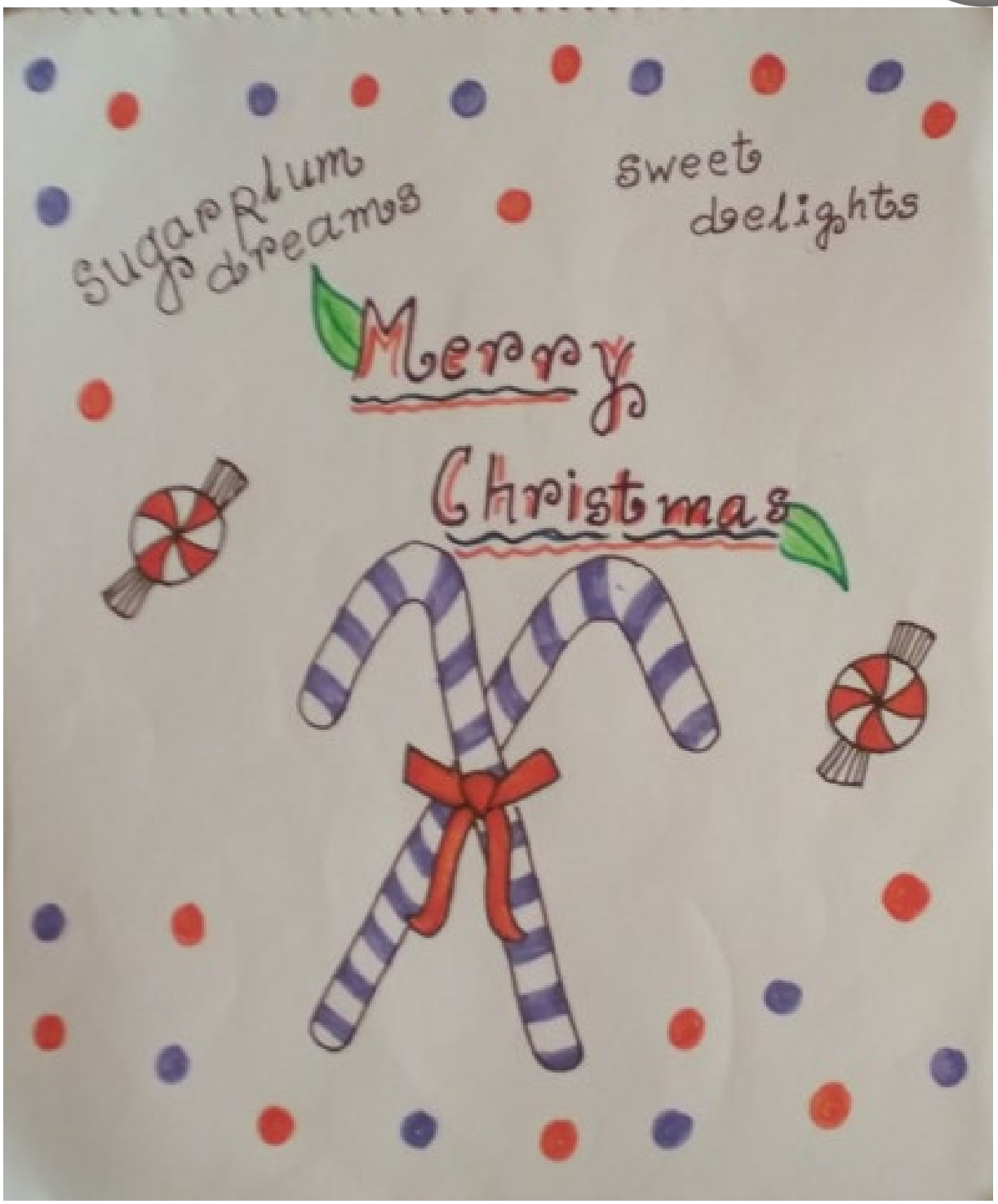
GYAN VIGYAN SARITA:शिक्षा

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

2nd Monthlye-Bulletin dt 1st December'18, Fourth Year of the Publication



Thanks for Everything 2019, G O O D B Y E !!!

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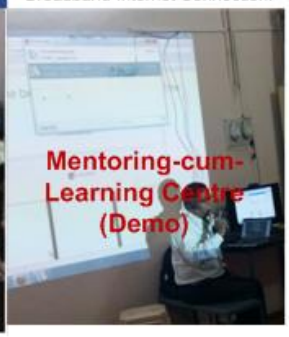
Aim at the Best, but...

Conceptual Representation
of
Online Mentoring
An Initiative To Bridge Gap between
Passionate Teachers
and
Desperate Students
** Selfless Endeavour*
to
Democratize Education
with a sense of
Personal Social Responsibility (PSR)

Equipments at Mentoring Center
1.Desk-/Lap-top
2. WebCam
3. Headset with Microphone
4. Digital Pen
AND
Broadband-Internet Connection

Cloud Internet
(Linking platform : cloud based with as low bandwidth as possible for seamless connectivity of audio-video-whiteboard across nodes where internt connectivity is poor- Presently A-VIEW is in use)

Equipments at Learning Center
1.Desk-/Lap-top
2. WebCam
3. A Mixer-cum-amplifier with Speakers
and Wireless Microphone
5. Overhead Projector.
6. UPS (For Continuous Power Supply to computer, internet modem and L&F)
AND
Broadband-Internet Connection:



Important Links
1. Good Internet Connectivity (Wired Broadband Connection)
2. Subject-wise Coordinator for Each Session to Bridge Learning Gaps between Mentor & Students

Special Features
1. Free and Open to all to adopt. Modify, change, correct
2. Welcomes participation, promotion and facilitation on Zero-Fund-Zero-Asset (ZFZA) basis
3. More details on Technological and Operational – please write on **http://www.gyanvigyansarita.in/contact/**

... 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

वैयक्तिक संगठन : समाज के विकास में सहयोगी

सरकार हर व्यक्ति तक पहुंच नहीं पाती है। सरकार हर व्यक्ति की प्रतिभा को समझ नहीं सकती है। प्रशासन हर व्यक्ति की गरिमा को संभाल नहीं सकता है। पर समाज अपने साथियों की हर हुनर को पहचान लेता है, समझ लेता है, उसका उपयोग करता है, उसको सहारा देता है, और उसकी समय पर रक्षा भी करता है। यही कारण है कि व्यक्तिगत संस्थायें समाज के विकास में अपनी सामर्थ्य के अनुसार सबको साथ लेकर काम करती हैं, अपने साथ काम करने वालों की मदद करती हैं, और खुद भी फलती-फूलती हैं। ऐसा इसलिये संभव हो पाता है क्योंकि व्यक्तिगत संस्थाओं के काम करने का उद्देश्य केवल सेवा और काम नहीं होता है बल्कि उन कामों के प्रतिफल को समाज को दिखाना भी होता है।

प्रकृति का नियम है कि विकास हमेशा जीवित रहता है। विकास प्रयास का सहभागी है, सक्रिय होना ही विकास करना है, नयी प्रवृत्तियों और विधाओं को जन्म देना ही विकास करना है। समाज वही जिंदा रहता है जो सदा विकासमान रहता है।

सामाजिक कार्य सरकारें भी करती हैं, परंतु वैयक्तिक और सरकारी सामाजिक कार्यों में अंतर यह होता है कि व्यक्ति अपने कार्यों से समाज को मजबूत करता है, समाज के लिये काम करता है, उसमें अपना स्थान बनाता है, उससे अपनी उन्नति करता है, अपने समाज के लिये हमेशा सोचता है और उसके प्रति सदा उत्तरदायी रहता है।

सरकारें बनते ही अपनी स्थिरता के लिये सोचने लगती हैं। अपने भविष्य के लिये चिंतित हो जाती हैं। फिर से दुबारा सत्ता में आने के लिये व्यवस्था में लग जाती हैं। सरकारें खुद मजबूत बनने लगती हैं, धन-संपदा एकत्र करने लगती हैं, नागरिकों की सुविधायें बढ़ाना और उनके लिये सोचना उनकी प्राथमिकता में पीछे रह जाता है।

दान और स्वैच्छिक संक्रिया, हर समाज में कल्याण के काम करने के लिये एक महत्वपूर्ण आवश्यकता है, परंतु यह वृत्तिक समाज कार्य से भिन्न है। विश्व के अनेक धर्मों ने दान को एक महान गुण बताया है।

हिंदू धर्म अन्य दानों की अपेक्षा विद्यादान को सर्वाधिक महान बताता है। यहूदी धर्म में पड़ोसी से प्रेम और जरूरतमंद की देखभाल पर बल दिया जाता है। ईसाई धर्म भ्रातृ - प्रेम को प्रोत्साहित करता है क्योंकि जेसस क्राइस्ट की देखभाल अजनबियों ने की थी। ईस्लाम में दान, प्रार्थना के समान माना गया है। सिखों का इतिहास, स्वैच्छिक सेवा के उदाहरणों से भरा पड़ा है। बुद्धवाद और जैनवाद निर्धन और जरूरतमंदों के प्रति करूणा का हिमायती है। पारसी के रूप में ज्ञात जरदुस्त धर्म के यहां एक कहावत है कि *उश्ता अहमई यहमई केहमाइचित* अर्थात् जो दूसरों को जब तक प्रसन्नता प्रदान करता है , तब तक वह सुखी रहता है।

1969 में स्थापित द ब्रिटिश ओपेन यूनिवर्सिटी पहली ऐसी दूरवर्ती विश्वविद्यालय था जिसने शिक्षा को शिक्षार्थी के दरवाजे तक ले जाकर उच्च शिक्षा देने का प्रयास किया और उनसे पढ़ने वालों को उपाधि यानि डिग्री दिया। यह इस विश्वास पर आधारित था कि शिक्षा ग्रहण करनेवालों ने उच्च गुणवत्तायुक्त शिक्षण पायी है क्योंकि शिक्षा देने वाले स्वयं में अत्यंत प्रवीण थे।

वर्तमान समय में कंप्यूटर संचारित आनलाइन पाठयक्रम के माध्यम से अत्यंत योग्य शिक्षक अपने विद्यार्थियों को बिना उनका समय बर्बाद किये उत्तम शिक्षा दे रहे हैं। हालांकि कुछ विद्वानों का मत है कि आनलाइन-अध्यापन का काम चुनौती भरा है और इसे बोर्ड और चाक की जगह लेने में अभी समय लगेगा जबकि सच्चाई यह है कि इस प्रकार के सामाजिक कार्य करने के लिये जो लोग आगे आ रहे हैं, उनके पास विशेष जानकारी है, वे बहुत निपुण हैं और उनमें भविष्य देखने की क्षमता है।

वैयक्तिक समाज कार्य एक सहायता मूलक कार्य है। यहां सहायता का उद्देश्य व्यक्ति की क्षमताओं का विकास करना और एक बार की सहायता के बाद उसे इस तरह तराशना है कि वह अपने को समाज में अच्छे से समायोजित कर ले और दूसरों की सहायता के लायक बन जाये।

सामाजिक कार्य प्राचीन परंपरागत मानवतावादी भारतीय दर्शन पर आधारित है जहां सहायता इस प्रकार की जाती थी कि सहायता प्राप्त करने वाले के अंदर हीन भावना न आ पाये और साथ ही साथ, वह भविष्य में अपनी समस्याओं से मुक्त भी हो जाये।

एक किस्सा सभी ने कभी न कभी अवश्य सुना होगा जिसमें कोई निर्धन किसी राजा के पास धन की फरियाद लेकर जब जाता और अपनी निर्धनता का रोना रोता था तब राजा प्रसन्न होकर इतना धन उसे दे देता था कि उसकी दरिद्रता कई पीढ़ियों तक के लिये समाप्त हो जाया करती थी और वह सहायता प्राप्त करने के बाद स्वयं ही दूसरों की सहायता करने वाला बन जाया करता था।

भारतीय परंपरा में दीन-दुखियों अथवा पीड़ितों की सहायता सदैव होती रही है। वशिष्ठ का राम को कर्त्तव्यबोध कराना, कृष्ण का अर्जुन को कर्म करने का उपदेश देना, सुदामा की दीन-हीन अवस्था दूर करना, बुद्ध का अंगुलिमाल के व्यवहार को परिवर्तित करना इन्हीं वैयक्तिक सामाजिक कार्यों के उदाहरण हैं।

कुछ लोगों का मत है कि पाश्चात्य जगत की सहायता और भारतीय सहायता दर्शन में अंतर यह है कि पाश्चात्य सहायतायें उनके धर्म को बढ़ावा देती हैं, जबकि भारतीय सहायतायें केवल मानवतावादी दृष्टिकोण अपनाकर की जाती हैं।

हड़प्पा संस्कृति से बौद्धकाल, मौर्यकाल, गुप्तकाल, हर्षकाल होते हुये वर्तमान तक का इतिहास है कि हमेशा जनता की भलाई के लिये ही सीख दी गयी है। बौद्धकाल की पुस्तक बोधिसत्व में इस बात का उल्लेख है कि दानी व्यक्तियों को कौन-कौन से कार्य करने होते थे। पहले उन्हें अपने सगे-संबंधियों तथा मित्रों की सहायता करनी होती थी, फिर उसके बाद असहाय रोगी, संकटग्रस्त अथवा दरिद्र व्यक्तियों की सहायता करनी होती थी।

मौर्य काल में यह सहायता व्यापक होकर बच्चों, बृद्धों और रोगग्रस्तों तक पहुंच गयी। सहायता करना धार्मिक कार्य माना जाने लगा, परंतु सहायता के लिये धर्म कभी समाज का विभाजक नहीं रहा। निर्धन बच्चों की निःशुल्क शिक्षा तक इसके दायरे में आ गयी।

फ्रायड आस्ट्रिया का न्यूरोलाजिस्ट और मनोविश्लेषक था। उसका मानना था कि मनुष्य का व्यवहार उसकी भावनाओं पर आधारित रहता है। यही भावनायें व्यक्ति को समाज कार्य करने की प्रेरणा देती हैं। समाज-कार्य एक शैक्षिक और व्यावसायिक विधा है जो समाज के जीवन-स्तर को हर हाल में ऊँचा उठाती है। सामाजिक कार्य हमेशा सकारात्मक होता है। बिना मन के सामाजिक कार्य नहीं किया जा सकता है। यह एक जुनून होता है।

आजादी के समय का गांधी जी का सर्वोदय की सोच भी एक सामाजिक कार्य है। भारत में 1936 से पहले सामाजिक कार्य को एक ऐच्छिक कार्य माना जाता था। 1936 में पहली बार समाज कार्य की व्यावसायिकता के बारे में सोचा गया। सर दोराबजी टाटा ग्रेजुयेट स्कूल आफ सोशल वर्क की स्थापना हुयी जो आजकल की टाटा इंस्टिट्यूट आफ सोसल साइंसेज है। इसमें सामाजिक कार्य के लिये ग्रेजुयेट की डिग्री बी0एस0 डब्ल्यू और मास्टर डिग्री एम0एस0डब्ल्यू दी जाने की शुरूआत हुयी। आज इस प्रकार के कई संस्थान भारत में कार्यकर रहे हैं।

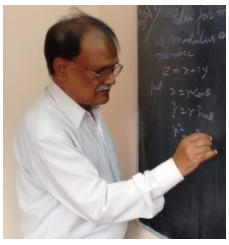
आज सामाजिक कार्यों का विस्तार युद्धक्षेत्र, अस्पताल, आपातकाल अथवा दैवी विपत्तियों के समय सामान्य हो गया है। लोग इतने जागरूक हैं कि वे अपना सबकुछ छोड़कर ऐसी परिस्थितियों में सहायता के लिये आ खड़े होते हैं और वह भी बिना धर्म, जाति, पांति, संप्रदाय की चिंता किये। यही नहीं ऐसे व्यक्ति सहायता के बाद अपनी पहचान उजागर किये बिना चले भी जाते हैं।

ज्ञान विज्ञान सरिता इसी प्रकार की एक सामाजिक विकास की आधारशिला है जो शिक्षा के माध्यम से समाज को उसकी परंपराओं, दायित्वों, कर्तव्यों और कर्मठता की पाठ पढ़ाती हुयी काम करती है कि समाज में कोई पीछे न छूट जाये, कोई कमी किसी में न रह जाये, कोई किसी प्रकार के ज्ञान को प्राप्त करने से बच न जाये। इस ज्ञान को बांटने के लिये जो आगे हैं, वे स्वयं में पूरी जिंदगी समेटे चलते-फिरते अनुभव के पिटारे हैं, अपने-अपने विषयों के मर्मज्ञ हैं और सबसे बड़ी बात यह है कि वे अपने विद्यार्थियों के चहेते हैं।

—00—

हमारा पंचवर्षीय प्रवास

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.

—00—

Coordinator's View

Activism Vs Reformism

Nature is dynamic and it has been ever changing and would continue to do so. Some changes are active changes which are induced by an external agent, while others are passive changes which occur in accordance with life-cycle of the system. These active changes are matter of serious consideration. Human species of life on this earth has capability to observe, correlate, explore options, choose one of it and then act upon. This faculty of human species has kept on growing and accelerating with its progress. Rest of the species simply acts upon for their survival and as per laws of nature. It is only the human species which has been able explore laws of nature and moderate the natural processes to its convenience and survival. It is intent behind initiation of the change process which makes a big difference, and it has compelled to classify such change agents as either activist or reformist. The rest who are driven by the change are passive persons.

Any kind of a situation that causes a discomfort is bound to create a response among the affected people. One response is looking for an immediate resolution to the discomfort. The other response is to eradicate the cause of discomfort. The first one can be achieved by creating a scare among people to react to the discomfort and thus compel the governing system to act upon for either appeasement or a window dressing. This creates an apparent relief. Nevertheless, the cause of problem keeps brewing. Recurrence of the problem is made apparent on a calculated occasion; rather one is in the hunt of an opportunity to do so. Eradication of the problem is never the intent. If that happens, the basic existence of the persons initiating response to discomfort would get endangered. This is nothing but activism and has appeared in different names as social activists, social sympathizers, custodian of social conscience and many more, as it may suit to an occasion or the audience. Thus objective of activism is short term, and motive is opportunism; and it is an opportunity of negotiation of interests.

In activism motivation is the gain derived out of indulgence. This gain could be financial, status, political or of any other kind. But, vision is short term, sometimes immediate. The engagement and continuance in the activism is very much similar to commercial decision in respect of what, when, where and whom to target. It is not emotional, but works on exploiting emotions of audience and creating an unachievable vision.

Reformism is prima-facie like activism. Here, reform is apparently aggressive, persuasive, vehemently forceful and at times too intense. But, genesis of reform is in inspiration derived from observation of suffering of innocents, and ill-effects of prevailing circumstances. It could be one's own, or nearest relation or selflessly of others. There have been great reformists all over the world. Citing any name is refrained as it may not be construed as an unjust and deliberate neglect of other great reformists. Yet they all evolved remedies very thoughtfully and sensibly, keeping in view long term consequences. It impacts basic interaction and thought process at all levels. Reformism is never self-serving and is based on coexistence among different sections of society and even with nature. Many of such reform initiatives have grown into laws of land. But, some of them remain in confinement of family practices; some appear in local or folk traditions, while there have been reforms to impact culture of clan, sect or society. Change is law of nature towards betterment, and orthodoxy is preserving the systems in place out. Such resistance to change is out of fear of change-consequence. There is a mixed action-reaction dynamics between reform and orthodoxy. It is only the level of awareness about evil of prevailing practices and opportunities and potential of welfare in reform which regulate the dynamics. In this dynamics proper and holistic education has an extremely important role to play.

The driving force of change is catalyzed by the education. It is the mode and impact of educational upbringing which branches into either activism or reformism. Activist are reactive to contemporary circumstances in a calculated manner, it is instantaneous. While, reformists act upon the historical trend of issue of concern and their proactive vision. Activists have a calculated roadmap and retreat, if necessary. It is a purely a business decision. But, reformists work with a selfless conviction and a vision. Their journey is will conceived with a clear roadmap. Yet, they are open for consideration, if needed, on any point of contention, if it is missed inadvertently. Reformists, therefore, are prepared to face all challenges, sufferings without getting volatile, whereas, propositions of activists' have no space for any kind of loss. Therefore, activists invariably go intemperate and volatile, if their expectations are not met; at times they turn out to be terrorists. Impelling requests with facts and logic is the way of reformists. While insisting upon the need of reform (आग्रह- Aagrah) they bear patience, because projection of reform is long-term and its target is innocent persons. They are aware that consequence of un-thoughtful reform

which might add to misery of the person for whom the reform is being pursued. But, selfish drive of activists are mischievous (दुराग्रह- duragrah) and if it goes wrong, it gives birth to a new opportunity for activists to meet their ends.

Every reformist is first an intrinsic and works without discrimination. Domain of reformists may have a reach right from within the family to anomalies in social and religious systems, gender discrimination, atrocities to animal, abuse of natural resources right from rivers, land, mountain and anything that is of irrational nature. There have been instances where reforms of wide-spread nature have taken a shape of legislative reform; whereas, an activists are discriminate and extrinsic. Thus a reformist tends to earn credibility which is in deficit with activists.

Educational upbringing has far reaching effects. Education is just not ability to read, perform calculation, get good score and acquire a high salaried position. It is all about ability to observe, correlate observations, analyze cause behind a certain occurrence, explore alternative ways to remedy a situation, choose one of the alternatives based on merit. This merit, in turn, is based on feasibility, economics, sustainable and coexistence with other people as well as nature. Ability to make right choice based on merit is manifestation of wisdom that grows gradually with realization of universal truth. This wisdom is reflected in honesty of thoughts, intentions and action (मनसा, वाचा, कर्मणा – Mansa, Vaacha, Karmna). But, the honesty alone is insufficient unless it is blended with a courage and ability to translate it in actions. This kind of ability garners credibility; it is an asset of a reformist. It grows over a period of time, it is never abrupt. An abrupt rise of acceptance is a result of emotional selling, a quality of an activist. Journey of reformist is long fire-walk where one is subjected to tests of all kinds of honesty viz. financial, intellectual, moral and professional honesty. It is very tough for one to prove to be honest on all fronts. Financial dishonesty is perceivable and becomes immediately apparent; while the other kinds of honesties are latent, and it takes time and efforts to realize them. Credibility of a reformist is proven during the fire-walk and this becomes his strength. It helps him to create awareness among people, with diverse interests, sometimes even of conflicting interests, on the need of change and vision associated with it. It promotes a kind of a harmony and a desire of coexistence among all, a natural instinct; whereas an emotional appeal created by an activist gets easily exposed. In this context quotation of Abraham Lincoln is very relevant – "*You can fool some people for all the time; all people for some time, but not all the people for all the time*".

Genesis of activism is since in emotional selling, it abruptly surfaces as an oriented mob fury; it responds to any emotional call among weaker section, be it economical, social or religious. Activists of keep playing their cards for widening the distrust between conflicting sections of the society, and thus maintain their relevance. Whereas wisdom, despite being wide spread, it lacks orientation. Therefore, wise people waste their time in debate and analysis-analysis-paralysis which breeds inaction and create a pasture for activists. This is the reason that despite multiple anomalies in prevalent in the society and systems, reforms are scarce. But, recurrence of activists' movements is abrupt and rampant. This kind of activistic-mobocracy has a potential to ride over dempcracy, a dangerous signal.

Therefore, seeds of reform must be sown in the educational system, which is essential to sustain inevitable dynamics of change. While doing so it is essential to remember that commercial education breeds activism, whereas reformism is byproduct of educational ethics

Conclusion: It is possible to cite multiple examples of activist in prevalence. It is an advertent act to refrain from specific mentions of activism, which is. Lest it be done, probability of being dragged into controversies and contradictions are seen to be prominent. Such reactions would distract the focused efforts being made on a social reform through education. This endeavour is to mentor deprived children, so as to groom among them competence to compete. It is a proactive reformist approach which has a long journey. This needs to be undertaken on urgency and to be complemented collectively. One and all is invited to know this initiative and get convinced with the need to bridge the disparity. Society is like a human body where each has to be strong and healthy to be able to function smoothly in coordination with others. Slightest malfunction of any of these is enough to steal peace and happiness. Aim of this bulletin, and this column, is to sensitize elite section of the society and make them conscious of their position and the role expected of them. This role unless played with a sense of personal social responsibility (PSR), it might end up in activism. These elite persons are competent to judge, choose and make a difference. Unless this happens, erosion in social norms would accelerate and engulf all of us, unsparingly.

—00—

An Appeal: for Interactive Online Mentoring Session (IOMS) at your establishment By Gyan Vigyan Sarita – A non-organizational educational initiative

Philosophy: Socio-economic reform through education with **Personal Social Responsibility** (PSR) in a non-remunerative, non-commercial and non-political manner.

Objective: Groom competence to Compete among un-/under-privileged children from 9th-12th in Maths, Physics and Chemistry, 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, as and when they arise, to the initiative

Operation:

a. **Mode:** Interactive Online Mentoring Sessions (IOMS) since July'16, which has been recently switched over to A-VIEW, a free web-conferencing S/w, with connectivity upto 5 Learning Centers, with One Mentoring Center.
b. **Participation:** Voluntary and Non-remunerative, Non-Commercial and Non-Political

Involvement:

a. **Promoter** –
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,
b. **Facilitator** –
i. Provide space and infrastructure for **Interactive Online Mentoring Sessions (IOMS).** Most of it is generally available, and may need marginal add-on,
ii. Garner support of elite persons to act as coordinators at the Learning Centre.
c. **Participator** –
i. As a Mentor,
ii. As Coordinator,
iii. Operational support
iv. E-Bulletin and Website promotion for increasing its depth and width across target students

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

The endeavour started with Chalk-N-Talk mode of mentoring unprivileged students starting from class 9th upto 12thI. n last more than Six years it has gone through many turbulences and is now settled with its IOMS model and looking forward to reach needy students. IOMS has been in operation since July'16. Currently regular sessions of IOMS are held regularly for class 9th and 10th, at Ramkrishna Mission School, Sithanagram, A.P. This is second year of mentoring at the school. We want to add more learning centers

*It is a small group of Four persons including **Prof. SB Dhar**, Alumnus-IIT Kanpur, **Shri Shailendra Parolkar**, Alumnus-IIT Kharagpur, settled at Texas, US and **Smt. Kumud Bala**, Retd. Principal, Govt. School Haryana. More details of the initiative are available on our website and operational aspects of IOMS online.*

***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.*

Contact: Dr. Subhash Kumar Joshi, **Coordinator** –Gyan Vigyan Sarita.
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e-Mail ID: subhashjoshi2107@gmail.com, **Website: http://www.gyanvigyansarita.in**

—00—

कौन हो तुम ? एक कविता

मधुकर पान्डेय

कुछ दिनों से एक अजीब सी बेचैनी है
मेरे अंतरतम में जब वह पूछ ता है बार बार कि
"कौन हो तुम?"
मैं उसको यही उत्तर देता हूँ कि " मैं एक प्राणी हूँ इस जगत का"
पर वह संतुष्ट नहीं होता, किसी दिन अचानक आधी रात में
वही प्रश्न दोहराता कि "कौन हो तुम?"

मैं समझ नहीं पा रहा था कि मुझसे यह सवाल
कौन और क्यों कर रहा है ?उसका मुझसे नाता क्या है
रिश्ता क्या है ? वह है कौन मेरे जीवन में इस तरह से
दखल देने वाला .., मुझसे अनाधिकार प्रश्न करने वाला ?

मैंने अब उसको अनदेखा करना शुरू कर दिया
जीवन का भरपूर आनंद लेना शुरू कर दिया |

एक दिन जब मैं अपनी सफलता का आनंद मना रहा था
मुझे देख कोई एक कोने में अजीब सा मुस्करा रहा था
उसकी मुस्कराहट मुझे बैचैन करने लगी
खामोश रह कर भी वह मुझे दोषी सा ठहराने लगी
रक्तचाप मेरा बढ़ाने लगा , मस्तिष्क भी गर्म होने लगा
मुझसे रहा ना गया सोचा आज इससे कर ही लेता हूँ बात साफ़
मुझे आता देख वह मुस्कराई..धीरे धीरे उत्सव स्थल के बाहर आई
मैं भी पीछे पीछे आया और पूछा कि "कौन हो तुम?"

वह फिर मुस्कराई और धीरे से बोली
मेरा ही प्रश्न मुझसे पूछते हो और
स्वयं इसका उत्तर देने से कतराते हो..
.मैंने कहा कौन सा प्रश्न और कैसा प्रश्न ?
उसने कहा"वही एक सवाल कि "कौन हो तुम?"

यह सुन कर मुझे झटका सा लगा कि
यह तो वही प्रश्न है जिससे मैं बचता रहा
इसके सवालों को अनदेखा करता रहा
लगता है कि यह ईर्ष्यालु है और मेरी
सफलता से जल रही है....

मैंने उससे कहा कि "देखो तुम जो भी हो , कल आना
हम लोग आराम से बैठेंगे तुम्हारी
बातों का सारा उत्तर दे देंगे....

उसने कहा कि तुम्हें कैसे मालूम कि कल आएगा ?
मैंने कहा कि क्यों नहीं आएगा ...
अगर आज बीत रहा है तो कल भी आएगा ही
उसने कहा "हाँ यह सत्य है कि कल आएगा ही
पर प्रश्न यह कि क्या तुम्हारा कल आएगा ?

यह सुन कर मुझे क्रोध एवं भय दोनों एक साथ आने लगे
मन में इस बिन बुलाये इस आगंतुक के प्रति कुविचार आने लगे.
सोचा कि क्या करूं, यह मेरी स्तिथि को समझ नहीं रही है
देश की गणमान्य हस्तियाँ वहा अंदर मेरी राह देख रहीं हैं
वहां अंदर मेरी सफलताओं के गुणगान हो रहे हैं
कई भामाशाह मेरे लिए धन दौलत की थैलियाँ खोल रहे हैं
भविष्य की सुन्दर सुन्दर योजनाएं बन रहीं हैं और यह
मेरे आने वाले कल पर ही प्रश्न चिन्ह लगा रही है |

मैंने उससे पूछा कि अच्छा बताओ तुम रहती कहाँ हो
मैं स्वयं तुम्हारे निवास पर आ जाऊंगा
बहुत सारे उपहार भी लाऊँगा और वहीँ
तुम्हारे सारे प्रश्नों के उत्तर भी दे डालूँगा |

वह फिर मुस्कराई अबकी बार कुछ ऐसे
जैसे वह मेरी बात को बचकाना समझ रही हो
मैंने दोहराया" देखो अपना पता तो बता दो वचन देता हूँ
कि कल अवश्य आऊंगा चाहोगी तो देर तक रुक जाऊँगा

पर अभी मुझे जाने दो देखो कि लोग मुझे ढूढ रहे होंगे
तुमसे अकेले बात करते देख ना जाने क्या कयास लगा रहे होंगे
बड़ी कीमत चुकाई है मैंने इस सफलता के लिए कुछ देर तो
देख लेने दो इन गणमान्यों को मेरे सामने सर झुकाते हुए |

वह लगातार मुस्करा रही थी आँखों में आखें डाल रही थी
बोली "कितने गरीब से लग रहे हो आज तुम मुझे"
इस झूठे मद में तुझे तेरा ही घर याद नहीं
अरे मैं तो तेरे ही घर में रहती हूँ , हर पल तुझको ही देखा करती हूँ
मैंने तो सदैब ही तुझे आवाज़ लगाईं ओ हर पल बाहर घूमनेवाले मनुष्य
कभी अपने अंदर भी झाँक कर देखा है कि वहां भी कोई रहता है
जो तुझे सदा आवाजें देता है..पर तू तो अप ने मन के दासत्व में
और माया कि आसक्ति में इतना मग्न हो गया है कि
पूर्ण वस्त्र पहन कर भी नग्न हो गया है
तू तो मदमस्त है अपनी ही इस दुनिया में
बना रहा है स्वप्नों के ये महल सागर की इस रेती में |

मैं अब बहुत क्रोधित होता जा रहा था
.
अपना मानसिक संतुलन खोता जा रहा था
फिर भी मैंने उसके सामने हाथ जोड़े और कहा कि
अब मुझे जाने दो कल ज़रूर आउंगा वादा रहा
वह फिर से एक बार मुस्कराई मैंने पूछा कि
अब क्या बात है क्यों मुस्करा रही हो
मुझे इस तरह से क्यों डरा रही हो ?

वह बोली कि अभी अगर मैं चली गई
तो तुम फिर कभी भी ना आ पाओगे
मैं तो सदा ही तुम्हारे पास थी पर तुम ही मुझसे दूर थे
इसी लिए आज तुमसे यही मिलना था तु म्हें कुछ बताना था
क्यों कि आज ही महत्वपूर्ण है यह पल ही सम्पूर्ण है
सुन पाओगे कि कौन हूँ मैं कहाँ मैं रहती हूँ?
विवशता में मैंने सर हिला कर स्वीकृति दे दी..

वातावरण में कुछ देर तक नीरवता रही छाई
तभी अंदर से एक गंभीर सी आवाज़ आयी कि
"मैं तुम्हारे शरीर में ही रहती हूँ..
क्यों कि मैं तुम्हारी ही आत्मा हूँ.....

कवि प्रचार माधयम के क्षेत्र में लगभग चार दशक से कार्यरत हैं तत्कालीन सिनेमा से लेकर नवीनतम तकनीकी पर आधारित सामुहिक प्रचार माध्यमों में कार्यरत रहकर प्रमुख संस्थानों जैसे ज़ी नेटवर्क,हिंदुजा ग्रुप , रिलायंस कम्युनिकेशन में जिम्मेदार पदों पर रहकर अनेक न्यूज़ और धार्मिक चैनल के सीईओ , एडिटर-इन-चीफ रहे हैं | वर्तमान मैं वे सामुहिक प्रचार माध्यमों के सलहाकार हैं | कविता लेखन उनकी रूचि है |

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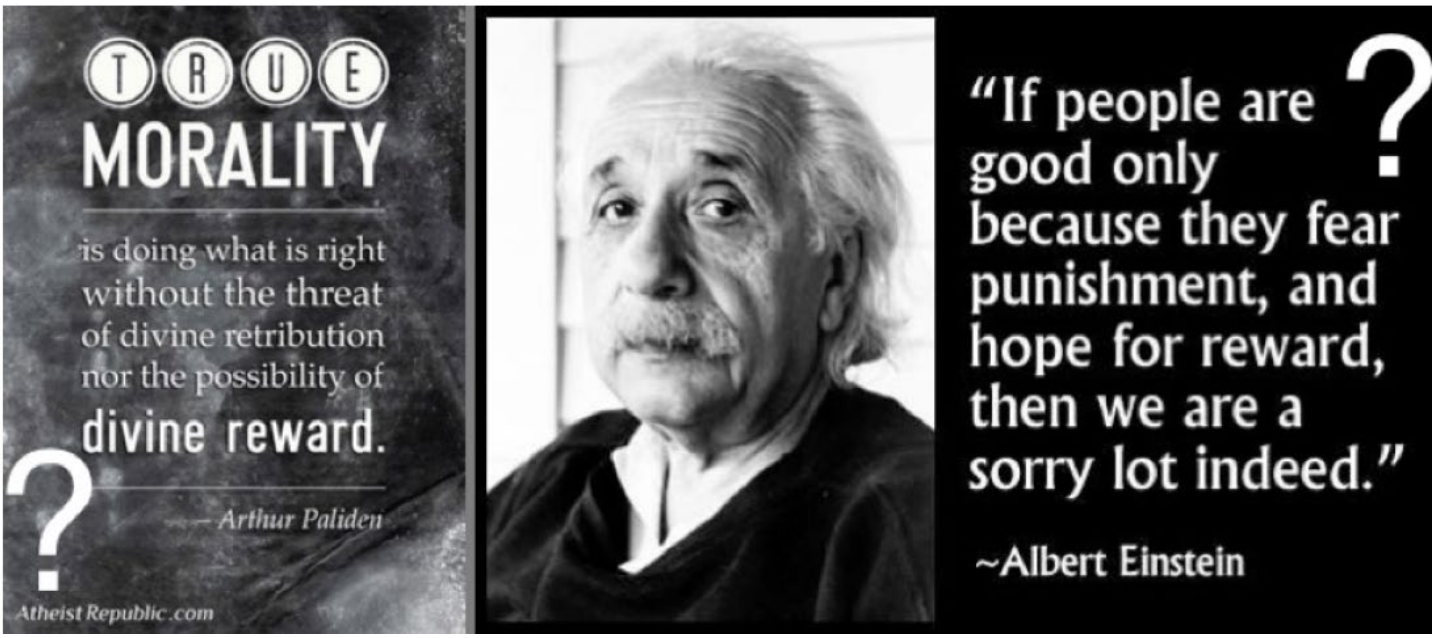
"I have been impressed with the urgency of doing. Knowing is not enough; we must apply. Being willing is not enough; we must do."

-Leonardo da Vinci



*"**Imagination** is more important than **knowledge**.*
*For **knowledge is limited**, whereas **imagination** embraces the entire world, stimulating progress, giving birth to evolution."*

- **Albert Einstein**

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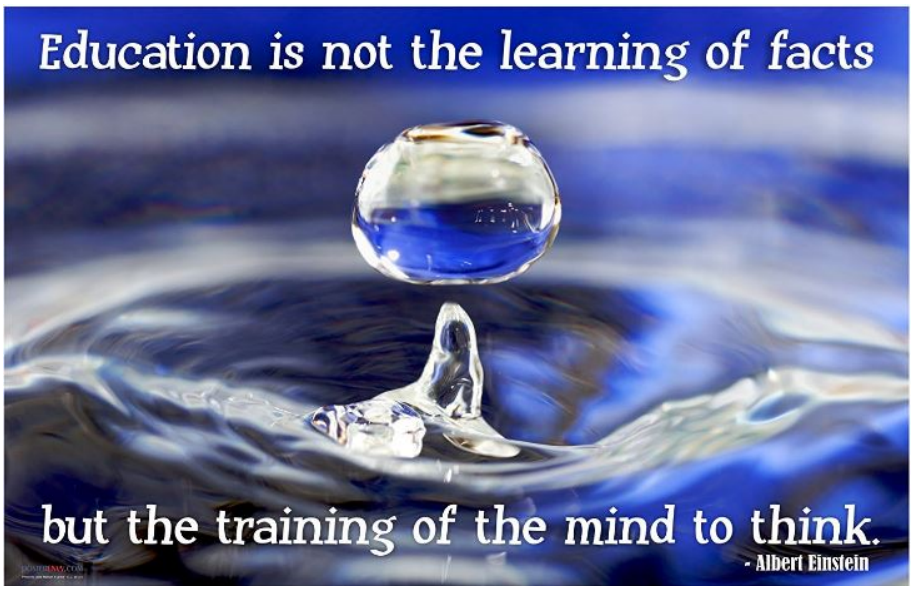

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Modern cynics and skeptics... see no harm in paying those
to whom they entrust the minds of their children
a smaller wage than is paid to those to whom
they entrust the care of their plumbing.
- John F. Kennedy

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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 the release of 1st Monthly e-Bulletin in its consecutive Fourth Year, we are gearing up for its 2nd Monthly e-Bulletin Gyan-Vigyan Sarita: शिक्षा .***
- ***This cycle of monthly supplement e-Bulletin Gyan-Vigyan Sarita: शिक्षा is aimed to continue endlessly, till we get your तन and मन support in this sefless educational initiatice to groom competence to compete among deprived children.***

We believe that this e-Bulletins shall make it possible for our esteemed contributors to make its contents rich in value, diversity and based on their ground level work and/or experiences.

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(22 December 1887 - 26 April 1920)

Mathematics has capability to make one understand the God and His creations.

- Srinivasa Ramanujan

अंदाज ए बयां

गाँधी जी का टूटा चश्मा

समीर लाल 'समीर'

जब चपरासी रामलाल जाले हटाता , धूल झाड़ता कबाड़घर के पिछले हिस्से में गाँधी जी की मूर्ति को खोजता हुआ पहुँचा तो उड़ती धूल के मारे गाँधी जी की मूर्ति को जोरों की छींक आ गई. अब छड़ी सँभाले कि चश्मा या इस बुढ़ापे में खुद को, चश्मा आँख से छटक कर टूट गया. गुस्से के मारे लगा कि रामलाल को तमाचा जड़ दें मगर फिर वो अपनी अहिंसा के पुजारी वाली उपाधि याद आ गई तो मुस्कराने लगे. उपाधियाँ और ऊँचाईयाँ स्वयं को भयभीत करती हैं. सोचने लगे कि एक चश्मा और होता तो वो भी इसके आगे कर देता कि चल , इसे भी फोड़ ले. मेरा क्या जाता है ? जितने ज्यादा चश्में होंगे , उतने ज्यादा लंदन से नीलाम होंगे. उतने ज्यादा मल्लैया उसे खरीग कर देशभक्ति के जामे की आड़ में देश को लूट कर भाग निकलेंगे. अतः मुस्कराते हुए बोले- कहो रामलाल , कैसे आना हुआ? पूरे साल भर बाद दिख रहे हो ?

गाँधी जी की मूर्ति को सामने बोलता देख रामलाल बोला-चलो बापू साहेब, बुलावा है. नई पार्टी बन रही है. नये मूल्यों के साथ- नये जमाने की-नये लोग हैं- नया इस्टाईल है-गाते बजाते हैं- हल्ला मचाते हैं-एक अलग तरह की पार्टी बना रहे हैं जिसमें पार्टी के भीतर ही पार्टी का लोकपाल होगा. आज आपका जन्म दिन है , आपके सामने वो आपका नाम लेकर शपथ लेकर पार्टी बनायेंगे. नहा लो , नये कपड़े पहने लो और चलो , फटाफट. बहुत भीड़ लगने वाली है. आपको नई पार्टी की योजनाओं, प्रत्याशियों और भविष्य को शुभकामनाएँ देनी हैं. याद आया आपको - ये वो ही लोग हैं जिनका कल तक आपके नाम से आंदोलन चलता था और आपका एकदम खास भक्त इनका नेता था- अब थोड़ा आपके भक्त से खटपट हो चली है. कुछ चंदे वगैरह का हिसाब किताब और कुछ महत्वाकांक्षा की उड़ान. खैर, आप तो जानते ही हो कि ऐसा ही होता आया है हमेशा. आपके लिए भला नया क्या है- आप तो हमेशा से ऐसी घटनाओं के साक्षी रहे हो- साबरमती के संत!

गाँधी जी बोले , देख भई रामलाल. एक तो तू ज्यादा चुटकी न लिया कर ये संत वंत बोल कर. बस , आज का ही दिन तो होता है जब मैं थोड़ा बिजी हो जाता हूँ. हर सरकारी दफ्तर से लेकर हर भ्रष्ट से शिष्ट मंडल तक लोग मेरी पूछ परक करके अपने इमानदार और कर्तव्यनिष्ट होने का प्रमाण देते हैं. ऐसे में ये एक और...कह दो भई इनसे कि कल रख लेंगे कार्यक्रम. नई पार्टी ही तो है- आज नहीं जन्मी तो क्या- कल जन्म ले लेगी. रंग तो अगले चुनावों में ही दिखाना है. एक दिन में क्या घाटा हो जायेगा? मेरा भी एक के बदले दो दिन मन बहला रहेगा.

रामलाल उखड़ पड़ा. कहने लगा एक तो साल भर आपको कोई पूछता नहीं. चुपचाप यहाँ पड़े रहते हो. आज पूछ रहे हैं तो आप भाव खा रहे हो कि आज नहीं कल. तो सुन लिजिये- यह कोई आपसे निवेदन या प्रार्थना नहीं है. बस , बुलाया है और आपको चलना है. आदेश ही मानो इसे. एक उम्र के बाद बच्चे जो कहें वो दिखने में भले निवेदन सा दिखे मगर उसे आदेश मानना ही आपकी इज्जत के लिए हितकारी है.

सारे भारत की जनता से उन लोगों ने पार्टी बनाने के लिए पूछ लिया है और सबने उनसे पर्सनली कह दिया है कि आप पार्टी बनाईये- आपकी जरुरत है. इसके बावजूद आप हैं कि आप नक्शे ही नहीं मिल रहे- हद है बापू!!

गाँधी जी ने परेशान होते हुए पूछा कि सारी जनता से कैसे पूछ लिया भई उन्होंने वो भी बिना वोट डलवाये?

रामलाल ने मुस्कराते हुए कहा कि बापू , आप तो बिल्कुले बुढ़ पुरनिया हो गये. इतना भी नहीं जानते कि उन्होंने फेसबुक से बताया था और खूब लोगों नें लाइक चटकाया. आजकल तो ऐसे ही पूछा जाता है. अब तो एसएमएस का फंडा भी बासी हो गया. आप तो रात दिन खाली रहते हो अपने आप को सोशलमीडिया वगैरह से अपडेट रखें वरना सलाहकार मंडल लायक भी न बचेंगे. कोई पूछेगा भी नहीं.

गाँधी जी सकपका गये. कहने लगे- मैं क्या जानूँ ? मेरा तो फेसबुक एकाउन्ट है नहीं- चल भई , तू कहता है तो चलता हूँ. मगर मेरा चश्मा तो बनवा दे. वरना उनका घोषणा पत्र पढ़े बिना उन्हें कैसे आशीर्वाद दूँगा ?

रामलाल हँसने लगा- अरे बापू , इतनी जल्दी भला कोई घोषणा पत्र बनता है. अभी चार दिन पहले तो बात हुई पार्टी बनाने की जब आपके खास भक्त से मतभेद हुआ. सब कार्यक्रम पहले से तय है. आप वहाँ मंच पर विराजमान रहेंगे. आपका माल्यार्पण होगा. तत्पश्चात वो आपको घोषणा पत्र (कोरे कागज का पुलिंदा) पकड़ायेंगे. यूँ भी घोषणा पत्र भरा भी हो तो कोरे कागज के समान ही है. कौन पूरा करता है उन्हें? आप अपना बिना शीशे का चश्मा पहने उसे पढ़ने का नाटक करियेगा और फिर कह दिजियेगा कि मुझे इनसे बहुत उम्मीद है . मैं इन्हें आशीष देता हूँ. ये एक नव भारत का निर्माण करेंगे. अब अच्छा या बुरा- ये तो आपने कहा नहीं- होगा तो नव ही. आप सेफ रहोगे और पूजे जाते रहोगे तो नो टेंसन- बस , चले चलो- मैं हूँ न!!

दूर बैठी जनता को क्या समझ आयेगा कि घोषणा पत्र भी कोरा है और आपके चश्में में भी शीशा नहीं है. सो तो आम जनता के चश्में का शीशा भी तो गुम ही है वरना हकीकत देखते हुए भी उसी नेता को फिर से क्यूँ चुनते?

गाँधी जी बोले कि रामलाल, ऐसा आशीर्वाद तो मैं सभी पार्टियों को देता आया हूँ मगर तू तो कह रहा था कि यह नई पार्टी है- नये मूल्यों के साथ- नये जमाने की-एक अलग तरह की जिसमें पार्टी के भीतर ही पार्टी का लोकपाल होगा.

अरे बापू, सभी तो एक न एक दिन नये थे. सभी कुछ नया ही करने आये थे..वो तो धीरे धीरे पुराने हो जाते हैं. ये भी हो जायेंगे. फिर वही ढाक और उसके वही तीन पात.

बस, इनमें एक नई चीज आपने सही पकड़ी- पार्टी के भीतर ही पार्टी का लोकपाल होगा. आपन दरोगा- आपन थाना- अब डर काहे का!!

गाँधी जी रामलाल को देखकर मुस्कराये. रामलाल उन्हें देख कर एक आँख दबाता है...और चल पड़ते हैं गाँधी जी नई धोती पहने...बिना शीशे का चश्मा ..एक हाथ में लाठी और दूसरे हाथ से रामलाल का कँधा थामे...पार्टी घोषणा स्थल की ओर.

कोशिश ये रही कि कोई टूटा चश्मा न देख ले वरना बदनाम औलाद होगी कि एक चश्मा भी बनवा कर नहीं दे सकते बुजुर्ग को.

यही अपनी औलाद को बदनामी से बचाने का भाव लिए कितने ही बुजुर्ग अपनी औलादों द्वारा दी जा रही तमाम तकलीफों के बावजूद भी मौन साधे मुस्करा रहे हैं.

चलते चलते:

कुछ तारे आकाश में चुप हैं , कुछ तारे पाताल में चुप

कुछ तारों का हाल देखकर , हम भी चुप और तुम भी चुप...

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।

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Nothing is more important than education,
because nowhere are our stakes higher;
our future depends on the quality of education of our children today.
- Arnold Schwarzenegger

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Education is not job training;
the function of education is to instill an appreciation
of our place in the flow of time and space,
to expand our intellectual and empathetic understanding
of nature and people.

- Jonathan Lockwood Huie

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Ayurveda- Health Care

Prevent And Treat Ourselves With Seasonal Diseases

Dr Sangeeta Pahuja

In this series of articles, we will describe how can we prevent and treat ourselves from the diseases in particular seasons.

In this month Hemant Ritu (early winter) has started. In this season due to cold, Vata gets absorbed into our body and detoriates the dhatus and leads to problems like cold, cough, dry skin problems like Psoriasis and Airthritis etc.

Firstly describing about common problems which occur in this season-

Respiratory tract Infection - In Ayurveda, Respiratory problems occur due to imbalance of Vata and Kaha Dosha.

Aggravating factors include - Contact with dust, pollen, smoke and cold breeze, drinking cold water, consuming frozen food items, consuming oily, spicy and junk food, inhabiting in cold and damp places.

Weak immune system - Ayurveda deals with Respiratory diseases in a holistic manner that involves cleansing of toxins through specific therapies, use if herbs, practice of breathing exercises, dietary and lifestyle changes.

Remedies - In Ayurveda some of the following herbs are used in the prevention and treatment of Respiratory tract infections.

Helpful Herbs –

- *Tulsi(ocimum sanctum)* -. It has antioxidant properties and an enzyme cyclo oxygenase, which has anti inflammatory properties. It's a good immunomodulator.

- *Vasaka (adhatoda vasika)* - The leaves of Vasaka has antiallergic and anti inflammatory properties.It has antitussive effect thus also helps to soothe the inflamed throat.

- *Black Pepper* – Its seeds contain an alkaloid called piperine which has anti-inflammatory properties and is very good bronchodilator. Thus helps to relieve breathing difficulties.

- *Dalchini (cinbamomum zeylanica*) - It has antimicrobial properties and is a bronchodilator and helpful in Respiratory infections.

- *Pippali (Piper longum)* - Pippali has been shown to have a rejuvenating effect on the lungs. It is very helpful in the recurrent attacks of asthma. It enhances the blood circulation towards the lungs and is very good expectorant and bronchodilator.

- *Giloy(Tinospora Cordifolia)* - It's an excellent immunomodulator. A powerhouse of antioxidants which fights with free radicals and keep your cells healthy and helpful in getting rid of diseases. It has Antipyretic properties and is anti-inflammatory in nature, hence helps to reduce problems like cough, cold, tonsillitis etc.

- *Shirish(Albizia lebback)* - It has antiallergic properties. So very helpful in allergic rhinitis cases.

- *Ela(Elletaria cardamomum)* - As it is a Vata kapha pacifying herb ,hence extremely helpful for Respiratory infections.

- *Licorice* - Components present in licorice are antioxidants such as flavonoids, saponins, sterols,choline, aminoacids, inositol,lacithin and vitamin B1,B2,B3,B6 and E.
- This root is demulcent and gentle relaxant, soothing to mucous irritation and beneficial in the treatment of cough ,cold and bronchial asthma.

- *Peppermint(Mentha x pipertia)* - It has menthol which has antihistaminic properties. It neutralizes the free radicals and prevent allergic attacks.

Breathing Exercises: Breathing exercises called Pranayam, they help to improve the lung function and reduce the frequency of symptoms in patients with chronic Respiratory problems.There are different type of breathing exercises that help in different conditions. For example Sukha Pranayam or Anulom vilom, which is a breathing exercise is helpful in wheezing problem.

Bhastrika pranayam which works well for congestion, and Ujjayini Pranayam helps to improve immunity so that probablity of recurrences of allergic problems are reduced.

Yoga for Respiratory problems - Some yoga postures are very helpful in people who suffer from chronic Respiratory disorders. When performed on a regular basis, they help to reduce the frequency as well as reduce the severity of symptoms. Some of the generally prescribed yogasan include – **(a)** Surya Namaskar, **(b)** Sarvangsan, **(c)** Bhujangasan, **(d)** Shalabhasan

Helpful diet and lifestyle : Old rice, wheat, barley, kulath, moong beans, Honey, Hot beverages like herbal tea, masala tea, and sprouts, nuts, and seeds in moderate amount are helpful to pacify kapha and to balance vata.

Eat plenty of fruits and vegetables which have beta cartotene, vitamin C and E like catrots, cantaloupe, sweet potato, leafy vegetables like spinach and Broccoli, Pumpkin etc. Add mulethi (licorice) in your diet on regular basis to balance kapha.

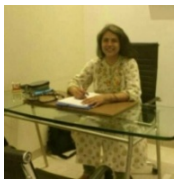
As regards lifestyle -

- Maintain appropriate weight
- Regular moderate exercise
- Wear face mask to purify the air you breathe
- Control GERD. If you are suffering from gastro-oesopheageal reflux disease as it can trigger asthma due to acid reflux.
- Try and Keep your house dust free
- Keep your windows closed during pollen season
- Decontaminate your decor
- Use Dehumidifier
- Reduce pet dander
- Cover your mouth and nose if it is cold or if going to crowdy places.

Unfavourable diet and lifestyle: Avoid heavy food items like dairy proucts, cheese, curd, buttermilk, cream, banana, oily, gresy food items, white flour, white sugar products, cold food, cold drinks and other refrigerated things. Avoid big meals and products like cabbage, carbonated drinks, onions, Garlic, fried food products which can cause gas and pressurize the diaphragm. Avoid products with artificial ingredients and preservatives.

Avoid sulphites as they can trigger Asthma. Sulphites are used as preservatives and can be found in wine, dried fruits, pickles, fresh and frozen food products. Avoid excessive physically demanding exercise.

Know Ayurveda, Follow Ayurveda and Stay Healthy.



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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

बालमूर्ति संस्थान के उत्कृष्ट प्रणेता गिजुभाई

सीमा फाटक

इस अध्ययन का मुख्य उद्देश्य यह है कि गिजुभाई बधेका का दर्शन व उनके विचारों तथा बालकों के प्रति उनकी सोच व उनके दिशा स्वप्न को समाज तक पहुँचाना। इस अध्ययन में निरिक्षण के माध्यम से दक्षिणामूर्ति, बालमूर्ति, चेतनवाड़ी को अध्ययन के लिए चुना गया पूरे अध्ययन को करने के बाद हमें खोज के तौर पर यही प्राप्त हुआ कि अगर गिजुभाई की शिक्षा कला को वर्तमान में लागू करें तो हम बालकों को आत्म निर्भर, निर्मिक चारित्रिक गुणों में निपुण कर पाएगें।

बालदेवो भव, रमतविधि, बालवार्ता, बालप्रणेता, खेल द्वारा शिक्षा सृजनशीलता, करके सिखाना।

गिजुभाई का जीवन परिचय: गिरिजा शंकर भगवान जी बधेका जो गिजुभाई के नाम से लोकप्रिय है। उनका नाम भारत में पूर्व प्राथमिक शिक्षा के क्षेत्र में एक जाना पहचाना है। उनका जन्म 15 नवम्बर 1885 को भगवान जी औरकाशीबा के घर में एक नायक का जन्म हुआ। प्राथमिक शिक्षा भवनगर से पूर्ण करने के पश्चात् आप वकील बनकर उच्च न्यायालय में पदस्थ हुए। आपने उच्च न्यायालय में वकालत छोड़कर शिक्षा के अंग में पदार्पण किया।आपने प्राथमिक शिक्षा क्षेत्र में इतने महत्वपूर्ण कार्य किया है कि आप प्राथमिक शिक्षा के पुरोवा माने जाने लगे। अपने इस कार्य में अगर इतने तल्लीन हो गए कि आपने स्वास्थ्य का भी ध्यान नहीं रहता था। अचानक आप किसी बिमारी से ग्रसित होकर 23 जून 1939 को इस संसार से कूच कर गए।

शिक्षा के क्षेत्र के इस कर्मठ योद्धा की अनुभूति बाल शिक्षा के लिए अपूरणीय अति है। वे बालकों के प्रबल समर्थक साथी व उन्नायक थे।

संस्थान:संस्था दक्षिनामूर्ति के नाम से जानी जाती है। जिसका अर्थ 'भगवान शिव' के बाल रूप से है। दक्षिणमूर्ति रूप ओजमयी व तेजपूर्ण है। यह संस्था भावनगर में टेकरी वाली संस्था के नाम से प्रसिद्ध है। यहाँ क वातावरण व्यक्ति में सकारात्मक उर्जा का संचार करता है। यह खुला व उन्मुक्त वातावरण का शिक्षण संस्थान है।

गिजुभाई बाल शिक्षण में नए प्रयोगों की दिशा में सक्रिय हुए। बच्चों को मारपीट व डांट-डपट के बजाय प्रेम प्यार और भरपूर स्वतंत्रता देकर शिक्षण के सफल प्रयोग किए। मांटेसरी पद्धति के सिद्धान्तों को आत्मसात् किया उन्हें भारतीय संदर्भों में अधिक प्रभावी बनाया तथा आयुवर्ग के अनुसार बालकों के लिए अनेक-नेक रोचक गतिविधियों का सूत्रपात किया।

भावनगर की दक्षिणामूर्ति उनकी साधना स्थली। सन् 1916 से 1936 के बीच जीवन का प्रत्येक क्षण बालकों से बातचीत, उनके मन को समझने, उनकी व्यथाएँ सुनने, समाधान करने, उनका विश्वास जीतने इन्द्रिय विकास के खेल ईजाद करने, शांति की क्रीडा शैक्षिक भ्रमण हाथ के काम, संगीत, नाटक, रचनात्मक कामों बाल संग्रहालय कहानी द्वारा शिक्षण आदि प्रवृत्तियों में बिताये।

दक्षिणमूर्ति बाल मंदिर में बच्चे हँसते-मुस्कराते हुए उत्साह के साथ आते और दिनभर मन वांछित गतिविधियों में लीन रह कर जीवन शिक्षा के उपयोगी पाठ पढ़ाते थे। विविध विषयों का शिक्षण भी वहाँ होता था। पर विविध सह शैद्विाक प्रवृत्तियों से सहयोग सहकार परिश्रम, परोपकार, त्याग, ईमानदारी स्नेह, मैत्री, करूणा, दया और अहिंसा के जो मानवीय गुण बालकों के जीवन में स्वतः विकसित होते थे, वैसा निराला पन अन्यन्त दुर्लभ था। गिजुभाई प्रयोग वीर शिक्षक ही नहीं थे बाल साहित्य के प्रणेता भी थे। उन्होंने गुजराती भाषा में दो सौ बाल पोथियाँ लिखकर पुरे गुजरात के बालकों को स्वाध्याय की ओर प्रेरित किया, अध्यापको को बाल शिक्षण के नूतन सिद्धांत एवं विधियों का प्रशिक्षण देने के लिए उन्होंने अध्यापन मंदिर स्थापित किया। मातापिता व अध्यापकों के लिए 15 पुस्तकें लिखी जिनमें दिवास्वप्न, कथा कहानी का शास्त्र, बाल शिक्षण, प्राथमिक शाला में शिक्षण आदि पुस्तकें मुख्य है। गाँधीजी ने जो काम राजनीति में किया वही काम गिजुभाई ने शिक्षा जगत में किया। महात्मा गाँधी उनकी प्रत्येक शैक्षिक गतिविधि से आश्वस्त थे तभी तो उनके असामायिक निधन पर उन्होंने लिखा था –"गिजुभाई के बारे में कुछ लिखने वाला मैं कौन हूँ"।

दक्षिणा मूर्ति की स्थापना 1920 में 30 बालकों के अध्यापन से हुई थी | भावनगर गुजरात का समृद्ध शहर है व दो महान व्यक्तियों, महात्मा गाँधी एवं गिजुभाई की कर्मस्थली भी| गिजुभाई ने यहाँ पर संख्या का निर्माण बालकों की आवश्यकताओं को देखते हुए किया है। यहाँ पर वातावरण बालकों का प्रकृति के करीब ले जाने व सानिध्य में रखने का कार्य करता है।

यहाँ शहरीकरण, आधुनिकीकरण व अंधानुकरण का नामोनिशान दिखाई नहीं देता है। यहाँ संस्थान में बालकों का अभिवादन शिक्षक के द्वारा उनके नाम के साथ किया जाता है। बालकों का प्रवेश आनंद के साथ करते हैं उन पर किसी प्रकार की जो जबरदस्ती या कठोर नियमों से उन्हें शासित नहीं किया जाता है।

यहाँ इन्द्रियों के माध्यम से शिक्षा ग्रहण करने के लिए प्रेरित किया जाता है। यहाँ बालकों के सर्वांगिण विकास पर अत्यधिक कार्य होता है। यहाँ अक्षर ज्ञान का महत्व बाद में बालकों को स्वकार्य की प्रेरणा पहले दी जाती है।

दर्शनशास्त्र : "खेल सच्ची शिक्षा है। खेल का मतलब चरित्र है।" शिक्षा मानव जीवन का प्रमुख अंग है। प्रकृतिवादी रूसों के शैक्षिक वचारों व गिजुभाई के शैक्षिक विचारों में समानता है।

गिजुभाई, शिक्षा दर्शन, मांटेसरी, फ्रोबेल के दर्शन शास्त्र से काफी समानता रखता है। ऐसा कहा जाता हैं कि शिक्षा शास्त्री भावी देश के शिक्षाशास्त्रियों के जन्म दाता है। प्रसिद्ध अंग्रेजी वि विलियम वुड्स वर्ध ने कहा है। ''चाईल्ड इज द फ़ादर ऑफ़ द मेन।''

19 वीं शताब्दी में कई महापुरूषों ने बालक के साथ सद्व्यवहार करने की आवाज उठाई। शिक्षा क्षेत्र में इस आंदोलन का श्री गणेश करने वाले फ्रांसीसी विचारक रूसों थे। जिसने अपनी पुस्तक 'इमीलश' में बाल शिक्षा का आदर्श उपस्थित किया।

फ्रोबेल ने कहा था ''प्रकृति की और लौटों।'' फ्रोबेल, रूसों, टैगोर गिजुभाई आदि शिक्षा का आधार बालक के अंतर को खोल देना समझते हैं।

दर्शन कहता हैं कि बालक में अंतर्निहित योग्यताओं को बाहर निकालने के लिए बालक को स्वतंत्रता देनी चाहिए। बालकों के उपर कोई रोक टोक नहीं होना चाहिए। इतनी स्वतंत्रता दी जानी चाहिए कि जिस गति से वह चाहे सीखे। ''गिजुभाई ने बाल देवों भव'' का नारा दिया था। बच्चों को मारना नहीं, डाँटना नहीं, लालच नहीं देना तो देना क्या? उन्हें स्वतंत्रता देनी है, उन्हें पूर्ण व्यक्तित्व के रूप में स्वीकार करें। गिजुभाई बच्चों के वकील की उपाधि दी गई है। गिजुभाई ने विश्व शांति के गुरू किील्ल के रूप से कार्य किया। गिजुभाई ने बच्चों की अभिव्यक्ति के विकास पर सर्वाधिक बल दिया। गिजुभाई मॉन्टेसरी से भी एक कदम आगे थे। रूसों के अनुसार, बालक को कोई मौखिक पाठ मत पढ़ाओं उसे तो केवल अपने स्वयं के अनुभव से सीखने दो।

गिजुभाई विद्यालय को मंदिर और उसमें अध्ययन करने आए विद्यार्थीयों को वे भगवान मानते थे।

गिजुभाई ने फ्रोबेल की रमत विधि को अपनाया उन्होंने मातृभाषा को ध्यान में रखते हुए गुजराती भाषा बालवाती, साहस कथा बुद्धि चार्तुय हास्यप्रद व जानवर व पक्षियों को अपनी साहित्य का भाग बताया, उनके साहित्य में नैतिक कहानी का समावेश ज्यादा था। कलना शक्ति को बढ़ाने के लिए साहित्य का आधार लिया। उन्होंने पाँच इन्द्रियों को बहुत महत्व दिया दर्शनेन्द्रियाँ, कर्णेन्द्रियाँ, घ्राणेन्द्रियाँ, स्वादेन्द्रियाँ, स्पर्शेन्द्रिया वार्ता, संगती नाटक रमत ये सृजनात्मक क्रिया है। जो अंदर है, वह सहज भाव से प्रकट होता है। इस प्रकार जो प्रकट होता हैं, वही शिक्षण है। बालावस्था , बीजारोपण की अवस्था है अगर अच्छे शिक्षक से परिचय हो गया तो आप आसमान की ऊँचाई छू सकते है।

उद्देश्य : गिजुभाई का उद्देश्य यह रहा है कि आज अध्यापक को नये युग के अनुसार अपनी सोच रखना चाहिए, क्योंकि हम पुराने विचारों को अपना कर विकास की राह नहीं पकड़ सकते। उनका उद्देश्य यह था कि -

- बच्चों को निडर बनाना।
- बालकों का स्वागत उनके नाम लेकर करें।
- बच्चों का आदर व सम्मान दिया जावे।
- बच्चों को प्रकृति के साथ परिचय करवायें।
- बच्चों को लोक गीत व कथा सुनायें।
- ग्लोब के माध्यम से भूगोल का ज्ञान दें।
- खेल खेल में उन्हें व्याकरण सिखयें, भाषा का ज्ञान करयें, कहानी सुनाए, पहेलियाँ सुलझायें।
- इतिहास का ज्ञान कहानी कथन के द्वारा कहे।
- बच्चों की जिज्ञासा वृत्ति पर लगाम न डालें।
- खेल खेलने दें व नए खेलों को खोजने को प्रोत्साहित करें।

गिजुभाई को अल्प समय में उत्तम शिक्षा शास्त्री व उच्चकोटि का शिक्षक प्रशिक्षक कहा जा सकता है। क्योंकि गिजुभाई में शिक्षण को बाल केन्द्रित हो इस पर महत्व दिया है। उन्होंने -

- शिक्षा को स्वाभावित व व्यवहारिक प्रक्रिया माना है।
- शैक्षणिक कार्यक्रम का केन्द्र शिक्षक या पाठ्यक्रम नहीं वरन् बच्चा है।
- बच्चों को स्नेह व सहानुभूति के साथ शिक्षा दें।
- शिक्षण को रोचक बनाए।
- करके सीखने पर बल दें।
- ज्ञात से अज्ञात की और शनैः शनैः बढ़ें।
- बच्चों में उत्पन्न जिज्ञासा को प्रस्फुटित होनें दें।

शैक्षिक निहितार्थ : गिजुभाई के शैक्षिक विचारों को शोध विषय बनाने का उद्देश्य यह था कि गिजुभाई ऐसे इकलौते भारतीय शिक्षा शास्त्री थे जिन्होंने बाल केन्द्रित शिक्षा पर जोर दिया उनकी शिक्षण पद्धति भी बाल शिक्षण व बालमनोविज्ञान को ध्यान में रखते हुए बनाई गई थी। शैक्षिक शोध केवल सैद्धान्ति अभ्यास पुस्तकालय की शोभा न होते हुए वरन् उसका शैक्षिक प्रयोग ज्यादा महत्वपूर्ण है। शिक्षा में नवप्रयोग हो सकते हैं। क्यों कि वर्तमान परिप्रेक्ष्य में बालक एक संवेदी तूफानों में घिरा है। जिसे वर्तमान भारतीय शिक्षा प्रणाली और जटिल बनाती जा रही है। इन विषय परिस्थितियों में गिजुभाई ही ऐसे शिक्षा शास्त्री है। जिनका शिक्षा दर्शन उत्तरोत्तर प्रासंगिक हो सकता है। इनका बाल शिक्षा दर्शन संपूर्ण शिक्षा जगत को मूल रूप देने में सहायक हैं, क्योंकि आज के गुरू का व्यक्तित्व बिखरा हुआ और उद्देश्यहीन हैं। वहाँ गिजुभाई के विचार बालक को एक पूर्ण रूप से विकसित आत्मनियंत्रित आत्मा अनुशासित एवं आत्मनिर्भर युवा देने में सक्षम है। जरूरत है तो केवल पाठ्यक्रम को उनके विचारों के अनुसार व्यवस्थित करने की।

पालकों के लिए -

- बालकों से लालच रिश्वत; डरा धमकाकर मारपीट करके काम न करवाएँ।

- पालक बालकों को अपने आदर्श रूप में प्रस्तुत करने का प्रयत्न ना करें।
- पालक बालक को उचित वातावरण व मार्गदर्शन देने का प्रयत्न करें।
- पालक बालक से कालिक आशाओं को थोपने का प्रयास न करें।

समाज के लिए - वर्तमान में व्याप्त समाज में हिंसक प्रवृत्तियों के लिए बाल शिक्षा उत्तदायी है। अतः गिजुभाई की चिंतन प्रक्रिया से बालकों में बालपन से ही आदरभाव, सम्मान, निर्भय, वातावरण, सृजन शीलता का विकास कर सकेगा। गिजुभाई का बाल साहित्य के माध्यम से आनंद, सहयोग व संतोष को विकसित करने में मदद करेगा। जो हिंसक वृत्तियों को कम करने में मदद कर सकेगा।

विद्यालय के लिए - गिजुभाई के आदर्शों से विद्यालय संगठन स्वानुशासन, पक्षपात अनैतिकता को कम करने में विकास कर सकेगा शैक्षिक वातावरण को पर्यावरण व प्रकृति स्वप्रेरणा का विकास कर सकेगा।

पाठ्यक्रम के निर्माता के लिए - वर्तमान पाठ्यक्रम शिक्षा के उद्देश्यों को पूर्ण करने में सक्षम नहीं है। पाठ्यक्रम निर्माता गिजुभाई के पाँच इन्द्रियों को आधार बनारक पाठ्यक्रम निर्माण कर सकेंगे, तो बालकों का भविष्य उज्जवल होगा। पाठ्य कर सकेंगे, तो बालकों का भविष्य उज्जवल होगा। पाठ्यक्रम निर्माता स्वार्थ लोलुप होकर बालकों के भविष्य के साथ खिलवाड़ न करें। इस बात का गिजुभाई के साहित्य से सबक ले सकेंगे।

शिक्षकों के लिए - गिजुभाई के विचारों को आधार मानकर शिक्षक छात्रों को स्वतः का मूल्यांकन करने के लिए प्रेरित करेंगे। उनमें कौशल निर्माण कर सकेंगे। बालकों में क्रियाशील, कलाशील, और प्रयोगशील सृजनशील बनाने में शिक्षक मुख्य भूमिका का निर्वाह कर सकेंगे। शिक्षक को बालकों को अपना बालक समझे व उसके साथ मधुर संबंध स्थापित करने का प्रयत्न करें।

वर्तमान में गिजुभाई के विचार व चिंतनों को राजमर्रा में अपनाने का अगर प्रयत्न किया तो हमारे देश की शिक्षा प्रणाली का नाम विश्व में एक विशेष स्थान ले सकेगा। व हमारा भारत भ्रष्टाचार कुरीतियों अन्य सामाजिक बुराइयाँ, व्यसन, धर्म, जाति प्रथा का पतन होने लगेगा। वर्तमान में शिक्षा का प्रमुख उद्देश्य मानव का बहु-आयामी विकास करना है।

ज्ञान-विज्ञान सरिता की सोच एवं शिक्षा पद्धति उच्चतर-माध्यमिक स्तर पर विज्ञान एवं तकनिकी का समावेश करके शिक्षा का प्रकृतिकरण है , और इसमें परोक्ष रूप से गिजुभाई की विचारधारा का आभास होता है |

लेखिका हैं एवं पिछले वर्षों से शिक्षक के रूप में कार्यरत हैं. प्रकृति, कला एवं शिल्पकारी उनकी रूचि है
E-mail: seemaphatak68@gmail.com

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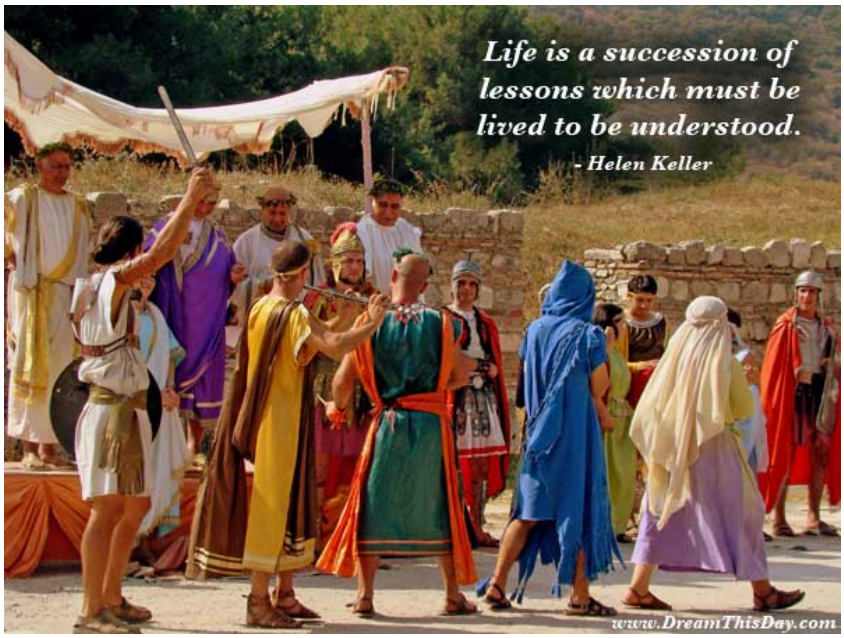

Let's Know About International Mathematical Olympiad

Prof. SB Dhar

Gyan Vigyan Sarita is starting a series of articles for the general awareness of its readers in which the basic knowledge about the national and world-wide competitions for the students of classes X and onwards will be on hand for their benefits. The articles will contain the information about the tests like : NTSE, NLSTSE, Science Olympiad, Geo Genius, KVPY, Silver Zone Olympiad, MAT, SAT, ASSET, IEO, NBO, IESO, TOEFL, IELTS, GRE, GMAT, MCAT, LSAT, and the most important IQ Test etc. This is the first article that explains about the IMO : The International Mathematical Olympiad. The Editor and The Coordinator

Viorel P. Barbu is a Romanian Mathematician. He was born on June 14, 1941 in Deleni, Vaslui County, Romania. In 1993, he was elected a titular member of the Romanian Academy.

Barbu completed his undergraduate degree at the Alexandru Ioan Cuza University of Iasi in 1964, and his Ph.D. at the same university in 1969.

Viorel Barbu appeared in the ***First International Mathematical Olympiad*** in 1959, and scored total 28 points. He got 17th rank overall. He was ***Honourable Mention*** that year.

The first ranker was ***Bohuslav Divis of Czeckoslovakia*** who scored 40 points and ranked 1. He was **Gold Medalist** that year.

Professor Viorel Barbu writes that *after fifty-nine years, the International Mathematical Olympiad remains a very respectable event and one of the most long-lived international educational and scientific competitions.*

Mathematics has always been a fresh and dynamical field of human creativity and a fundamental science to the benefit of scientific knowledge and technical achievements. It is the role and duty of young mathematicians to bring and develop new ideas and to construct new bridges between mathematics and other scientific fields.

The International Mathematical Olympiad (IMO) is the World Championship Mathematics Competition for High School students. Let us know the ABC's of this prestigious competition.

(a) The first IMO was held in 1959 in Romania, with 7 countries participating.
(b) It has gradually expanded to over 100 countries from 5 continents.
(c) It is held annually in a different country.
(d) India hosted it in the year 1996 with 75 countries and 424 students
(e) For 2019, the host country is UK
(f) For 2020, the host country is Russian Federation
(g) For 2021, the host country is USA
(h) For 2022, the host country is Norway, and
(i) Japan will hold it in 2023.
(j) Year 2023 will be the 64th edition.
(k) In 2018, in Romania, 107 countries participated with total students 594 out of which 60 were girls.

Top Country-wise 2018 Result:

(a) USA 1st
(b) Russia 2nd
(c) China 3rd
(d) Ukrain 4th
(e) Thailand 5th, and
(f) India 28th

Specifics of IMO:

(a) There are only six problems in Mathematical Olympiad.

(b) It is for pre-College/University students.

(c) Only in year 1980, it was not held.

(d) Each country sends a team of up to six students, plus one team leader, one deputy leader, and observers.

Contents Of The Question Paper

(a) The contents range from extremely difficult Algebra and pre-Calculus problems to problems on branches of mathematics not conventionally covered at school and often not at university level either.

(b) It contains Projective and Complex Geometry, Functional Equations, Combinatorics, and well-grounded Number theory

(c) The extensive knowledge of theorems is required.

(e) Calculus, though allowed in solutions, is never required.

(f) Awards are given to approximately the top-scoring 50% of the individual contestants.

(g) Teams are not officially recognized.

(h) ***Contestants must be under the age of 20***.

(i) An individual may participate any number of times in the IMO.

(j) In January 2011, ***Google sponsored*** €1 million to the International Mathematical Olympiad organization.

World Famous Performers:

(a) Zhuo Qun Song, Teodor von Burg, Lisa Sauermann, John Lian, Josh Li and Christian Reiher, have performed exceptionally well in the IMO, winning multiple gold medals.

(b) GrigoryMargulis, Jean-Christophe Yoccoz, Laurent Lafforgue, Stanislav Smirnov, Terence Tao, Sucharit Sarkar, Grigori Perelman, Ngô Bảo Châu and Maryam Mirzakhani have gone on to become notable mathematicians..

(c) Several former participants have won awards such as the *Fields Medal*.

Examination & Question Paper

(a) The Paper consists of six problems.

(b) Each problem is worth seven points

(c) The maximum total score is 42 points.

(d) No calculators are allowed.

(e) The examination is held over two consecutive days

(f) Each day the contestants have four-and-a-half hours to solve three problems.

(g) The problems are usually disguised so as to make the solutions difficult.

Making Of Question Paper

(a) Each participating country, other than the host country, submits suggested problems to a Problem Selection Committee provided by the host country,

(b) The problems are shortlisted.

(c) The team leaders arrive at the IMO a few days in advance of the contestants and form the IMO Jury.

(d) They select the six problems from the shortlist.

(e) The Jury aims to order the problems so that the order in increasing difficulty is Q1, Q4, Q2, Q5, Q3 and Q6.

(f) Since the leaders know the problems in advance of the contestants, they are kept strictly separated and observed.

Cutoffs and Awards

(a) The cutoffs (minimum scores required to receive a gold, silver or bronze medal respectively) are chosen so that the numbers of gold, silver and bronze medals awarded are approximately in the ratios 1:2:3.
(b) Participants who do not win a medal but score seven points ***on at least one problem*** receive an ***honorable mention.***
(c) Special prizes may be awarded for solutions of ***outstanding elegance*** or involving good generalizations of a problem.

Penalties: North Korea was disqualified for cheating at the 32nd IMO in 1991, and again at the 51st IMO in 2010.

The following nations have achieved an all-members-gold IMO with a full team:

(a) China, 11 times:
In 1992, 1993, 1997, 2000, 2001, 2002, 2004, 2006, 2009, 2010 and 2011
(b) United States, 3 times:
In 1994, 2011, and 2016
(c) Russia, 2 times:
In 2002 and 2008
(d) South Korea, twice:
In 2012 and 2017
(e) Bulgaria, once: in 2003
(f) ***The only countries to have their entire team score perfectly*** in the IMO were the United States in 1994.

Mathematics Olympiad In India

(a) The Mathematics Olympiad activity is undertaken from 1986 by ***The National Board for Higher Mathematics*** (**NBHM**) which was founded in 1983.
(b) NBHM runs the activity in collaboration with the ***Homi Bhabha Centre for Science Education, Mumbai***.
(c) The main purpose of this activity is to support mathematical talent among high school students in the country.

(d) NBHM has also taken on the responsibility for selecting and training the **Indian team** for participation in the **International Mathematical Olympiad** every year.
(e) While NBHM coordinates and supports Mathematics Olympiad contests all over the country, regional bodies, mostly voluntary, play an important role at different stages.
(f) For the purpose of administering Mathematics Olympiad contests, the country has been divided in 16 regions.
(g) A regional coordinator is appointed who is responsible for conducting these tests in each region.

The Mathematics Olympiad Programme leading to participation in the International Mathematical Olympiad consists of the following stages:

Stage 1:

(a) Regional Mathematical Olympiad (RMO) is held in each region normally between September and the first Sunday of December each year.
(b) The regional coordinator ensures that at least one centre is provided in each district of the region.
(c) All high school students up to class XII are eligible to appear for RMO.
(d) RMO is a 3-hour written test containing about 6 to 7 problems.
(e) Each regional coordinator has the freedom to prepare his/her own question paper or to obtain the question paper from NBHM.
(f) The regions opting for the NBHM question paper hold this contest on the 1st Sunday of December.
(g) On the basis of the performance in RMO, a certain number of students from each region are selected to appear for the second stage.
(h) Regional coordinators charge ***nominal fees*** to meet the expenses for organizing the contests.

Stage 2:

(a) Indian National Mathematical Olympiad (INMO) is held on the first Sunday of February each year at various Centres in different regions.
(b) Only students selected on the basis of RMO from different regions are eligible to appear for INMO.
(c) INMO is a 4-hour written test.
(d) The question paper is set centrally and is common throughout the country.
(e) The top 30-35 performers in INMO receive a certificate of merit.

Stage 3:

International Mathematical Olympiad Training Camp (IMOTC)

(a) The INMO certificate awardees are invited to a month long training camp (junior batch) conducted in May-June, each year.
(b) In addition, INMO awardees of the previous year that have satisfactorily gone through postal tuition throughout the year are invited again for a second round of training (senior batch).

Stage 4: International Mathematical Olympiad (IMO)

(a) The team selected at the end of the camp, a "leader" and a "deputy leader," represent India at the IMO that is normally held in July in a different member country of IMO each year.
(b) The leader and deputy leader are chosen by NBHM from among mathematics teachers/researchers involved in the Mathematics Olympiad activity.
(c) Travel to IMO venue and return takes about two weeks.
(d) Students of the Indian team who receive gold, silver and bronze medals at IMO receive a cash prize of Rs. 5,000/-, Rs. 4,000/- and Rs. 3,000/- respectively, from NBHM during the following year at a formal ceremony at the end of the training camp.
(e) The Ministry of Human Resource Development (MHRD) finances international travel of the eight-member Indian delegation connected with international participation.
(f) NBHM finances the entire in-country programme and takes care of other expenditure.
(g) Students aiming for selection for participation in IMO should note that RMO is the first essential step for the programme.
(h) To appear for RMO, students should get in touch with the RMO co-ordinator of their region well in advance, for enrolment and payment of a nominal fee.

Syllabus for Mathematics Olympiads: The syllabus for Mathematics Olympiads (***Regional, National & International***) is pre-degree college mathematics.

The areas covered are:

(a) Number systems
(b) Arithmetic of integers
(c) Geometry
(d) Quadratic equations and expressions
(e) Trigonometry
(f) Co-ordinate Geometry
(g) Systems of Linear Equations
(h) Permutations and Combinations
(i) Factorisation of Polynomials
(j) Inequalities
(k) Elementary Combinatorics
(l) Probability Theory
(m)Number Theory
(n) Infinite series
(o) Complex Numbers
(p) Elementary Graph Theory.

Note:

1. ***The syllabus does not include calculus and statistics***
2. ***The syllabus is in a sense spread over class IX to class XII levels, but the problems under each topic are of an exceptionally high level in difficulty and sophistication.***
3. ***The difficulty level increases from RMO to INMO to IMO.***

PRMO 2018

Pre-RMO exam:

It is the First step to Indian Mathematical Olympiad.

(a) The website for PRMO is http://www.mtai.org.in/prmo
(b) Eligibility for year 2018 was as under:

Candidates born on or after August 1, 1999 and studying in Class 8,9,10,11 or 12 were eligible to write PRMO 2018.

(c) Further, the candidates must be Indian citizens.
(d) The PRMO is a machine-correctable 3-hour duration test of 30 questions.
(e) Each question has an answer which is a number with one or two digits.
(f) All Kendriya Vidyalaya, Jawahar Navodaya Vidyalaya and Atomic Energy Central Schools may also register as registration centres regardless of the number of students and may accept to register students from other schools.
(g) The KVs and JNV schools will be exam centres.
(h) A carbon copy of the answer sheet (OMR) will be given to the student after the exam; students can check their answers as against the answers which will be uploaded on the MTA website.
(i) From each region, the top (up to) 300 students from Classes 8,9,10,11 and the top (up to) 60 students from Class 12 will be eligible to write the Regional Mathematics Olympiad exam.
(j) For the KV, JNV schools which have a countrywide coverage, the number to be selected is up to 5 per cent from Classes 8,9,10,11 and up to 1 per cent from Class 12, of the number of registrations.

Procedure to be followed by a new country wishing to take part in the International Mathematical Olympiad

If a country would like to become a participant in the International Mathematical Olympiad (IMO), the procedure is as follows:

(a) The Ministry of Education of the country, and/or the country's national Mathematical Association, should send a formal letter of application for an invitation to send an Observer to the next IMO. The letter of application should be addressed to the Secretary of the IMO Advisory Board, at the address below.
(b) The application should include information on how the country plans to select and prepare its national team for the event. Copies of national Mathematical Olympiad papers, for example, should be included. Any other relevant information (such as participation in regional Mathematical Olympiads) should also be included.
(c) The application is then considered by the IMO Advisory Board. If the application for Observer status is approved, the host country of the next IMO will issue an invitation to the country to send an Observer or Observers (who must be adults) to the IMO. The country will be responsible for paying all costs involved, including the travelling expenses of the Observer/s, and the relevant accommodation costs as set by the host country. (When a country becomes a full member of the IMO, all accommodation costs of the Team Leader, Deputy Team Leader and the team members are covered by the host country.)
(d) At the IMO the Observer will be able to gain a great deal of insight into how the IMO is run, the standards expected of participating countries, and how other countries select and train their teams.
(e) With the agreement of the host countries for the following two years, full membership of the

IMO is then granted for the following year by the IMO Advisory Board.

Most Decorative Participants From India Who Won Gold Medal

(a) Debdyuti Banerjee (2012) scored 28 with rank 33

(b) Prafulla Susil Dhariwal (2012) scored 28 with rank 33

(c) Akashnil Dutta (2011) scored 28 with rank 39

(d) Nikhil Ashok Savale (2002) scored 34 with rank 12

(e) Abhay Kumar Jha (2001) scored 35 with rank 17

(f) Sucharit Sarkar (2001) scored 33 with rank 21

(g) Abhinav Kumar (1998) scored 32 with rank 26

(h) Chetan Balwe (1998) scored 31 with rank 29

(i) N. Venkataramana Tejaswi (1998) scored 31 with rank 29

(j) Ajay C. Ramdoss (1996) scored 30 with rank 25

(k) Rina Panigrahy (1990) scored 38 with rank 11

In 2018 IMO, Indian team consisted of Mr. Sutanay Bhattacharya, Spandan Ghosh, Amit Kumar Mallik, Anant Mudgal, Pulkit Sinha and Pranjal Srivastava. Their respective results were as under:

Sutanaya Bhattacharya: Rank 193, Total Score 21, Bronze Medal

Spandan Ghosh: Rank 193, Total Score 21, Bronze Medal

Amit Kumar Mallik: Rank 368, Total Score 10, Honourable Mention

Anant Mudgal:Rank 122, Total Score 26, Silver Medal

Pulkit Sinha: Rank 122, Total Score 26, Bronze Medal

Pranjal Srivastava: Rank 122, Total Score 28, Silver Medal

Fifty-nine years have passed since 1959, the International Mathematical Olympiad remains a very respectable event and one of the most long-lived international educational and scientific competitions.

Mathematics has always been a fresh and dynamical field of human creativity. It has been also a fundamental science to the benefit of scientific knowledge and technical achievements.

Let us hope the young mathematicians will develop new ideas to construct new bridges between mathematics and other scientific fields.

Long Live Mathematics, The Language Of Science!

Author is Editor of this Bulletin Gyan Vigyan Sarita: **शिक्षा,** and contributor of column **'Growing with Concepts -Mathematics:'**

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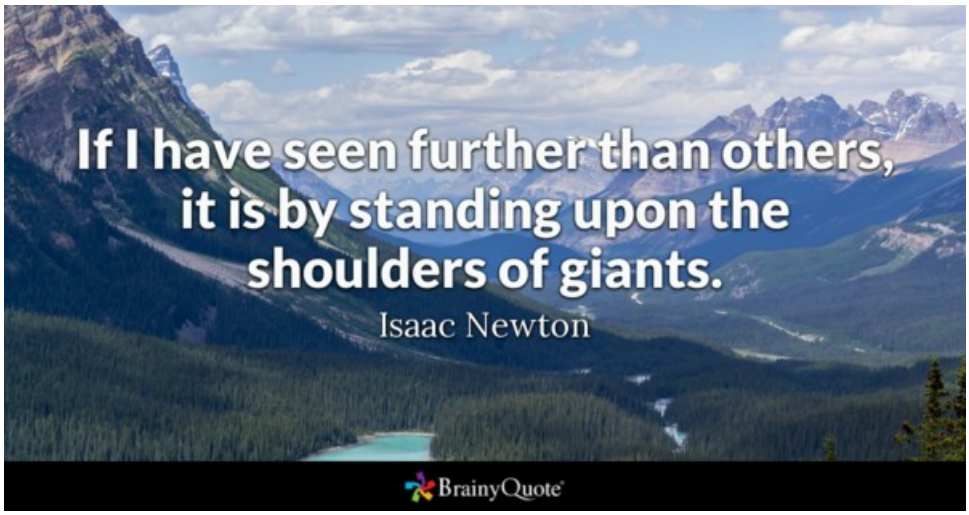

GROWING WITH TECHNOLOGY : PRESERVING CULTURAL HERITAGE
(Deepawali Celebrations)

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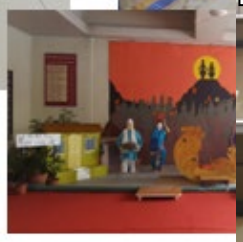

Mrs Mona Sahay is primarily an IT Professional, having served in USA & worked as freelance corporate trainer for many top companies. Currently she has switched over to ladies garment design receiving a phone three art works which won her First Prize for Three Successive years in co India.

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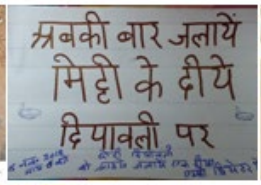

Human Sensitivity in Deepawali Celebrations

Residents at Mahagun Moderne, Sector 78, NOIDA, UP

professional couple at traditional creativity, at Bangalore

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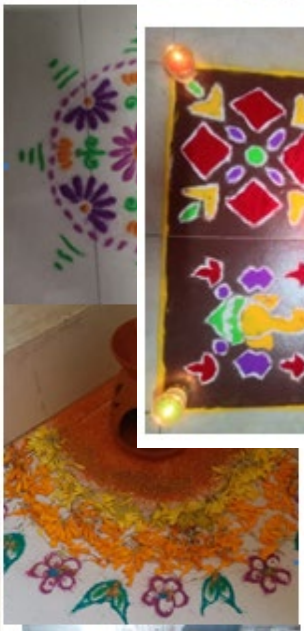

Mrs. Kanchan is an Engg. Graduate from Jabalpur. She is an IT Professional and currently working in Veritas, Pune. Her hobbies are drawing, painting, cooking, reading and classical dance.

Aarna Gupta, daughter of Doctor-Engineer Deepa Couple, growing with cultural creativity. She studying Class First, Somerville School, Sector 22 NOIDA.

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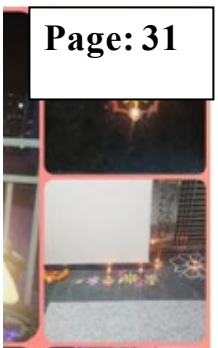
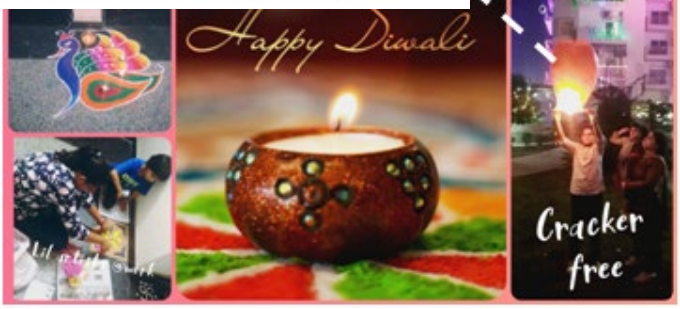
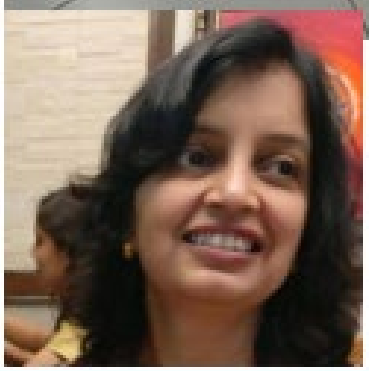
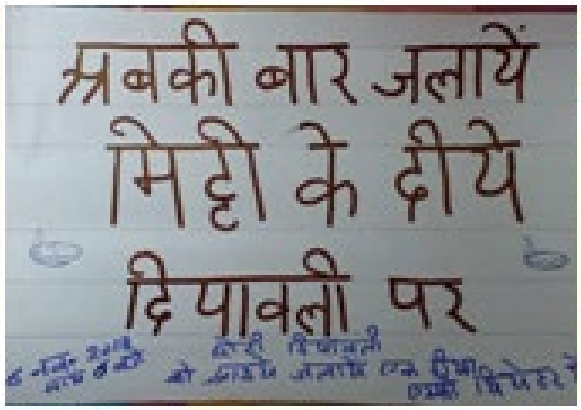


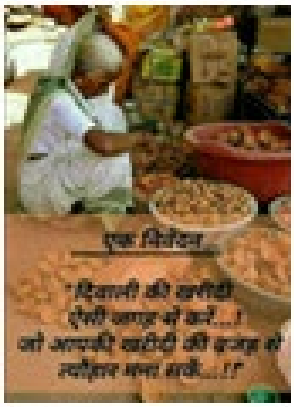


Nidhi Joshi, an IT Professional at Adobe, NOIDA, with her Two daughter Dishita (12 Years) and Amira (5 Years), celebrating Deepawali with Rangoli and lamps, blending technology in traditions, in an eco-friendly manner.



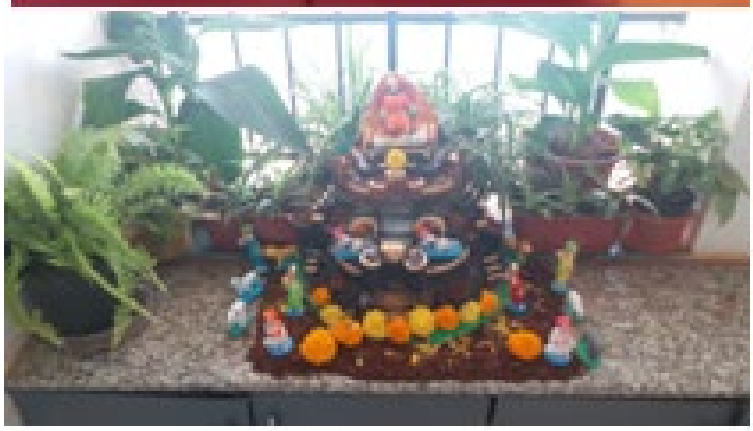
Mrs Mona Sathye, is primarily an IT Professional, having served in USA for 6 years and bach home she worked as freelance corporate trainer for many top companies. Currently she is back to her first love – Art. Currently she has switched over to ladies garment design receiving a phenomenal response. Above are her three art works which won her First Prize for Three Successive years in competition organized by Times of India. E-mail: msathaye@gmail.com

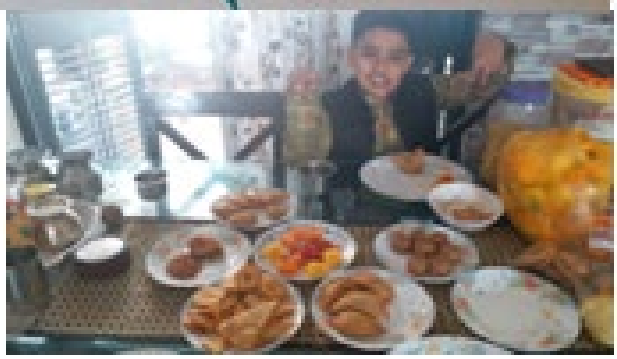




Human Sensitivity in Deepawali Celebrations

Residents at Mahagun Moderne, Sector 78, NOIDA, UP





Mrs. Kanchan Karve, is an Engg. Graduate from Jabalpur. She is an IT Professional and currently working in Veritas, Pune. Her hobbies, are drawing, painting, cooking, reading and classical dance:

Kritika Dwivedi, 6 Years old child of a professional couple at traditional creativity, at Bangalore

Aarna Gupta, daughter of Doctor-Engineer Doctor Couple, growing with cultural creativity. She studies in Class First, Somerville School, Sector 22 NOIDA.

Nidhi Joshi, an IT Professional at Adobe, NOIDA, with her Two daughter Dishita (12 Years) and Anura (5 Years), celebrating Deepawali with Rangoli and lamps, blending technology in traditions, in an eco-friendly manner.

Email: nidhi.joshi39@gmail.com

कामना...

मृणालिनी घुळे

आयेगा दिन और सूहाना
बीत गया है साल पुराना
खुशी खुशी दो उसे विदाई
नयी भोर दे रही दिखाई
दूर रहे दु:ख की परछाई
प्रगति की बाजे शहनाई
गये साल की बीती बातें
नये साल की नयी हैं रातें
रातें होंगी अब चमकीली
भोर सुनहरे किरणों वाली
सबके घर हों सदा प्रकाशित
सब सोचें एक दूजे का हित
बैर भाव न पैर धरे अब
नव विकास की राह चलें सब
मिलकर हो आपद् का सामना
यही चाह और यही कामना।

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

बचपन -

डॉ. संगीता पाहुजा

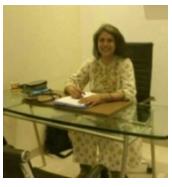
वो प्यारा,सलोना बचपन,
माता -पिता की छांव में बीता वो बचपन,
हर बच्चे को राजकुमार/राजकुमारी
होने का अहसास कराता बचपन|

सोना-जागना,खाना -पीना,पढ़ना-लिखना,
सबकी फिक्र माता-पिता की झोली में
डाल कर निश्चिंत खिलता बचपन,
कब तब्दील हुआ यौवन में,वृद्धावस्था में,न जान पाया बचपन।

बढ़ती उमर की जिम्मेदारियों में दब गया वो बचपन,
स्वछंद जीवन की चाह में हर दिल में ता उम्र बसता है बचपन|

पाकर अवसर फिर जीवंत होकर
पलभर में उम्र के अहसास को भुला देता बचपन,
हर गिले शिकवे से बेखबर
सब कुछ माफ कर देता बचपन|

है हुनर जिसमें बचपन जीवन्त रखने का
निश्चिंत और स्वस्थ रहता वो तन मन।



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 |
संपर्क: मो. क्र.- 9953967901,
E-mail: sangeeta.pahuja3@gmail.com

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Students' Section

Bhavani Nadgonde, is a studying Information Design at Sristi Institute of Technology and Design, Banglore. She pass CBSC 12th in 2018 with 92% taking a rare combination of M PCM with Biology. Sketching is her hobby

E-mail: anadgonde@gmail.com

Ill–Effects of Junk Food

Dishita Joshi

The level of consumption of junk food amongst the youngsters is increasing day by day. The ill-effects of junk food are not shown upon immediately but after a few years. Eating junk food once in a week is fine but eating junk food more often can be really harmful for the body.

The major reason behind the increment in the level of consumption of junk food amongst the teenagers is the availability of junk food. Junk food is easily available almost everywhere we go. Nowadays, it has become so difficult to find a food joint with healthy food. Nowadays, it has also become fashionable to eat junk food amongst the youngsters. Another and the most important reason for the high demand of junk food is that it is extremely delicious.

There are innumerable bad effects of eating junk food in a large quantity. There are a number of diseases which are caused due to excessive eating of junk food. Diabetes, obesity are some examples of such diseases. Nowadays, people suffer from these diseases at a much early age. It also increases the cholesterol level in a person's body. Eating junk food not only affects one's physical health but also mental and emotional. Many people suffer from diseases like hypertension due to excessive eating of junk food.

To decrease the consumption of junk food certain steps should be taken. Mixing of unhygienic ingredients into food items should be checked and prevented. Certain food items which have more chances of spreading diseases should be banned in food shops, joints and canteens by the government .

So, junk food should not be eaten all the time and eating of healthy food should be encouraged.

She is a student of class VII in The Khiatan School, Noida, Her hobiies are vocal music, drawing and painting and playing lawn tennis

E-mail ID: joshipn@gmail.com

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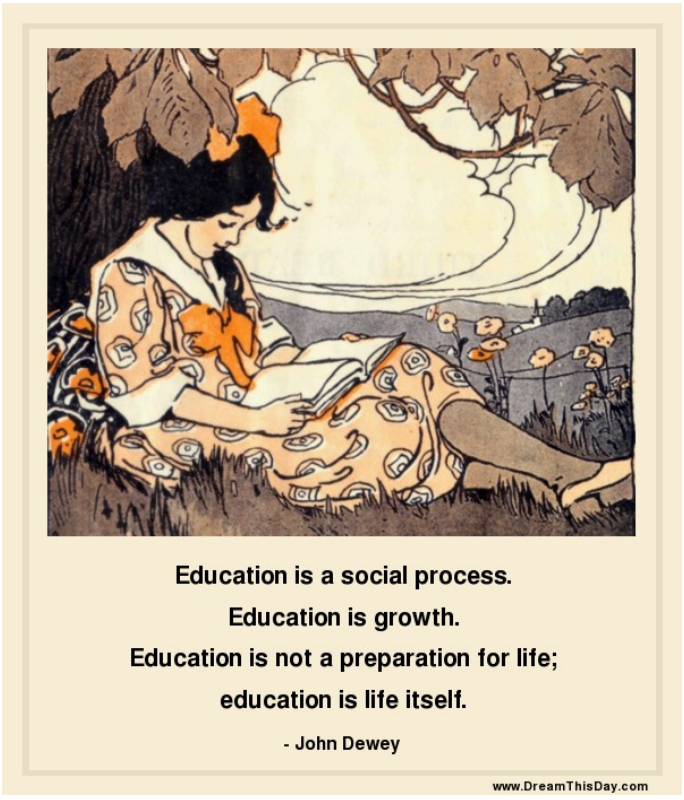

Answers to Science Quiz : November'18

Kumud Bala

1. (b)	2. (a)	3. (b)	4.(d)	5. (b)	6. (c)	7. (a)	8. (a)	9. (c)	10. (a)
11. (c)	12. (c)	13. (c)	14. (a)	15. (c)	16. (a)	17. (b)	18. (b)	19. (c)	20. (b)
21. (c)	22. (b)	23. (a)	24. (b)	25. (b)	26. (c)	-	-	-	-

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ANSWER: CROSSWORD PUZZLE November'18: Festivals of India

Prof. S.B. Dhar

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GROWING WITH CONCEPTS - Mathematics

LET'S DO SOME PROBLEMS IN MATHEMATICS-IV

Prof. SB Dhar

Mathematics segment of all competitive examinations including JEE-Mains and JEE-Advanced is specially a test of common sense and understanding of the basic concepts. If the concepts are applied correctly at proper places, the time is saved as well as the correct solution is reached. Time management plays a crucial role in achieving the higher ranks.

It has been observed that some of the competitions' problems consist of various concepts and tricks too. So, all that a solution seeker needs is the availability of all the concepts at his/her finger tips at the moment of need. There is no short-cut for it. The only possible way to meet this problem is to practice well by writing them on paper with pen or pencil.

Some typical problems are hereby selected for the readers. These problems may appear simple but be assured that they will not behave so when one starts writing their solutions. Solutions are possible only if approach is correctly planned.

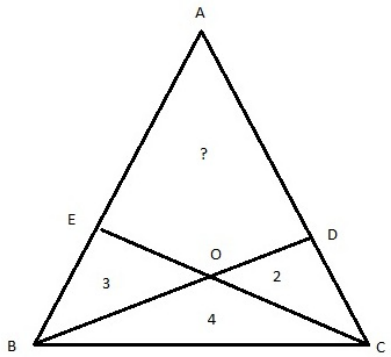
I am not writing any solution of any problem this time. I expect the readers to solve these problems according to their understanding. One thing is clear with these problems that they do not have only one way of solution but may be solved by many ways. The readers may try for the solutions. If the readers find all the solutions, we shall assume out efforts for a year-long writing concepts have been successful. However, the complete solutions of this set of problems will appear in the coming issue of e-bulletin. If the reader is anxious to know about the solution, to match his/her solution, he/she may contact the coordinator's email.

Best of Luck !

Problems!

1. *Let ABCDE be a convex pentagon such that AB=BC=CD, ∠EAB=∠BCD, and ∠EDC=∠CBA. Show that the perpendicular line from E to BC and the line segments AC and BD are concurrent.*

2. *Refer the triangle ABC in the figure. BD and CE are the line segments to sides AC and AB respectively meeting at O. The areas of ΔOBE=3 units, ΔOCD=2 units, and Δ OBC=4 units.*



Find the area of the quadrilateral AEOD.
(**Ans: 7.8 units**)

3. *Let $a_1, a_2, a_3, \ldots, a_n$, k and M be positive integers such that $\frac{1}{a_1}+\frac{1}{a_2}+\cdots.+\frac{1}{a_n}=k$ and $a_1 a_2 a_3 \ldots a_n = M$. If M > 1, then show that $P(x) = M(x+1)^k-(x+a_1)(x+a_2)\ldots(x+a_n)$ has no positive roots.*

4. *Find all functions f:R→R such that $f\big(f(x)f(y)\big)+f(x+y)=f(xy)$ for all x, y ∈ R.*
(**Ans: x→0, x→(x - 1) , x→(1 - x)**)

5. *Find all pairs (x,y) of prime numbers with x>y for which the number $\frac{(x+y)^{x+y}(x-y)^{x-y}-1}{(x+y)^{x-y}(x-y)^{x+y}-1}$ is an integer.*
(**Ans: The only pair is (3,2)**)

6. *If a>b>c>0; the distance between (1,1) and the point of intersection of the lines ax+by+c=0 and bx+ay+c=0 is less than 2√2, then show that a+b-c>0.*

7. *A teacher writes the equation (x-1)(x-2)....(x-2019)=(x-1)(x-2)...(x-2019) on the board. He asks his students to erase some linear factors from both the sides so that each side still has at least one factor and the resulting equation has no real roots. Can you find the least number of linear factors one needs to erase to achieve this?*
(**Ans:2019**)

8. *Let $n \geq 3$ be a positive integer. Find the maximum number of diagonals of a regular n-gon one can select, so that any two of them do not intersect in the interior or they are perpendicular to each other.*
(**Ans: n-2 if n is even and n-3 if n is odd**)

9. *Let ω be a complex cube root of unity with $\omega \neq 1$ and $P = (p_{ij})$ be a n x n matrix with $p_{ij} = \omega^{i+j}$, then $P^2 \neq 0$ when n = 55,56,58*

10. *Show that the value of $\cot(\sum_{n=1}^{23} \cot^{-1}(1+k=1n2k$ is 2523*

11. *Find all the pairs (f, g) of functions from the set of real numbers to itself that satisfy $g(f(x+y)) = f(x) + (2x+y)g(y)$ for all real numbers x and y.*
(**Ans: Either both f and g vanish identically, or there exists a real number C such that $f(x)=x^2+C$ and $g(x)=x$ for all real numbers x**)

12. *Let ABC be a triangle with in-centre I. A point P in the interior of the triangle satisfies $\angle PBA+\angle PCA=\angle PBC+\angle PCB$. Show that $AP \geq AI$ and that equality holds if and only if P coincides with I.*

13. *Let N be the set of all positive integers. Find all functions $f : N \to N$ such that for all positive integers m and n, the integer f(m)+f(n)-mn is non-zero and divides mf(m)+nf(n).*
(**Ans: $f(n)=n^2$ for any $n \in N$**)

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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Science in general and Physics in particular is not a subject to learn, but an area of observation and exploration by correlation, integration and analysis of repetitive nature, and then conclusion.

It is a real thrill, full of fun.
But, it can't be done in dicrete manner, it has to be done patiently, like climbing stair far a faster and purposeful journey.
This is where role of education come in; it is to streamline the process.

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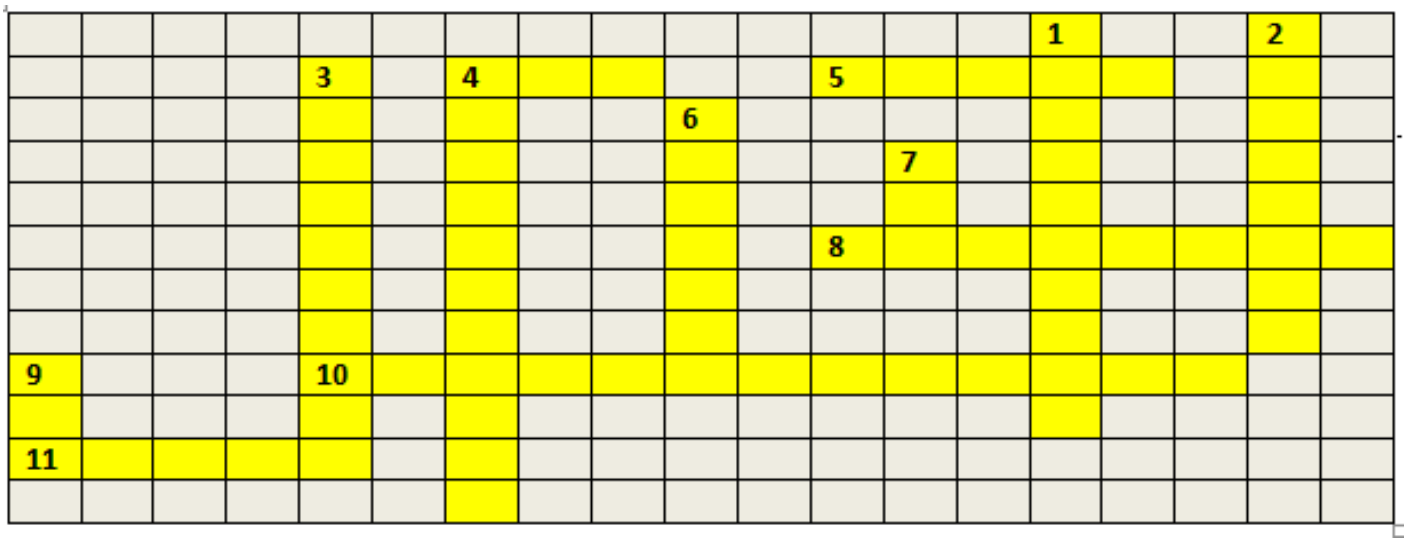
CROSSWORD PUZZLE December'18
INTERNATIONAL MATHEMATICAL OLYMPIAD

Prof. SB Dhar



ACROSS

4 Number of Problems each year in IMO

5 Points of each problem in IMO

8 Branch of Mathematics not included in IMO

10 Contestant from India scoring highest for India so far

11 Country participating maximum number of times in IMO

DOWN

1 Australian-American participant who got Fields Medal

2 Most successful contestant bagging 5Gold and 1 Bronze medals

3 Country penalized twice for cheating in IMO

4 Second most participating country of the world in IMO

6 Country where the first IMO was organized

7 The first rank holder country in 2018 IMO

9 ***Beautiful Young Minds*** documentary about IMO was made by

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Take care of your thoughts,
For they are formed and moulded by our thoughts.
Those whose minds are shaped by selfless thoughts,
Give jot when they speak or act.
Joy follows them like a shad,
that never leaves them.

\- ***Gautama Buddha***

—00—

Growing with Concepts : Physics **Code: Phy/MRB-1/S/004**

Solving Problems Involving – Mechanics of Rigid Bodies

(Gravity and Mechanical Properties of Matter)

Aim of education is not to make a student expert, but to inculcate in him/her **spirit of expertise**; the one who can observe, correlate, analyze, evolve alternatives, **choose the best one** in the given circumstances, and implement it. The **best choice** lies in its feasibility, economics, sustainability with coexistence, in society as well as with nature. **Expertise** is a natural consequence of continuous, consistent and commitment in the educational pursuit.

Problems in Concepts of Physics, Volume I & II by H C Verma has been included in this series of questions. These questions encompass and integrate concepts and give a good practice in applying thoughtfully and skillfully In addition question that appeared in IIT-JEE posses a merit of nuance and novelty. In view of this compendium of question that appeared in the examination 2013-1979 brought out by DC Pandey have also been included in this series.

Nevertheless, there is always a limit to which diversity, complexity and integration of concepts can be catered. However, the best can yield only through practice with question from text book and those appeared in examination being targeted. Certainly, this practice with varied question would enhance analytical ability and thereby training of mind to handle unknown problems, an essential attribute of a trouble shooter in real life.

Illustrations have been developed to elaborate integration of concepts in each question to address students deprived of able guidance due to any kind of barrier, be it economical, geographical or sociological. This may call upon a bit of patience from students of affluent class who are either at higher academic platform or rich guidance available readily.

Another important requirement for accuracy and speed is striking a balance between algebraic and numerical solution of a problem. Generally questions are so articulated that most of the variables either cancel out or end-up in simple calculations, and not to the least to test numerical skills. However, there is no thumb-rule for it, but only through a practice of question one builds a judgment on where to use numerical values. Typically in some of the illustrations specific footnote has be made.

This set of questions, both Objective and Subjective, is towards ending of section on Mechanics with Question bank on Fluid Mechanics to follow. Thereafter, chapter on Mechanics of Mentors' Manual, posted as free web resource would be revisited for moderation, correction and addition, before question banks on following chapters of physics are brought out.

This Mentors' Manual together with series of Question Banks, free web-resource, might be found useful by teachers in remote location to benefit their students with grater conceptual clarity and grow it into making their intuition conceptual, speedy and correct. Students, who may choose to use it are advised to use the set in sequence from the beginning, should they not feel disconnect between concept and illustrations. It needs to be remembered that ***there is no short-cut to knowledge and excellence***.

Experience of response of students through their difficulties, doubts and question during Interactive Online Mentoring Sessions (IOMS) for students at remote and rural areas is our biggest resource in developing illustrations. However, we reiterate on importance of group dynamics, inculcated in IOMS, through group learning to enhance conceptual clarity and much needed personality trait going forward.

Possibility of inadvertent typographical errors is this document is not ruled out. It is pertinent to invite attention in the context of this unassisted endeavour of building the document full of mathematical expressions, graphics, in addition to the conceptual depth and width is not ruled out. We would gratefully welcome suggestions for value addition and corrections, if needed. Your bit of effort in this would be with a sense of Personal Social Responsibility (PSR) towards deprived children. If few of the children, being targeted by us, are benefitted we, collectively, will have lived upto demographic dividend expected of us.

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Code: Phy/MRB-I/S/004

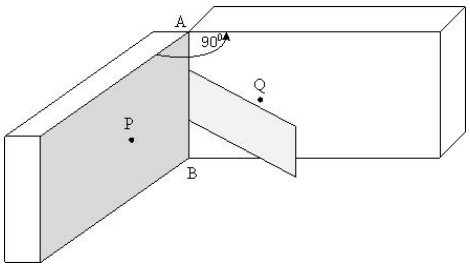
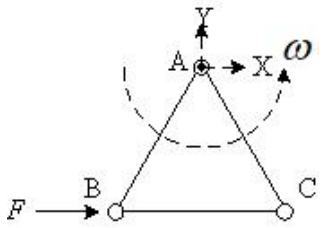
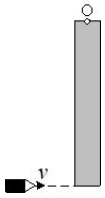
Mechanics of Rigid Bodies : Subjective Questions (Typical)

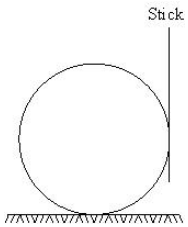
No of Questions: 33 **Time Allotted: 9 Hours**

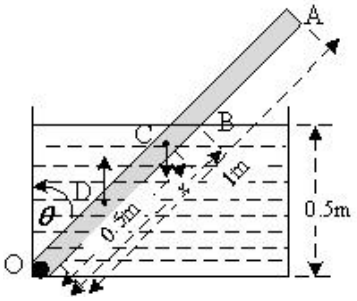
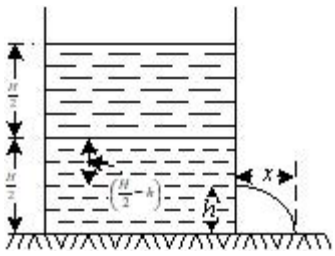
All questions are compulsory

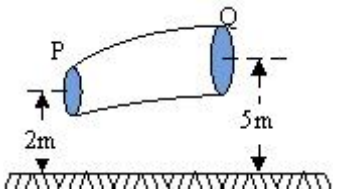
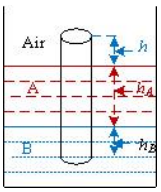
(Attempt questions in three discerete parts of 10+10+13 questions)

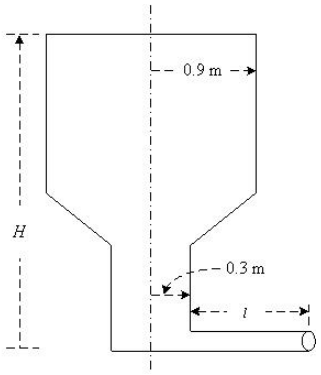
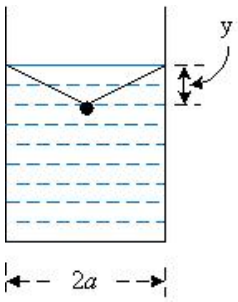
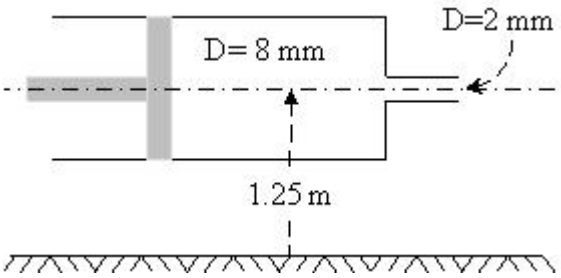
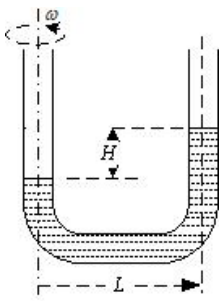
[Note: Figures are conceptual only and not to the scale]

Q-01	A rod AB of mass M and length L is lying on a frictionless surface. A particle of mass m travelling along the surface hits the end A of the rod with a velocity v_0 in a direction parpendicular to AB. The collision is elastic. After the collision the particle comes to rest with respect to the rod. (a) Find the ratio $\frac{m}{M}$, (b) A point P on the rod is at rest immediately after collision. Find the distance AP. (c) Find the linear speed of the point P a time $\frac{\pi L}{3v_0}$ after the collision.
Q-02	Two heavy metallic plates are joined at 90^0 to each other.A a laminar sheet of mass 30 kg is hinged at the line AB joining the two heavy metallic plates. The hinges are frictionless. The moment of inertia of the laminar sheet about an axis parallel to AB and passing through its centre of mass is 1.2 kg-m^2. Two rubber obstacles P and Q are fixed on each metallic plate at a distance 0.5 m from the line AB. This distance is chosen so that the reaction due to the hinges on the laminar sheet is zero during the impact. Initially the laminar sheet hits one of the obstacles with an angular velocity γ rad/s and turns back. If the impulse on the sheet due to each obstale is 6 N-s – (a) Find the location of the centre of mass of the laminar sheet from AB (b) At what angular velocity does the laminar sheet comes back after the first impact? (c) After how many impacts does the laminar sheet cmoes to rest? 
Q-03	Three partcles A, B and C, each of mass m are connected to each other by three massless rigid rods massless rigid rods to form a rigid, equilatral traingular body of side l. This body is placed on a horizontal frictionless table forming X-Y plane and is hinged to it at the point A, so that it can move without friction about the vertical axis through A, as shown in the figure. The body is set into rotational motion on the table about A with a consant angular velocity ω. (a) Find the magitude of the horizontal force extered by the hinge on the body. (b) At time T, when the side BC is parallel to the X-axis, a force F is applied on B along BC, as shown. Obtain the X-component and the Y-component of the force exerted by the hunge on the body, immediately after time T. 
Q-04	A rod of length L and mass M is hinged at point O. A small bullet of mass m hits the rod as shown in the figure. The bullet gets embedded in the rod. Find angular velocity of the system just after impact. 

Q-05	A solid cylinder rolls without slipping on an inclined plane making an angle θ with the horizntal. Find the linear acceleration of the cylinder of mass M.
Q-06	Four solid spheres each of diameter $\sqrt{5}$ cm and mass 0.5 kg are placed with their centers at the corner of a square of side 4 cm. The moment of inertia at the system about the diagonal of the square is $N\times10^{-4}$ kg-m^2, find N.
Q-07	A boy is pushing a ring of mass 2 kg and radius 0.5 m with a stick as shon in the figure. The stick applies a force of 2 N on the ring and rolls it without slipping with an enough acceleration of 0.3 m/s^2. The coefficient of friction between the ground and the ring is large that rolling always occurs and the coefficient of friction between the stick and the ring is $\left(\frac{P}{10}\right)$. Find the value of P. 
Q-08	Two satellites S_1 and S_2 revolve around a planet in a coplanar circular orbit in the same sense. Their period of revolution are 1 hour and 8 hours respectively. The radius of the orbit of S_1 is 10^4 km.. When is S_2 closest to S_1 Find – a. Speed of is S_2 relative to S_1 b. Angular speed of is S_2 as actually observed by an astraunaut in S_1
Q-09	Three particles each of mass m are situated at vertices of an equilateral traingle of side length a. The only forces acting on the particles are their mutual gravitational forces. It is desired that each particle moves in a circle while maintianing the original separation a. Find – (a) the initial velocity that should be given to each particle and (b) time period of the circular motion.
Q-10	An artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of escape velocity from the earth. (a) Determine height of the satellite above te earth's surface. (b) If the satellite is stopped suddenly in its orbit nd allowed to fall freely onto the earth, find the speed with which it hits the surface of the earth.
Q-11	Distance between the centres of two stars is $10a$. The masses of the stars are M and $16M$ respectively and their radii are a and $2a$ respectively. A body of mass m is fired from the surface of the larger star towards the thesmaller star. What should be its minimum initial speed to reach the surface of the smallr star? Obtain the expression in terms of G, M and a.
Q-12	There is a crator of depth $\frac{R}{10}$ on the surface of the moon having radius R. A projectile is fired vertically upward from the bottom of the crator with velocity, which is equal to the escape velocity V_e on the surface of the moon. Find the maximum height attained by the projectile.
Q-13	Gravitational acceleration on the surface of a planet is $\frac{\sqrt{6}}{11}g$, here g is the gravitational acceleration on the surface of the earth. The average mass density of the planet is $\frac{2}{3}$ times that of the earth. If the escape speed on the surface of the earth is taken to be 11 kmps, find escape speed on the surface of the planet .

Q-14	A column of mercury of length 10 cm is contained in the middle of a horizontal tube of length 1 m which is closed at both ends. The two equal length contain air a standard atmospheric pressure of 0.76 m of mercury. The tube is now turned to vertical position. By what distance will the column of mercury be displaced? Assume temperature to be constant.
Q-15	A boat floating in a water tank is carrying a number of large stones . If stones are unloaded into water what will happen to what will happen to the water level?
Q-16	Two identical cylindrical vessels with their bases at the same level each contain a liquid of density ρ .The height of the liquid in one vessel is h_1 and in the other it is h_2. The area of either base is A. What is the work done by gravity in equalizing the levels when the two vessels are connected?
Q-17	A wooden plank of length 1 m and uniform cross—section is hinged at one end to the bottom of a tank as shown in the figure. The tank is filled with water upto a height 0.5 m. The specific gravity of the plank is 0.5. Find the angle θ that the plank makes with vertical in te equilibrium position (exclude the case $\theta = 0^0$). 
Q-18	A ball of density d is dropped on to a horizontal solid surface. It bounces elastically from the surface and returns to its original position in time t_1. Next, the ball is relased and it falls through the same height before striking the surface of a liquid of density d_1. (a) If $d < d_1$, obtain an expression (in terms of d, t_1 and d_1) for time t_2 the ball takes to come back to the position from which it was released. (b) Is motion of the ball simple harmonic? (c) If $d = d_1$, how does the speed of he ball depend on its depth inside the liquid? Neglect frictional and other dissipative forces. Assume the depth of the liquid to be large. [Assume size of ball to be a point mass]
Q-19	A container of large uniform cross-section area A resting on a horizontal srface., holds two immiscible, non-viscous and incompressible liquid of densities d and $2d$ each of height $\frac{H}{2}$ as shown in the figure. The lower density liquid is open to the atmosphere having pressure p_0.  (a) A homogeneous solid cylinder of length $L\left(L < \frac{H}{2}\right)$ of cross-sectional area $\frac{A}{5}$ is immersed such that it folats with its axis vertical at the liquid-liquid surface with length $\frac{L}{4}$ in the denser liquid. Determine - i. The density of the solid ii. The total pressure at theb bottom of the container. (b) The cylinder is removed and the original arrangement is retored. A tiny hole of area $s <<$ is punched on vertical side of the container at height h. Determine – i. The initial speed of efflux of the liquid at the hole, ii. The horizontal distance x travelled by the liquid initially, and iii. The height h_m at which the hole should be punched so that liquid travels the maximu distance x_m

	initially. Also calculate x_m. (Neglect air resistance in calculations)
Q-20	A thin rod of negligible mass and area of cross-section 4×10^{-6} m^2, is suspended vertically from one end, has a length of 0.5 m at 100^{0}C. The rod is cooled to 0^{0}C, but preventd from contracting by attaching a mass at lower end. Find – (a) This mass, and (b) The energy stored in the rod, given for the rod Youg's Modulus $Y=10^{11}$ N/m2, Coefficient of liear expansion $\alpha=10^{-5}$K^{-1} and g =10 m/s^2.
Q-21	A large open container of negligible mass and uniform cross-sectional area A has a small hole of cross-sectinal area $\frac{A}{100}$ in its side wall near the bottom. The containeris kept on a smooth floor and contains liquid of density ρ and mass m_0. Assuing that the liquid starts flowing out horizontally through the hole at $t=0$. Calculate – (a) The acceleration of the container, and (b) Velocity of efflux when 75% of the liquid has drained out
Q-22	A non-viscous liquid of uniform density 1000 kg/m^3 flowing in streamline motion along a tube of variable cross section. The tube is inclined alongthe vertical plane as shown in the figure. The area of cross-section of the tube at height 2 m and 5 m are respectively 4×10^{-3}m^2 and 8×10^{-3}m^2. Velocity of the liquid at P is 1 m/s. Find the work done per unit volume by pressure and gravity force as the liquid flows from point P to Q. 
Q-23	A wooden stick of length L, radius R and density ρ has a small metal piece of mass m (of negligible volume) attached to its one end. Find the maximum value for the mass m in terms of given parameters) that would make the stick float vertically in equilibrium inliquid of density $\sigma>\rho$.
Q-24	A unform solid cylinder of density 0.8 g/cm^3 floats in equiibrium in a combination of two non-mixing liquids A and B with its axis vertical. The densities liquids A and B are 0.7 g/cm^3 and 1,2 g/cm^3, respectively. The height of liquid A is $h_A=1.2$ cm . The length of the part of the cylinder immersed in iquid B is $h_B=0.8$ cm.  (a) Find the total exerted by liquid A on the cylinder, (b) Find h, the length of the part of the cylinder in air, and (c) The cylinder is depressed in such a way that its top surface is just below the upper surface of liquid A and is then released. Find the acceleration of the cylinder immediately after it is released.
Q-25	A soap bubble is being blown at the end of very narrow tube of radius b. Air of density ρ moves with a velocity v moves inside the tube and comes to rest inside the bubble. The surface tension of the soap solution is T. After sometime the bubble having grown to radius r sepratates from the tube. Find the value of r. Assume that $r>>b$, so that you can consider the air to be falling normally to bubble's surface.

Q-26	A liquid of density 900 kg/m^3 is filled in a cylindrical tank of upper radis 0.9 m and a lower radius 0.3 m. A capillary tube of length l is attached at the bottom of the tank as shown in the figure.The capillary has outer radius 0.002 m and inner radius a. When pressure p is applied at the top of the tank, volume flow rate of the liquid is 8×10^{-6} m^3/s and if capilary tube is detached, the liquid comes out from the tank with a velocity 10 m/s. Determine the coefficient of viscosity of the liquid. [Given: $\pi a^3 = 10^{-6}\text{m}^2$ and $\frac{a^2}{l} = 2\times10^{-6}$ m] 
Q-27	A container of width $2a$ is filed with a liquid. A thin wire of weight per unit length λ is gently placed over the liquid surface in the moddle of the surface as shown in the figure. As a result, the liquid surface is depressed by a distance $y(y << a)$. Determine the surface tension of the liquid. 
Q-28	A small sphere falls from rest in a viscous liquid. Due to friction, heat is produced. Find the relation between the rate of production of heat and the radius of the sphere at terminal velocity.
Q-29	Consider a horizontally oriented syringe containing water located at a height of 1.25 m above the ground. The diameter of the plunger is 8 mm and the diameter of the nozzle is 2 mm. The plunger is pushed with a constant speed of 0.25 m/s. Find the horizontal range of water stream on the ground. [Take $g = 10\,\text{m/s}^2$] 
Q-30	In Searl's experiment, which is used to find Young's modulus of elasticity, the diameter of experimental wire is $D = 0.05$ cm (measured by a scale of least count 0.001 cm and length is $L = 110$ cm (measured by a scale of least count 0.1 cm). A weight of 50 N causes an exension of length $l = 0.125$ cm (measued by a micrometer of least count 0.001cm). Find maximum possible error in the value of Young's Modulus. Screw gauge and meter scale are free from error.
Q-31	A u-shaped tube contains a liquid of density ρ and it is rotated about the line as shown in the figure. Find the difference in the levels of the liquid column. 

Q-32	Two soap bubbles A and B are kept in a closed chamber where the air is mantained at pressure 8N/m^{-2}. The radii of both bubbles A and B are 2 cm and 4 cm respectively. Surface tension of the soap-water used to make bubbles is 0.04 Nm^{-1}.Find the ratio $\frac{n_B}{n_A}$, where n_A and n_B are number of moles of air in the bubbles A and B respectively.
Q-33	A cylindrical vessel of height 500 mm has an orifice (small hole) at its bottom. The orifice is initially closed and warer is filled in it upto height H. Now the top is completely sealed with a cap and the orifice at the bottom is opened. Some water comes out from the orifice and the water level in the vessel becomes stmeady with height of water colun being 200 mm. Find the fall in height (in mm) of water level due to opening of the orifice. [Take atmospheric pressure $=10\times10^5$ Nm^{-2}, density of water = 1000 Kgm^{-3} , and $g=10$ ms^{-2} . Neglect effect of surface tension]

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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.

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Code: Phy/MRB-I/S/004

Mechanics of Rigid Bodies : Answers to Subjective Questions (Typical)

A-01	(a) $\frac{1}{4}$ (b) $\frac{2}{3}L$ (c) $\frac{v_0}{2\sqrt{2}}$
A-02	(a) 0.1 m (b) 1 rad/s (c) Sheet wil never come to rest
A-03	(a) $\sqrt{3}ml\omega^2$ (b) Force on the hinge (i) X-component $F_{hx}=-\frac{F}{4}$ (ii) (i) Y-component $F_{hy}=\sqrt{3}ml\omega^2$
A-04	$\frac{3mv}{(M+3m)L}$
A-05	$\frac{2}{3}g\sin\theta$
A-06	9
A-07	3
A-08	(a) $-\pi\times10^4$ km/h (b) 3.0×10^{-4} rad/s Anticlockwise
A-09	(a) $\sqrt{\frac{GM}{a}}$ (b) $2\pi\sqrt{\frac{a^3}{3GM}}$
A-10	(a) 6400 km (b) 8 km/s
A-11	$\frac{\sqrt{51}}{2}\sqrt{\left(\frac{GMm}{a}\right)}$
A-12	99.15 R
A-13	3 kmps
A-14	2.95 cm
A-15	Water level would fall.
A-16	$\frac{\rho Ag}{4}(h_1-h_2)^2$
A-17	45^0
A-18	(a) $\frac{d_1t_1}{(d_1-d)}$ (b) No (c) Continue to move
A-19	(a) (i) $\frac{5}{4}d$ (ii) $\frac{(6H+L)dg}{4}$ (b) (i) $\sqrt{\frac{2h}{g}}$ (ii) $\sqrt{h(3H-4h)}$ (iii) $\frac{3}{4}H$

A-20	(a) 40 kg (b) 0.1 Joule
A-21	(a) 0.2 ms^{-2} (b) $v'=\sqrt{5\left(\frac{m_0}{A\rho}\right)}=\sqrt{\frac{5m_0}{A\rho}}$
A-22	(a) 2.96×10^4 J/m^3 (b) 3×10^4 J/m^3
A-23	$\pi R^2 L\left(\sqrt{\rho\sigma}-\rho\right)$
A-24	(a) Zero (b) 0.25 cm (c) $\frac{g}{6}$
A-25	$\frac{4T}{\rho v^2}$
A-26	$\frac{1}{720}$ N-s/m^2
A-27	$\frac{\lambda g a}{2y}$
A-28	Proportional to r^5
A-29	2 m
A-30	$\Delta Y=1.09\times10^{10}$
A-31	$\frac{\omega^2 L^2}{2g}$
A-32	6
A-33	0.6 mm

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I don't think anybody anywhere can talk about the future...
without talking about education. Whoever controls the education of our children,
controls our future.

- Wilma Mankiller

There are two educations.
One should teach us how to make a living,
and the other how to live.

- John Adams

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Growing with Concepts: Chemistry

IDEAL GAS EQUATION

Kumud Bala

A gas which obeys Boyle's law, Charles's law and Avogadro's law strictly is called ideal gas. Such a gas is hypothetical. It is based on the assumption that intermolecular forces are not present between the molecules of an ideal gas. However, real gases do not obey these laws at all conditions. This will be learnt later. Boyle's law gives the effect of pressure on the volume of a gas at constant temperature where as Charles's law gives the effect of temperature on the volume of a gas at constant pressure. By combining these two laws, we get an equation which gives the simultaneous effect of the changes of pressure and temperature on the volume of the gas. This is known as ideal gas equation or combined gas law.

Derivation: Let the volume of a certain mass of a gas change from V_1 to V_2 when the pressure is changed from P_1 to P_2 and temperature from T_1 to T_2. The gas equation can be derived in two steps.

Step1- let us change the pressure of the gas from P_1 to P_2 at a constant temperature T_1, the volume will change from V_1 to new volume say V_x. Then according to Boyles's law, $P_1V_1 = P_2V_x$ or $V_x = \frac{P_1V_1}{P_2}$…….. (i)

Step 2- let the temperature of the gas be change toT_2 at constant pressure P_2 so that volume may change from V_x to V_2. Thus, according to Charles's law, $\frac{V_x}{T_1} = \frac{V_2}{T_2}$ or $V_2 = \frac{v_xT_2}{T_1}$. Substituting the value of V_x from equation (i) we get $V_2 = \frac{P_1V_1}{P_2} \times \frac{T_2}{T_1}$, or $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$. Thus $\frac{PV}{T}$ = constant (K). This is known as combined gas laws. This can be used to calculate unknown variable. Knowing any five variables, the sixth can be calculated.

Alternative derivation for the gas equation: The ideal gas equation can be derived directly by combining Boyle's law, Charles's law and Avogadro's law as follows: According to Boyles's law, V α 1/P at constant T……. (i)

According to Charles's law, V α T at constant P …….. (ii)

According to Avogadro's law, V α n at constant T and P … (iii)

where 'n' is the number of moles of the gas. Combining equations (i), (ii) and (iii) we get: $V \alpha \frac{nT}{P}$ or PV α nT or PV = nRT where R is constant of proportionality and is known as molar gas constant. The value of R is same for all gases. Therefore, it is also called universal gas constant. For 1 mole of the gas, the ideal gas equation becomes PV = RT. A gas that obeys ideal gas equation exactly is called an ideal gas. An ideal gas equation is also called the equation of state because it defines the state of the gas completely when all the variables have been specified.

Ideal gas equation in terms of density (relationship between molar mass and density of gas): Molar mass of an ideal gas can be calculated from the gas equation as: PV = nRT or $P = \frac{nRT}{V}$. Now, number of moles (n) = $\frac{Mass\ of\ substance\ (m)}{Molar\ mass\ (M)}$ ∴ $P = \frac{m}{M} \times \frac{RT}{V}$. But mass per unit volume is density i.e., $\frac{m}{V} = d$, ∴$P = \frac{dRT}{M}$ or $M = \frac{dRT}{P}$. This expression can be used for the calculation of molecular mass of a gaseous substance.

Nature and values of the gas constant R: In order to understand the significance of R, let us examine the nature of quantities in the ideal gas equation: PV = nRT or $R = \frac{PV}{nT}$ i.e., $R = \frac{Pressure \times Volume}{moles \times Temperature}$ (pressure = force/ area, area = $(length)^2$ and volume = $(length)^3$)

$$\therefore R = \frac{force \times length^3}{length^2 \times moles \times temperature} = \frac{force \times length}{moles \times temperature}$$

$$= \frac{work}{moles \times temperature}$$ (force x length = work) .

So R = work done per degree per mole. Thus, R may be expressed in different units depending upon the units of work.

Numerical value of the gas constant (R):

(i) At N.T.P conditions, for 1 mole of the gas, P = 1 atmosphere, V = 22.4 litres, T = 273K, n = 1 mole. ∴ $R = \frac{P \times V}{n \times T} = \frac{1atm \times 22.4L}{1mole \times 273K}$ = 0.0821 litre-atmosphere K^{-1} $mole^{-1}$. If V = 22400cm^3(ml) , R = 82.1 cm^3 atmosphere $K^{-1}mol^{-1}$.

(ii) When pressure is expressed as Pa and volume in m^3, then R is expressed as Joule K^{-1} mol^{-1}. We know that one mole of a gas at S.T.P (1bar pressure and 273K) occupies a volume of $22.7\times10^{-3}m^3$.

$$R = \frac{P \times V}{n \times T} = \frac{105\ Pa \times 22.7\times10^{-3}\ m^3}{1\ mol \times 273.15K} = \frac{105 Nm^{-2} \times 22.7\times10^{-3}\ m^3}{1mol \times 273.15K}$$

$= 8.314 Nm\ mol^{-1}K^{-1}$ $= 8.314 J\ mol^{-1}K^{-1}$ (Nm = 1 J)

$= 2\ cal\ mol^{-1}K^{-1}$ (4.184J = 1 calorie)

(iii) When pressure is expressed as Pa and volume in dm^3, then R is expressed in SI units, put P = 1bar =

101325Pa, V = 22.4 ×10^{-3} m^3 = 22.4 dm^3 , T = 273K , R = $\frac{101.325kPa \times 22.4\ dm^3}{1mol \times 273\ K}$ = 8.314k Pa dm^3 K^{-1} mol^{-1}

(iv) When pressure is expressed in bar and volume in dm^3, then R is expressed as bar dm^3 mol^{-1} K^{-1}. We know that 1 mol of a gas at S.T.P (1 bar pressure, 273.15) occupies 22.7 dm^3. Then, R= $\frac{1\ bar \times 22.7\ dm^3}{1mol \times 273.15K}$ = .0831 bar dm^3mol^{-1} K^{-1}

Value of universal gas constant R in different units

Units of volume (V)	Required units of pressure	Value of constant (R)
Litres or dm^3	Atmosphere	0.0821 L atmosphere $K^{-1}mol^{-1}$ or 0.0821 dm^3atmosphere K^{-1} mol^{-1}
cm^3 or ml^3	Atmosphere	8.21 cm^3 atmosphere K^{-1} mol^{-1}
dm^3	Bar	0.08314 dm^3 bar K^{-1} mol^{-1}
m^3	Pa	8.314 Pa m^3 K^{-1} mol^{-1}
m^3	Nm^{-2}	8.314 Nm K^{-1} mol^{-1} or 8.314JK^{-1} mol^{-1} (Nm = J) or 2 cal mol^{-1} K^{-1} (4.184 J = 1calorie)
cm^3	Dynes/ sq. cm	8.314 x 10^7 ergs $degree^{-1}$ mol^{-1} or 8.314 J$degree^{-1}$ mol^{-1} (10^7 ergs = 1 joules)

It may be noted that although R may be expressed in different units, but for pressure –volume calculations, R must be taken in the same units as those used for pressure and volume.

Numerical 1- A sample of nitrogen occupies a volume of 1.0 L at a pressure of 0.5bar at 40°C. Calculate the pressure if the gas is compressed to 0.225 ml at -6°C.

Solution: P_1 = 0.5bar , P_2 = ? , V_1 = 1.0L, V_2 = 0.225ml, T_1 = 273+40=313K, T_2 = 273-6= 267K According to gas equation – $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$,

$P_2 = \frac{P_1V_1}{T_1}\frac{T_2}{V_2} = \frac{o.5bar \times 1.0L \times 267K}{313K \times 0.225 \times 10^{-3}L}$ = 1895.6 bar

Numerical 2 – Calculate the moles of hydrogen (H_2) present in a 500ml sample of hydrogen gas at a pressure of 1 bar and 27°C.

Solution – According to ideal gas equation, PV = nRT , P= 1 bar, V = 500ml = 500X 10^{-3} dm^3, T = 27+273 = 300K, R = 0.083 bar $dm^3K^{-1}mol^{-1}$ .Now, n = $\frac{PV}{RT}$ = $\frac{1\ bar \times 500 \times 10-3\ dm3}{0.083\ bar\ dm^3\ mol^{-1}\ K^{-1} \times 300K}$ = 0.0201 mol = 2.01x 10^{-2} mol.

Numerical 3- Calculate the mass of 120 ml of N_2 at 150°C and 1 x 10^5 Pa pressure.

Solution-According to ideal gas equation, PV= nRT = $\frac{mRT}{M}$ [mole (n) = $\frac{mass\ (m)}{molecular\ mass\ (M)}$] m = $\frac{PVM}{RT}$, P= 10^5 Pa = 10^5 Nm^{-2}, V = 120X $10^{-6}m^3$, M = 28, T = 273+150°C = 423K , R =8.314 Nm K^{-1} mol^{-1} Mass of gas, m = $\frac{105N\,m^{-2} \times 120 \times 10-6\ m^3 \times 28}{8.314\ Nm\ mol^{-1}\ K^{-1} \times 423K}$ = 0.0955g

Numerical 4- The density of a gas at 27°C and 1 bar pressure is 2.56 g/L. Calculate the molar mass.

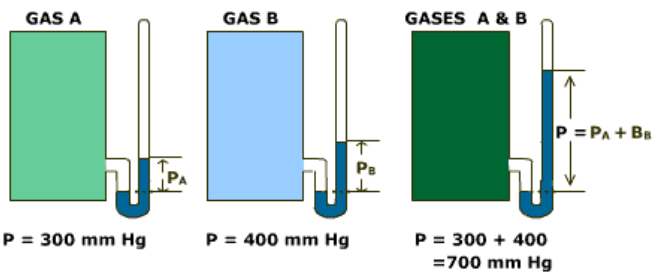
Solution- we are given P = 1.0 bar, T = 27+273 = 300K, d = 2.56g/L or 2.56 g/dm^3 . We know that M = $\frac{dRT}{P}$ = $\frac{2.56g}{dm^3} \times \frac{0.083bar\ dm^3}{mol \times K} \times \frac{}{1\ bar} \times 300K$ = 63.74 g/mol [R=0 .083 bar dm^3mol^{-1} K^{-1}]

Numerical 5-Calculate the density of ammonia (NH_3) at 30°C and 5 bar pressure.

Solution- PV =nRT or P=$\frac{m}{v} \times \frac{RT}{M} = \frac{dRT}{M}$ d = $\frac{PM}{RT}$ = $\frac{5\ bar \times \frac{17g}{mol}}{0.083\ bar\ dm^3 mol^{-1}\ K^{-1} \times 303K}$ = 3.37g/dm^3

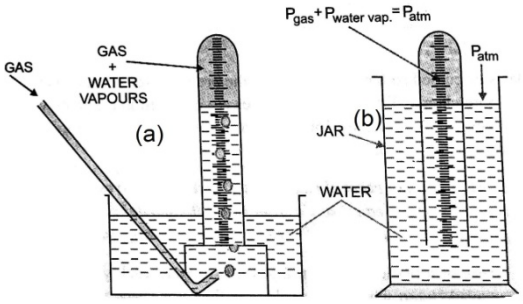
Dalton's law of partial pressure:- This law was formulated by John Dalton in 1801. It deals with the pressure exerted by a mixture of non-reacting gases enclosed in a vessel. Dalton's law of partial pressure stated that the total pressure exerted by a mixture of two or more non-reacting gases in a definite volume is equal to the sum of the individual pressures which each gas would exert if it occupies the same volume alone at a constant temperature. For example, if p_1, p_2, p_3 ..... are individual pressures of gases known as partial pressures, then the total pressure P_{total} of the mixture of gases at the same temperature is given by the following relation: $P_{total} = p_1 + p_2 + p_3 + ...$ The partial pressure of each gas means the pressure which that gas would exert if present alone in the vessel at the same temperature as that of the mixture.

Illustration of the Dalton's law of partial pressures:- To demonstrate the law, let us consider three vessels each of 1 litre capacity. Let the first vessel contains a gas 'A' having a pressure 300 mm Hg and the second contains a gas 'B' having a pressure 400 mm Hg. Now, if we put both the gases A and B in the third vessel at the same temperature, the total pressure in the third vessel would be $P_{total} = P_A + P_B$ = 300+ 400 =700mm Hg.



Partial pressure in terms of mole fraction:- Mole fraction is a method of expressing concentration of a substance in a mixture as a fraction of total moles of all substances. If n_1 moles of any substance are present in n moles of the mixture, then mole fraction x_1 of the substance, $x_1 = \frac{n_1}{n}$, for example, for a mixture of two substances A + B having moles n_A and n_B respectively, then their mole fractions are: $x_A = \frac{n_A}{n_A+n_B}$ or $x_B = \frac{n_B}{n_A+n_B}$. Suppose at temperature T, three gases enclosed in the volume V exert partial pressure P_1, P_2, P_3 respectively, then, $P_1 = \frac{n_1RT}{V}$, $P_2 = \frac{n_2RT}{V}$, $P_3 = \frac{n_3RT}{V}$ where n_1, n_2 and n_3 are the number of moles of these gases. Thus, $P_{total} = P_1 + P_2 + P_3 = n_1\frac{RT}{V} + n_2\frac{RT}{V} + n_3\frac{RT}{V} = \frac{RT}{V}(n_1 + n_2 + n_3)$. On dividing P_1 by P_{total}, we get $\frac{P_1}{P_{total}} = (\frac{n_1}{n_1+n_2+n_3})\frac{RT}{V}X\frac{V}{RT}$ but $\frac{n_1}{n_1+n_2+n_3} = \frac{n_1}{n} = x_1$ (because $n_1 + n_2 + n_3$ = total number of moles =n) where x_1, is the mole fraction of first gas. Thus, $\frac{P1}{Ptotal} = x_1$ or $P_1 = x_1 \; x \; P_{total}$. Similarly for other two gases, $P_2 = x_2 \; x \; P_{total}$, $P_3 = x_3 \; x \; P_{total}$. In general, for i^{th} gas having partial pressure P_i and mole fraction x_i, we have $P_i = x_i \; x \; P_{total}$. Thus, if total pressure of a mixture of gases is known, then the above equation can be used to calculate pressure exerted by individual gases. Thus, the partial pressure of gas in the mixture is the product of its mole fraction and total pressure of the mixture.

Application of Dalton's law:- In the determination of pressure of a dry gas, whenever a gas is collected over water, it is moist i.e., it is saturated with water vapors which exert their own pressure. The pressure due to water vapors is called aqueous tension. The mixture of gas and water vapors have a total pressure equal to atmospheric pressure when the water level is same inside and outside the vessel. For example, oxygen gas is collected over water as shown in figure.



When the water level inside the container becomes equal to outside level then, $P_{atm} = P_{total}$ (equal to pressure of gas + water vapours) $= P_{Oxygen\ gas} + P_{H2O}$, $\therefore P_{O2} = P_{atm} - P_{H2O}$ (P_{Water} = pressure due to water vapours is called aqueous tension) , $P_{Dry\ gas} = P_{Moist\ gas}$ – aqueous tension (t°C).

Numerical 1 – 135 ml of a gas is collected over water at 25°C and 0.993 bar. If the gas weighs 0.160g and the aqueous tension at 25°C is 0.0317, calculate the molar mass of the gas.

Solution: $P_{gas} = P_{total} - P_{H2O}$, $P_{total} = 0.993$ bar, $P_{H2O} = 0.0317$ $\therefore P_{gas} = 0.993 - 0.0317 = 0.9613$ bar , Now, $PV = nRT$ but $n = \frac{m}{M}$, $PV = \frac{m}{M}RT$ or $M = \frac{mRT}{PV}$, m = 0.160g, V= 135 ml = 0.135dm^3,T= 273+ 25 = 298K,

P = 0.09613 bar, R = 0.083 bar dm^3 $mol^{-1}K^{-1}$, substituting the values,

$$M = \frac{0.160g \times 0.083bar\ \ dm^3\ mol^{-1}\ K^{-1} \times 298K}{0.9613\ bar\ \times o.135\ \ dm^3} = 30.49 g\ mol^{-1}$$

Numerical 2- Calculate the total pressure in a mixture of 8g of oxygen and 4g of hydrogen confined in a vessel of 1 dm^3 at 27°C (R= o.o83 bar $dm^3K^{-1}mol^{-1}$)

Solution:- Partial pressure of oxygen gas – $P = \frac{nRT}{V}$, n = 8/32 = ¼ mol , V =1 dm^3 , T = 273 +27 =300K

$P_{O2} = \frac{1 \times .083 \times 300}{4 \times 1} = 6.225$ bar. Partial pressure of hydrogen gas- $P = \frac{nRT}{V}$, n = 4/2= 2 mol, $P_{H2} = \frac{2 \times .083 \times 300}{1} =$ 49.8 bar

Total pressure = $P_{O2} + P_{H2} = 6.225 + 49.8 = 56.025$ bar

ASSIGNMENT

1. For an ideal gas, number of moles per litre in terms of its pressure p, gas constant R and temperature T is (a) $\frac{pT}{R}$ (b) pRT (c) p/RT (d) RT/p
2. The pressure and temperature of 4 dm^3 of carbon dioxide gas are doubled. Then the volume of carbon dioxide gas would be-
   (a) $2dm^3$ (b) $3dm^3$ (c) $4dm^3$ (d) $8dm^3$
3. In the gas equation PV = nRT, the value of universal gas constant would depend only on
   (a) the nature of the gas
   (b) the pressure of the gas
   (c) the temperature of the gas
   (d) the units of measurement.

4. 8.2 L of an ideal gas weight 9.0 g at 300K and 1 atmosphere pressure. The molecular mass of gas is-
(a) 9 (b) 27 (c) 54 (d) 81

5. A 0.5 dm^3 flask contains gas 'A' and 1dm^3 flask contains gas 'B' at the same temperature. If density of A is 3.0 g/dm^3 and that of 'B' is 1.5g/dm^3 and the molar of A is ½ of B, then the ratio of pressure exerted by gases is
(a) $P_A/P_B = 2$ (b) $P_A/P_B = 1$
(c) $P_A/P_B = 4$ (d) $P_A/P_B = 3$

6. The density of a gas is equal to-
(a) nP (b) PM/RT (c) P/RT
(d) M/V
(Here, P = pressure, T= temperature, V = volume, R = gas constant, n = number of moles and M= molecular weight)

7. The value of gas constant R is 8.314 X. Here X is represents ……
(a) Litre atmosphere$K^{-1}mole^{-1}$
(b) cal mol^{-1} K^{-1}
(c) $JK^{-1}mol^{-1}$
(d) none of these.

8. The value of gas constant per mole approximately is –
(a) 1 cal (b) 2 cal (c) 3 cal (d) 4 cal

9. When the pressure of 5L of N_2 is doubled and its temperature is raised from 300K to 600K, the final volume of the gas would be –
(a) 10L (b) 5L (c) 15L (d) 20L

10. If the density of a gas A is 1.5 times that of B then the molecular mass of A is M. The molecular mass of B will be-
(a) 1.5 M (b) M/1.5 (c) 3M (d) M/3

11. A cylinder is filled with a gaseous mixture containing equal masses of CO and N_2. The ratio of their partial pressure is -.
(a) $P_{N2} = P_{CO}$ (b) $P_{CO} = 0.875\ P_{N2}$
(c) $P_{CO} = 2P_{N2}$ (d) $P_{CO} = ½\ P_{N2}$

12. At room temperature Dalton's law of partial pressure is not applicable to –
(a) H_2 and N_2 mixture (b) H_2 and Cl_2 mixture
(c) H_2 and CO_2 mixture (d) none of these.

13. The total pressure of a mixture of two gases is -
(a) the sum of partial pressure of each gas
(b) the difference in partial pressures
(c) the product of partial pressure
(d) the ratio of partial pressures.

14. Equal masses of SO_2, CH_4 and O_2 are mixed in empty container at 298K, when total pressure is 2.1 atmospheres. The partial pressure of CH_4 in the mixture is –
(a) 0.5atm (b) 0.75atm
(c) 1.2atm (d) 0.6atm

15. Air contains 79% N_2 and 21%O_2 by volume. If the pressure is 750 mm of Hg, the partial pressure of O_2 is
(a) 157.5mm of Hg (b) 175.5 mm of Hg
(c) 315.0 mm of Hg

ANSWERS TO THE ASSIGNMENTS

1 (c)	2 (c)	3 (d)	4 (b)	5 (c)	6 (b)	7 (c)	8 (b)	9 (b)	10 (b)
11 (a)	12 (b)	13 (a)	14 (c)	15 (a)	-	-	-	-	-

Author is M.Sc. (Chem.), M.Ed. and Advanced Diploma in German Language (Gold Medallist). She retired as a Principal, Govt. School Haryana, has 3-1/2 years' experience in teaching Chemistry and distance teaching through lectures on Radio and Videos. She has volunteered to complement mentoring of students for Chemistry through Online Web-enabled Classes of this initiative

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SCIENCE QUIZ December-2018

Kumud Bala

1. If a body covers a full circle then displacement is -.
   (a) 1 (b) 0 (c) distance (d) not sufficient

2. What is latent heat of fusion of ice?
   (a) 333.55kJ/Kg (b) 540kJ/Kg
   (c) 300kJ/Kg (d) 233.44kJ/Kg

3. Golgi apparatus helps in cell division.
   (a) True (b) False

4. Ribosome makes
   (a) Lipids (b) Fats
   (c) Protein (d) starch

5. A substance that can't be broken down into simpler substances using any chemical means is:
   (a) An element (b) A compound
   (c) A mixture (d) A colloid

6. Measurable or numerical information is called:
   (a) Qualitative data (b) Quantitative data
   (c) A variable (d) A hypothesis

7. What is true of a balanced chemical equation?
   (a) There are always more products than reactants
   (b) The number of moles of products equals the number of reactants
   (c) Both sides of the reaction have the same number and types of atoms
   (d) Energy is always released.

8. The stage in which the storage of food and synthesis of materials take place inside the cell just before the cell division is called –
   (a) Telophase (b) Inner phase
   (c) Prophase (d) Metaphase

9. Which of the following is made use of to open the tightened lid of a bottle?
   (a) Superficial expansion (b) Linear expansion
   (c) Thermal expansion (d) Cubical expansion

10. Centriole is associated with –
    (a) Reproduction (b) DNA synthesis
    (c) Respiration (d) Spindle fibre formation

11. Reproduction is essential for living organisms in order to-
    (a) Keep the individual organ alive
    (b) Fulfill their energy requirements
    (c) Maintain growth
    (d) Continue the species for ever

12. A simple multicellular animal having tentacles living in fresh water usually reproduces by the a sexual process of –
    (a) Binary fission (b) Spore formation
    (c) Budding (d) Fragmentation

13. The rapid spreading of bread mould on slices of bread are due to:
    A. Presence of large number of spores in air
    B. Presence of large number of thread-like branched hyphae
    C. Presence of moisture and nutrients
    D. Formation of round shaped sporangia:

    (a) (A) and (C) (b) (B) and (D)
    (c) (A) and (B) (d) (C) and (D)

14. Right part of the human heart contains –
    (a) Oxygenated blood
    (b) Mixed blood
    (c) Deoxygenated blood
    (d) No blood

15. Which of these is not a raw material for photosynthesis?
    (a) Carbon dioxide (b) Water
    (c) Oxygen (d) None of these

16. Which life process converts chemical energy into heat energy?
    (a) Nutrition (b) Respiration
    (c) Excretion (d) Transpiration

17. Which of the following has the longest small intestine?
    (a) Carnivore (b) Omnivore
    (c) Herbivore (d) Autotroph

18. Pancreatic juice contains enzymes which digest:
    (a) Proteins and carbohydrates only
    (b) Proteins and fats only
    (c) Fats and carbohydrates only
    (d) Proteins, fats and carbohydrates
19. Gypsum can be obtained from plaster of Paris:
    (a) By dehydrating it
    (b) By moisturizing it
    (c) By heating it
    (d) It is not possible
20. More the pH of a solution less the –
    (a) Concentration of H^+ (b) Concentration of H
    (c) Concentration of OH^- (d) Both (a) and (b)

(Answers to this Science Quiz December'18 shall be provided inMonthly e-Bulletin dt. 1st January'19)

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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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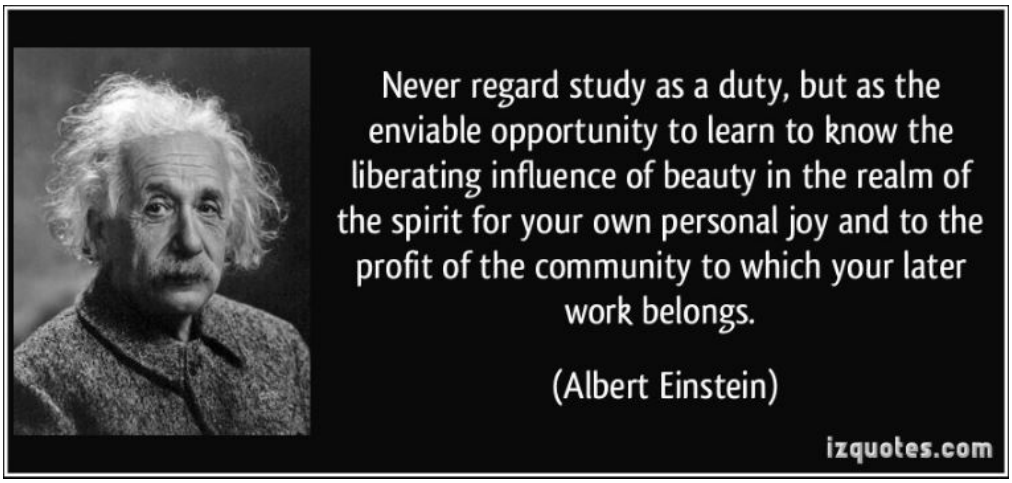

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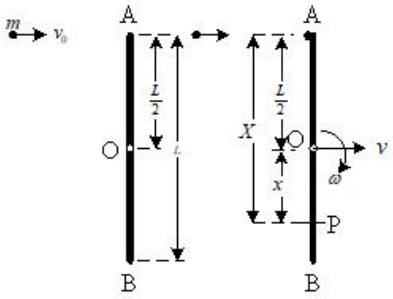
Mechanics of Rigid Bodies : Illustrations of Subjective Questions (Typical)

I-01



In the given problem given that (a) there is no external force, (b) collision is elastic and (c) after collision particle comes to rest an hence linear omentum of the system shall be conserved. Accordingly, $m\times v_0 + M\times 0 = m\times 0 + M\times v \rightarrow m\times v_0 = M\times v \rightarrow \frac{m}{M}=\frac{v}{v_0}$. To define the ratio, relationship between the velocities v_0 and v is needed which can be obtained from other conditions specified in the problem.

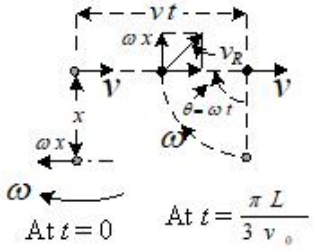
In absence of external force, there is no torque on the rod and, therefore, principle of conservation of angluar momentum shall also apply. Thus,change in angular momentum of the particle, during the collision about O, $\Delta\vec{L}_p = m\left(\frac{L}{2}j\right)\times\left(v_0\hat{i}\right)=\frac{mLv_0}{2}\left(-\hat{k}\right)$. While gain in angular momentum of the rod, , initialy at rest, is $\Delta\vec{L}_R = I\,\omega\left(-\hat{k}\right)=\frac{ML^2}{12}\omega\left(-\hat{k}\right)$, here (-)ve sign is since direction of rotation is clockwise and MOI of rod, about its COM O , is $I=\frac{ML^2}{2}$. Accordingly, $\Delta\vec{L}_p=\Delta\vec{L}_R\rightarrow\frac{mLv_0}{2}\left(-\hat{k}\right)=\frac{ML^2}{12}\omega\left(-\hat{k}\right)_0$. Thus, it leads to $mv_0 = ML\omega\rightarrow\frac{m}{M}=\frac{L\omega}{6v_0}$.

The given problem being of elastic collision principle of conservation of energy would also apply and hence, $\frac{1}{2}m{v_0}^2=\frac{1}{2}Mv^2+\frac{1}{2}\left(\frac{ML^2}{12}\right)\omega^2\rightarrow\frac{m}{M}{v_0}^2=v^2+\left(\frac{L^2}{12}\right)\omega^2$.

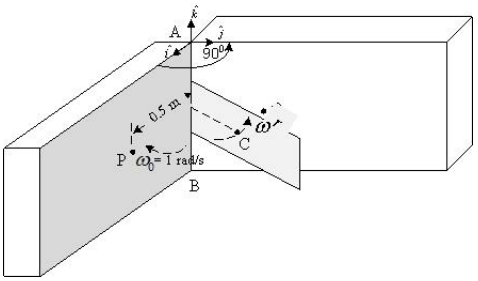
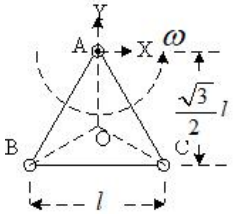
Using the above three ratio derived for $\frac{m}{M}=k$, it leads to $k{v_0}^2=\left(kv_0\right)^2+\left(\frac{L^2}{12}\right)\left(\frac{6kv_0}{L}\right)^2=k^2{v_0}^2+3k^2{v_0}^2$

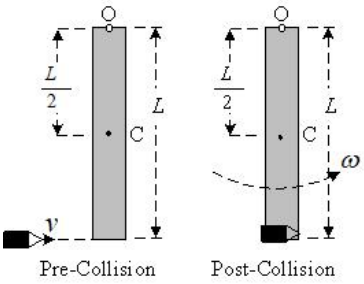
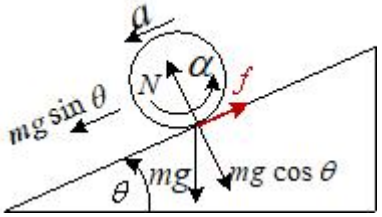
This reduces to $k{v_0}^2=4k^2{v_0}^2\rightarrow k=\frac{1}{4}\rightarrow\frac{m}{M}=\frac{1}{4}$, this is answer of part (a). Accordingly, from Conservation of linear momentum $v=\frac{1}{4}v_0=\frac{1}{4}v_0$, and $\left(\frac{L^2}{12}\right)\omega^2=\frac{1}{4}{v_0}^2-\left(\frac{1}{4}v_0\right)^2=\left(\frac{1}{4}-\frac{1}{16}\right){v_0}^2=\frac{3}{16}{v_0}^2\rightarrow\omega=\frac{3}{2}\left(\frac{v_0}{L}\right)$.

Let point P is at a distance x from O, the COM of the rod, therefore , it will have linear velocity a resultant of linear veocity acquired due to collision $v\left(+\hat{j}\right)$, and linear velocity due to angular motion of the rod $\vec{v}_{IP}=\omega\left(-\hat{k}\right)\times x\left(-\hat{j}\right)=\omega x\left(-\hat{i}\right)$. Fir farticle to be at rest $\vec{v}_P=0=v\hat{i}+x\omega\left(-\hat{i}\right)\rightarrow v=x\omega$. Thus using the values of v and ω derived above, $x=\frac{v}{\omega}=\frac{\frac{1}{4}v_0}{\frac{3}{2}\left(\frac{v_0}{L}\right)}=\frac{L}{6}$. Therefore, distance of point P from A, the point of collision, is $X=\frac{L}{2}+\frac{L}{6}=\frac{2}{3}L$, this is part (b) of the answer,



Part (c) of the answer requires to determine – (a) displacement of COM O is

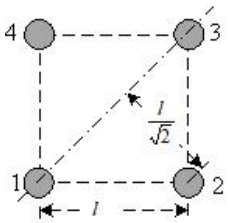
	$x = v \times t = \frac{v_0}{4}\left(\frac{\pi L}{3v_0}\right) = \frac{\pi L}{12}$ and angular dsplacement of rod is $\theta = \omega t = \frac{3}{2}\left(\frac{v_0}{L}\right)\left(\frac{\pi L}{3v_0}\right) = \frac{\pi}{2}$. Accordingly liear velocity of point point P would $v_R = \sqrt{v^2 + (\omega x)^2} = \sqrt{\left(\frac{v_0}{4}\right)^2 + \left(\left(\frac{3v_0}{2L}\right)\left(\frac{L}{6}\right)\right)^2} = \sqrt{\frac{v_0^2}{16} + \frac{v_0^2}{16}} = \frac{v_0}{\sqrt{8}} = \frac{v_0}{2\sqrt{2}}$, this part (c) of the answer.
I-02	Let us assume centre of mass of the laminar be at C at distance r from the line AB, as shown in the figure. Change in angular velocity od the laminar $\Delta\omega = (\omega - (-1))\hat{k} = (1+\omega)\hat{k}$ and, therefore, change in linear velocity of C is $\Delta\vec{v} = \Delta\vec{\omega} \times \vec{r} = (1+\omega) r\,\hat{j}$. Given that linear impulse of of the CM on P is $\Delta P = 6 = m\Delta v = 30(1+\omega)r$, therefore, $(1+\omega)r = \frac{6}{30} = \frac{1}{5}$.  Likewise, angular impulse, about line AB, caused by impact of the laminar on rubber stopper P would be $\Delta L = \Delta P(0.5) = I\Delta\omega \rightarrow 6(0.5) = (I_C + Mr^2)(1+\omega) \rightarrow 3 = (1.2 + 30r^2)(1+\omega)$. This with the vale of ΔP calculated above transforms into $3 = (1.2+30r^2)\left(\frac{1}{5r}\right) \rightarrow 30r^2 - 15r + 1.2 = 0$ is a quadratic equation with values of $r = \frac{15 \pm \sqrt{15^2 - 4\times 30 \times 1.2}}{2\times 30} = \frac{15 \pm \sqrt{225-144}}{60} = \frac{15 \pm 9}{60}$, i.e. $r = 0.4$ m, and $r = 0.1$ m. Testing these values of r, in equation of $\omega = \frac{1}{5r} - 1$, with $r = 0.4$ we get $\omega = \frac{1}{5\times 0.4} - 1 = 0.5 - 1 = 0.5$, which is not possible with given that the laminar rebounds. Alternately, with $r = 0.1$ we get $\omega = \frac{1}{5\times 0.1} - 1 = 2 - 1 = 1$ rad/s, Thus part (a) of the answer is $r = 0.1$ m , while part (b) of the answer is $\omega = 1$ rad/s. It is to be noted that the magnitude of the angular velocity of the laminar tre and post impact on P is 1 rad/s, i.e. it remains unchanged and hence, rotational kinetic energy of the laminar pre-/post-collision is $E = \frac{1}{2} I\omega^2 = \frac{1}{2}(1.2 + 30\times 0.1^2)1^2 = 0.75$ Joule, i.e. there is no loss of energy, and hence laminar would continue to impact on P and Q reversibly. This is part (c) of the answer.
I-03	The problem has two parts and is split in part (a) and (b). In part (a) uniform circular motion of the systems with an angular velocity ω sets in centrietal force on the hinge A. The COM of the system of three masses of mass m placed on vertices of an equliateral triangle of side l shall be at the centoid O at a distance $r = \frac{\frac{l}{2}}{\cos 30} = \frac{\frac{l}{2}}{\frac{\sqrt{3}}{2}}\frac{l}{\sqrt{3}}$. When, the system is having a uniform angular velocity,  the cetripetal force exterted by the hinge shall be $F_C = (3m)r\omega^2$. Accordingly, $F_C = 3m\frac{l}{\sqrt{3}}\omega^2 = \sqrt{3}ml\omega^2$,

	this part (a) of the answer. In part (b) the force F exerts a torque about hinge A causing an angular acceleration α such that $\vec{\tau} = \vec{d} \times \vec{F} = \left(\frac{\sqrt{3}}{2} l\left(-\hat{j}\right)\right) \times F\hat{i} = \frac{\sqrt{3}}{2} lF\hat{k}$, This system having MI is $I = m\left(0 + l^2 + l^2\right) = 2ml^2$ about A, will experience an angular acceeration α under infulence of the torque such that $\vec{\tau} = I\vec{\alpha} = 2ml^2\alpha\,\hat{k}$. Thus eqating two expressions of torque $\vec{\tau} = 2ml^2\alpha\,\hat{k} = \frac{\sqrt{3}}{2} lF\hat{k} \rightarrow \alpha = \frac{\sqrt{3}F}{4ml}$. Therefore, linear accelelarion of O, the COM of the system, when BC is parallel to X-axis as given, shall be $a_x = \alpha r = \left(\frac{\sqrt{3}F}{4ml}\right)\left(\frac{l}{\sqrt{3}}\right) = \frac{F}{4m}$ and, therefore, corresponding psuedo-force shall be $F_x = (3m)a_x = 3m\left(\frac{F}{4m}\right) = \frac{3F}{4}$. Since the only external force is F while F_{hx} is the reaction offered by the hinge, and therefore force equation $F + F_{hx} = F_x \rightarrow F_{hx} = F_x - F = \frac{3}{4}F - F = -\frac{F}{4}$. Thus forces offered by hinge, while BC is parallel to X-axis, along in a direction opposite to that of F, i.e, $F_{hx} = -\frac{F}{4}$ and force along Y-axis is the centripetal force $F_{hy} = F_C = \sqrt{3}ml\omega^2$. These $F_{hx} = \frac{F}{4}$ and $F_{hy} = \sqrt{3}ml\omega^2$ part (b) of the answer.
I-04	Pre-collision angular momentum of the bullet about O is $P_i = mLv$. Post-collision which is inelastic, let ω be the angular velocity of the rod hinged at O. Therefore, moment of inertia of thesystem about O is $I = \left(\frac{ML^2}{12} + M\left(\frac{L}{2}\right)^2\right) + mL^2 = \left(\frac{M}{3} + m\right)L^2$. Therefore, post collison angular momentum $P_p = I\omega$.. Thus as per principle of conservation of momentum $P_i = P_p \rightarrow mLv = \left(\frac{M + 3m}{3}\right)L^2\omega \rightarrow \omega = \frac{3mv}{(M + 3m)L}$. This is the answer. 
I-05	The cylinder experience a frictional force $f = \mu N = \mu mg\cos\theta$. Therefore, linear acceleration a of the cylinder would be such that $ma = mg\sin\theta - f$, it leads to $ma = mg\sin\theta - f \rightarrow a = g\sin\theta - \frac{f}{m}$. The frictional force would exert a torque about COM of the cylinder such that $\tau = rf$. And $\tau = I\alpha = \frac{mr^2}{2}\alpha$, therefore, combining the the Two equations $\tau = rf = \frac{mr^2}{2}\alpha \rightarrow \alpha = \frac{2f}{mr}$. Given that cylinder is rollig without slipping for which necessary condition is $a = r\alpha = r\left(\frac{2f}{mr}\right) = \frac{2f}{m}$. Thus, $\frac{2f}{m} = g\sin\theta - \frac{f}{m} \rightarrow \frac{3f}{m} = g\sin\theta \rightarrow \frac{f}{m} = \frac{g\sin\theta}{3}$. Using this value of $\frac{f}{m}$, the acceleration of cylinder is $a = g\sin\theta - \frac{g\sin\theta}{3} = \frac{2}{3}g\sin\theta$. N.B.: In the problem of pure rolling frictional force is anywhere between limiting values, and therefore such 

problems must be solved by taking variable f and accordingly determine angular acceleration α which in turn will determine angular velocity of rolling ω and linear velocity ω and linear acceleration a without slipping. Taking $f=\mu N$ in case of rolling would lead to wrong results. As such a careful observation must be made in statement of the problem.

I-06

Moment inertia of the system about any diagonal1-3 or 2-4, would be same due to symmetry. Accordingly, diagonal 1-3 is chosen for the solution, and $I=I_1+I_2+I_3+I_4$ .Moment of inerita of a sphere is $I=\frac{2}{5}MR^2$ and by symmetry $I_1=I_3=\frac{2}{5}\times 0.5\times\left(\frac{\sqrt{5}}{2}\times 10^{-2}\right)^2=\frac{1}{5}\times\frac{5}{4}=\frac{1}{4}=0.25\times 10^{-4}$ kg-m^2, and $I_2=I_4=I_1+M\left(\frac{l}{\sqrt{2}}\right)^2$

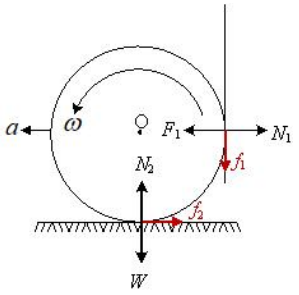


Using given values, $I_2=I_4=I_1+M\left(\frac{l}{\sqrt{2}}\right)^2=0.25\times 10^{-4}+0.5\times\frac{(0.04)^2}{2}=0.25\times 10^{-4}+\frac{\left(5\times 10^{-1}\right)\times\left(16\times 10^{-4}\right)}{2}$ It leads to $I_2=4.25\times 10^{-5}$. Therefore, $I=2I_1+2I_1=2\times 0.25\times 10^{-4}+2\times 4.25\times 10^{-4}=9\times 10^{-4}$ kg-m^2. Given that $I=N\times 10^{-4}$ kg-m^2, thus equating derived and given value $I=9\times 10^{-4}=N\times 10^{-4}$, therefore, $N=9$, this is the answer.

N.B.: Units of given quantities must be carefully converted, and this is the catch in extremely simple problem.

I-07

In the instant case rolling of ring without slipping is specified on ground but the probem is silent in respect of in repect of pure rolling between the stck and the ring. Therefore, frictional force between ring and the ground $f_2\leq\mu_2 N_2$, while $f_1=\mu_1 N_1$ to aloow for slipping between stick and the ring.



Moment of inertia of the ring is $I=MR^2$ Let F_1 is the push provided by the stick to the ring and, $F_1-f_2=Ma=2\times 0.3=0.6$ N .. **(a)** . Angular acceleration of the ring is caused by f_2 frictional reaction on the ring in backward direction due to friction on the road in direction of rolling. Whereas, at stick pushing the ring frictional force on the ring f_1 is downward. Thus net trque experienced by the ring is $\tau_2=(f_2-f_1)R=I\alpha=(MR^2)\left(\frac{a}{R}\right)\rightarrow(f_2-f_1)=Ma$. It leads to $Ma=F_1-f_2=f_2-f_1=0.6$ .. **(b)**.

Combining (a) and (b) we get $F_1-f_1=1.2\ldots$ **(c)**

Further, with the given data $F_1=N_1$ and thus $f_1=\mu_1 N_1=\left(\frac{P}{10}\right)N_1=(0.1P)F_1$ **...(d)** .Combining (c) and (d)

$F_1-(0.1P)F_1=1.2\rightarrow(1-0.1P)F_1=1.2\rightarrow F_1=\frac{1.2}{1-0.1P}\ldots$**(e).**

As regards the force applied by the stick is 2 N it has two components F_1 and f_1 such that $f_1^2+F_1^2=2^2$. It leads to $((0.1P)F_1)^2+F_1^2=4\rightarrow F_1^2=\frac{4}{1+0.01P^2}\ldots$.**(f)**

Combining (e) and (f) we get $\frac{4}{1+0.01P^2}=\left(\frac{1.2}{1-0.1P}\right)^2\rightarrow(1-0.1P)^2=(1+0.01P^2)(36\times 10^{-2})$. It leads to a quadratic expression $(0.06P)^2+0.2P-0.64=0\rightarrow 36\times 10^{-4}\times P^2+20\times 10^{-2}\times P-64\times 10^{-2}=0$. This can be simplified into $0.36\times P^2+20P-64=0$, it leads to $P=\frac{-20\pm\sqrt{20^2-4(0.36)(-64)}}{2\times 0.36}$. It further solves into

$$P=\frac{-20\pm\sqrt{400+92.16}}{0.72}=\frac{-20\pm\sqrt{492.16}}{0.72}=\frac{-20\pm\sqrt{492.16}}{0.72}=\frac{-20\pm22.185}{0.72}=\frac{2.185}{0.72}=3.03\approx3.$$

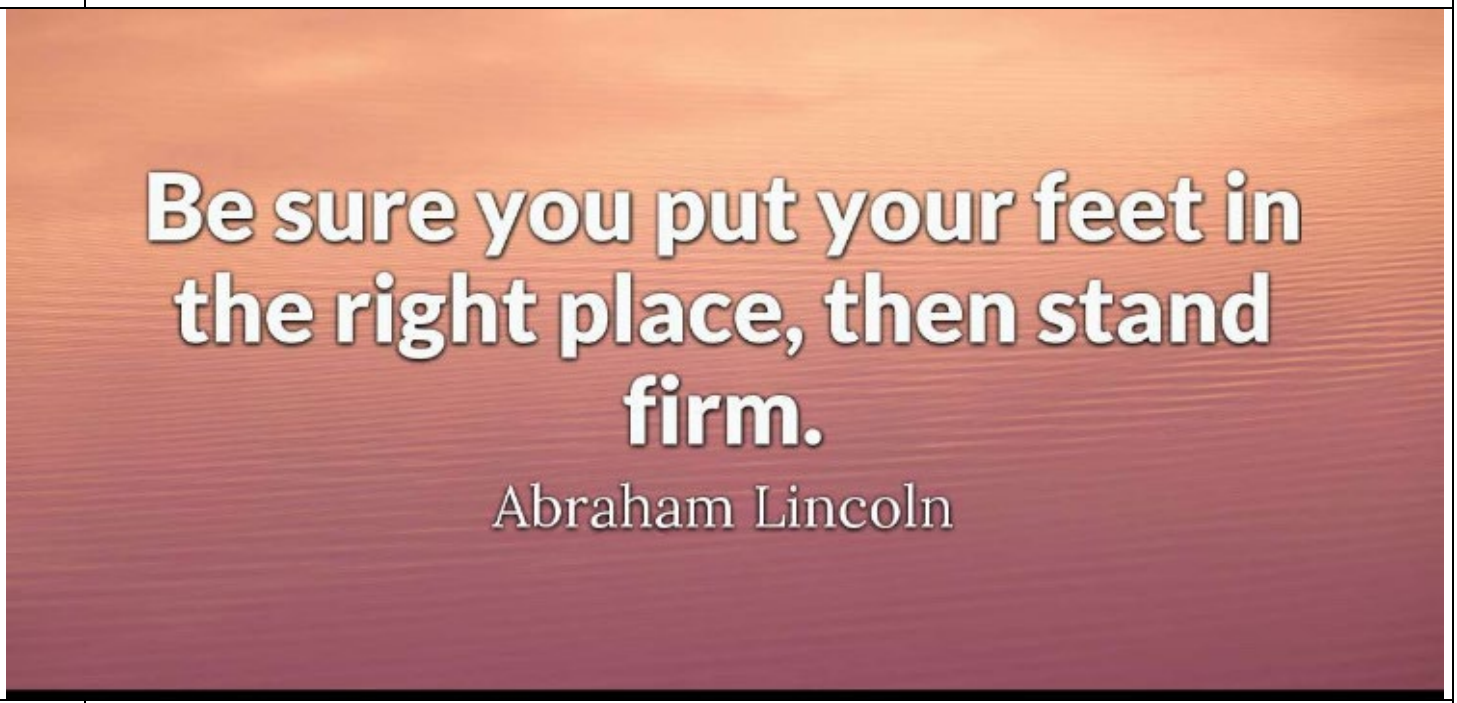
Thus value of $P=3$, is the answer.

N.B.: **(a)** The force of 2 N eis stated to be xerted by stick on the ring. It is resulting into push for rolling which is radially horizontal at the point of contact and frictional force which is tangential and vertically downward. Both these components of the 2 N force are variables shich satisfy the remaining conditions of the problem. Takimg this force to be simplistically horizontal is incorrect.

(b) Frictional force during rolling of this ring combines frictional forces on Two wheels of bicycle. Ring with the earth experiences frictional force in a direction backward (in direction of linear velocity of the at point of contact, similar to that of front (driven) wheel of the bicycle. While the ring with stick experiences force vertically downward (in direction opposite to that of the linear velocity of ring at the point of contact, similar to that of rear (driving) wheel of the bicycle. Thus this example beautiffuly combines frictional effect of two separate wheels of bicycle into a single ring.

(c) This involves many variables and hence equation, retaining them in algebric form for substituition of values at theend is liable for errors, and simplification in numeric form at each stage will make the solution simple.

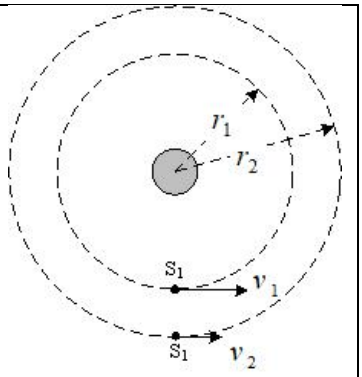
(d) In this problem numerical values over a wide range were involved and, therefore, it requires cautious handling and conversion of numerical values for ease of calculations.



I-08 The position of Two coplanar satellites of a planet orbitting in the same sense (clockwise), when they are closest, is shown in the figure. This is possible only when they are along the same radial. Given that radius of the orbit is 10^4 km while time period of both the orbits are $T_1=1$ hour and $T_2=8$ hours respectively.

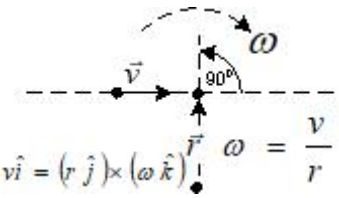
For a satellite of mass m to perform uniform circular motion around a planet of mass m in an orbit, necessary condition is $\frac{mv^2}{r}=G\frac{Mm}{r^2}\rightarrow v=\sqrt{\frac{GM}{r}}$ and time period of the revolution of the satellite is $T=\frac{2\pi r}{v}=\frac{2\pi r^{\frac{3}{2}}}{\sqrt{GM}}\propto r^{\frac{3}{2}}$. Accordingly for the two satellites $\frac{T_1}{T_2}=\left(\frac{r_1}{r_2}\right)^{\frac{3}{2}}\rightarrow\frac{1}{8}=\frac{\left(10^4\right)^{\frac{3}{2}}}{r_2^{\frac{3}{2}}}$ km. Therefore, $r_2=\left(2\times10^2\right)^{3\times\frac{2}{3}}=\left(2\times10^2\right)^2=4\times10^4$ km. Thus it is possible to determine velocity of each satellite

$v = \frac{2\pi r}{T}$. Accordingly, $v_1 = \frac{2\pi \times 10^4}{1} = 2\pi \times 10^4$ km/h and $v_1 = \frac{2\pi \times (4\times 10^4)}{8} = \pi \times 10^4$ km/h.



Thus relative is S_2 w.r.t. S_1 is $\vec{v}_{2,1} = v_2\hat{j} - v_1\hat{j} = (\pi\times 10^4 - 2\pi\times 10^4)\hat{j} = -\pi\times 10^4\,\hat{j}$. Thus magnitude of the relative velocity is $-\pi\times 10^4$ km/h i.e. in opposite sense, clockwise. This is the answer of part (a).

Part (b) of the question is actually requiring relative angular speed of S_2 w.r.t. S_1 at an instance they are closest to each other and in part (a) of the solution $v_{2,1}$ has been determined and $\vec{r} = \vec{r}_2 - \vec{r}_1 \rightarrow \vec{r} = 4\times 10^4\hat{i} - 10^4\hat{i} = 3\times 10^4\hat{i}$, hence $\vec{\omega}_{2,1} = \vec{r}\times\vec{v}_{2,1}$. Since at the given instant $\vec{v}_{2,1}$ and $\vec{r}$ are perpendicular, and division of vectors is not valid, hence using scalar division magnitude of $\omega = \frac{v_{2,1}}{r} = \frac{\pi\times 10^4}{3\times 10^4} = \frac{\pi}{3}$ rad/hour which translates into standard unit $\frac{\pi}{3\times 60\times 60} = 3.0\times 10^{-4}$ rad/s. This is part (b) of the answer.

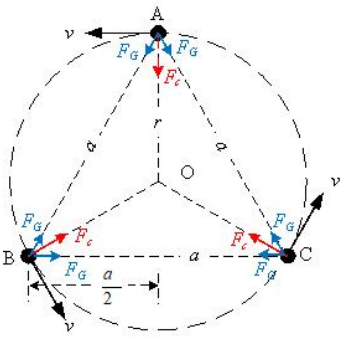


N.B.: **(a)** It is to be noted that standard concept of angular velocity needs to be applied instead of $\vec{\omega}_{2,1} = \vec{\omega}_2 - \vec{\omega}_1$ which is not applicable in anguar velocities.

(b) In, vector analysis multiplication of vector is valid but division of vector is invalid, accordingly $\vec{v} = \vec{r}\times\vec{\omega}$ and hence $v = r\,\omega\sin\theta$. But, when v, r and θ are known then by scalar division $\omega = \frac{v}{r\sin\theta}$ and direction vectors of angular velocity is $\hat{\omega} = \hat{v}\times\hat{r}$. Likewise, $r = \frac{v}{\omega\sin\theta}$ while $\hat{r} = \hat{\omega}\times\hat{v}$.

I-09

The system of three particles A, B, and C each of mass m positioned one at each of the vertices of an equilateral triangle of side a, is set in a motion with a uniform speed v. During the motion seperation between particles remains unchanged. Thus centripetal force on each of the particle is $F_C = \frac{mv^2}{r}$. By geometry of equilateral triangle $\frac{a}{2} = r\cos 30^0 = r\frac{\sqrt{3}}{2} \rightarrow r = \frac{a}{\sqrt{3}}$. Therefore, $F_C = \frac{mv^2}{\frac{a}{\sqrt{3}}} = \frac{\sqrt{3}mv^2}{a}$. This centripetal force is contributed by gravitational pull $F_G = G\frac{m^2}{a^2}$ on each particle by other two particles. Resultant force of the two F_G on any particle is along the bisector of the angles of the vector and $F_R = 2F_G\cos 30^0 = 2F_G\frac{\sqrt{3}}{2} = \sqrt{3}F_G = \frac{\sqrt{3}Gm^2}{a^2}$. For the system to be moving along the circle continuously necessary condition is $F_C = F_G \rightarrow \frac{\sqrt{3}mv^2}{a} = \frac{\sqrt{3}Gm^2}{a^2} \rightarrow v = \sqrt{\frac{Gm}{a}}$, this is art (a) of the answer.



The time period of the circular motion is $T = \frac{2\pi r}{v} = \frac{\frac{2\pi a}{\sqrt{3}}}{\sqrt{\frac{Gm}{a}}} = 2\pi\sqrt{\frac{a^3}{3GM}}$, this is part (b) of the answer.

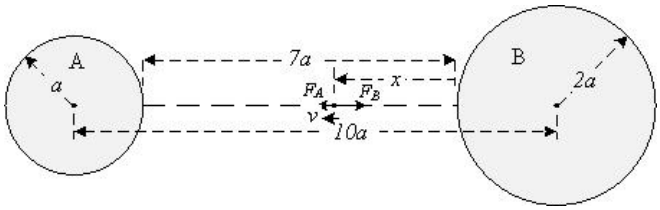
I-10

Escape velocity of a satellite is from kinetic energy of the satellite required on the surface of the earth to take it beyond gravitational field of the earth. Accordingly, $\frac{1}{2}mv^2 = \int_R^\infty \frac{GMm}{r^2}dr = -GMm\left[\frac{1}{r}\right]_0^\infty = \frac{GMm}{R}$. It leads to $v = \sqrt{\frac{2GM}{R}}$.

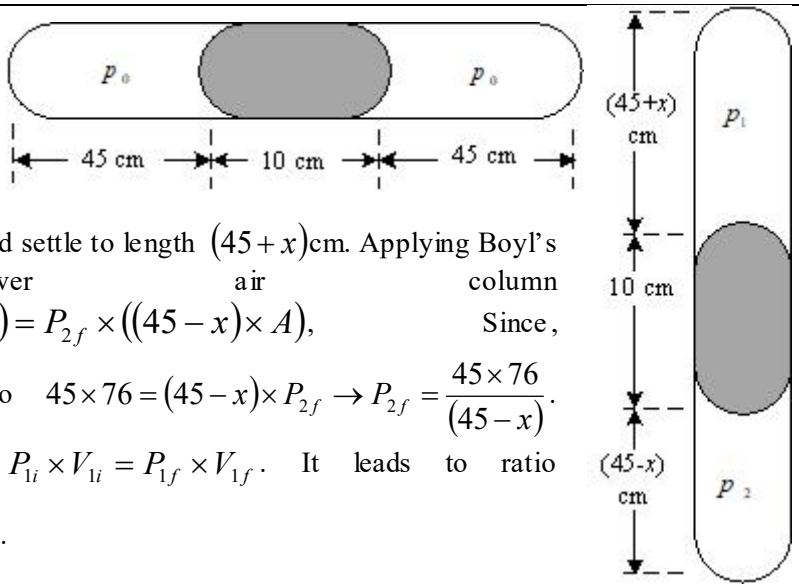
Given that the satellite is revolving around the earth by a velocity $v_0 = \frac{v}{2} = \frac{\sqrt{\frac{2GM}{R}}}{2} = \sqrt{\frac{GM}{2R}}$, at a height h above the surface of the earth. Thus radius of the orbit $r = R + h$.

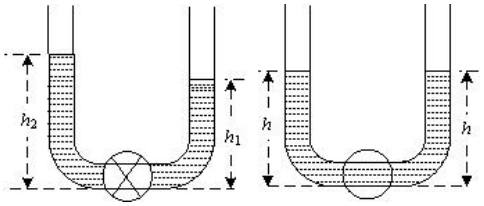
In this orbit balance centripetal and gravitational forces is $F_C = F_G \rightarrow \frac{mv_0^{\,2}}{r} = \frac{GMm}{r^2} \rightarrow \left(\sqrt{\frac{GM}{2R}}\right)^2 = \frac{GM}{r}$. It leads to $\frac{GM}{2R} = \frac{GM}{r} \rightarrow r = 2R = R + h \rightarrow h = R$. Since radius of the earth's surface is 6400 km hence h=6400 km, this is part (a) of the answer.

When the satellite is suddenly stopped potential energy of the satellite in the orbit would convert into kinetic energy and corresponding velocity. Accordingly, $\frac{1}{2}mV^2 = \int_R^{2R} \frac{GMm}{r^2}dr = -GMm\left[\frac{1}{r}\right]_R^{2R} = GMm\left[\frac{1}{R} - \frac{1}{2R}\right]$, it

	leads to $\frac{V^2}{2}=\frac{GM}{2R}=\left(\frac{GM}{R^2}\right)\left(\frac{R}{2}\right)=\frac{gR}{2}\rightarrow V=\sqrt{gR}=\sqrt{10\times6400\times10^3}=\sqrt{8^2\times10^6}=8\times10^3$ m/s or 8 km/s. this is part (b) of the answer.
I-11	Let, a body of mass m is projected with a velocity V from the surface of the star B towards A it shall have kinetic energy $KE=\frac{1}{2}mV^2$. During travel from star B to A at any distance x from surface of the star net force o the body is $F=F_B-F_A$, here $F_B=\frac{G\times16M\times m}{(2a+x)^2}$ and $F_A=\frac{G\times M\times m}{(10a-(2a+x))^2}$.  Therefore, $F=GM\,m\left(\frac{16}{(2a+x)^2}-\frac{1}{(8a-x)^2}\right)$. When the body projected from B towards A there will be a point P where $F=0\rightarrow\frac{16}{(2a+x)^2}=\frac{1}{(8a-x)^2}$,and it leads to $4^2(8a-x)^2=(2a+x)^2\rightarrow4(8a-x)=(2a+x)\rightarrow5x=30a\rightarrow x=6a$. Once this particle travels a distance , it will be at brink of gravitational field of A and a slightest displacement towar it would make it reach A like a free-fall under gravity. There, net work done for on the particle shall have to be $W=\int_0^{6a}Fdx$. It resolves into $W=\int_0^{6a}GM\,m\left(\frac{16}{(2a+x)^2}-\frac{1}{(8a-x)^2}\right)dx=GMm\left(\int_0^{6a}\frac{16}{(2a+x)^2}dx-\int_0^{6a}\frac{1}{(8a-x)^2}dx\right)=-GMm\left[\frac{16}{(2a+x)}-\frac{1}{(8a-x)}\right]_0^{6a}$ It resolves into $W=-GMm\left[\left(\frac{16}{(2a+6a)}-\frac{1}{(8a-6a)}\right)-\left(\frac{16}{(2a)}-\frac{1}{(8a)}\right)\right]=-\frac{GMm}{a}\left[\left(2-\frac{1}{2}\right)-\left(8-\frac{1}{8}\right)\right]$, which is further simplified into $W=-\left(\frac{GMm}{a}\right)\left(\frac{3}{2}-\frac{64-1}{8}\right)=\left(\frac{GMm}{a}\right)\left(\frac{63}{8}-\frac{3}{2}\right)$. It further simplifies into $=\frac{63-12}{8}\left(\frac{GMm}{a}\right)=\frac{51}{8}\left(\frac{GMm}{a}\right)$ Equating the two energies $\frac{1}{2}mV^2=\frac{102}{8}\left(\frac{GMm}{a}\right)$, it further simplifies to $V^2=\frac{51}{4}\left(\frac{GMm}{a}\right)\rightarrow V=\frac{\sqrt{51}}{2}\sqrt{\left(\frac{GMm}{a}\right)}$ m/s, this is the answer.
I-12	Escape energy of the projectile is $E=\frac{1}{2}mV_e^{\,2}=\frac{GMm}{R}$, thus $V_e=\sqrt{\frac{2GM}{R}}$. When the projectile is fired from the bottom of the crator with a velocity V_e, to reach the highest point, the kinetic energy is utilized in two parts – (a) work done W_{AB} in moving the projectile from A to B within the moon, i.e. inside the crator and (b) work done W_{BC} in moving the projectile from B to C above the moon. Thus as per energy conservation of energy $E=W_{AB}+W_{BC}$.

	Gain in potential energy by projectile from B to C is $W_{BC}=\int_{R}^{R+h}F_r dr$. It resolves into $W_{BC}=\int_{R}^{R+h}\frac{GMm}{r^2}dr=\left[-\frac{GMm}{r}\right]_{R}^{R+h}=\left[\frac{GMm}{R}-\frac{GMm}{R+h}\right]$. As regards gain in potential energy by projectile from A to B is $W_{AB}=\int_{\frac{99R}{100}}^{R}F_x dx$, here $F_x=\frac{GM_x m}{x^2}$, where $M_x=\frac{4}{3}\pi x^3\rho$. Here density of moon is $\rho=\frac{M}{\frac{4}{3}\pi R^3}$, accordingly $M_x=\frac{4}{3}\pi x^3\left(\frac{M}{\frac{4}{3}\pi R^3}\right)=M\left(\frac{x}{R}\right)^3$. Therefore, $W_{AB}=\int_{\frac{99R}{100}}^{R}\frac{GmM}{x^2}\left(\frac{x}{R}\right)^3 dx=\frac{GmM}{R^3}\int_{\frac{99R}{100}}^{R}x\,dx$. It simplifies into $W_{AB}=\frac{GmM}{R^3}\left[\frac{x^2}{2}\right]_{\frac{99R}{100}}^{R}=\frac{GmM}{2R^3}\left(R^2-\left(\frac{99R}{100}\right)^2\right)=\frac{GMm}{2R}\left(1-\frac{99^2}{100^2}\right)=99.5\times10^{-4}\times\frac{GMm}{R}$. Accordingly,. Using these values $\frac{GMm}{R}=\left(\frac{GMm}{R}-\frac{GMm}{R+h}\right)+99.5\times10^{-4}\times\frac{GMm}{R}\rightarrow\frac{1}{R+h}=\frac{99.5\times10^{-4}}{R}$. It further simplifies into $10^4\times R=(R+h)\times99.5\rightarrow R(10000-99.55)=99.5h\rightarrow h=\frac{9900.15}{99.5}R=99.15R$, this is the answer. N.B.: Kinetic energy consumed by projectile during travel between B and C can be found by potential diference between the points and is $W_{BC}=V_B-V_C=\frac{GMm}{R}-\frac{GMm}{R+h}$, since effective mass of the moon remians same during the travel. But, W_{AB} cannot be determined the same way since effective mass changes with change in x during travel from A to B. This is the sharp difference that needs to handeled carefully.
I-13	Acceleration due to gravity on surface of any celestial body earth is $g=\frac{F_g}{m}=\frac{\frac{GMm}{R^2}}{m}=\frac{GM}{R^2}$, here mass of the celestial body is $M=\frac{4}{3}\pi R^3\rho$, therefore, $g=\frac{G\left(\frac{4}{3}\pi R^3\rho\right)}{R^2}=\left(\frac{4}{3}\pi G\right)R\rho\rightarrow g\propto R\rho\rightarrow R\propto\frac{g}{\rho}$. Further escape velocity $V=\sqrt{\frac{2GM}{R}}=\sqrt{2\left(\frac{GM}{R^2}\right)R}=\sqrt{2gR}=\sqrt{2g\left(\frac{g}{\rho}\right)}\rightarrow V\propto\frac{g}{\sqrt{\rho}}$. It leads to, ratios of escape

	vaeocity on planet and earth as $\frac{V_P}{V_E}=\frac{\frac{g_P}{\sqrt{\rho_P}}}{\frac{g_E}{\sqrt{\rho_E}}}=\left(\frac{g_P}{g_E}\right)\times\left(\sqrt{\frac{\rho_E}{\rho_P}}\right)$. Using the given ratios of gravity $\frac{g_P}{g_E}=\frac{\sqrt{6}}{11}$ and density $\frac{\rho_P}{\rho_E}=\frac{2}{3}$ on planet and earth, we get $\frac{V_P}{V_E}=\left(\frac{\sqrt{6}}{11}\right)\times\left(\sqrt{\frac{3}{2}}\right)=\frac{3}{11}\rightarrow V_P=\frac{3}{11}\times V_E=\frac{3}{11}\times\left(11\times10^3\right)$. It leads to escape velocity on palnet $V_P=3\times10^3$ m/s 0r 3kmps. This is the answer. N.B.: This is a simple problem of algebric ratio and proportions, applied in physics, using the given ratios of density and acceleration due to gravity on planet and eart. It is solved numerically at the end.
I-14	On tilting the given tube to vertical position, the mercury column will exert additional pressure leading to compression of lower air column and settle at length $(45-x)$cm. Since mercury is incompressible, there will be expansion in upper air column and it would settle to length $(45+x)$cm. Applying Boyl's law to lower air column $P_{2i}\times V_{2i}=P_{2f}\times V_{2f}\rightarrow P_{2i}\times(45\times A)=P_{2f}\times((45-x)\times A)$, Since, $P_{2i}=P_{1i}=76$cm mercury, it leads to $45\times76=(45-x)\times P_{2f}\rightarrow P_{2f}=\frac{45\times76}{(45-x)}$. Likewise, for upper air column $P_{1i}\times V_{1i}=P_{1f}\times V_{1f}$. It leads to ratio $45\times P_{1i}=(45+x)\times P_{1f}\rightarrow P_{1f}=\frac{45\times76}{(45+x)}$.  Further, writing pressure balance equation in vertical position of the tube $P_{2f}=P_{1f}+10$. With the values P_{1f} of and P_{2f} determined above $\frac{45\times76}{(45-x)}=\frac{45\times76}{(45+x)}+10\rightarrow\frac{1}{(45-x)}-\frac{1}{(45+x)}=\frac{10}{45\times76}$. It resolves into $\frac{2x}{45^2-x^2}=\frac{1}{9\times38}\rightarrow x^2+(2\times9\times38)x-45^2=0\rightarrow x=\frac{-18\times38\pm\sqrt{(18\times38)^2-4(-45^2)}}{2}$. It gives two possible values 2.95 and -686.9 Since, value of even if negative cannot lead to $(45-x)$cannot be. Greater than 90 cm and hence the only possible value is $x=2.95$ cm. This is the answer.
I-15	When boat is carrying number of large stones, it replaces water of volumes $V_i=\frac{W_B}{\rho_W}+\frac{W_S}{\rho_W}$, but when the stones are unloaded the volume of water replaced is $V_f=\frac{W_B}{\rho_W}+\frac{W_B}{\rho_S}$, Since $\rho_S>\rho_W$, therefore, volume of water replaced in two cases is $\frac{W_S}{\rho_W}>\frac{W_B}{\rho_S}$, numerator beng same, and hence, net volume of water replaced when stones are unloaded in water V_f is less than V_i,. Moreover, rise in water level is directly dependent on volume of water replaced and hence water level would fall. This is the answer. N.B.: Answering this question has to be done analytically since it is category of objective questions. Moreover, going by perception, even in objective questions, might miss some fine concept involved and thus could lead to wrong answer.

I-16	With regerence to base line, potential energy of liquid column of same area A, of height h_1 height is $PE_{1i}=(h_1A\rho)g\left(\frac{h_1}{2}\right)$ and of height h_2 height is $PE_{2i}=(h_2A\rho)g\left(\frac{h_2}{2}\right)$, but when liquid column height  equalizes in both the columns net potential energy $PE_f=2\times((hA\rho)g)\left(\frac{h}{2}\right)$. Let W is the work done in eqiualizing the water level, then $PE_i=PE_{i1}+PE_{i2}=PE_f+W\rightarrow W=(PE_{i1}+PE_{i2})-PE_f$. It leads to $W=\left(\frac{(h_1{}^2A\rho)g}{2}+\frac{(h_2{}^2A\rho)g}{2}\right)-gh^2A\rho$. Since volume of liquid is unchanged, hence, $A(h_1+h_2)=2Ah$, or $2h=h_1+h_2$ It simplifies into $W=\frac{A\rho g}{2}\left(h_1{}^2+h_2{}^2-2\left(\frac{h_1+h_2}{2}\right)^2\right)=\frac{A\rho g}{4}\left(2h_1{}^2+2h_2{}^2-(h_1+h_2)^2\right)$. It leads to $W=\frac{A\rho g}{4}\left(h_1{}^2+h_2{}^2-2h_1h_2\right)=\frac{\rho Ag}{4}(h_1-h_2)^2$. This is the answer.
I-17	By geometry $\cos\theta=\frac{0.5}{x}\rightarrow x=\frac{\sec\theta}{2}$, here x is length of the submerged plank.On the plank two torqus are acting – (a) due to buyoancy force about hinge O is anticlockwise such that , h $\tau_B=((Wtx)\rho_Wg)\frac{x}{2}\sin\theta$, here, W- is the width of the plank, *t*- is the thickness of the plank It leads to $\tau_B=\frac{Wt\rho_Wg}{2}\times x^2\times\sin\theta$ or $\tau_B=\frac{Wt\rho_Wg}{2}\times\frac{\sec^2\theta}{4}\times\sin\theta$. and (b) due to gravtational force about the hinge O is clockwise.such that $\tau_G=(Wt\times1\times\rho_P)g\times\left(\frac{1}{2}\sin\theta\right)$. n the position of equilibrium $\tau_B=\tau_G\rightarrow\frac{\sec^2\theta}{4}=\frac{\rho_P}{\rho_W}$. Given that relative density of te plank is $\frac{\rho_P}{\rho_W}=\frac{1}{2}$. It simplifies into $\frac{\sec^2\theta}{4}=\frac{1}{2}\rightarrow\cos^2\theta=\frac{1}{2}\rightarrow\cos\theta=\frac{1}{\sqrt{2}}$ or $\theta=45^0$. This is the answer.
I-18	Since bouncing the ball is elastic and hence, it return to the same height in time t_1. Therefore, time taken to touch the ground shall be $\frac{t_1}{2}$ and velocity of striking ground under acceleration due to gravity shall be $v=0+g\frac{t_1}{2}=\frac{gt_1}{2}$. Now for calclulating retardation due to gravity, sssume size of ball to be a point mass. This simplifies calculation

of retardation during partial immersion.

(a) According, upward thrust $F_U = V(d-d_1)g \rightarrow a_U = \frac{V(d-d_1)g}{V\rho_B} = \frac{(d-d_1)g}{\rho_B}$. Since, $d < d_1$ hence $d-d_1$ is (-)ve and hence a_U shall act as retardation and $0 = \frac{gt_1}{2} + \frac{(d-d_1)g}{\rho_B}t \rightarrow t = \frac{dt_1}{2(d_1-d)}$ is time taken by the ball to come to rest. Since, a_U continues to act till ball is immersed, and hence it will take same time to reach surface of the water and hence time for the ball to come out is $t_2 = 2t = \frac{dt_1}{(d_1-d)}$. Further, ball while coming out of the liquid shall have same upward velocity as during immersion. Thus motion of ball in air is synonymous to the ball re-bouncing from the surface. Therefore total time for the ball dropped in the liquid to reach back to the same height is $t_1 + t_2 = t_1 + \frac{dt_1}{(d_1-d)} = \frac{d_1 t_1}{(d_1-d)}$, this is the answer for part (a).

(b) Acceleration of the ball in air is uniformly g towards the surface of the liquid but acceleration of the ball inside the liquid, towards the same point is $a_U = \frac{(d-d_1)g}{\rho_B} \rightarrow a_U \neq g \rightarrow t_1 \neq t_2$, hence it is not uniform on either side and hence not SHM. Hence answer is NO for part (b)

(c) When $d = d_1 \rightarrow a_U = \frac{(d-d_1)g}{\rho_B} = 0$, this is a case of Zero retardation and hence non-retarding force on the ball which lead to motion of the ball with velocity v, as per Newton's First law of Motion. Hence ball will continue to move on till it reaches bottom of the liquid. This is the answer to part ©

N.B.: (a) Assuming ball like a point mass is important to get a feasible solution and answer.
(b) Another characterstic of SHM is acceleration of the particle, while being always directed toward mean position, it is proportional to the distance of the particle from mean position, and not constant as in the instant case. This is addition concept which shall be covered in SHM.

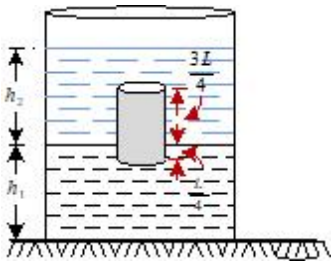
I-19

Part (a) : The crossectional area of the container is A has volume of both the liquid $V = V_1 = V_2 = A \times \frac{H}{2}$.

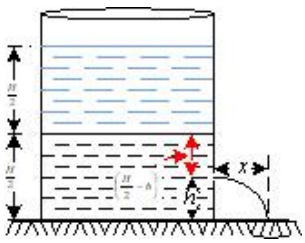
When cylinder of cross-sectional area $\frac{A}{5}$ and length $L < \frac{H}{2}$ is immersed in the liquid, given that volume of heavier liquid displaced is $v_1 = \frac{A}{5} \times \frac{L}{4}$, and volume of lighter liquid displaced is $v_2 = \frac{A}{5} \times \frac{3L}{4}$. Therefore, height of denser liquid above the bottom of the container is such that $A\frac{H}{2} = A \times \left(h_1 - \frac{L}{4}\right) + \left(A - \frac{A}{5}\right) \times \frac{L}{4} \rightarrow \frac{H}{2} = \left(h_1 - \frac{L}{4}\right) + \frac{4}{5} \times \frac{L}{4} = h_1 - L\left(\frac{1}{4} - \frac{1}{5}\right) \rightarrow \frac{H}{2} = h_1 - \frac{L}{20}$. It get us to $h_1 = \frac{H}{2} + \frac{L}{20}$.

Likewise, height of lighter liquid in the container is $A\frac{H}{2} = A \times \left(h_2 - \frac{3L}{4}\right) + \left(A - \frac{A}{5}\right) \times \frac{3L}{4} \rightarrow \frac{H}{2} = \left(h_2 - \frac{3L}{4}\right) + \frac{4}{5} \times \frac{3L}{4} = h_2 - 3L\left(\frac{1}{4} - \frac{1}{5}\right) \rightarrow h_2 = \frac{H}{2} + \frac{3L}{20}$.

Therefore, pressure on the bottom of the container shall be $p = p_0 + h_1 \times 2d \times g + h_2 \times d \times g = (2h_1 + h_2)dg$. It leads to $p = p_0 + \left(2\left(\frac{H}{2} + \frac{L}{20}\right) + \left(\frac{H}{2} + \frac{3L}{20}\right)\right)dg = \left(\frac{3H}{2} + \frac{L}{4}\right)dg = \frac{(6H+L)dg}{4}$, this is the answer of part (b).



At the level of bottom of the cylinder of density ρ again there is a pressure balance between that due to the cylinder and the liq. uid column and its sides, and therefore there is no liqiud flow. Thus, $L\rho g = \frac{L}{4}\times 2d\times g + \frac{3L}{4}\times d\times g \rightarrow \rho = \left(\frac{2}{4}+\frac{3}{4}\right)d = \frac{5}{4}d$ .This is part (a) of the answer.



Part (b): Cylinder removed and a small hole of area s is punched at height h. The liquid coming out shall have kinetic energy equal to pressure energy at the hole, as per Bernoulli's principle. Accordingly, the energy balance equation for a small length of jet of liquid is $\frac{1}{2}(s\Delta x 2d)v^2 = (s\Delta x 2d)\times g\times\left(\frac{H}{2}-h\right)+(s\Delta x d)\times g\times\frac{H}{2}$. It simplifies into $v^2 = 2g\left(\frac{H}{2}-h\right)+\frac{gH}{2} = \left(\frac{3}{2}H-2h\right)g \rightarrow v = \sqrt{\left(\frac{3H-4h}{2}\right)g}$., this is answer of part (i).

Time taken by the jet to reach ground shall be with Second equation of motion, with, initial vertical velocity to be Zero, $h = 0+\frac{1}{2}gt^2 \rightarrow t = \sqrt{\frac{2h}{g}}$. Therefore, for horizontal distance travelled by the jet, there is no acceleration and as per Second equation of motion $x = vt+0 = \left(\sqrt{\left(\frac{3H-4h}{2}\right)g}\right)\times\sqrt{\frac{2h}{g}} = \sqrt{h(3H-4h)}$, this part (ii) of the answer.

The distance travelled by jet is a function of $x = f(h)$ and therefore for the maximum distance travelled condition is $\frac{dx}{dh} = 0 \rightarrow \frac{d}{dh}\left(\sqrt{h(3H-4h)}\right) = 0$. It is a case of differentiation and $0 = \frac{d}{dh}\left(\sqrt{h(3H-4h)}\right) = \frac{1}{2\sqrt{h(3H-4h)}}\frac{d}{dh}\left(3Hh-4h^2\right) = \frac{1}{2\sqrt{h(3H-4h)}}(3H-8h) \rightarrow 3H-8h = 0 \rightarrow h = \frac{3}{8}H$. Hence, maximum distance shall be $x = \sqrt{\left(\frac{3H}{8}\left(3H-4\times\frac{3H}{8}\right)\right)} = 3H\sqrt{\left(\frac{1}{8}\right)\left(\frac{1}{2}\right)} = \frac{3H}{4}$, this is part (iii) of the answer.

N.B.: This is a good example of integration of multiple concepts in one question.

I-20

When rod of length $l = 0.5m$ is cooled from $t_1 = 100^0$C to $t_0 = 100^0$, change in length $\Delta l = \alpha l(t_2-t_1) = -100\alpha l$. To restore the same length it is subjected to tensile load of mass $F = mg$. Therefore, as per principle of elasticty $Y\frac{\Delta l}{l-\Delta l} = \frac{Mg}{a} \rightarrow M = \frac{Ya\Delta l}{(l-\Delta l)g} = \frac{10^{11}\times\left(4\times10^{-6}\right)\left(100\times10^{-5}\times0.5\right)}{\left(0.5-100\times10^{-5}\times0.5\right)\times10}$.

Since, $0.5-100\times10^{-5}\times0.5\approx0.5$, $M = \frac{2\times10^{(11-6+2-5)}}{0.5\times10} = 4\times10 = 40$ kg.This is part (a) of the answer.

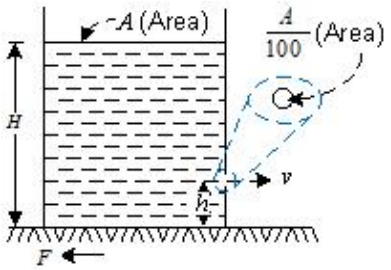
Energy given to the rod $U = \frac{1}{2}\left(\frac{Ya}{l}\right)(100\times\alpha\times l)^2 = 0.5\times10^4\times Ya\alpha^2 l = 0.5\times10^4\times10^{11}\times\left(4\times10^{-6}\right)\left(10^{-5}\right)^2\times0.5$

It leads to $U = 2\times10^9\times10^{-10}\times0.5 = 0.1$ Joule.

N.B.: In this example approximation of $l-\Delta l\approx l$, simplifies calculation, and ids little thing to remember.

I-21

In the container of height H cross section A, a hole of area $\frac{A}{100}$ is near the bottom, as shown in the figure $h<<, H-h\approx H$. Thus velocity of liquid efflux shall be $(s\times\Delta x\times\rho)Hg=\frac{1}{2}(s\times\Delta x\times\rho)v^2\rightarrow v=\sqrt{2Hg}$. Since the container is on a frictionless surface and therefore $F=\frac{\Delta(mv)}{\Delta t}=\frac{m_{t+\Delta t}v_{t+\Delta t}-m_t v_t}{\Delta t}=\frac{(s\times\Delta x\times\rho)v}{\Delta t}=s\rho v\frac{\Delta x}{\Delta t}=s\rho v^2=s\rho(2Hg)$

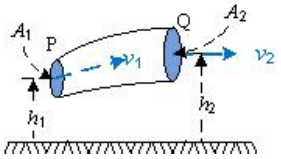


Therefore acceleration of the container of negligible mass containing liquid $M=AH\rho$ is $a=\frac{2\frac{A}{100}\rho Hg}{AH\rho}=\frac{g}{50}$, it leads to $a=\frac{10}{50}=0.2\,\text{ms}^{-2}$, taking $g=10$ ms^{-2}. This is part (a) of the answer.

When, 75% of liquid has drained out, then remaining head responsible for the efflux is $H'=H-0.75H=0.25H$. Therefore velocity of efflux at ths stage is $v'=\sqrt{2H'g}=\sqrt{2\times0.25H\times g}=\sqrt{5H}$. Since, $m_0=AH\rho\rightarrow H=\frac{m_0}{A\rho}$. Therefore, $v'=\sqrt{5\left(\frac{m_0}{A\rho}\right)}=\sqrt{\frac{5m_0}{A\rho}}$. This is answer of part (b)..

I-22

Energy of liquid at any point as per Bernaulli's principle is $E=\rho g(h+H)+\frac{1}{2}\rho V^2$., here, H corresponds to atmospheric pressure. Further as per principle of continuity of flow of incompressible liquid, in the instant case, $A_1v_1=A_2v_2\rightarrow\frac{v_2}{v_1}=\frac{A_1}{A_2}$.

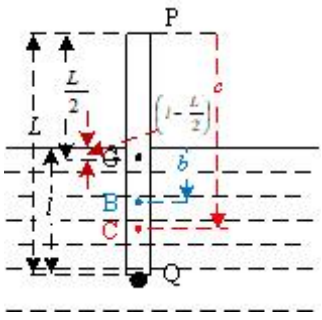


Therefore, workdone per unit volume of liquid flwng from P to Q is $W=E_P-E_q$, which leads to $W=\left\{\rho g(h_1+H)+\frac{1}{2}\rho v_1^{\,2}\right\}-\left\{\rho g(h_2+H)+\frac{1}{2}\rho v_2^{\,2}\right\}=\rho\left\{g(h_1-h_2)+\frac{1}{2}v_1^{\,2}\left(1-\left(\frac{v_2}{v_1}\right)^2\right)\right\}$. This reduces to a form in the given data $W=\rho\left\{10(2-5)+\frac{1}{2}1^2\left(1-\left(\frac{A_1}{A_2}\right)^2\right)\right\}=1000\left\{-30+0.5\left(1-\left(\frac{4\times10^{-3}}{8\times10^{-3}}\right)^2\right)\right\}$. It simplifies into $W=1000\{-30+0.5(1-0.25)\}=1000(-30+0.375)=29.625\times1000=2.96\times10^4\,\text{J/m}^3$, this is part (a) of the answer.

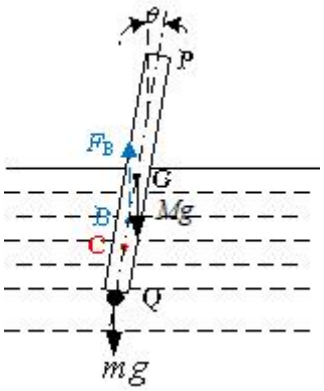
But, workdone by gravity per unit volume is $W_g=\rho g(h_1-h_2)=1000\times10\times(5-2)=3\times10^4\,\text{J/m}^3$, this answer of part (b)

I-23

When the stick of length L, area $A=\pi R^2$ and density ρ put in water with its end Q ihaving an a mass m nside water, its length l is dipped inside the water, is such that $\pi R^2L\rho+m=\pi R^2l\sigma\rightarrow l=\frac{\pi R^2L\rho+m}{\pi R^2\sigma}$. It will have centre of buyonacy (COB) B at a depth $b=\frac{\int_0^l Ax\sigma\,dx}{Al\rho}=\frac{\left[\frac{x^2}{2}\right]_0^l}{l}=\frac{l^2}{2l}=\frac{l}{2}$ below liquid surface. But, center of mass (COM) of the system C shall be from end P at a distance



$$c=\frac{(AL\rho)\frac{L}{2}+mL}{AL\rho+m}=\frac{\pi R^2L^2\rho+2mL}{2(\pi R^2L\rho+m)}.$$



When stick is vertical, COM and COB shall pass through its centre line and thus there will be no torque. But, stick is tilted clock wise by an angle θ shown in the figure, mass m of metal piece and mass of the stick $M=\pi R^2L\rho$ will exert torque at C, the COM of the system and it should remain in equilibrium.

But, an additional force F_B acting at B, and it would cause anticlockwise torque about C, to normalize the angle $\theta\to 0$. Likewise, if the stick is tilted anticlockwise, torque due to F_B about C would be clockwise and perform similar corrective action. This is a case of stable equilibrium and shall remain valid as long as either B is above C or at C and mathematically $\text{QB}_{\text{Length}}\geq\text{QC}_{\text{Length}}\to\frac{l}{2}\geq L-c\to\frac{\pi R^2L\rho+m}{2\pi R^2\sigma}\geq L-\frac{\pi R^2L^2\rho+2mL}{2(\pi R^2L\rho+m)}$. It leads to an equation in m written as $\frac{AL\rho+m}{2A\sigma}\geq\frac{2AL^2\rho+2Lm-AL^2\rho+2Lm}{2(AL\rho+m)}\to(AL\rho+m)^2\geq A^2L^2\rho\sigma$. This further simplifies into $AL\rho+m\geq AL\sqrt{\rho\sigma}\to m\geq AL(\sqrt{\rho\sigma}-\rho)$. Substituting value of A in terms of giver R, $m\geq\pi R^2L(\sqrt{\rho\sigma}-\rho)$, or minimum value of $m=\pi R^2L(\sqrt{\rho\sigma}-\rho)$. Given that $\sigma>\rho$ and hence $\sqrt{\rho\sigma}-\rho$ is (+)ve and so also is m which is realistic. This is the answer.

I-24

Let A is the area of cross-section of the cylinder, and h is its height. Therefore, mass of the cylinder is $M=AH\rho=0.8Hh$. Mass of the liquids displaced $M=A(h_A\rho_A+h_B\rho_B)=A(0.7\times1.2+1.2\times0.8)=1.8A$.

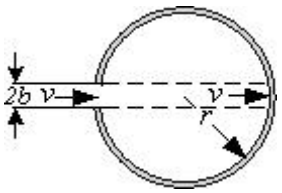
Equating the two $M=0.8AH=1.8A\to H=\frac{1.8}{0.8}=2.25$ cm. Therefore length of the cylinder in the air is $h=H-(h_A+h_B)=2.25-(1.2+0.8)=0.25$ cm. This is answer of part (b).

Force exerted by liquid A on the cylinder is resultant of all hydrostatic forces around the curved surface, in the figure,is equated to zero, as shown in the figure. This is answer of part (a).

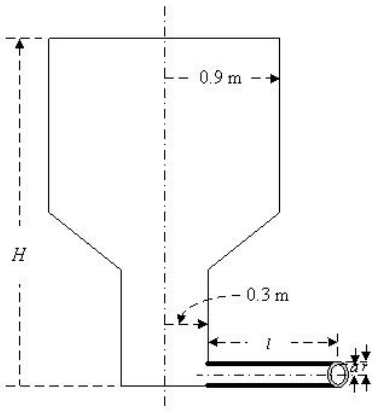
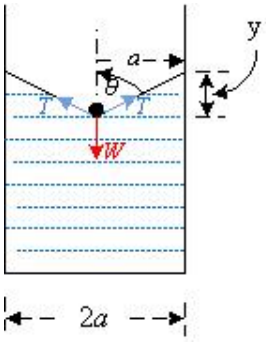
When cylinder is depressed to the extend that its top surface is just below the upper surface of the liquid, in this case net upward thrust is $F=(M_A+M_B-M)g$ here $M_A=Ah_A\rho_A=1.2\times0.7\times A=0.84A$ and $M_A=Ah_B\rho_B=A(H-h_A)\rho_B=A(2.25-1.2)\times1.2=1.05\times1.2\times A=1.26A$ and $M=AH\rho$, it simplifies into $M=A\times2.25\times0.8=1.8A$ are masses of displaced liquid A & B respectively. Accordingly, $a=\frac{F}{M}=\frac{(M_A+M_B-M)g}{M}=\frac{A(0.84+1.26-1.8)}{1.8A}=\frac{2.1-1.8}{1.8}g=\frac{0.3}{1.8}g=\frac{g}{6}$. This is answer of part (c).

I-25

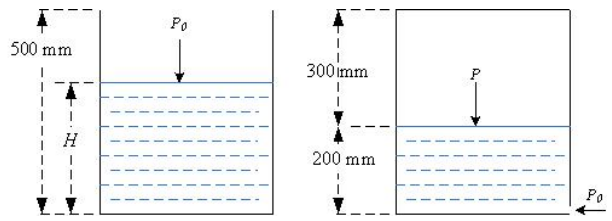
Inside a bubble of radius r pressure of air p_i is more than that outside p_o and this keep bubble blown. Difference of pressure $\Delta p=p_i-p_o=\frac{4T}{r}$, having two surfaces inner and outer as shown in the figure. This pressure diiference being inversly proportional to r keep on reducing with increase of r.



Air flowing with a velocity, through tube of radius b, comes to rest inside the bubble, at a surface of the bubble against the tube through which air is blow. Therefore force exerted by the air blown into the air $F_A=\frac{dp}{dt}=Av\rho(v-0)=A\rho v^2$. Likewise, correspoding force due to surface tension, at the instance of seperation of bubble from the tube $F_{ST}=\Delta p\times A$. Till such time $F_A<F_{ST}$,

	the bubble keep growing. Therefore, at limiting condition, causing seperation of bubble $F_A = F_{ST} \rightarrow A\rho v^2 = A\left(\frac{4T}{r}\right) \rightarrow r = \frac{4T}{\rho v^2}$, this is the answer.
I-26	Let v_1 is the velocity of the liquid in tank with radius 0.9 m and v_1 is the velocity of the liquid in upper part of tank with radius 0.9 m and $v_2 = 10$ m/s is the velocity of the liquid in lower part of the tank with radius 0.3. And, as per principle of continuity of flow $A_1 v_1 = A_2 v_2 \rightarrow v_1 = \left(\frac{r_2}{r_1}\right)^2 v_2 = \left(\frac{0.3}{0.9}\right)^2 v_2$, it leads to $v_1 = \frac{v_2}{9}$.  Whereas , as per Bernoulli's principle, $p + p_0 + \frac{1}{2}\rho v_1^{\,2} + \rho g H = \frac{1}{2}\rho v_2^{\,2} + p_0$ Accordingly, $p + \rho g H = \frac{1}{2}\rho\left(v_2^{\,2} - v_1^{\,2}\right) \rightarrow p + \rho g H = \frac{1}{2}\rho\left(v_2^{\,2} - \left(\frac{v_2}{9}\right)^2\right) \rightarrow p + \rho g H = \frac{4\upsilon}{81}\rho v_2^{\,2}$. As per Poseullie's Equation of flow of liquid through a capillary $Q = \frac{\pi P a^4}{8\eta l} \rightarrow \eta = \frac{\pi P a^4}{8lQ}$, here $Q = 8\times10^{-6}$ is given while $P = p + \rho g H$ determined above and η is coefficient of viscosity. Accordingly, $\eta = \frac{\left(\frac{40}{81}\rho v_2^{\,2}\right)(\pi a^2)}{8Q}\left(\frac{a^2}{l}\right)$. Substituting the values $\eta = \frac{\left(\frac{40}{81}\times900\times10^2\right)(10^{-6})}{8\times8\times10^{-6}}\left(2\times10^{-6}\right) = \frac{10^{-1}}{9\times8} = \frac{1}{720}$ N-s/m^2 , This is the answer
I-27	The wire is since resting of the surface of water, making angle θ with the vertical and gaving a dip y from the edge in contact with the container, Thus, as per free body diagram sgown in the figure $W = 2Tl\cos\theta \rightarrow l\lambda g = 2Tl\cos\theta \rightarrow T = \frac{\lambda g}{2\cos\theta}$. Given that $y << a \rightarrow \cos\theta \approx \frac{y}{a}$ It leads to $T = \frac{\lambda g}{2\left(\frac{y}{a}\right)} = \frac{\lambda g a}{2y}$, this is the answer. 
I-28	Terminal velocity of a spherical ball in viscous fluid is $v_T = \frac{2r^2 g}{9\eta}\left(\rho_S - \rho_L\right)$. While the viscous force is $F_v = 6\pi\eta r v_T$. Hence, rate of heat production $\frac{dQ}{dt} = F_v \times v_T = \left(6\pi\eta r v_T\right)\times v_T = 6\pi\eta r v_T^{\,2} = 6\pi\eta r\left(\frac{2r^2 g}{9\eta}\left(\rho_S - \rho_L\right)\right)^2$. It leads to $\frac{dQ}{dt} = 6\pi\eta r\left(\frac{2r^2 g}{9\eta}\left(\rho_S - \rho_L\right)\right)^2 = \frac{8\pi g^2 r^5}{27\eta}\left(\rho_S - \rho_L\right)^2 \rightarrow \frac{dQ}{dt} \propto r^5$, This is the answer.
I-29	In the instant case, there is no change in potential energy within the synige, bei g horizontal. The plunger has a velocity $v_1 = 0.25$ m/s. Let velocity of the jet be v_2, therefore, by principle of continuity of flow

	$v_1 A_1 = v_2 A_2 \rightarrow v_2 = v_1 \frac{A_1}{A_2} = v_1 \frac{\frac{\pi d_1^{\,2}}{4}}{\frac{\pi d_2^{\,2}}{4}} \rightarrow v_2 = v_1 \left(\frac{d_1}{d_2}\right)^2 = 0.25 \times \left(\frac{8}{2}\right)^2 = 0.25 \times 16 = 4\,\text{m/s}.$ Time (t)taken by the jet having zero verical velocity to reach the ground, from second equation of motion, as per Second Equation of Motion $h = 0 + \frac{1}{2} g t^2 \rightarrow t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 1.25}{10}} = \sqrt{\frac{1}{4}} = 0.5\,\text{s}$. Hence horizontal range of the syringe is $R = v_2 \times t = 4 \times 0.5 = 2\,\text{m}$, this is the answer. N.B.: All subjective questions are not necessarily, difficult and involve too many concepts.
I-30	Mathematically Young's Modulous of Elasticity $Y = \frac{\text{Stress}}{\text{Strain}} = \frac{\frac{F}{A}}{\frac{l}{L}} = \frac{F \times L}{\left(\frac{\pi D^2}{4}\right) l} = \frac{4FL}{\pi D^2 l}$. Here F is Force in Newton, L is length in meter, Diameter in meter and extension in length. Accordingly all data is converted into the SI units. With the given values with minmum 3 sgnificants digits $Y = \frac{4 \times 50 \times 1.10}{\frac{22}{7} \times \left(5 \times 10^{-4}\right)^2 \times \left(1.25 \times 10^{-3}\right)}$. Accordingly, $Y = \frac{7 \times 22 \times 10^1}{22 \times \left(2.5 \times 10^{-7}\right) \times \left(1.25 \times 10^{-3}\right)} = \frac{7}{3.125} \times 10^{11} = 2.24 \times 10^{11}$ is also expressed in 3 SGs. As regards maximum possible error is summtion of relative errors in measurements. Accordingly, $\frac{\Delta Y}{Y} = \frac{\Delta L}{L} + 2 \times \frac{\Delta D}{D} + \frac{\Delta l}{l} \rightarrow \frac{\Delta Y}{Y} = \frac{0.1}{110} + \frac{2 \times 0.001}{0.05} + \frac{0.001}{0.125} = 0.0009 + 0.04 + 0.008 = 0.0489$. Therefore, error shall be $\Delta Y = 0.0489 \times Y = 0.0489 \times 2.24 \times 10^{11} = 0{,}109 \times 10^{11} = 1.09 \times 10^{10}$ This error shall also be expressed in Three SGs as $\Delta Y = 1.09 \times 10^{10}$. This is the answer. N.B.: It is experienced that students while going forward in their lerning of concepts, skip basic concepts studied in earlier chapter, as much as aprroximation and error analysis. This can be integerated in any concept and may not be asked in isolation.
I-31	When the tube is at rest there is no radial force in horizontal part of tube of length L. But, when it is set into an angular velocity, it will experience centrigugal force, acting radially outward $F = \int_0^L dm \times \left(x\omega^2\right)$. It solves into $F_C = \int_0^L \left(A dx \rho\right)\left(x\omega^2\right) = A\rho\omega^2 \int_0^L x dx = A\rho\omega^2 \left[\frac{x^2}{2}\right]_0^L = \frac{A\rho\omega^2 L^2}{2}$. The only way this can be compensated is by pressure created by rise of fluid in outer tube and this $F_H = \left(AH\rho\right)g$. Thus at equilibrium $F_C = F_H \rightarrow \frac{A\rho\omega^2 L^2}{2} = AH\rho g \rightarrow H = \frac{\omega^2 L^2}{2g}$, this is the answer. N.B.: Centrifugal force in fluid in vertical arms of the tube would be countered by the vertical walls of tube. Therefore, it would not influence value of H arrived at as an answer..
I-32	The gas law $pv = nRT$. Therefore, for air the two bubble $p_A v_A = n_A R T_A$ and $p_B v_B = n_B R T_B$. Therefore,

	Further, $\frac{p_A v_A}{p_B v_B}=\frac{n_A T_A}{n_B T_B}\rightarrow\frac{n_B}{n_A}=\frac{(p_B v_B)T_A}{(p_A v_A)T_B}$. Given that both the bubbles are kept in a close chamber and, therefore, $T_A=T_B$, therefore, $\frac{n_B}{n_A}=\frac{p_B v_B}{p_A v_A}$. Difference, difference in pressure inside a bubble is $\Delta p=\frac{4s}{r}$, therefore net pressure inside bubble is $p=p_0+\Delta p$, and this well decide number of moles inside the bubble; while volume of the bubble is $v=\frac{4}{3}\pi r^3$, therefore, $(p_0+\Delta p)v=\left(8+\frac{4s}{r}\right)\left(\frac{4}{3}\pi r^3\right)$. Therefore, $\frac{n_B}{n_A}=\frac{\left(p_0+\frac{4s}{r_B}\right)\left(\frac{4}{3}\pi r_B{}^3\right)}{\left(p_0+\frac{4s}{r_A}\right)\left(\frac{4}{3}\pi r_A{}^3\right)}\rightarrow\frac{n_B}{n_A}=\frac{\left(p_0+\frac{4s}{r_B}\right)r_B{}^3}{\left(p_0+\frac{4s}{r_A}\right)r_A{}^3}$, it leads to $\frac{n_B}{n_A}=\frac{\left(8+\frac{4\times0.04}{0.04}\right)(0.04)^3}{\left(8+\frac{4\times0.04}{0.02}\right)(0.02)^3}=\frac{(8+4)}{(8+8)}\times8=6$. This is the answer.
I-33	When cylinder, of area of cross-section A, is filled to height H, volume of air above liquid, in the cylinder, is $V_0=A(0.5-H)$ and it is at pressure p_0. Next, cylinder is so sealed that air of volume V_0 at pressure p_0 is above the liquid level. Thereafter an orifice is punched at its bottom, and it allows the fluid inside to drain. As a consequence liquid level inside cylinder drops and so also the air pressure inside the cylinder. After some time drain of the water stops.  This is the instance when pressure at the orifice is in equlibrium such that $p+\rho g(0.2)=p_0\rightarrow p=p_0-0.2\rho g=10\times10^5-0.2\times10^3\times10=998\times10^3$. Morevoer, the drain being slow as per Boyle's Law $p_0V_0=pV\rightarrow p_0(A\times(0.5-H))=p(A\times0.3)\rightarrow H=\frac{0.5\times p_0-0.3\times p}{p_0}$. Substituiting the values, $H=\frac{0.5\times10\times10^5-0.3\times998\times10^3}{10\times10^5}=\frac{5-0.3\times9.98}{10}=\frac{5-2.994}{10}=\frac{2.006}{10}=0.2006$ m or 200.6 mm. Therefore fall in the levelof water is $H-200=200.6-200=0.6$ mm. This is the answer.

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Universal Equation: $0=1+e^{i\pi}$

Mathematics is the language of natural consequence.

—00—

Theme Song :

PREMISE:*We are pleased to adopt a song* **" इतनी शक्ति हमें देना दाता....."***from a old Hindi Movie**Do Aankhen Barah Haath दो आँखें बारह हाथ of 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 Each Achieves More
(TEAM)

Every end, so also end of this e-Bulletin, is a pause for a review, before

Resuming of the journey far beyond ...