it an interesting problem] Accordingly, $f_1 \leq \mu \cdot m_1 \cdot g \rightarrow f_{1max} = (0.3) \cdot 20 \cdot 10 = 60$ N and $f_2 \leq \mu \cdot m_2 \cdot g \rightarrow = f_{2max} = (0.3) \cdot 5 \cdot 10 = 15$ N. Thus, $f_1 \neq f_2$, but given that $f_1 = 2 \cdot f_2$. This is possible only when mass m_1 is in state of rest w.r.t M. This is a case of static friction and under this condition $f_1 < f_{1max}$ and thus mass m_1 and mass M shall have same acceleration (a) under influence of force F. String connecting mass m_1 and m_2 are considered to be in-extensible, since nothing otherwise is defined in the problem. Therefore, mass m_2 shall also be experiencing same acceleration a as that of mass m_1 and M, and $f_2 = f_{2max} = 15$. Accordingly as per given condition $f_1 = 2 \cdot f_{2max} = 2 \cdot 15 = 30$N.

Given that $f_1 = 2 \cdot f_{2max} = 2 \cdot 15 = 30$N. Since, coefficient of friction of mass M w.r.t. ground is not defined it is taken to be Zero and hence frictional force on mass M is also $f = 0$. Such an assumption is important, and shall have to be taken unless universal quantity like g occurs.
Now, since motion of given masses is in horizontal direction, and hence, analyzing figure with all forces in action, horizontal forces on mass M shall form an equation $F - f_1 = M \cdot a$. Here, $f_1 \leq f_{1max}$. $\rightarrow F - 30 = 50a$
As regards mass m_1 equation of horizontal forces shall be $f_1 - T = m \cdot a \rightarrow 30 - T = 20 \cdot a \rightarrow T = 30 - 20a$. And for mass m_2 the equation shall be $T - f_2 = m_2 \cdot a \rightarrow f_2 = 15 = T - 5a \rightarrow T = 15 + 5a$.
Equating two values of T, it leads to $30 - 20a = 15 + 5a \rightarrow 25a = 15 \rightarrow a = \dfrac{15}{25} = \dfrac{3}{5}$ m.s^{-2}
It together with equation of mass M leads to $F = 30 + 50a = 30 + 50\dfrac{3}{5} = 30 + 30 = 60$N. And eqn. for mass m_2 leads to $T = 15 + 5\dfrac{3}{5} = 15 + 3 = 18$N.
Accordingly, desired Three variables are and the solution is $F = 60$N, $T = 18$N and $a = \dfrac{3}{5}$ m.s^{-2}

I-04

Geometrical setup of the problem is shown in the figure, where turn table is horizontal and rotating about its center at an angular speed ω. Hence, each mass would experience a centrifugal force $= mr\omega^2$. Accordingly force on mass m_1 would be $f_1 = m_1 l\omega^2$ and on mass m_2 would be $f_2 = m_2(L-l)\omega^2$. Now, that there is no friction on mass m_2. And coefficient of friction of mass m_1 is 0.5 hence maximum frictional force on it would be $f_{f1_{max}} = \mu N_1 = \mu m_1 g \rightarrow 0.5 \cdot 10 \cdot 10 = 50$ N.

Since both masses are connected with a string of length $L = 0.3$ m, $l = 0.124$ m and hence a tension T in the string will act as centripetal force. Thus horizontal forces, which will affect equilibrium position of the masses, along diameter of the turn table, will have satisfy equation for mass m_1 as $f_1 = T + f_{f1} \rightarrow m_1(0.124)\omega^2 = T + f_{f1} \rightarrow 10(0.124)10^2 = T + f_{f1} \rightarrow 124 = T + f_{f1}$. Likewise, for mass m_2 the equation shall be $f_2 = T + f_{f2} \rightarrow m_1(L-l)\omega^2 = T \rightarrow 5(0.3 - 0.124)10^2 = T \rightarrow T = (0.176)500 = 88$ N. Substituting value of T in equation for mass m_1, it leads to $124 = 88 + f_{f1} \rightarrow f_{f1} = 124 - 88 = 36$ N. **This is part (a) of the solution.**

At ω_{max} when mass m_1 tends to slip $f_{f1} \rightarrow f_{f1_{max}} = 50$ N and $m_1 \cdot l \cdot \omega^2 = m_2(L-l)\omega^2 + f_{f1_{max}} \rightarrow 10 \cdot (0.124) \cdot \omega^2 = 5 \cdot (0.3 - 0.124) \cdot \omega^2 + 50 \rightarrow (1.24 - (0.5)(0.176))\omega^2 = 50 \rightarrow 0.36\omega^2 = 50 \rightarrow \omega = \sqrt{\dfrac{50}{0.36}} = 11.75$ rad.s^{-1}. **This is part (b) of the solution.**

For both bodies to be at equilibrium without frictional force coming into play necessary requirement is $T = m_1 \cdot l \cdot \omega^2 = m_2 \cdot (L-l) \cdot \omega^2 \rightarrow m_1 \cdot l = m_2 \cdot (L-l) \rightarrow (m_1+m_2)l = m_2 \cdot L \rightarrow l = \frac{m_2}{m_1+m_2}L \rightarrow l = \frac{5}{15}0.3 = 0.1$ m, this distance of mass m_1 from O. Accordingly, distance of mass m_2 from O is $L - l = 0.3 - 0.1 = 0.2$ m. **This forms part (c) of the solution.**

I-05

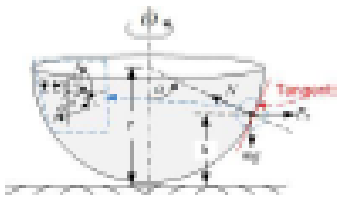
Given the geometry of the system where lengths CE=OP and hence $\angle CPO = 60^\circ \rightarrow \angle OCP$ and hence ΔOCP is equilateral therefore length $OP = R$. Therefore, for holding ring at spring of natural length $\frac{3}{4}R$ is stretched by a length $R - \frac{3}{4}R = \frac{1}{4}R$ and hence it would exert a force $F = \frac{1}{4}R \cdot \frac{mg}{R} \rightarrow \frac{mg}{4}$.
Free body diagram of the ring is shown in the figure. In this angles $\alpha = 60^\circ$ and $\beta = 30^\circ$ between vectors are shown in inset, and are determined geometrically.
It forms part (a) of the solution

Tangential force $F_t = F \cdot \cos 30^\circ + mg \cos 30^\circ = (\frac{mg}{4} + mg) \cdot \frac{\sqrt{3}}{2} = \frac{5\sqrt{3}mg}{8}$ N. Thus acceleration of ring, along the tangent at point as per NSLM, calculates to $a_t = \frac{\frac{5\sqrt{3}mg}{8}}{m} = \frac{5\sqrt{3}g}{8}$ m $\cdot$ s^{-2} tend to accelerate the ring P, along it.
And, normal force is derived from forces acting on the ring are F and weight mg. Accordingly, $F_r = mg \cos 60^\circ - F \cdot \cos 60^\circ \rightarrow F_r = (mg - F)\cos 60^\circ \rightarrow (\frac{mg}{4} - mg)\frac{1}{2} = -\frac{3mg}{8}$ N. Therefore, $N = -F_r$, it implies that $|N| = |F_r| = \frac{3mg}{8}$ N

Thus Tangential acceleration $a_t = \frac{5\sqrt{3}g}{8}$ m $\cdot$ s^{-2} and normal reaction $N = \frac{3mg}{8}$ N, form part (b) of the solution .

I-06

On the particle three forces are acting, one is gravitational, second is centrifugal force due to rotation about its vertical axis, and third is reaction offered by inner surface of the bowl. Since, inner surface of bowl is frictionless, there will not be frictional force. For the ball to remain stationary w.r.t. bowl net tangential force must be zero. All forces are sown in the figure and geometrically $\cos\alpha = \frac{r-h}{r} \rightarrow \sin\alpha = \sqrt{\frac{r^2-(r-h)^2}{r^2}} = \frac{\sqrt{h(2r-h)}}{r}$ and $\beta = \frac{\pi}{2} - \alpha$.

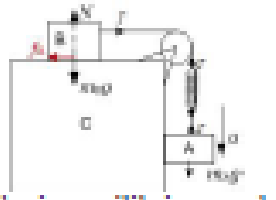


Thus equation of forces for equilibrium on tangential line at point P would be $F_c \cos\alpha = mg\cos\beta$, here $F_c = m(\sqrt{r^2-(r-h)^2})\omega^2$.
Accordingly, substituting values $m(\sqrt{h(2r-h)})\omega^2\frac{(r-h)}{r} = mg\frac{\sqrt{h(2r-h)}}{r} \rightarrow \sqrt{h(2r-h)})\omega^2(r-h) = g(\sqrt{h(2r-h)}) \rightarrow \omega^2(r-h) = g \rightarrow h = r - \frac{g}{\omega^2}$ m .**This is answer for part (a) of the question**
From the above $\omega^2 = \frac{g}{r-h} \rightarrow \omega = \sqrt{\frac{g}{r-h}}$. Since $0 < h \leq r$, as increases in the range $h \rightarrow r$ the $\omega \rightarrow \infty$, therefore minimum ω limit for $h \rightarrow 0$ the value is $\omega_{min} = \sqrt{\frac{g}{r}}$. **This answer for part (b) of the problem.**

From above $g = \omega^2(r-h)$. Given are r and ω, therefore, $\Delta g = \omega^2 \Delta h$. Given that $\Delta h = 10^{-4}$. Taking $g = 9.8$ m $\cdot s^{-2}$ would depend upon $\Delta g = {\omega_{min}}^2 \Delta h \rightarrow \sqrt{\frac{g}{r}}^2 \Delta h = \sqrt{\frac{9.8}{0.1}}^2 10^{-4} = \frac{9.8}{0.1} \times 10^{-4} = 9.8 \times 10^{-3}$ m$\cdot s^{-2}$. **This is answer for part (c) of the question.**

I-07

Given that both the masses A and B are moving with uniform velocity, and none of the masses are experiencing any force as per NFLM. This can happen when weight of the mass A has stretched the spring fully; let extension in spring is Δl. Thus $K\Delta l = m_A g \rightarrow \Delta l = \frac{m_A g}{1960} = \frac{2 \times 9.8}{1960} = 0.01$ m. Accordingly, force on both ends of the spring and tension in the string shall be $T = K\Delta l = 2 \times 9.8 = 19.6$ N.



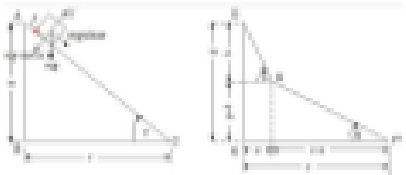
With the given condition of uniform velocity, horizontal force on mass B must also be in equilibrium and accordingly $f_B = T = 19.6 \rightarrow \mu N_B = 19.6 \rightarrow 0.2 \times m_B \times g = 19.6 \rightarrow 0.2 \times m_B \times 9.8 = 19.6 \rightarrow m_B = \frac{19.6}{1.96} = 10$ kg. **This is part (a) of the answer.**

Answer to part (b) of the question is energy in the spring $E = \frac{1}{2}K\Delta x^2 = \frac{1}{2}1960 \times (0.01)^2 = 0.098$ J.

It is to be noted that mass A is suspended vertically and its component along perpendicular to the surface shall make an angle 90° and hence normal reaction on the surface shall be Zero [$\cos 90° = 0$. Thus frictional force between vertical surface of block C and block A shall be Zero

I-08

Free body diagram for Fig (a) are shown and will b used to arrive at generic equation of velocity V_C. The same equation shall be used in parts for Fig (b) for Two section, with different inclinations, to derive velocity V_P. Block is free to slide along inclined plane and acceleration shall be $a_{AC} = g(\cos\alpha - \mu\sin\alpha)$.

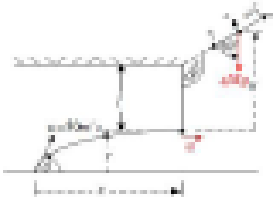


Thus according to kinematics ${V_C}^2 = 2a_{AC}y\,\mathrm{cse}\alpha = 2g(\cos\alpha - \mu\sin\alpha)y\,\mathrm{cse}\alpha = 2g(y\cot\alpha - y\mu) \rightarrow {V_C}^2 = 2g(x - \mu y)$. This equation of mechanics has been reduced geometrical relationship, and shall be used to solve for ${V_P}^2$ in Fig. (b)

Now in Fig. (b) there are Two slope DG and GF with inclinations θ_1 and θ_2 respectively. And, generic equation of Fig. (a) ${V_C}^2 = 2g(a - \mu b)$ and ${V_P}^2 = {V_C}^2 + 2g((x-a) + \mu(y-b))$. It leads to ${V_P}^2 = 2g(a - \mu b) + 2g((x-a) + \mu(y-b)) = 2g(x - \mu y)$. Thus $V_C = V_P = \sqrt{2g(x - \mu y)}$. **This is answer to the problem.**

I-9

Solution to this problem involves kinematics, conservation of momentum, conservation of energy and centrifugal action. Let u is the velocity of the combined mass $4M = M + 3M$ post collision, and v is the velocity of the combined mass before centrifugal force $= 4M\frac{v^2}{l}$ and tension $T = 4Mg\cos 60°$ in the string are in equilibrium, a necessary condition for string to remain stretched until it turn through an angle 120°. As bob tends to swing beyond 120° its potential energy will increase and in turn velocity would decrease. This would reduce centrifugal force which keep string stretched. Moreover, with increase of the swing angle, angle between the string and g would reduce, which will cause increase in component of $4Mg$ centripetal force. This imbalance creates condition of collapse of the string.



This leads to $4M\frac{v^2}{l} = 4Mg\cos 60° \rightarrow v^2 = \frac{gl}{2} = \frac{50}{3}$.

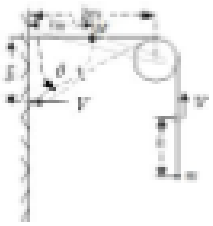
Taking principle of conservation of momentum $MV\cos\theta = 4Mu \rightarrow u = \frac{50}{4}\cos\theta = \frac{25}{2}\cos\theta$.

Taking energy balance equation post collision until limiting condition for stretched string $\frac{1}{2}4Mv^2 = \frac{1}{2}4Mv^2 + 4Mgl(1+\cos 60^\circ) \rightarrow u^2 = v^2 + gl\frac{3}{2} \rightarrow u^2 = v^2 + 10\frac{10}{3}\frac{3}{2} \rightarrow (\frac{25}{2}\cos\theta)^2 = \frac{50}{3} + 100 \rightarrow = \frac{350}{3} \rightarrow \cos^2\theta = \frac{1400}{1875} = \frac{56}{75} \rightarrow \cos\theta = \sqrt{\frac{56}{75}} = 0.86 \rightarrow \theta = 30^\circ$. **This part (a) of the answer.**

Time taken by bullet to the bullet of mass M to reach its highest point, at which it strikes hanging bob of mass $3M$mass, is $t = \frac{V\sin\theta}{g}$; this is from GFEM equation of motion. During this time, bullet horizontally covers,with uniform velocity, a distance $X = (V\cos\theta)(\frac{V\sin\theta}{g}) = \frac{V^2\sin 2\theta}{2g} = \frac{50^2 \times \sqrt{3}}{2\times 2\times 10} =$ 108.25 m. Likewise, for height attained equation shall be $0 = V^2\sin^2\theta - 2gY \rightarrow Y = \frac{V^2\sin^2\theta}{2g} = \frac{50\times 50\times(\frac{1}{2})^2}{2\times 10} = 31.25$ m. **These values of X and Y are part (b) of the answer.**

I-10

This solution involves principle of conservation of energy. Let the mass M will move down along a circular path, as shown in figure and shall have a velocity V when it touches the wall. The string shall remain stretched during movement of masses. At this instant the end of inclined portion of the string attached to the mass shall have a component of V along its inclined length $= V\cos\theta$. By geometry $\cos\theta = \frac{2}{\sqrt{2^2+1^2}} = \frac{2}{\sqrt{5}}$. When mass M reaches wall length of string between wall and pulley is $1+\sqrt{5}$ m as against 2 m in initial condition, eventually it increases by $(1+\sqrt{5}) - 2 = \sqrt{5} - 1$ m.



Since string is in-extensible, hence mass M will descend through a height, 1 m, and mass m will rise through a height $(\sqrt{5}-1)$ m, and shall have a velocity $v\frac{2}{\sqrt{5}}$. This makes information complete for evolving energy balance equation.

Accordingly, $(PE_{Mi} + KE_{(Mi)}) + (PE_{mi} + KE_{(mi)}) = (PE_{Mf} + KE_{(Mf)}) + (PE_{mf} + KE_{(mf)}) \rightarrow \Delta(PE_M + KE_{(M)}) + (PE_m + KE_{(m)})$.

Thus, $\Delta PE_M = -Mg\cdot 1 = -2\times 9.8 = -19.6$ J; $\Delta PE_m = mg\cdot(\sqrt{5}-1) = 0.5\times 9.8\times 1.24 = 6.08$ J;

Thus, $\Delta KE_M = \frac{1}{2}Mv^2 = v^2$ J; $\Delta KE_m = \frac{1}{2}m(v\cos\theta)^2 = \frac{1}{4}v^2(\frac{2}{\sqrt{5}})^2 = \frac{v^2}{5} = 0.2v^2$ J;

Thus, $\Delta PE_M + \Delta PE_m + \Delta KE_M + \Delta KE_m = 0 \rightarrow \Delta KE_M + \Delta KE_m = -(\Delta PE_M + \Delta PE_m) \rightarrow v^2 + 0.2v^2 = 19.6 - 6.08 \rightarrow v = \sqrt{\frac{13.52}{1.2}} = 3.36 \approx 3.4$ m-s^{-1}

[**Note:** Variation in LSD of answer depends upon rounding of digits and LSDs od the quantities that appear in calculation. It is a practice to take result of each intermediate calculation to SDs one more than LSD. And final result is rounded to appropriate LSD.]

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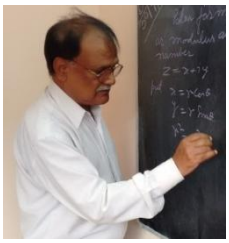
हमारापंचवर्षीयप्रवास

Start: June-2012



April-2015

June-2016……..

पारम्परिक शैक्षणिक मार्दर्शन से प्रारम्भ कर आज हम तकनीकी-विकास के सहारे मूलभूत प्रासंगिकता को आगे बढ़ने में संलग्न हैं…

यह प्रयास अपने सामाजिक कर्त्तव्य के प्रति सहजविनीत आग्रह है; कृपया इस पर विचार करें.

Theme Song :

**PREMISE:*We are pleased to adopt a song*" इतनीशक्तिहमेंदेनादाता....."*from a old Hindi Movie Do Aankhen Barah Haath दोआँखेंबारहहाथof year 1957, directed by The Late V. Shantaram. The lyrics are by Shri Bharat Vyas, singer Melody Queen Sushri Lata Mangeshkar, and Music Direction by Vasant Desai. It has become a widely accepted inspirational song and/or prayer in many educational institutions and socially inspired initiatives engaged in mentoring of unprivileged children. This newly formed non-organizational initiative, being selflessly operated by a small set ofcompassionate persons, finds its philosophy in tune with the song and conveys its gratitude to all he eminent persons who brought out the song in a manner that it has attained an epitome of popularity. While working its mission and passion, the group invites one and all to collectively complement in grooming competence to compete among unprivileged children. The song/prayer goes as under -*

इतनी शक्ति हमें देना दाता, मन का विश्वास कमजोर होना
हम चले नेक रस्ते पे हम से, भूलकर भी कोई भूल होना ||

दूर अज्ञान के हो अंधेरे, तू हमें ज्ञान की रोशनी दे
हर बुराई से बचते रहें हम, जितनी भी दे भली ज़िन्दगी दे
बैर होना किसी का किसी से, भावना मन में बदले की होना ||

इतनी शक्ति हमें देना दाता, मन का विश्वास कमजोर होना
हम चले नेक रस्ते पे हम से, भूलकर भी कोई भूल होना ||

हमना सोचें हमें क्या मिला है, हम ये सोचे किया क्या है अर्पण
फूल खुशियों के बाँटे सभी को, सबका जीवन ही बन जाए मधुबन
अपनी करुणा का जल तू बहा के, कर दे पावन हर एक मन का कोना ||

इतनी शक्ति हमें देना दाता, मन का विश्वास कमजोर होना
हम चले नेक रस्ते पे हम से, भूलकर भी कोई भूल होना ||

Together **E**ach **A**chieves **M**ore
(**TEAM**)

Every end, so also end of this e-Bulletin, is a pause for a review, before Resuming of the journey far beyond ...