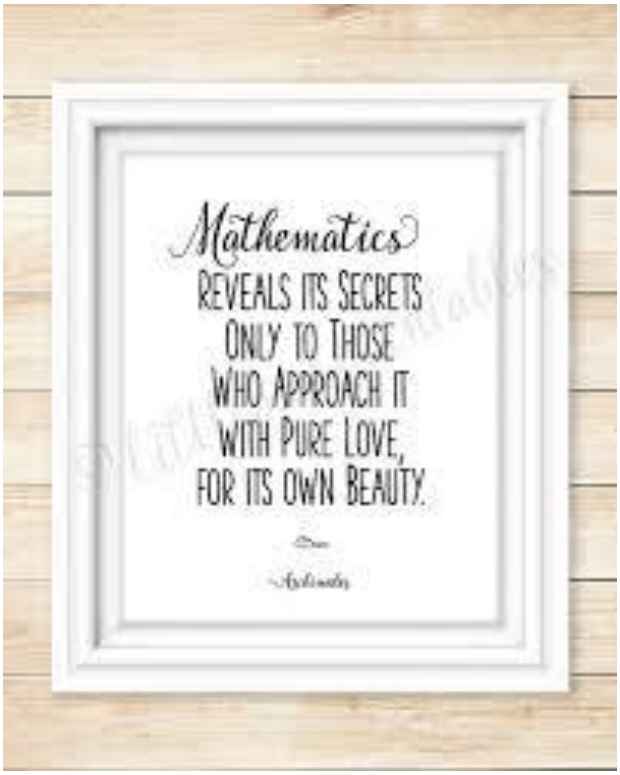
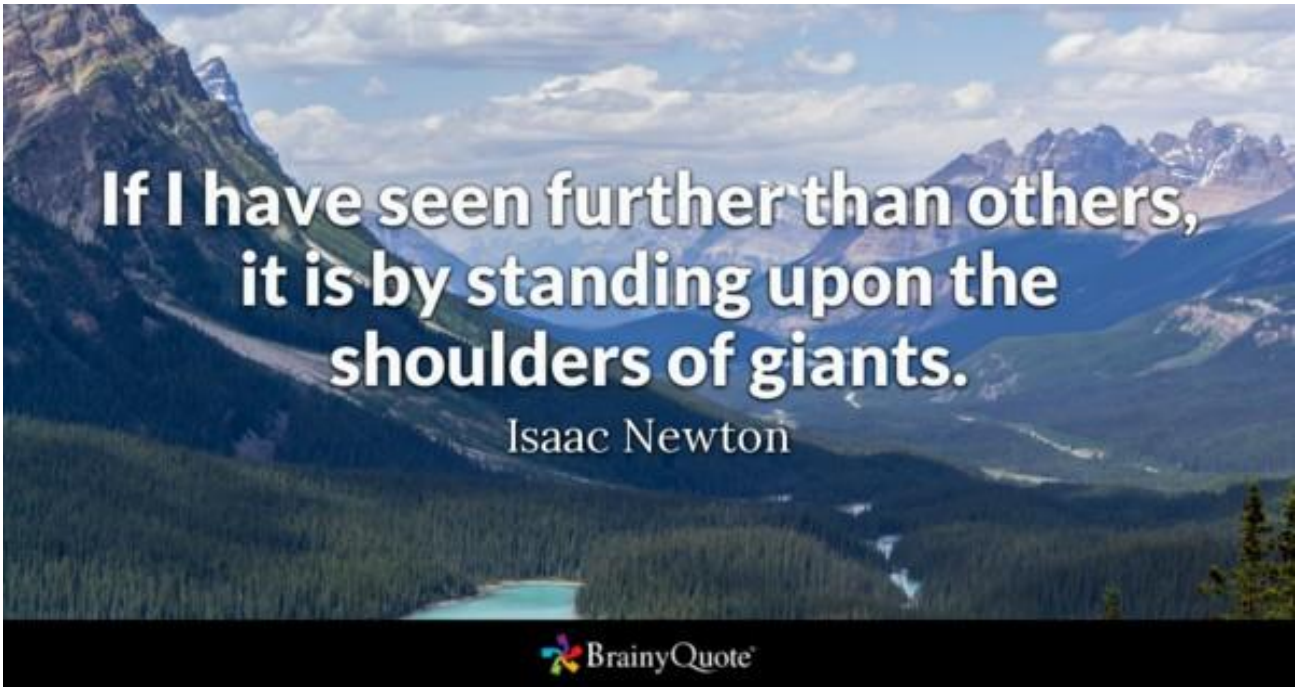
GYAN VIGYAN SARITA:शिक्षा

A Non-organizational, Non-remunerative, Non-commercial and Non-political Initiative
To Mentor Unprivileged Children with a Sense of Personal Social Responsibility (PSR)

Monthly e-Bulletin GgyanVigyanSarita:शिक्षा March 01, 2020 (54th Issue)





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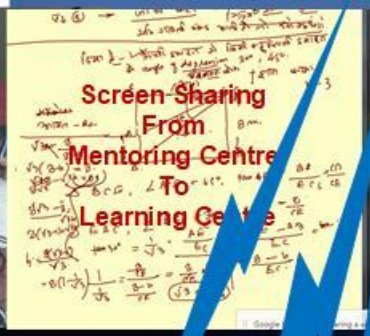
Aim at the Best, but...

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 all Six nodes. Presently Google Hangouts 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 Centres in Interactive Online Mentoring Sessions (IOMS)

Learning Centre (if asked for by Mentor)		Mentoring Centre (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	9,000	Projector	-
Web camera	2,000	Web camera	-
Mixer cum amplifier with Speaker and Wireless microphones	14,000	Headset with Microphone	3,000
Total (Max. if nothing is available)	**45,000**	Total	28,000
Wireless Surface Writing Device (WSWD). It shall be required when Learning Centre is ready for collaborative use of Whiteboard.	15,000	Wireless Surface Writing device	15,000
Total with Total with WSWD (***at a later date once IOMS stabilizes***)	60,000	Total with Total with WSWD	**43,000**
Estimated Recurring Cost			
a. Internet charges, based on estimated monthly data transfer which depends upon choice of cloud platform, and tariffs of ISP b. Cloud Platform Charges, to be shared across Learning Centres		Internet charges, based on estimated monthly data transfer which depends upon choice of cloud platform, and tariffs of ISP	
Cloud platform : Google Hangouts is a free Video Conferencing cloud platform. Though it provides free connectivity upto 15 nodes, connectivity of maximum 5 Learning centres is made in IOMS. This self-imposed limitation is to – a) maintain quality of interaction and mentoring, b) open an opportunity for more co-passionate mentors to collectively participate in mentoring deprived and unprivileged children.		IOMS is since an initiative driven with **Personal Social Responsibility (PSR)** operating on **Zero-Fund-&-Zero-Asset (ZFZA)** basis.. The IT Infrastructure with the Mentors has been in use and is working. But, at any stage if upgradation becomes essential, support of facilitators or learning centres would be gratefully welcomed, on ZFZA basis, to maintain continuity of this selfless initiative.. Operating cost of Mentor, if required, shall be supported by Learning Centres	

Specification: These are 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 centres and mentoring centres. These specifications have been updated based on experience of operation of IOMS with available options. MS WhiteBorad a free App of MS office has been tried out in IOMS and is found satisfactory, until a better option is available.

Web Camera: iBall 20.0 HD with a wall mounting

Projector: Portronics POR 624 LED Projector Beam 100 Lumen, Screen Size 130 Inch , 800x480px resolution

Sound System: Ahuja Make PA Mixer Amplifier Model DPA-370, 30 W Max/37W Max, with PA wall speakers PS-300T 10W, and a wireless unit AWM-490V2 Dual Cordless Microphones. This sound input/out when decoupled with USB sound adopter to connect to the computer required echoless environment is achieved in the Classroom and networked mentor and Learning Centres.

Cloud Platform: Google Hangout, a free-ware is used for IOMS in video-conferencing mode. Though it provides pre connectivity upto 15 Nodes, connecting maximum only 5 Learning Centres in one session is envisaged.

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

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

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

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संपादकीय

चलिये, जल बचाने की मुहिम चलायें

ब्रह्मांड में जीवन की खोज के लिये, मनुष्य जहां कहीं जाता है, वहां सबसे पहले जल के होने की संभावना की खोज करता है। उसे मालूम है कि पृथ्वी पर पहला जीवन जल के किनारे ही पनपा था। हम जल के बिना जीवन की कल्पना नहीं कर सकते हैं। जल की मौजूदगी में ही हमारा जीवन पनपता है। जल पीकर हम अपनी प्यास बुझाते हैं। जल का उपयोग हम नहाने, खाना पकाने, और कपड़ा धोने में करते हैं।

कहा जाता है कि जल है तो कल है यानि हमारा जीवनचक्र जल के अधीन है। हमें नहीं भूलना चाहिये कि जल तभी तक बना रहेगा, जब तक हम इसका संरक्षण करते रहेंगे।

जल केवल मनुष्य के लिये ही नहीं, बल्कि हर जीव के जीवन के लिये बहुमूल्य है। हमारी पृथ्वी का लगभग तीन चैथाई भाग जल से घिरा है परंतु इसमें से केवल 3 प्रतिशत ही पीने लायक है और शेष 97 प्रतिशत खारा है।

पीने लायक 3 प्रतिशत जल में से 2 प्रतिशत ग्लेशियर एवं वर्फ के रूप में है, अर्थात् हमारे पास पीने का जल केवल 1 प्रतिशत ही उपलब्ध है।

नगरों की संख्या बढ़ने के कारण जल की खपत बढ़ रही है। औद्योगिक ईकाइयां बढ़ रही हैं। वातावरण में प्रदूषण बढ़ रहा है जिसके कारण पीने का जल हर दिन प्रदूषित होता जा रहा है।

जहां पीने का जल बड़ी मुश्किल से मिलता है, वहां जल का महत्व लोगों को मालूम हो रहा है, परंतु अन्य जगहों पर इसकी बर्बादी बदस्तूर जारी है। शहरों में फर्श चमकाने, गाड़ी धोने, और गैर जरूरी कामों में पीने वाले जल का दुरूपयोग अब भी हो रहा है।

जल को हम अमृत मानते हैं पर उसको बचाने की फिक्र नहीं करते हैं। हम जानते हैं कि बूंद- बूंद से समुद्र बना है, पर हम यह नहीं याद रखते कि अगर हमने जल का संरक्षण नहीं किया तो बूंद-बूंद खत्म होकर समुद्र रिक्त भी हो जायेगा।

जल की मात्रा घट रही है। ध्रुवीय क्षेत्रों में वर्फ पिघल रही है। महासागर सिकुड़ रहे हैं। कई हिस्सों में जल का संकट बढ़ रहा है। जितना जल पृथ्वी पर बरसना चाहिये उतना नहीं बरस रहा है। प्राकृतिक स्रोत सूख रहे हैं। परंतु हम जल को बचाने की मुहिम चलाने में विलंब कर रहे हैं।

देश के महानगरों में रोजाना गाड़ियों के धोने में लाखों लीटर पीनेवाला जल खत्म हो जाता है। कई नगरों में पाइप लाइनों के वाल्वों की खराबी से प्रतिदिन काफी जल बेकार बह जाता है।

सामान्य तौर पर पीने के लिये एक व्यक्ति को 3 लीटर और जानवरों को लगभग 50 लीटर जल चाहिये।

हम मंजन करते समय करीब 25 से 30 लीटर जल खर्च कर देते हैं क्योंकि नल खुला रखते हैं, उसे बंद नहीं करते हैं। नहाते समय बाथटब में सैकड़ों लीटर जल खर्च कर देते हैं।

पृथ्वी की हरियाली और इसके तापमान को नियंत्रित करने के लिये जल बहुत जरूरी है। अगर जल का अभाव हुआ तो हमारी पृथ्वी बंजर हो जायेगी।

जल को बचाने के लिये हमें सबसे पहले अनावश्यक कामों में हो रहे जल के उपयोग को बंद करना होगा। वर्षा के जल को संग्रह करने की कोशिश करनी होगी। अधिक संख्या में पेड़-पौधे लगाने होंगे और मौजूद पेड़ों की कटाई रोकनी होगी।

पीने लायक जल बचा रहे, इसके लिये हमें नदियों के जल को दूषित होने से रोकना होगा, उद्योग-धंधों से निकलने वाले दूषित जल को नदियों में आने से रोकना होगा, और ध्यान रखना होगा कि नदियों व तालाबों में कूड़ा-कचरा व गंदगी न फेंकें।

विश्व समुदाय ने पीने लायक जल को बचाने के लिये वर्षों से जागरूकता फैलाने का काम शुरू कर रखा है। संयुक्त राष्ट्र की पहल से वर्ष 1993 से विश्व जल दिवस (World Water Day) हर वर्ष 22 मार्च के दिन मनाया जाता है।

इस दिन को मनाने का उद्देश्य है कि सब लोग जल के महत्व को समझें, सब लोग याद रखें कि पीने लायक जल पृथ्वी पर बहुत अधिक नहीं है, और इस जल को बचाने के लिये हमेशा प्रयत्नशील रहना चाहिये।

वर्ष 2019 के विश्व जल दिवस की थीम थी: (Leaving No One Behind) किसी को पीछे नहीं छोड़ना, अर्थात् साफ और स्वच्छ जल सबका अधिकार है। इससे कोई भी वंचित नही रहना चाहिये।

वर्ष 2020 की थीम हैः (*Nature and Climate Change)* अर्थात् जल और जलवायु परिवर्तन में संबंध अटूट है। जल के रहते हमारी जलवायु सुरक्षित है, हमारा जीवन सुरक्षित है और हमारी सृष्टि सुरक्षित है।

हमें अपनी गिलास वहीं तक भरनी चाहिये, जहां तक हमें जरूरत हो। हमें अपने बच्चों को बताना होगा कि वे जल की इज्जत करें ताकि उनको, उनके जीवनकाल में, जल मिलता रहे।

रेगिस्तान में आते ही हर किसी को जल की कीमत का एहसास हो जाता है। जब कुंयें सूख जाते हैं, तब हमें जल की कीमत समझ में

आती है। जब हम जल के लिये टैंकर के आने का इंतजार करते हैं, तब हमें जल की कीमत समझ में आती है।

हमें याद रखना होगा कि जल बचाया तो जा सकता है लेकिन बनाया नहीं जा सकता है।

क्या यह सच नहीं है कि हम लोगों के दादा जी ने जल नदी में देखा, पिताजी ने कुयें में देखा, हमने नल में देखा, और हमारे बच्चे आजकल बोतल में देख रहे हैं। कल इनके बच्चे जल को कहां देखेंगे? जरा सोच कर देखिये।

ज्ञानविज्ञानसरिता परिवार अपने शैक्षणिक कार्यक्रमों के दौरान लोगों को जल बचाने और सोच समझ कर जल को खर्च करने के लिए जागरूक कर रहा है।

आइये, ज्ञानविज्ञानसरिता परिवार की जल बचाने की मुहिम में हम सब सहयोगी बनें और जल-संरक्षण को जीवन-संरक्षण मानकर इसे जिम्मेदारी से खर्च करने और बचाने की कोशिश में लग जायें।

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Humanity is acquiring all the right technology for all the wrong reasons.

\- ***R. Buckminster Fuller***

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EVOLUTION OF IOMS

- Philosophy of IOMS had its inception in Sarthak Prayash an NGO, in May'2012 in Chalk-N-Talk Mode with stray students.
- Its manifestation in the form of e-Bulletin started in 2016, on 2nd October with its First Issue **Subodh *पत्रिका***
- In May' 2017 the initiative was upgraded to IOMS, in its primitive form, with the efforts of its Shri Shailendra Parolkar
- This initiative was reorganized as Gyan Vigyan Sarita in 2017 with its e-Bulletin in the name of **Gyan Vigyan Sarita – शिक्षा**
- With this e-Bulletin as Fourth Annual issue, we are stepping in Fifth year of broadening communication to invoke participation of those who can make a difference, for the larger good.
- Presently it is a satisfactory working model on 'Minimum Need' basis.
- Currently about 75 students in Two rural schools, one is RKM High School in A.P. and other is Army Public School, Dinjan, Assam, are being ng mentored. At Dinjan it is our first step to mentor children of our brave soldiers securing our frontiers
- We continue to look forward…..

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Roots of education are bitter, but the fruit is sweet.

\- ***Aristotle***

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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 to 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 next Monthly e-Bulletin Gyan-Vigyan Sarita: शिक्षा due on 1st of ensuing month.***
- ***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.***

Formatting Guidelines: (a) Paper Size A4, (b) Fonts: Times Roman (English), Nirmala UI (Hindi), (c) Font Size Title/Author Name/Text: 14pt/12pt/10 pt (d) Margins: top/bottom/left/right – 1"/1"/0.4"/0.4", (e) Photoprofile of author – In 4-5 lines with mail ID and Photo. We will be pleased to provide softcopy of template of an article, in MS Word to the author on advise.

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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We have learnt that LIFE is neither fast nor sudden leaps;

It grows gradually and sreadily through pits and rises.

We have learnt on every fall, more was needed from us;

Irrespective of how others were.

We have learnt that when tide is against, swim hardest to keep moving ahead;

When in favour swim fastest to create a reserve in case of contingencies.

We have also learnt that reasons are in abundance to justify losses,

But there is only ONE reason to do good beyond self.

LIFE is MUST for sustainable coexistence.

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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

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Coordinator's View

IOMS: Opportunities, Challenges and Expectations of Mentors?

IOMS – Interactive Online Mentoring Sessions *is not a buzzword. It is passion, inspiration and vision into action. Visions are gloomy so are passion and inspiration good to talk about. But, translating them into action involves multiple challenges to the mentor. Likewise, there are certain expectations from the beneficiaries for them to avail its benefits. These expectations are non-financial in nature and in-line with duties and responsibilities of beneficiaries. The IOMS is since driven selflessly with an inspiration of* ***personal social responsibility (PSR)*** *and executed in a non-organizational, non-remunerative, non-commercial and non-political manner proactive participation of beneficiaries is an urgent necessity. Does it not need to responded in a manner such that more mentors, schools, social organizations, corporate and individuals choose merit in discharge of PSR as an inevitable social reform? This article brings forth first-hand realizations during nearly eight years of endeavour by a small group of four co-passionate persons to invoke collective complementing of efforts among elites. We are committed to carry it forward until last breadth.*

Readers of this article, generally elites, may have an anguish as to - *why our pointer is always towards them*? The basic reason lies in differences in perceptions of PSR. In this series ground realizations are being introspected with a set of questions: **(a)** A*re we not among the privileged one to receive care, concern and facilitation in education*? **(b)** *Is it not that our present and future is due to education that we received*? (c) *Is it not that we expect, right from within family to anywhere outside, discharge of responsibility by persons, institutions and any other to take care of welfare of those below them in the pyramid*? If this is true, then – **(d)** *Is it not brutality to be engaged only in accomplishment of personal gains and comforts*? Yet, it is believed that these questions would not offend persons awakened with PSR.

IOMS is since an endeavor in the field of education, it is essential to briefly review **half-truth** of prevalent educational perspective. When education is seen as a means of livelihood, amassing wealth, power and position, there is disregard for the complementary-half of education, the wisdom, an epitome of education. *In absence of wisdom, education is only ornamental*. Thus to know *what education is,* it is essential to know the process of education. It starts at **(a)** *ability to observe*, **(b)** *preserve observations for correlations*, **(c)** *passion to determine desirable and undesirable observations*, **(d)** *pursuit to explore alternatives to optimize observations*, **(e)** *patience selection of one of the alternative for the larger and sustainable good*, and **(f)** *perseverance to make the selection a reality*, this is a skill and an integral outcome of education. These **A5Ps** when perpetuated continuously leads to a sense of judgement and strength to implement them; this is called *creativity in physical space and wisdom in metaphysical space*. The height that one is able to reach os exponentially dependent on the pursuit. It comes neither from knowledge nor from intelligence. Creativity and wisdom evolves continuously like spiral until it becomes intuitive. It grows with every cycle of its implementation for the larger good. *Wisdom in its highest form is enlightenment*.

IOMS is not a buzzword, it is homogeneous fusion of philosophy contained in its constituent words. Each of the constituent word is incomplete without the remaining three. IOMS is a means to discharge PSR and not an end in itself. Different aspects of IOMS have been addressed in various articles, nevertheless, its brief overview is contextual. IOMS is a philosophy not in words but in action. Its focus is to *groom competence to compete among unprivileged children without discrimination*. Students of privileged families are not targeted; they are blissful to have parents who can afford and choose expensive schools and guidance. Inspite of this, these students are welcome to learn with the target students, but definitely not in exclusion. This perspective towards privileged students is strategic and if they and their parents choose to associate in IOMS, it would definitely infuse in them sensitivity and sensibility that goes in making of responsible citizens. Moreover, IOMS is for 4-5 clusters of students, and not individually. This is essential to optimize use of IT resources, and time and effort of selfless volunteering mentors who are scarce in availability. It involves inspiration to perform A5Ps of education with full honesty and commitment, to catalyze effectiveness of IOMS.

In this context IOMS is defined with each of the constituent word, but in reverse order. **Sessions** implies that it is neither onetime nor an occasional activity to suit one's convenience. Education to be able to achieve its objective it has to be facilitated and pursued for more than a decade. Thus, unless grooming is persistent and with perseverance it is cosmetic, and a futile exercise. **Mentoring** is different from teaching; it's aim is to bring in transformation in students who are deprived ones. This transformation is neither limited to academics nor just enhancing intelligence and skill, rather it is aimed at infusing collective wisdom for the larger good. **Online** is the operational methodology where state-of-the-art compunication (computer+communication) technology is used to connect mentors and group of students who are otherwise inaccessible to each other. It is optimal utilization of the prevalent socio-technological environment. **Interactive** is the characteristic of audio-visual and e-communication of students, local subject teacher and head of the learning center, called ***beneficiaries***, with the mentor. This makes it multi-dimensional and multi-directional. Its motive is to infuse confidence among students in their ability to solve problems and not the least to shadow their growth.

Here an example of walking towards a lamp in the dark is relevant. While one walks facing the lamp, it becomes brighter as per inverse square law and shadow follows him. But, no

sooner one turns his back towards lamp he is doubly disadvantaged; first is deprivation of light and second is shadow remains unreachable. In this example lamp signifies wisdom, capability and all positive traits of competence, while shadow represents marks attained in examination and all associated benefits. Therefore, in IOMS attempt is to invoke conceptual clarity leading to competence and completing syllabus with an aim of scoring higher marks in examinations is just incidental. In the process mentor extends hand holding to students to imagine, observe and correlate their learning in their environment. Imagination is blind and boundary less, but, revelation requires honesty and modesty to accept ignorance as a first step to be followed with tireless desperation to overcome ignorance with how and why? This process starts with *viewing like data collection; observation of data is experience; analysis of observation is information; classification of information is knowledge; speed and accuracy to apply knowledge is intelligence and ability to use intelligence for the larger and sustainable good manifests as creativity or wisdom.*

It may not be out of context to state that any of the best intentions are just worth of one's ability to convert them into reality. IOMS proposition is typical blend of remote education and classical chalk-n-talk mode. It offers bilateral interaction between all the participants in online audio-visual mode with off-line e-communications, implementation aspects of IOMS. Though, interaction is the first keyword of IOMS, yet it is being elaborated at the end to consolidate contentions of IOMS and to emphasize upon challenges that mentors have to face, and no less demanding expectations from the beneficiaries.

Challenges: These are the concerns where mentor has to pro-act in furtherance of IOMS

(1) ***Strata of target students***: In IOMS students are considered to be biological equivalent and have a potential to be groomed in line with the theory of evolution. Genetic differences and family background of students are not allowed to hinder process of grooming. Yet, socio-economic, hygienic, cultural and geographical background of target students in non-residential schools deserves concern, but not the sympathy. This concern has been funneled into efforts to –

a. lift them from the bottom, i.e. lowest level of their academic understanding, else education bears risk of becoming disinteresting. That would defeat the whole exercise.

b. correlate academic understanding in the language and environment of students. Mentor, while grooming, has to have tolerance to bear with colloquial language of these students.

c. patience in continuity to mentor, back-and-forth involving repetition if necessary, so that students absenting or missing learning in previous sessions do not find the subject matter out of context. They have none at home to help them make anything that they have missed.

d. steer learning process away from rote learning in a manner such that concepts become intuitive.

e. recognize creativity of the students and dovetail it in the learning process

Despite all constraints students in class 9th are at a stage ready to differentiate between TV show and an online mentoring session. This is the reason to choose class 9th as starting point of IOMS.

(2) ***Dovetailing in Education System*:** Mentors volunteering in IOMS are either non-teachers or teachers of students at much higher level. Thus adapting to learning needs of target students requires lot of mental conditioning, re-familiarization with the texts books and an academic descend to the level of target students that after a gap of 4-5 decades. Though it is not a cake walk, yet it is vouched from experience that it is not a difficult task. It is compared with cycling, swimming and typing which one never forget; all that it needs is a little effort and passion to reach out to deprived students. It is realized that in this pursuit mentors, who are otherwise self-sufficient both financially and physically, and have lived their life satisfactorily, are benefitted with much required psychological revitalization. It in turn positively influences their health, personal and family life. In addition, they create a legacy for their descendent to feel proud of.

Expectations: These are the areas where respective beneficiaries have to act upon to stabilize IOMS in their own domain, where remote mentor volunteering in IOMS as a non-entity has no jurisdiction.

(1) ***IT Infrastructure*:** It is the pedestal for IOMS and basic requirements are broadband connectivity of the system, surrounding noise free sound system, addition extended screen and wireless surface writing device. It is advised to start with a video-conference with whatever is available. As IOMS rolls on need-based gradual upgradation can always follow. Cost of IT setup drawn out on must-be basis; is minimum as well as insignificant as compared to benefits being passed on to students, and schools in their efforts to improve their credentials. Since IOMS is volunteered at no-cost basis with its financial model of IOMS is Zero-Fund-&-Zero-Asset (ZFZA), no school should find it difficult to embrace IOMS.

(2) ***Role of Administration*:** More than often it is experienced that administration acts on **ABCDE *principle*** to any a new proposition and more so if it is unconventional. In this **A-** means *avoid, B*-means *bypass*, **C**-means *confuse*, **D**- means *diffuse it to the extent one can* and lastly **E-** means *execute it if it is inevitable*. Yet they are prompt either to toe the line or to work for their own preferences or priorities. Administration in education is classified in two tier as under –

a.*Super Administration*: *They are custodian of educational institutions and supposed to work for improvement in education as their primary duty and responsibility*. They lays policies and guidelines for improvement in educational system. In last seven years of pursuit of this endeavor many super administrators, right from district to the top level, were requested for an audience to **(i)** first know IOMS, **(ii)** then evaluate the proposition, and then **(iii)** identify 4-5 schools for pilot implementation having same curriculum and medium of instruction. *We are still in waiting for a **kind** reciprocation. While presenting general scenario we have refrained from making direct references; our aim is resolution of problems in the system and neither vengeance nor jeopardizing any one.*

b.*School Administration*: *Principal or headmaster of school is first responsible person for performance of his school*. He is vested with requisite discretionary powers to act upon for improvement in academic and multidimensional performance of students and school. In case of need approval can always be sought from the competent authority, a routine administrative process. We appealed to numerous heads of schools, but only two schools have embraced IOMS with a resolve to continue it. *Is it not an indicator of gravitational descend of disconcern and irresponsibility?*

Once a school embraces IOMS the head of institution is expected to perform certain roles that are important to stabilize IOMS viz. **(i)** up-gradation of IT infrastructure as per need, **(ii)** designation of coordinator with responsibility and authority for ensuring smooth functioning of IOMS, **(iii)** periodical review of IOMS, **(iv)** pro-actively communicate with the mentor for any support, if needed, **(v)** organize need based or an occasional visit of mentor to create direct interaction with teachers, students and their parents so as to revamp the IOMS initiative, **(vi)** support SOS needs of upgradation or maintenance of IT infrastructure on ZFZA; these are of marginal cost, but vital for continuity of IOMS, and **(vii)** share his experience on IOMS with heads of other schools; it is based on the theme that ***t****ogether* ***e****ach* ***a****chieves* ***m****ore* (TEAM). *Mentors are non-entity persons yet having volunteered selflessly to complement efforts of teachers at school, and, therefore, deserve unequivocal support in the interest of students and school.*

(3) ***Role of Coordinator***: *Coordinator, preferably subject teacher, is a nodal person. He has an important role to complement in bridging the learning gaps if any*. Some of them are to encourage – **(i)** students to organize themselves in groups of 4-6 students, **(ii)** inspire and monitor flow of notes and question by students to the mentor; this helps students to explore how and why of concepts, difficulties, doubts, problems and observations, **(iii)** encourage intra and inter group discussions on sticky concepts, **(iv)** students to send solution of problems and derivations to the mentor; this helps students to receive guidance of mentor to make improvement in their answering and presentation skills, **(v)** regulate flow subject in IOMS so as to make it maintain a balance between academics and conceptual growth of students and **(vi)** promptly communicate to the mentor on any interruption or inability to have session on a particular day .

These are important initiatives to invoke ***group dynamics*** among students. It also serves as a feedback to the mentor to regulate his efforts based on understanding of concepts by students, an inevitable necessity in IOMS. But, this can happen effectively only when students do self-study, for which there is no substitute.

(4) ***Role of Students*:** Education is never unilateral, invoking group dynamics and out-of-box thinking among students are key features, among many nuances, of IOMS. Therefore, best possible collective efforts of administration, coordinator/teachers and mentors to groom competence and wisdom among students cannot yield results unless students are awakened and receptive to the initiatives. Accordingly, students have to have faith in the ability of their teachers and mentors to safeguard their academic interest while grooming competence in them. Therefore, students are expected and advised time-and-again to respond to their advice both promptly and faithfully. In addition, catalyzing out-of-the-box thinking among students is another important feature of IOMS. This is ventured by encouraging students to **(i)** *list their observations, without any kind of blinders, and tracking them individually with the reasons until they are satisfied,* **(ii)** *visualize the concepts learnt by them in their environment,* **(iii)** *open up to the mentors with doubts and confusions*.

In IOMS spontaneous answer to question so arising is not guaranteed, nevertheless, with our experience of nearly eight years it is assured with certainty that they will be provided satisfactory illustration of concepts underlying their observations. *Education is not free and personalized*

tutoring. It is a structured process where a bit of patience is required to climb certain steps before class is ready to understand necessary illustrations.

It considered essential to *caution students against heavy leaning on web-resources*, especially until they graduate to college education. This is primarily due to **(i)** *single quarry is responded with multiple search results which are neither tiered nor scrutinized for authenticity*, **(ii)** *students may either get confused with multiple information or waste time in searching out the desired one*, **(iii)** *questions and concepts there are random unlike text books and reference books deals with subject matter systematically and are easy to understand*, **(iv)** *reach out to their mentor with its correct source*. Students need to know that their mentors and teachers are better placed to decipher web-resources and extend quick guidance. Likewise, *questions from different competitive examinations are also random and involve integration of concept not learnt earlier. Therefore, students must attempt such question only after they have completed their text book with reasonable proficiency.*

(5) ***Collective Complementing of Efforts*:** IOMS is an endeavor which has no jurisdiction over target schools and is being volunteered remotely by non-entity, but passionate mentors inspired with PSR. They cannot perform unless it is complemented by the beneficiary academic establishments. Some of the areas for them to respond favourably are –

a. Scheduling of session minimum 60 minutes and not usual 40 minutes. This is to allow conclusion of a topic being mentored. Moreover, incidental loss of voice, whiteboard or image transmission needs little extra time.

b. IOMS since targets concurrent sessions **upto 4-5 learning centers** of same class, subject, syllabus and medium of instructions (language) each learning center must exercise readiness to parallel their IOMS schedules. The limited number of learning centers is not a yardstick, but it is based upon comfort level of mentor. It is definitely not advisable to exceed the limit so as to maintain efficacy of interaction.

c. Mentors and local teacher can complement each other for greater participation of students to enlarge spread and penetrate into areas hitherto deprived of educational opportunities.

(6) Common: There are some areas where each of the player in IOMS can collectively complement, salient of them are as under –

a. In the event of non-availability of teachers, for various reasons, continuity of learning of students can be maintained through IOMS. All that it requires is communication of the filler needs to the mentor in advance.

b. Faith in self, honesty and hard work are pre-requisite to create a reform like IOMS. Capability is no barrier; it grows squarely with the passionate involvement. This is the first-hand realization.

c. Tall claims and advertisement of coaching institutes and tutors are marketing gimmicks. They are parallel schooling and are commercially oriented with least concern in PSR. Their efforts are distracting attention of parents and students away from regular school education.

d. ZFZA is a pre-declared agenda of IOMS, and there are no hidden costs involved in it. Accordingly, occasional visit of mentor at learning center and marginal support in upkeeping of IT infrastructure of mentor are incidental.

e. IOMS is flagship of **Gyan Vigyan Sarita**. It publishes a monthly e-bulletin with a regular column **Students' Domain.** It **i**s dedicated to creative works and environmental concerns of students. Schools and students can enrich the column through their contributions and benefit themselves by exposing to the outer word. Creativity and environmental concerns are integral parts of education,

Conclusions: *Reform in education is a mammoth task. None. howsoever omniscient, omnipresent and omnipotent may be can do it individually. Are not the elite persons better placed to collectively complement in such initiatives*? *If not, who else can do it? Are they the unprivileged persons*? *Do they have any inkling of educational needs*? *Can they be expected to become torch bearer of such initiatives*? *Is it a political agenda where crowd with narrow perspective matters*? *It is requested to please introspect and then only brainstorm on the issues raised above. We would gratefully welcome your kind and proactive guidance in furtherance of our endeavor, but with a sense of urgency. Time cannot wait for our convenience or pleasure. In this context it would be unfair, rather most unfortunate, to leave mentors, who have selflessly volunteered for the cause, to face the cruel irony in prevalence.*

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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-organizational, 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, 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 a 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 non-teacher by profession, soon after submission of Ph.D. Thesis in 2012, at one of the IITs, under taken after retirement got inspired to mentor unprivileged students.*

The endeavour started with Chalk-N-Talk mode of mentoring unprivileged students starting from class 9th upto 12th. Since then it has gone through many ground level experiences and in July'16 it was upgraded to IOMS, a philosophy in action to reachout to more number of deprived students. Currently regular sessions of IOMS are held regularly for students of class 9th and above at few Learning Centeres. Efforts are being made to integerate more learning centers and mentors to diversify its scope and utilize our full capacity.

*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 can be online accessed at IOMS .*

***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 above at **Involvement**, to make the mission more purposeful and reachable to target children.*

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अंदाज ए बयां

भ्रष्टाचार की एक्सपायरी डेट

-समीर लाल 'समीर'

सुबह सुबह भईया जी के यहाँ पहुँचा. बड़ी गमगीन मुद्रा में नाश्ता कर रहे थे. मुंशी बाजू में बैठा लिस्ट बना रहा था. भईया जी लिखवाते जा रहे थे:

- नगर निगम से पानी के दोनों नल रेग्यूलर कराना है.
- राशन कार्ड से बाबू जी का नाम हटवाना, जिनकी मृत्यु आज से ५ साल पहले हो चुकी है.
- स्व. पिता जी का नाम वोटर लिस्ट से हटवाना है. ५ साल से टल रहा है.
- गैस कनेक्शन नौकर के नाम से हटाकर खुद के नाम ट्रांसफर कराना है.
- २० साल के अनुभव के बाद ड्राईविंग का लर्निंग और फिर मेन लायसेन्स लेना है.
- २०१७ में खरीदी गाड़ी का रजिस्ट्रेशन कराना और लाईफ टाईम टेक्स भरना है.
- १२ वर्ष पूर्व जारी स्वतंत्रता संग्राम सेनानी का प्रमाण पत्र, भूलवश जारी के पत्र के साथ सरकार को वापस करना है.
- गैरेज बढ़ाकर दो फुट सड़क घेरने का नक्शा, नक्शा ऑफिस से नियमित कराना है.
- आयकर विभाग में वालेन्टरी स्कीम में आय घोषित कर टैक्स भरना है.
- खेत में सिंगल बत्ती कनेक्शन अपने नाम से कराना है.
- घर के पीछे वाले हिस्से में कटिया हटवाकर कनेक्शन मीटर से करवाना है.
- बालिकाओं के लिए 'रंगीन तितली' और महिलाओं के लिए 'माँ वैभव लक्ष्मी' नामक चार साल पहले बनाये दो एन जी ओ को बंद करवाना है.

और भी जाने क्या क्या काम जिसमें पूर्व की कारगुजारियाँ और कुछ कार्य आने वाले समय में करने के मंसूबे थे, सबके कागजात जल्दी से जल्दी बनवाने की कवायद में लगे थे.

मैने उनके चेहरे पर उभर आई इस परेशानी का कारण पूछा तो कहने लगे कि अब दु-धारी तलवार पर चलने का जमाना आ रहा है तो यह सारी परेशानी तो होना ही है.

तब पता चला कि आधी झंझट तो इससे आन पड़ी कि भईया जी ने खुद ही साथियों को भड़का कर आनन-फानन में जो भ्रष्टाचार उन्मूलन समिति बनाकर खुद को स्वयंभू अध्यक्ष घोषित किया था, उसे इनके दिल्ली वाले संपर्क ने इनका संजीदा कदम मानते हुए मान्यता दिला दी और सरकारी ग्रान्ट और भूमि के आबंटन के लिए दरखास्त भी लगवा दी ताकि एकाध महिने में अप्रूव हो जाये. मौका नाजूक था तो भईया जी मना भी नहीं कर पाये और न ही बता पाये कि यह समिति तो देश का माहौल और अगले साल आने वाले चुनाव को देखते हुए टेम्परेरी बनाई थी.

बाकी की आधी झंझट इस वजह से कि इस समिति के बैनर तले जिस जोर शोर के साथ १५ अगस्त तक 'भ्रष्टाचार मुक्त भारत' के अनशन कार्यक्रम में जोश दिखाते हुए वो अपने साथियों के साथ धरने पर बैठे थे, उसके लिए उनकी सोच यह थी कि अन्य आंदोलनों की तरह यह भी नींबू पानी आदि पिलाकर समाप्त करवा दिया जायेगा और बात आई गई हो जायेगी, साथ ही भईया जी का रुतबा भी बन जायेगा. जनता का क्या है वो तो किसी और मसले में उलझ कर इसे भूल जायेगी. उसकी तो आदत ही भूल जाने की है. मगर हाय री किस्मत, सरकार आंदोलनकारियों की शर्तें मान गई. सारा का सारा प्लान धाराशाई हो गया.

यूँ तो सरकार हजारों किसानों के मरने पर चुप बैठी रही, लोकपाल पर चुप लगा गई, गुर्जरों को बहला फुसला लिया और आज जब भईया जी की बारी सामने आई तो एकदम पलट गई. तुरंत मांगे मान ली. भईया जी की नजर में यह सरकार की सरासर चीटिंग है. कोई कन्सिस्टेन्सी नाम की चीज ही नहीं है इस सरकार की कार्य प्रणाली में.

किसी के साथ कैसा व्यवहार और किसी के साथ कैसा? ऐसा कहीं होता है क्या..सरकार-सरकार खेलना है तो फेयर गेम खेलो या फिर खेलो ही मत. कोई क्रिकेट है क्या कि जिसको मर्जी हो खिलवा लिया, जिसको मर्जी हो बैठाल दिया. मैच जीते की हारें, उसकी किसे फिक्र?

अब भईया जी को चिन्ता सता रही है कि जब इतना हो गया तो कहीं १५ अगस्त से सच में भ्रष्टाचार न बंद हो जाये. किसका भरोसा करें? जिस सरकार पर इतने दिन तक भरोसा किया वो तक तो पलट गई. तो अब समझो कि भरोसा नाम की चिड़िया उड़ गई. १५ अगस्त से तो जानिये गौरैय्या हो गई, विलुप्त प्रजाति की तर्ज पर भ्रष्टाचार भी विलुप्त प्रजाति हो जाएगा.

अच्छा खासा तो चल रहा था. सब कामों के रेट फिक्स से ही थे. किसी को कब कहाँ कोई दिक्कत हुई, कौन सा काम अटक गया- सारी नौटंकी खड़ी करके रख दी. बेवजह का बवाल खड़ा कर दिया. बता दे रहे हैं और चाहो तो स्टॉम्प-पेपर पर लिख कर दे दें- आने वाली पीढ़ी कोसेगी की ये बुजुर्ग तो भ्रष्टाचार हटवा कर निकल लिए, अंजाम हमें भुगतना पड़ रहा है. सब पछतायेंगे कि यह क्या कर बैठे हमारे बुजुर्ग. फिर न कहना कि आगाह नहीं किया था..

अगली पीढ़ी जब इतिहास पढेगी तो कहेगी कि इतनी बढ़िया व्यवस्था थी, सब काम हुआ जा रहा था. सब मिल-जुल कर ऐश कर रहे थे. पता नहीं कैसे और किसको बर्दाश्त नहीं हुआ, अब

भुगते हम. तब शायद कोई आंदोलन चलाएगा कि भ्रष्टाचार वापस ले आओ. ये रोज-रोज का टंटा हमको पसंद नहीं है.

बहुत खराब आदत पड़ी है सबकी -एक दिन कहते हैं अंग्रेज भारत छोड़ो..फिर मनाते हैं कि वो ही ठीक थे...वापस आ जाओ. बस, आना-जाना ही लगा रहेगा तो काम कब होगा?

अब अगर १५ अगस्त को भ्रष्टाचार बंद हो गया तो यह सारे लिस्ट के काम कैसे होंगे? इसमें से एक भी काम बिना सेटिंग और लेन-देन के होता है क्या भला? इसीलिए भलाई इसी में लग रही हैं कि ये सारे काम करवा कर रख लें फिर इत्मिनान से खुल कर नारा लगा पायेंगे- 'भ्रष्टाचार हटाओ, देश बचाओ'

समय मात्र ४ -५ महिने का बचा है और काम का तो मानो ढेर हो.आप भी जाकर अपना बकाया काम निपटाईये, और हमें भी निपटाने दिजिये.

वैसे भी आपकी जरुरत तो नारा लगाने के लिए ही पड़ेगी, अभी क्यूँ समय खराब करते हैं?

लौटते हुए मैं भी सोचने लगा कि वाकई ऐसे कितने सारे काम पेन्डिंग पड़े हैं जो भ्रष्टाचार खतम हो जाने के बाद तो करवा पाना संभव ही नहीं होंगे. बस यही सोच कर लगा कि समय बहुत कम बचा है. मैंने महसूस किया कि मेरी चाल एकाएक तेज हो गई है और मैं मन ही मन कामों की लिस्ट बनाता घर की तरफ चला जा रहा हूँ.

लोकप्रिय चिट्ठाकार समीर लाल व्यवसाय से चार्टर्ड एकाउंटेंट हैं। आजकल वे कैनेडा 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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Problems are meant to be solved; every solution open doorway to new problems.
This is an endless journey to discovery of nature.

We are, what we are, because of rigorous efforts of countless persons.

—00—

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

—00—

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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Ayurveda- Health Care

Ginger (Zingiber Officinale)

Dr Sangeeta Pahuja

Ginger is an important herb in Ayurveda , especially for rejuvenation and healing. Ginger is also replete with multiple medicinal properties and health benefits.

According to AYURVEDA ginger pacifies vata and kapha.

नागरं कफवातघ्नं,विपाके मधुरं कटु।
वृष्योष्णं रोचनम हृद्धं,सस्नेहं लघु दीपनं।।
कफानिलहरं स्वयं विबन्धनादशूलनुत।
कटूष्नं रोचनं हृध् वृष्यं चर्वादकं स्मृतं।।

Ginger has anti-inflammatory, anti-bacterial, anti-fungal, anti-viral properties. Therefore, it has been used in ayurvedic formulations to treat many diseases.

Ginger has beneficial effects on the enzymes trypcin and pancreatic lipase, which are important for digestion. It reduces nausea.

Ginger is very helpful in prevention and treatment of respiratory problems.

Clinical studies determined that phytochemical properties in the ginger may combat inflammation.

Ginger is the excellent source of antioxidants, so it reduces various types of oxidative stress.

Ginger root is used to treat IBS, loss of appetite, cold-flu, Dysmenorrhea, Arthritis, fever, headache, dyspepsia, toothache, Hypertension and aids in preventing internal blood clots.

Ginger root can be made into herbal tea, to ease gut inflammation and boost your liver health.

Ginger has been shown to work against skin, ovarian, colon and breast cancer.

Major active ingredients in ginger are terpens and an oleo-resin called gingerol. These two and other ingredients in ginger provides anti septic and lymph cleansing properties.

Ginger reduces the bacteria H. pylori. It also increases the peristaltic movements, thus relieves constipation.

Ginger is cardio-protective as it improves blood circulation and prevent clotting. promote circulation in the limbs and eliminate pain in the limbs. can also help with the symptoms in the finger caused by Raynaud's disease. Also helpful in treating chronic fatigue. Due to its anti inflammatory and analgesic properties, it is also useful for those with carpal tunnel syndrome.

It eliminates bad breath. Ginger has been used for a long time to treat halitosis. Since it increases salivary secretions, it can also be used by people who always have dry mouth.

Ginger is potent aphrodisiac. It increases libido in both men and women. It improves sperm count and motility.

Depending on your ailments, you can drink ginger tea and you can choose Capsule, smoothies, essential oil etc.

You can add other herbs in ginger to enhance the benefits and to get better results.

While drinking ginger tea, keep in mind that it's rather spicy, you can add stevia, honey, Maple syrup or brown sugar as sweetener

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The Geeta: Template of Mentor-Students Interaction- Part I

Prakash Kale

Introduction: Geeta, by which Arjun a dejected and bewildered person's morale gets restored and he becomes ready for war, is an unparallel book (Grantha) in Indian culture and philosophy. Labeling it as religious Granth, is limiting its all the useful radiance. Sages and thinkers alike have written many commentaries on it. It has been also described as Psychological book (Better than Carl Jung's) or a unique mental treatment process itself. ***In fact, out of ignorance in young age we feel it can be read in old age and on reaching an old age we feel had we read it in young age life would have been different and better.*** So here in Part I, an attempt has been made to use it as model for class room interaction (useful for young ones). Being in very condensed form, continuity has been sacrificed and so while reading, the meaning of content may be ignored; concentration be made on process of teaching and learning. Geeta is all about Yoga which means uniting with Parmatama; it implies uniting the individual consciousness with the Ultimate Consciousness, Scene of the whole conversation between Krishna and Arjun is the sacred plain of Kurukshetra, a field of religious battle Mahabharat.

Arjun said: *O Krishna please place my chariot between both of the armies so that I may look upon those warriors arrayed for battle with me, whom I have to fight in preparation for combat* (21/1). It is like a student trying to observe challenges of examination. Having observed all, Arjun said *O Krishna, I do not see any good in slaying kinsmen in this battle, nor do I desire victory nor a Kingdom or even (see) happiness* (31/1). *By killing these aggressors, sin will surely come upon us; therefore it is not proper of us to slay the sons of Dhrtarashtra along with our family members; since how by slaying our own kinsmen will we be happy*(37/1). *Although these men, their heart afflicted by greed do not see the sinful reaction in quaralling with friends and the crime of destroying family members; why should we not refrain from this sinful act understating this grevious crime of destroying family members* (38,39/1). Core contention in the utterances have been emphasised by underligned. Expressing his disgust Arjun sits down in Chariot, implying his decision to give up and not to take up the battle. Krishna observing his state of mind and knowing well that under this state of mind Arjun cannot win the battle, counter questions him with a different perspective of battle instead of ordering him to stand up and fight.

Lord Krishna said : *O Arjuna from where has this illusion of yours appeared in this moment of crisis ? This is neither befiiting honorable men nor conducive to heavenly spheres; it is the cause of infamy* (2/2). *Do not yield to unmanliness, this is not worthy of you . Give up this base weakness of heart and rise up for battle.*(3/2). Arjuna gets utterly confused with Krishn's views and accepts that he may not be correct and therefore requests for guidence.

Arjuna said: *We do not know what is better for us whether we conquer or they conquer us;*(6/2). *Now my natural qualities are besieged by weakness and apprehension and my thinking bewildered regarding rightousness. I am asking you to please state what is definitely good for me. I am your disciple, surrendered to you, kindly instruct me.* (7/2).

Lord Krishna said: *You are mourning for those not worthy of sorrows; yet speaking like one knowledgeable. The learned neither laments for the dead nor the living. Soul is not the body and that is the essence.* (11/2) *Any One who thinks the soul is the slayer and anyone who thinks the soul is slain both of them are in ignorance; the soul never slays nor is slain* (19/2) He gave an example - *Just as a man giving up worn out garment accepts other new apparel, in the same way the embodied soul giving up old and worn out bodies verily accepts new bodies*(22/2). But even if you think otherwise, *death is certain for every born person and one who is dead, birth is certain; therefore, you ought not to lament for an inevitable truth* (27/2). Now he emphasizes upon practical aspect - *considering your righteousness you should not falter; indeed for up holders of justice there does not exist a more appropriate endeavor than a battle for righteousness.* (31/2) Taking a social perspective he says - *if you do not take up war, your enemies will speak many malicious and insulting words discrediting your prowess. Alas what could be more painful than that*? *Either being slain you will attain the heavenly abode or by gaining victory you will reap the earthly opportunities of doing good; therefore O Arjun, confident of success rise up and fight.* (37/2). Thus Krishna brainstormed Arjun to make his point that in both situations Arjun is the gainer; which was otherwise perceived by him as a sin, and was worrying about uncertainty of result of war. Krishna crossed these points

Further, Krishna explains, how to become steady-self to avoid perceived sin. *Being equipoised in happiness and unhappiness, profit and loss, victory and defeat; thereafter prepare for battle and in this way you will not incur sinful reactions* (38/2). *You certainly have*

the right for prescribed activities but never, at any time, in their results. You should never be motivated by the results of action, nor there any attachment in doing your prescribed activities (47/2). Be in present, study well do not worry about result of exam. *When your spiritual intelligence is unaffected and uninfluenced by karmic interpretations of the Vedas remains steady; at that time you will achieve the pure spiritual state by science of uniting with Parmatma*.(53/2). Arjun gets fully shaken up to know as to how that self would be?

Arjuna said: *O Krishna what are the signs of one properly situated in perfect knowledge*? *Of one absorbed in pure spiritual consciousness*? *How does one steadfast in this consciousness talk*? *How does he sit*? *How does he walk*? (54/2) Krishna answers all the questions and further on tells as to why someone is not equipoised and its consequences?

Krishna said: *While concentrating on objects of the senses a person develops attachment to the sense objects; from attachment desires are born, from desire, if not fulfilled, anger arises. From anger delusion occurs, from delusion bewilderment of memory, after forgetfulness of memory the loss of spiritual intelligence and losing spiritual intelligence one perishes* (62,63/2). *Whichever among the various senses the wandering mind becomes engrossed in that sense certainly leads astray his intelligence like the wind snatches away boat on the water* (67/2) . Krishna has advised to become equipoise and fight, while Arjun still is with conviction to not to fight, wrongly understands this to become equipoised and become indifferent to battle and asks.

Arjun said: *O Krishna if spiritual intelligence is considered better by you then why fruitive activities O Krishna are you engaging me in such horrendous activities? My spiritual intelligence is certainly becoming confused by your words of conflicting conclusions; therefore, ascertaining one of them, please reveal definitely that by which I may obtain the greatest benefit* (1,2/3).

Lord Krishna said: *O sinless one, in this world two kinds of faith were just previously declared by me; the science of Uniting with Parmatama by the path of knowledge (Gyan Yoga) for the empiric philosophers and the science of Uniting with Parmatama by the path of action (Karma Yoga) for the yogis.(*3/3) *You should perform your prescribed Vedic activities since action are better than renouncing actions; by ceasing activity even your living would not be possible*.(8/3) *In fact, all activities are being enacted by the senses of the material nature (Maya/Gunas) without exception; but the unrealized, deluded by false identification of being the body, thinks: "I am the doer"*(27/3). *Lastly Performing one's natural duty, even if it is tinged with faults, is far better than performing another's prescribed duty perfectly; even death in performing one's natural prescribed duty is better, for performing prescribed duties of others who are fraught with danger*.(35/3). It is like working based on our own aptitude rather imitating others. Now Arjun ask why someone engages in activity other than prescribed one.

Arjun said: *What is it that incites one to commit sinful acts even against one's will as if compelled by force* (36/3*).*

Lord Krishna said: *It is because of lust which becomes anger arising from the mode of desire; know this lust to be insatiable, extremely sinful and greatest enemy in the world.* (37/3) Now the conversation proceeds on what is superior to which and thus how to control mind. Thus knowing the individual consciousness to be superior to the intelligence, Krishna continues *O mighty armed one, steady the mind by self realization and conquer this insatiable enemy in the form of lust.* (43/3). Now on his own Krishna starts explaining the paths of action and knowledge as well as the wisdom regarding the supreme knowledge. Lord Krishna said: *I instructed the imperishable science of uniting with Parmatama unto the Sun God Surya, who taught it unto his son Vaisvastu Manu, who related it unto his son King Iksvaku* (1/4) *This is the very same ancient science of uniting with Parmatama and which the supreme secret*; *therefore it is being described by Me unto you today because you are My devotee and friend*.(3/4). But Arjun doubts this.

Arjun said: *Your birth is recent the sun-god's birth is previous; therefore you instructing in ancient times, how am I to understand this*? (4/4)

Lord Krishna said: *Many births of Mine and also of yours have passed O Arjun; I am knowledgeable of all of them; but you do not know* (5/4), and continues to explain. Krishna said: *Bereft of desire, controlled in mind and body, relinquishing all conceptions of*

proprietorship, that never incurs sinful reaction performing only actions to maintain body sustenance.(21/4) *O Arjun, just as a blazing fire turns wood to ashes, similarly the fire of knowledge turns all reactions from fruitive activities to ashes* (37/4*). Therefore O Arjun, by the sword of transcendental knowledge destroy these doubts of the self, born of ignorance, situated in the heart and taking shelter of science of uniting with Parmatama arise for the battle* (42/4). Still Arjun has not come out of his confused state of mind.

Arjuna Said: *O Krishna from renunciation of activities again you are also praising activities in the science of uniting with Parmatma to arise for the battle. Please tell me definitely which one of the two is more beneficial?* (1/5)

Lord Krishna said: *Both renunciation of actions and prescribed actions in the science of uniting with Parmatma lead to the path of liberation; but of the two prescribed actions in the science of uniting with Parmatma is superior to renunciation of fruitive activities* (2/5). And continues to explain importance of controlling the mind. Krishna said: *For the being that who has conquered the mind; it is the best of friends; but for one those whose mind is uncontrolled, that very mind acts is the worst of enemies*.(6/6).

Arjuna said: *O Krishna in this science of uniting with Parmatma by equality of vision as described by you; I do not perceive a permanent situation due to flickering nature. The flickering mind is certainly turbulent and obstinate; I think that subduing the mind is more difficult than the wind*.(33, 34/6).

Lord Krishna said: *O mighty armed one, undoubtedly the mind is fickle and difficult to master; but it can be controlled by diligent practice and detachment from sense enjoyment*.(35/6). Now Arjun asks what if practice etc. is not taken to logical end.

Arjun said: *O Krishna! what is the fate of the unsuccessful transcendentalist engaged with faith in the science of uniting with Parmatma; but whose mind deviates failing to achieve perfection in the science of uniting with Parmatma* (37/6).

Lord Krishna said: *O Arjuna! there never exist destruction for one in this life nor in the next life; since dear friend anyone who is engaged in virtuous acts never comes to evil*.(40/6). Practice /study never goes waste. Further he describes his own majestic transcendental opulence and says - *Those who endeavor for liberation from old age and death take shelter of Me; such persons learn the Ultimate Truth, the embodied self and the entire subject of action and reaction (*29/7).*Those who know Me, the Ultimate Personality as the governing principle, as the underlying foundation of all the demigods and as unmitigated sustainer of the performance of all sacrifices; they with their minds absorbed in Me can know Me even at the moment of death* (30/7). Krishna has used above words without explaining, therefore, Arjun asks for clarification.

Arjun said: *O Krishna, what is the ultimate truth*? *What is the embodied self*? *What is the frutive action*? *What is the governing principle of the phenomenal existence and what is the declared the underlying foundation of all the demigods*? *O Krishna who is the lord of sacrifice within the body*? *How is it situated and how can this be known at the moment of death by the self-controlled*. 1,2/8). Krishna Answers all these a little later.

Krishna Said: *Therefore constantly remember Me at all times and fight, offering your mind and spiritual intelligence unto Me and certainly you shall attain Me without doubt*.(7/8)

Arjun said: *O Krishna, how shall I know the perfecting science of uniting with Parmatama; always mediating on You in every way and in which various manifestations are You to be contemplated by me. Please elaborate the process of devotion to you by perfecting the science of uniting with Parmatama; also of your majestic transcendental opulence; since there is no satiation for me hearing this nectar*.(17,18/10). *Arjun wishes to know way of devotion Bhakti Yoga and Krishna's power once again.*

Lord Krishna said: *O Arjuna, I shall explain to you only the divine personal majestic opulence which are prominent since there is no end to My extensive glory*.(19/10). *O Arjuna, I alone is the creator, maintainer and destroyer of all creations, of knowledge; I am spiritual knowledge and arguments; I am the logical conclusion*.(32/10) He continues to describe all, but at the end he question - *What is*

necessity there for you?, *O Arjuna of such detailed knowledge and so many examples*? *I am there to support this entire universal manifestation situated in but a fraction of Myself.*(42/10)

Arjuna said: *By these supremely confidential instructions regarding the wisdom of self, which merciful unto me, was spoken by You; this illusion of Mine has been dispelled.*(1/11) Here Geeta should have ended, but out of curiosity or doubt he continues to say and ask.

In these conversations in. Part I, it is observed that Arjun, who is doubting his teacher's advice, how teacher's passion and patience take him out of his bewildered state of mind. In second part, we will see as to how curiosity and eagerness to learn more is ignited in Arjun. It is of relevance to students.

Contd.. Part 2/2.

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Education is not filling of a pail, but lighting of a fire.

- William Buttler Yates

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Who cares what am I or I do, as long as I am not either useful or dreadful. Can I take first step to befriend other by complementing my usefulness, for the larger good.

—00—

Strength and sense of judgement comes from wisdom and not mere knowledge.

—00—

रास्ते मुश्किल तो क्या ?

मृणालिनी घुळे

रास्ते मुश्किल तो क्या
दूर हो मंज़िल तो क्या

डगमगा जाना नहीं
आस को खोना नहीं

ठोकरों में विघ्न हों
लक्ष्य में संकल्प हो

हौसला टूटे नहीं
सब्र भी छूटे नहीं

शिशिर का जाना है तय
बहार का आना है तय

इसलिए चलते रहो
राह पर बढ़ते रहो

अगर सच्ची है लगन
पग तले होगा गगन

हर दिन लगता एक नव अध्याय सा....

डॉ. संगीता पाहुजा

हर दिन लगता एक नव अध्याय सा।
अनगिनत पृष्ठों से बनी एक पुस्तक।
कभी ना खत्म होने वाला पाठ्यक्रम।
रखता हरदम सबको व्यस्त।

बार बार दोहराते हर पाठ को।
फिर एक नया पाठ मिल जाता।
सृष्टि की इस पाठशाला में,
हर रूह में बसता एक शिष्य और एक अध्यापक।

समझने और समझाने की इस कशमकश में,
व्यतीत होता यह जीवन।
जीवन की इस सांझ में,
अनुभवों का जब होता संगम।
परिपक्व होती बुद्धि,
देती उत्तर हर प्रश्न का।

फिर भी नासमझ रहता प्राणी।
होकर लिप्त इस मायाजाल में।
हर दिन लगता एक नव अध्याय सा।
हर दिन लगता एक नव अध्याय सा।।

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।
ई-मेल: mrinalinighule46@gmail.com

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,
ई-मेल : sangeeta.pahuja3@gmail.com

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If you can find a path with no obstacles, it probably doesn't lead anywhere

- Frank A. Clark

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अयोध्या काँड, रामचरित मानस

मुकेश आनंद

(राम का राजा दशरथ को दुखी देखकर कैकेयी से कारण पूछना, कैकेयी का अपने वरदान आदि के बारे में बताना और राम का दशरथ के सामने कैकेयी को उत्तर देना)

(काव्यानुवाद)

मन में मुस्काए सूर्यकुल के सूरज,
श्री राम कोष हैं आनंद के सहज।
किया निवेदित वचन पवित्र निर्दोष से,
कोमल, सुंदर मानो वाणी के आभूषण से ।।

सुनो माता, उस पुत्र का भाग्य है अनुपम,
जिसको प्रिय लगते हैं माता पिता के वचन।
माता पिता को हो जिनसे संतोष सुलभ,
हे माता, संसार में ऐसे पुत्र होते हैं दुर्लभ ।।

वन में मुनिगनों से होगा विशेष सान्निध्य,
और वहाँ सब तरह मेरा ही हित होगा,
इस बात पर आपकी सहमति है,
और फिर पिता की आज्ञा का पालन भी होगा। ।।

प्राणों से प्यारे भरत राज्य पाएँगे,
इतने अच्छे भाग्य मेरे अब कब आएँगे।
ऐसे कार्य के लिए अगर मैं वन नहीं जाऊं,
तो मूर्ख समाज का मैं मुखिया गिना जाऊँ ।।

जो कल्पवृक्ष को छोड़, करते सेवा अरेंड़ की,
और माँग लेते हैं विष, छोड़कर प्याली अमृत की,
वे मूर्ख भी नहीं चूकेंगे ऐसा अवसर पा कर,
माता आप ही बताएँ बात मन में विचार कर ।।

हाँ माता, एक बात का मुझे विशेष दुख है ,
महाराज इतनी सी बात पर क्यूँ व्याकुल हैं।
इतनी छोटी बात और इतना भारी दुख है,
इस बात पर सहज होता नहीं विश्वास है ।।

राजा धैर्य और गुणों के अथाह समुद्र हैं,
हुआ मुझसे ही कुछ बड़ा अपराध है।
इसलिए मुझसे कुछ कहते नहीं राजा,
सब सच बताइये, आपको मेरी शपथ है माता ।।

अनुवादक एक अधिवक्ता एवं सामाजिक कार्यकर्ता हैं| सामाजिक विषयों पर पाठन, चिंतन –मनन, लेखन एवं उन पर कार्यान्वन उनकी अभिरुचि है |
E-mail ID: lawexcel@gmail.com

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Inetellectualism is not about criticizing or advising without any responsibility of implementation; it is about taking upon responsibility of actions for the larger good.

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बचा लो रिश्ते

भावना मिश्रा

(सौहार्द्द -मिलन के पर्व होली पर एक भाव ...)

कुछ कह दिये तुम
कुछ सह लिये हम
कुछ कहते - कहते
रूक गये हम,
कुछ बच गये रिश्ते
कुछ टूट गये रिश्ते ...
जिंदगी का यही दस्तूर है ।

बचा लो रिश्ते हम -तुम
कुछ सह लो तुम
कुछ कहते-कहते
रूक जाए हम
कुछ माफ़ कर दो तुम
कुछ माफ़ी माँग ले हम
कुछ नज़र अनदेखा कर दे हम- तुम
गले लगा लो ,गले लग जाओ
बचा लो रिश्ते, बचा ले रिश्ते ..

लेखिका कला संकाय से स्नातक तथा एक गृहणी हैं। वे अपने पुत्र मनन्न और पुत्री नव्या के साथ अपने परिवार तथा बुजर्गों की सेवा का आनंद लेती हैं। संगीत (गायन) ,नृत्य एवं भ्रमण इनके शौक हैं।

ई -मेल : bhawna.ragini@gmail.com

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The value of a college education is not the learning of many facts but the training of mind to think.

- **Albert Einstein**

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Answers: Science Quiz- February'2020

Kumud Bala

1 (B)	2 (D)	3 (D)	4 (C)	5 (B)	6 (D)	7 (A)	8 (A)	9 (A)	10 (B)
11 (B)	12 (A)	13 (B)	14 (C)	15 (D)	16 (A)	17 (C)	18 (B)	19 (A)	20 (A)
21 (B)	22 (A)	23 (D)	24 (D)	25 (D)	-	-	-	-	-

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ANSWER: CROSSWORD PUZZLE, February'2020
(Raman Effect)

Prof. S.B. Dhar

											1O							
											P							
											T							
	2O	P	T	I	C	A	L	A	M	P	L	I	F	I	E	R		
											C					3K		4H
							5C				A					S		E
							V				L					K		L
							6R	A	M	A	N	S	P	E	C	T	R	U	M
							A					C					I		H
							M					I					S		O
				7R	A	M	A	N	E	F	F	E	C	T			H		L
							N					N					N		T
												T					A		Z
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8R	A	M	A	N	S	P	E	C	T	R	O	S	C	O	P	Y			
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Compunication (Computer with Communication capability i.e. internet) has forged the world, which is otherwise fragmented into narrow boundaries, into a global village. All that we need to do is to connect the most deprived persons through strings of education. Compunication provides the much needed solution in the form of Virtual Class Rooms.

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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

Akanksha Kashyap

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The Piglet and The Fox

Natchya Tiwari

Once upon a time, there lived a mother pig and piglets. Mother Pig has always taught piglets to take a bag of ground pepper with them if they have to leave the house without the mother pig and the sister pig.

One day, the piglet was drinking water in a stream. Coincidently, an old fox appeared. The piglet felt cowed but she controlled her consciousness and asked the fox, "What are you doing here uncle fox?"

The fox smiled and said, "I coincidently came here and smelt you. You smelt really good. Your meat must be so sweet!"

The piglet felt more scared but she still controlled her consciousness and said, "If you want to eat me, then eat me because I probably don't have the wisdom to fight with you but please don't take my magic medicine bag because my mom made this magic medicine hardly and I have to take this magic bag to the eagle. Anyone who applies this medicine will have sharp eyes and be able to see everything even in the distance."

When the fox heard so, he asked the piglet that he wanted to see the magic medicine. The piglet got a chance. She took out the bag and gave it to the old fox. The old fox quickly applied the medicine in his eyes. Suddenly, he started crying very loudly with pains and the piglet ran away from there.

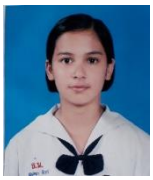
Moral of the story:

We should know to control our consciousness in every situation.

We shouldn't trust anybody easily.

We should think logically.

Author is a student of CRM School in Chiangrai (Thailand). She studies in Grade 8. Her hobbies are swimming, playing basketball, badminton & bicycling. She loves reading books. She is fond of writing short stories. She believes that one should always live by the rules because staying with the rules generates discipline. Discipline is very necessary for the students.



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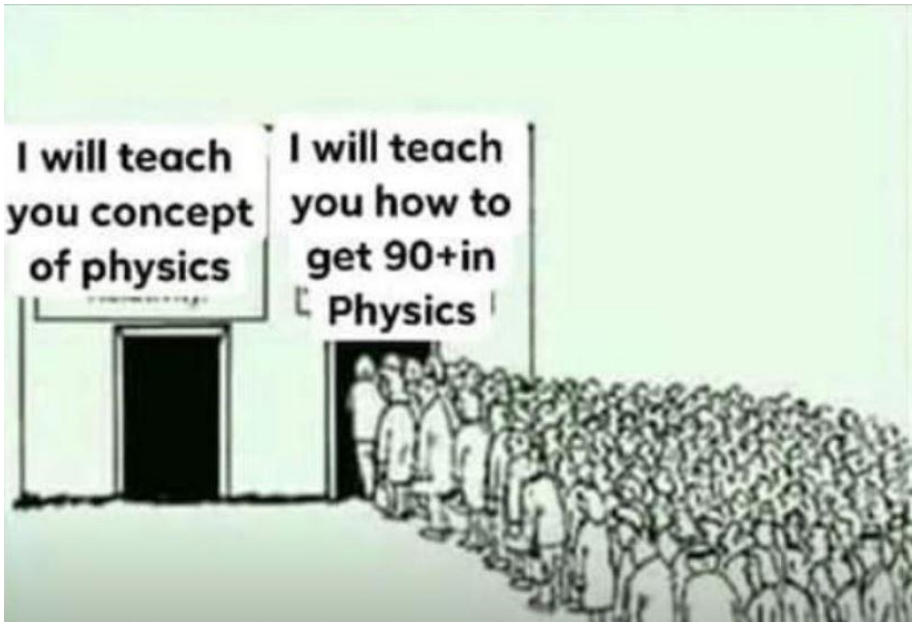

TIME MANAGEMENT

Bala Ramyasri

Do you know why there is a difference between a topper and an average? That difference is proper time management. A topper student schedules his time. While an average student does not do that. He should also know time never comes back. Thus a student should take out time for personal development too.Since personal development is important for their growth.**Time Management the process of planning and exercising conscious control of time spent on specific activities, especially to increase effectiveness, efficiency, and productivity.**Time management for students has become a crucial need. Education has become vast. Therefore proper scheduling of time is important

How to Manage Time?: A person should eliminate unnecessary activities from their daily schedule. On weekends you should do it. Especially should socialize on weekends. Also, include traveling time in schedule. This ensures accuracy. Most Noteworthy, make a time table on paper. In which you should write your daily activities. This will create discipline in your life. Moreover, you should complete the task daily. However, there will be some changes in the schedule with time. Finally, your schedule needs to be practical. You cannot make a schedule unless you know your daily timings. Each persons' schedule is unique if you copy you won't progress in life.

*" **Life and Time** are the world's best teachers. **Life** teaches us to make good use of **time,** and **time** teaches the value of **life**." – A.P.J. Abdul Kalam*

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Growing With Concepts - Mathematics

LET'S DO SOME PROBLEMS IN MATHEMATICS-XVII

Prof. SB Dhar

This article contains some of the questions that were asked in the recent examination JEE MAIN 2020 held on 7th, 8th and 9th of January. JEE MAIN is organized by NTA (The National Testing Agency). It is a computer based examination.

On the basis of the result of this examination, the aspirants become eligible for sitting in the JEE ADVANCED for the Admission in 23 IITs (Kharagpur, Bombay, Kanpur, Madras, Delhi, Guwahati, Roorkee, Bhubneswar, Hyderabad, Jodhpur, Patna, Ropar, Indore, Gandhinagar, Mandi, Varanasi, Palakkad, Tirupati, Dhanbad, Bhilai, Goa, Jammu, and Dharwad).

The minute observation of the Questions asked in the Test reveals that the questions are from the whole syllabus (i.e. Algebra, Calculus, Coordinate Geometry of 2-dimensions and 3-dimensions, Trigonometry, Statistics and Reasoning). One who aspires to get good percentile must prepare the FULL syllabus and avoid the selective study.

QUESTIONS with Hints

1. If the system of linear equations
$2x+2ay+az=0$,
$2x+3by+bz=0$,
$2x+4cy+cz=0$,
where $a, b, c \in R$ are non-zero and distinct; has a non-zero solution, then
(a) a, b, c are in AP
(b) $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in AP
(c) $a + b + c=0$
(d) a, b ,c are in GP

Hint:

For non-trivial solution $\begin{vmatrix} 2 & 2a & a \\ 2 & 3b & b \\ 2 & 4c & c \end{vmatrix} = 0$

$\Rightarrow ab + bc = 2ac$

$\Rightarrow a, b, c$ are in HP or $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in AP.

Hence **Option (b) is the correct answer.**

2. The greatest positive integer k, for which 49^k+1 is a factor of the sum $49^{125} + 49^{124}+\ldots+49^2+49+1$, is
(a)32 (b)63
(c)65 (d)60

Hint:

$$\frac{49^{126}-1}{48} = \frac{(49^{63}+1)(49^{63}-1)}{48}$$

Use Binomial Theorem to expand and find that it is the product of 63 and some positive integers.
Thus **option (b) is the correct answer**.

3. If $g(x)=x^2+x-1$ and $(gof)(x)=4x^2-10x+5$, then $f\left(\frac{5}{4}\right)$ is
(a) $\frac{1}{2}$ (b) $\frac{-3}{2}$
(c) $\frac{-1}{2}$ (d) $\frac{3}{2}$

Hint:

$$g(f(x)) = f^2(x) + f(x) - 1$$

$$g\left(f\left(\frac{5}{4}\right)\right) = 4\left(\frac{5}{4}\right)^2 - 10\left(\frac{5}{4}\right) + 5 = -\frac{5}{4}$$

$$g\left(f\left(\frac{5}{4}\right)\right) = f^2\left(\frac{5}{4}\right) + f\left(\frac{5}{4}\right) - 1 = \frac{-5}{4}$$

$$f^2\left(\frac{5}{4}\right) + f\left(\frac{5}{4}\right) - 1 = \frac{-5}{4}$$

$$f^2\left(\frac{5}{4}\right) + f\left(\frac{5}{4}\right) + \frac{1}{4} = 0$$

$$\left(f\left(\frac{5}{4}\right) + \frac{1}{2}\right)^2 = 0$$

$$f\left(\frac{5}{4}\right) - = \frac{1}{2}$$

Hence **option (c) is the correct answer**.

4. Let α be a root of equation $x^2+x+1=0$ and the matrix $A=\frac{1}{\sqrt{3}}\begin{pmatrix} 1 & 1 & 1 \\ 1 & \alpha & \alpha^2 \\ 1 & \alpha^2 & \alpha^4 \end{pmatrix}$. Then the matrix A^{31} is
(a) A^3 (b) A^2
(c) I_3 (d) A

Hint:

$A^2=\frac{1}{3}\begin{pmatrix}1 & 1 & 1\\ 1 & \omega & \omega^2\\ 1 & \omega^2 & \omega\end{pmatrix}\begin{pmatrix}1 & 1 & 1\\ 1 & \omega & \omega^2\\ 1 & \omega^2 & \omega\end{pmatrix} = \begin{pmatrix}1 & 0 & 0\\ 0 & 0 & 1\\ 0 & 1 & 0\end{pmatrix}$

$\Rightarrow A^4=I$ or $A^{30}=A^{28} \times A^3=A^3$

Hence **correct answer is option (a)**

5. If $Re\left(\frac{z-1}{2z+i}\right)=1$, where $z=x+iy$, then the point (x,y) lies on a

(a) straight line whose slope is $\frac{-2}{3}$

(b) straight line whose slope is $\frac{3}{2}$

(c) circle whose diameter is $\frac{\sqrt{5}}{2}$

(d) circle whose centre is at $\left(\frac{-1}{2},\frac{-3}{2}\right)$

Hint:

$z = x + iy$

$$\frac{z-1}{2z+i}=\frac{(x-1)+iy}{2(x+iy)+i}$$

$$=\frac{(x-1)+iy}{2x+(2y+1)i}\times\frac{2x-(2y+1)i}{2x-(2y+1)i}$$

$$Re\left(\frac{z-1}{2z+i}\right)=\frac{2x(x-1)+y(2y+1)}{(2x)^2+(2y+1)^2}=1$$

Or $2x^2+2y^2+2x+3y+1=0$

It is a circle with centre $\left(\frac{-1}{2},\frac{-3}{2}\right)$

Hence **the correct answer is option (c).**

6. Total number of 6-digit numbers in which only and all the five digits 1,3,5,7 and 9 appear, is

(a) 5^6 (b) $\frac{1}{2}(6!)$

(c) 6! (d) $\frac{5}{2}(6!)$

Hint:

1,3,5,7,9

For digits to repeat we have ${}^5C_1$ Choices

Six digits can be arranged in $\frac{6!}{2!}$ ways

Hence total such numbers are $\frac{6!}{2!}\times 5$

The **correct answer is option (d)**

7. If the sum of the coefficients of all even powers of x in the product $(1+x+x^2+\ldots+x^{2n})(1-x+x^2-x^3+\ldots+x^{2n})$ is 61, then n is

(a)30 (b)31

(c)32 (d)33

Hint:

Let

$(1+x+x^2+\ldots+x^{2n})(1-x+x^2-x^3+\ldots+x^{2n}) = a_0+a_1x+a_2x^2+\ldots.$

On putting x=1,

$1(2n+1)=a_0+a_1+a_2+\ldots.+a_{2n}$ ….(i)

On putting x=-1,

$(2n+1)1=a_0-a_1+a_2-\ldots.+a_{2n}$ ….(ii)

From (i)+(ii),

$4n+2=2(a_0+a_2+\ldots.)=2 \times 61=122$

$\Rightarrow n=30$

Hence **option (a) is the correct answer**.

8.In a workshop there are five machines and the probability of any one of them to be out of service on a day is $\frac{1}{4}$. If the probability that at most two machines will be out of service on the same day is $\left(\frac{3}{4}\right)^3 k$, then k is

(a) $\frac{17}{2}$ (b) $\frac{17}{4}$ (c) $\frac{17}{8}$ (d) 4

Hint:

The required probability

= Probability (No machine has fault)
+ Probability(One machine has fault)
+ Probability(Two machines have fault)

$={}^5C_0\left(\frac{3}{4}\right)^5+{}^5C_1\left(\frac{1}{4}\right)^1\left(\frac{3}{4}\right)^4+{}^5C_2\left(\frac{1}{4}\right)^2\left(\frac{3}{4}\right)^3=\left(\frac{3}{4}\right)^3\times\frac{17}{8}$

Or $k=\frac{17}{8}$

Hence **the correct answer is option (c)**

9. Let α and β be the roots of the equation $x^2-x-1=0$. If $k=(\alpha)^k+(\beta)^k$, $k\geq 1$, then which of the following statements is not true?

(a) $p_5=p_2.p_3$ (b) $p_1+p_2+p_3+P_4+p_5=26$
(c) $p_3=p_5-p_4$ (d) $p_5=11$

Hint:

$\alpha^5=5\alpha+3$ …(i)

$\beta^5=5\beta+3$ ..(ii)

On adding (i) and (ii)

$p_5=5(\alpha+\beta)+6=5(1)+6=11$

Similarly,

$p_2=3$, $p_3=4$

Hence **option (d)is correct answer**

10.If $\frac{3+i\sin\theta}{4-i\cos\theta}, \theta\in[0,2\pi]$, is a real number, then an argument of (sinθ + icosθ) is

(a)$\pi-\tan^{-1}\frac{3}{4}$ (b) $\tan^{-1}\frac{4}{3}$

(c) $\pi - tan^{-1}\frac{4}{3}$ (d) $-tan^{-1}\frac{3}{4}$

Hint:

$z = \frac{3+i\,sin\theta}{4-i\,cos\theta} = \frac{3+i\,sin\theta}{4-i\,cos\theta} \times \frac{4+i\,cos\theta}{4+i\,cos\theta}$

Since z is a purely real and hence

3cosθ + 4 sinθ =0 or tanθ =$-\frac{3}{4}$

arg$(sin\theta + i\,cos\theta)$=$\pi+tan^{-1}\frac{cos\theta}{sin\theta}$ =) $= \pi +$

$tan^{-1}\left(\frac{-4}{3}\right) = \pi - tan^{-1}\left(\frac{4}{3}\right)$

The **correct answer is option (c)**

11. If the sum of the first 40 terms of the series 3+4+8+9+13+14+18+19+….. is (102)m, then m is

(a)25 (b)20

(c)10 (d)5

Hint:

Group the series in pairs of twos (1,2),(3,40,(5,6),…and so on to get

S=7+17+27+37+47+….upto 20 terms = (102)(20)

Hence m=20

Option **(b) is the correct answer**.

12.Let A, B, C and D be four non-empty sets. The contrapositive statement of

" If A ⊆B and B⊆ D, then A ⊆C" is

(a) If A ⊄C, then A ⊆B and B⊆ D

(b) If A⊄ C, then A⊄ B and B⊆ D

(c) If A⊆ C, then B⊂ A or D⊂ B

(d) If A⊄ C, then A⊄ B or B⊄ D

Hint:

Let P=A⊂ B, Q=B⊂ C, R=C⊂ A

Contrapositive of (P∧ Q)→ R is

~R→~ (P∧ Q)=~R→~ (P) ∨ ~(Q)

Hence **option (d) is the correct answer**.

13.Let $\vec{a}, \vec{b}$, $\vec{c}$ a be three unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. If $\lambda = \vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}$ and $\vec{d} = \vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}$ then the ordered pair $(\lambda, \vec{d})$ is

(a) $\left(\frac{3}{2}, 3\vec{a} \times \vec{c}\right)$ (b) $\left(\frac{-3}{2}, 3\vec{c} \times \vec{b}\right)$

(c) $\left(\frac{3}{2}, 3\vec{b} \times \vec{c}\right)$ (d) $\left(\frac{-3}{2}, 3\vec{a} \times \vec{b}\right)$

Hint:

$\left|\vec{a} + \vec{b} + \vec{c}\right|^2 = 0$

Or,

$3+2(\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a}) = 0$

Or,

$\vec{a}.\vec{b} + \vec{b}.\vec{c} + \vec{c}.\vec{a} = -\frac{3}{2} = \lambda$

Also,

$\vec{d} = \vec{a} \times \vec{b} + \vec{b} \times (-\vec{a} - \vec{b}) + (-\vec{a} - \vec{b}) \times \vec{a} = \vec{a} \times \vec{b} + \vec{a} \times \vec{b} + \vec{a} \times \vec{b} = 3\vec{a} \times \vec{b}$

Hence **option (d) is the correct answer**.

14.If $(\alpha) = \sqrt{2\left(\frac{tan\alpha+cot\alpha}{1+tan^2\alpha}\right) + \frac{1}{sin^2\alpha}}$, $\alpha \in \left(\frac{3\pi}{4}, \pi\right)$,then $\frac{dy}{dx}$ at $\alpha = \frac{5\pi}{6}$ is

(a) 4 (b) $\frac{4}{3}$ (c) $\frac{-1}{4}$ (d)-4

Hint:

Rewrite

$y(\alpha) = \sqrt{\frac{2cos^2\alpha}{sin\alpha\, cos\alpha} + \frac{1}{sin^2\alpha}} = \sqrt{2cot\alpha + cosec^2\alpha}$

$=|1 + cot\alpha| = -1 - cot\alpha$

And

$\frac{dy}{dx} = cosec^2\alpha \Rightarrow \frac{dy}{dx}\ at\ \alpha = \frac{5\pi}{6}$ is 4.

Hence **the correct answer is option (a)**

15.Let *y=f(x)* is the solution of the differential equation $e^y\left(\frac{dy}{dx} - 1\right) = e^x$ such that *y(0)=0*, then *y(1)* is

(a)2e (b)1+log$_e$2

(c)log$_e$2 (d)2+log$_e$2

Hint:

Let $e^y = t$

Differentiating both sides wrt x

$e^y\frac{dy}{dx} = \frac{dt}{dx} \Rightarrow \frac{dt}{dx} - t = e^x$

Use LDE method to solve using Integrating factor.

IF=$e^{\int(-1)dx} = e^{-x}$

And the solution is $te^{-x} = \int e^x.e^{-x}dx = x + C$

Or

$e^y.e^{-x} = x + C$

x=0, y=0 gives C=1

Therefore, $e^{y-x} = x + 1$

or $e^y = (x+1)e^x \Rightarrow y = x + log_e(x+1)$

and $y(1) = 1 + log_e 2$

The **correct answer is option (b)**

16. If f(a+b+1-x)=f(x) for all x, where a and b are fixed positive real numbers, then $\frac{1}{a+b}\int_a^b x\big(f(x)+f(x+1)\big)dx$ is equal to

(a) $\int_{a+1}^{b+1} f(x+1)dx$

(b) $\int_{a-1}^{b-1} f(x+1)dx$

(c) $\int_{a+1}^{b+1} f(x)dx$

(d) $\int_{a-1}^{b-1} f(x)dx$

Hint:

Let I=$\frac{1}{a+b}\int_a^b x\big(f(x)+f(x+1)\big)dx$ …(i)

Replace *x* by *a+b-x*

I = $\frac{1}{a+b}\int_a^b (a+b-x)\big(f(a+b-x)+f(a+b+1-x)\big)dx$

I = $\frac{1}{a+b}\int_a^b (a+b-x)\big(f(x+1)+f(x)\big)dx$ ….(ii)

Replace x by x+1. On (i)+(ii)

2I=$\int_a^b \big(f(x+1)+f(x)\big)dx$

$= \int_a^b f(x+1)dx + \int_a^b f(x)\,dx$

$=\int_a^b f(a+b-x+1)dx + \int_a^b f(x)\,dx$

$=2\int_a^b f(x)\,dx$

Put x=t+1 to get the desired result.

Option (b) is the correct answer.

17. Let the function *f: [-7,0] →R* be continuous on [-7,0] and differentiable on (-7,0).

If *f(-7) =-3* and *f'(x)* ≤ 2, for all x∈(-7,0), then for all such functions f, *f(-1)+f(0)* lies in the interval:

(a) [-6, 20] (b) (-∞, 20]

(c) (-∞ , 11] (d) [-3, 11]

Hint:

Use LMVT for [-7,-1]

$\frac{f(-1)-f(-7)}{(-1+7)} \le 2$ or

$\frac{f(-1)+3}{6} \le 2 \Rightarrow f(-1) \le 9$

Similarly for interval [-7,0] LMVT will give

f(0) ≤ 11 ⇒ f(0)+f(-1) ≤20

Option (b) is the correct answer.

18.$\lim_{x\to 2} \frac{3^x+3^{3-x}-12}{3^{-x/2}-3^{1-x}}$ is equal to

(a) 36 (b) 37 (c) 38 (d) -36

Hint:

Assume $3^{x/2}=t$

Rewrite the expression as,

$\lim_{t\to 3} \frac{t^2+\frac{27}{t^2}-12}{\frac{1}{t}-\frac{3}{t^2}} = \lim_{t\to 3} \frac{t^4+27-12t^2}{t-3} = 36$

Hence **option (a) is the correct answer**.

19. Let S be the set of points where the function, f(x)=$\big|2-|x-3|\big|, x \in R$ is not differentiable. Then $\sum_{x\in S} f(f(x))$ is equal to

(a) 6 (b) 5 (c) 4 (d) 3

Hint:

Given that f(x) is not differentiable at x=1,3,5

$\sum f\big(f(x)\big) = f\big(f(1)\big)+f\big(f(3)\big)+f(f(5))$ =1+1+1=3

Hence **option (d) is the correct answer**.

20. If θ_1 and θ_2 be respectively the smallest and the largest values of θ in (0,2π)-(π) which satisfy the equation, $2\cot^2\theta - \frac{5}{\sin\theta} + 4 = 0$, then $\int_{\theta_1}^{\theta_2} cos^2 3\theta\, d\theta$ is equal to

(a)$\frac{\pi}{9}$ (b) $\frac{\pi}{3}+\frac{1}{6}$

(c) $\frac{2\pi}{3}$ (d) $\frac{\pi}{3}$

Hint:

Simplify the given expression as

(2sinθ-1)(sinθ-2) =0

⇒ sinθ≠0, sinθ≠2, sinθ=1/2

⇒θ=π/6, 5π/6

And $\int_{\theta_1}^{\theta_2} cos^2 3\theta\, d\theta = \int_{\pi/6}^{5\pi/6} cos^2 3\theta\, d\theta$

⇒ $\int_{\pi/6}^{5\pi/6} \frac{1+cos6\theta}{2} d\theta$ =π/3

Hence **option (d) is the correct answer**.

21. The area (in sq. units) of the region

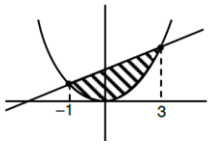
{ (x,y) ∈ R^2 : $4x^2 \le y \le 8x+12$} is

(a) $\frac{127}{3}$ (b) $\frac{125}{3}$

(c) $\frac{128}{3}$ (d)$\frac{124}{3}$

Hint:

Draw the sketch as below to ascertain the limits.



On solving the equations

$4x^2=y$ and $y=8x+12$, x=-1 and 3

The required area

A= $\int_{-1}^{3}(8x+12-x^2)dx$ = 128/3

Hence **correct answer is option (c).**

22. Let *y=y(x)* be a function of x satisfying $y\sqrt{1-x^2}=k-x\sqrt{1-y^2}$ where k is a constant and $y\left(\frac{1}{2}\right)=-\frac{1}{4}$. then $\frac{dy}{dx}$ at x=$\frac{1}{2}$ is equal to

(a) $\frac{\sqrt{5}}{2}$ (b)- $\frac{\sqrt{5}}{2}$

(c) $\frac{2}{\sqrt{5}}$ (d)- $\frac{\sqrt{5}}{4}$

Hint:

Given $x=\frac{1}{2}, y=\frac{-1}{4} \Rightarrow xy=-\frac{1}{8}$

On differentiating both sides w r t x,

$y.\frac{1.(-2x)}{2\sqrt{-x^2}}+y'\sqrt{1-x^2}=-\left\{1.\sqrt{1-y^2}+\frac{x(-2y)}{2\sqrt{1-y^2}}y'\right\}$

$\Rightarrow y'\left(\sqrt{1-x^2}-\frac{xy}{\sqrt{1-y^2}}\right)=\frac{xy}{\sqrt{1-x^2}}-\sqrt{1-y^2}$ $\Rightarrow$y'=$\frac{-\sqrt{5}}{2}$

Option (b) is the correct answer.

23. Let *f(x)* be a polynomial of degree 5 such that x= ± 1 are its critical points. If $\lim_{x\to 0}\left(2+\frac{f(x)}{x^3}\right)=4$ then which one of the following is not true?

(a) x=1 is a point of minima and x=-1 is a point of maxima of *f*

(b) *f*(1)-4*f*(-1)=4

(c) x=1 is a point of maxima and x=-1 is a point of minima of *f*

(d) *f* is an odd function

Hint:

Let $f(x)=ax^5+bx^4+cx^3$ $\lim_{x\to 0}\left(2+\frac{ax^5+bx^4+cx^3}{x^3}\right)=4$

$\Rightarrow$2+c=4

$\Rightarrow$c=2

f'(x)=$5ax^4+4bx^3+6x^2=x^2(5ax^2+4bx+6)$

$\Rightarrow$f'(1)=0$\Rightarrow$5a+4b+6=0

and

f'(-1)=0

$\Rightarrow$5a-4b+6=0

On solving b=0 and a=-6/5 $f(x)=-\frac{6}{5}x^5+2x^3$ Minima at x=-1 and maxima at x=1

Option (a) is the correct answer.

24. If *y=mx+4* is a tangent to both the parabolas, $y^2=4x$ and $x^2=2by$, then b is equal to

(a) -64 (b)-32 (c)-128 (d)128

Hint:

General equation of a tangent to $y^2=4ax$ is given by

$y=mx+\frac{a}{m}$

Compare the two equations

$y=mx+\frac{1}{m}$ and y=mx+4

$\Rightarrow m=\frac{1}{4}$

$\Rightarrow y=\frac{1}{4}x+4$ is also a tangent to parabola $x^2=2by$

Hence it will cut the curve at one point only.i.e. b=-128

Option (c) is the correct answer.

25.Let P be a plane passing through the points (2,1,0), (4,1,1) and (5,0,1) and R be any point (2,1,6). Then the image of R in the plane P is

(a)(6,5,-2) (b)(4,3,2) (c)(6,5,2) (d)(3,4,-2)

Hint:

Equation of plane is

$\frac{x-2}{1}=\frac{y-1}{1}=\frac{z-6}{-2}=\frac{-2(2+1-12-3)}{6}$ $\Rightarrow$(*x*,*y*,*z*)=(6,5,-2)

Option (a) is the correct answer.

26.If the distance between the foci of an ellipse is 6 and the distance between its directrices is 12, then the length of its latus rectum is

(a) $\sqrt{3}$ (b) $3\sqrt{2}$ (c) $\frac{3}{\sqrt{2}}$ (d)$2\sqrt{3}$

Hint:

2ae=6 and 2a/e= 12 $\Rightarrow$ $a^2=18$

We know that $b^2=a^2-a^2e^2=18-9=9$.

Hence LR= $2b^2/a=3\sqrt{2}$

The correct option is (b)

27. Let A(1,0), B(6,2) and C(3/2,6) be the vertices of a triangle ABC. If P is a point inside the triangle ABC such that the triangles APC, APB, and BPC have equal areas, then the length of the line segment PQ, where Q is the point (-7/6, - 1/3) is

(a) 2 (b) 3 (c) 4 (d) 5

Hint:
P will be centroid of ABC
$\Rightarrow$PQ=$\sqrt{\left(\frac{24}{6}\right)^2+\frac{9}{3}}=5$
Option (d) is the correct answer.

28.The locus of the mid-point of the perpendiculars drawn from points on the line, *x=2y* to the line x=y is
(a)3x-2y=0 (b)3x-3y=0
(c)5x-7y=0 (d)7x-5y=0

Hint:
Let P be (h,k), a point on x=2y be (2α,α), and a point on y=x be (β,β)
Slope of PQ=$\frac{k-\alpha}{h-2\alpha}=-1\Rightarrow\alpha=\frac{h+k}{3}$ …(i)
Also, 2h=2α+β and 2k=α+β$\Rightarrow$α=2h-2k …(ii)
From (i) and (ii)
(h+k)=3.2 (h-k)=6(h-k)
$\Rightarrow$5h-7k=0
$\Rightarrow$5x-7y=0
Option (c) is the correct answer.

29. Let A and B be two events such that the probability that exactly one of them occurs is 2/5 and the probability that A or B occurs is ½, then the probability of both of them occur together is
(a) 0.02 (b) 0.10 (c) 0.01 (d) 0.20

Hint:
P(exactly One) = $\frac{2}{5}$
$\Rightarrow P(A)+P(B)-2P(A\cap B)=\frac{2}{5}$
$P(A\cup B)=\frac{1}{2}$
$\Rightarrow P(A\cap B)=\frac{1}{10}$
Option (b) is the correct answer.

30. If $\frac{\sqrt{2}\,sin\alpha}{\sqrt{1+cos2\alpha}}=\frac{1}{7}$ and $\sqrt{\frac{1-cos2\beta}{2}}=\frac{1}{\sqrt{10}}$, then tan(α+2β) is
(a) -2 (b) 2 (c) -1 (d) 1
Hint:
$\frac{\sqrt{2}\,sin\alpha}{\sqrt{2}\,cos\alpha}=\frac{1}{7}$ and
$\sqrt{2}\frac{sin\beta}{\sqrt{2}}=\frac{1}{\sqrt{10}}$
$\Rightarrow tan\alpha=\frac{1}{7}$ and $sin\beta=\frac{1}{\sqrt{10}}$
Use formula $\tan(\alpha+2\beta)=\frac{tan\alpha+tan2\beta}{1-tan\alpha tan2\beta}$
The correct option is (d)

The author, 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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Problems are meant to be solved; every solution open doorway to new problems.
This is an endless journey to discovery of nature.
We are, what we are, because of rigorous efforts of countless persons.

—00—

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

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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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.

Growing into an expert, is a process during which 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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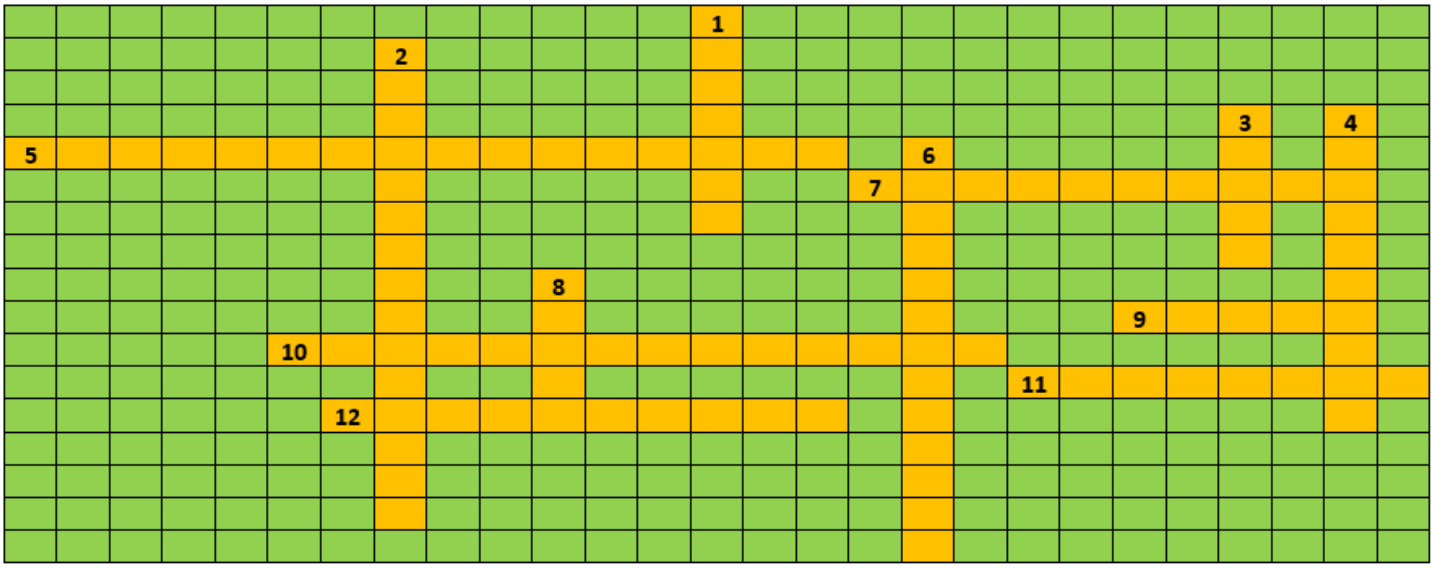
CROSSWORD PUZZLE March'2020 : WATER CONSERVATION

Prof. SB Dhar



ACROSS

5 WWD Theme of 2019

7 WWD focuses on universal right of ….

9 Water is a human …..

10 Climate change increases pressure on …….

12 Water conservation manages natural resources of

DOWN

1 All plants and animals need water to …..

2 "Water is human right" was told by

3 Aquduct is used for

4 Water conservation may be done by rain water ……

6 WWD 2020 Theme

8 WWD is celebrated in the month of

—00—

Answer to this Crossword Puzzle shall be provided in next issue of this e-Bulletin

—00—

Problems are meant to be solved; every solution open doorway to new problems. This is an endless journey to discovery of nature.

We are, what we are, because of rigorous efforts of countless persons.

—00—

Growing with Concepts : Physics

Wave and Motion : Light Waves - Selected Problems

Vision is the next to sense of touch and sound that one experiences after birth. Vision is all about wave optics while actual object is different in colour, shape and size. Analysis of visual effects is completely a wave phenomenon. Light waves are characteristically different from sound waves and vibrations in strings. Basic differences are both quantitative in terms of velocity, wavelength and frequency and nature. Sound waves and those in string or air are mechanical while light is electromagnetic wave. Since light is a wave its qualitative treatment in reflection, refraction, and interference is similar to that of sound waves. In diffraction quantitative difference becomes significant. But, in case of polarization is characteristic to light waves which does not exist in light sound waves.

These concepts howsoever well they may have been understood remain a burden on memory unless they are practiced in solving problem. In the process concepts become intuitive so much so that one would find it easy to visualize how they apply real life physical experiences. This also helps to sharpen observation followed by enhancement in analytical capability, a pre-requisite for creativity and innovation of a person.

Science is a subject not to learn but a matter of realization through experiments and its visualization in surrounding. But, our target students are not equipped either to conduct experiment or an environment which facilitates visualization of science in play around him. This is where simulation is a technique to validate concepts and study effect of variation in parameters related to the concept. Educations creates an opportunity of learning concepts without drainage of time and efforts in reinventing the wheel.

Solving typical problems with gradual increase in complexity helps to build power of visualization of concepts, without losing confidence in one's ability to solve problems. It requires reasonable proficiency in language to understand problem, in first go. Next comes evolving solution or answer based on concepts learnt. At this stage simpler calculations are being skipped in elaboration, with a hope that reader would be able to decipher intermediate steps.

Competitive examinations and problems encountered in real life are never straight application of formula. They demand integration interdisciplinary knowledge. Yet ability to solve such typical problems, that one is groomed, enhances competence to handle unknown problems speedily, correctly and with a greater degree of clarity and confidence, an essential attribute of thought process needed for success in life.

Mentors' Manual is one of the dimensions of the Gyan Vigyan Sarita through which efforts are being made to reach out to remote teachers through our experience of mentoring unprivileged children who are more close to ground. Moreover, they are disconnected from us by virtue of multiple barriers. Despite, direct interaction has been possible through Interactive Online Mentoring Sessions (IOMS) a working model of connecting unprivileged children in a selfless manner. This experience is being disseminated to the teachers spread out by writing of chapters of an open source Mentors' Manual. Wave Optics, in the manual has been placed after Simple Harmonic Motion and Sound considering interrelation of concepts..

India, growing digital, provides optimism to every student to be able to have an access to virtual laboratory, where without any physical laboratory, involving consumption of equipment and material. It provides an opportunity to carry out virtual experiments in an e-environment. In this environment excellent simulation videos available on the web either free or on price. Problem mostly encountered by students is in sequencing and scaling of concepts and selection of an appropriate video out of a big list of search results. This severely distracting. But, mentors are best person to use these videos to modulate and upgrade their illustrations. Yet it does not rule out importance of problem solving.

In light of this Question Banks including problems from various sources and they are being supported with illustrations is being created. These illustrations are not just solutions but an attempt to bring home use of basics involved in solving problems. In an effort to compile problem there some good text books including those authored by Prof. H.C. Verma and a team of authors Robert Resnick, David Halliday and Kenneth S. Krane and many more. Some objective questions from different examinations have also been included. These questions are graded and authors have attempted to incorporate all concepts covered in the book. Thus it necessitates a student to read each chapter carefully before taking up questions.

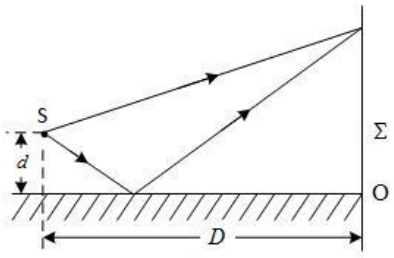
Some students may find illustrations to be a bit lengthy and dwelling into basics more than their need. However, if they want to use this resource they are requested have patience.

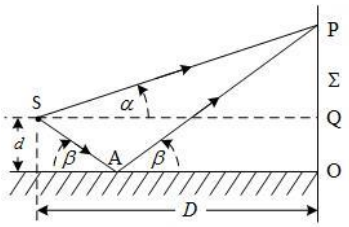
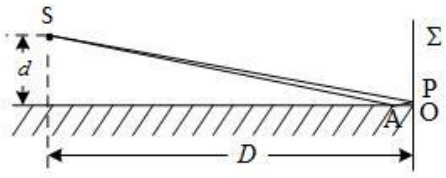
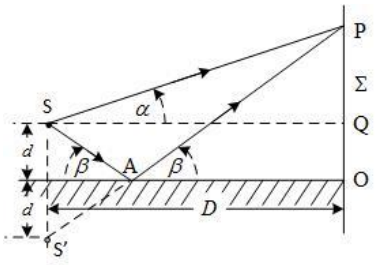
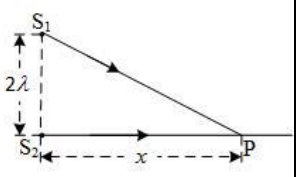
Few question with their illustrations are drawn from Part-3, Set-1, on Light waves. The complete set of 70 questions has uploaded as a free web-resource.

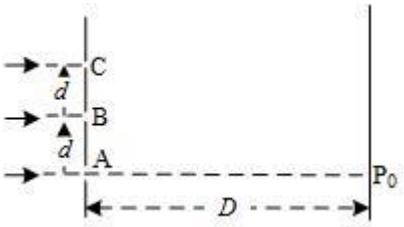
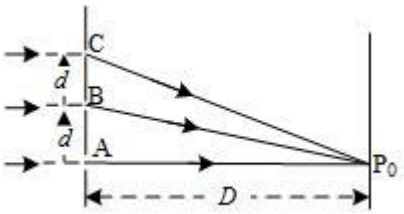
This initiative of a small group of passionate persons is aimed at to mentor unprivileged children and is driven with a sense of **Personal Social Responsibility (PSR)** in a *non-organizational, non-remunerative, non-commercial and non-political manner*. You are welcome to add value to this initiative by way of suggestion, advising correction or new type of questions, or any other form that suits to your competence and convenience.

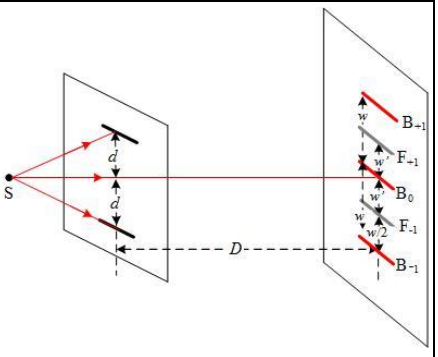
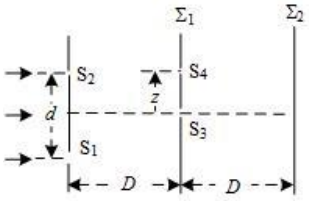
Selected Problems

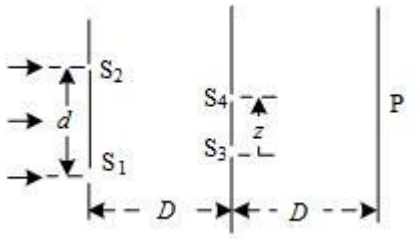
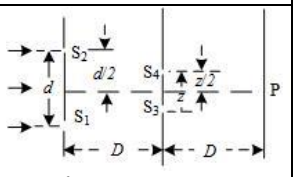
Q-01	When light is refracted into a denser medium (a) Its wavelength and frequency both increase (b) Its wavelength increases but frequency remains unchanged (c) Its wavelength decreases but frequency remains unchanged (d) Its wavelength and frequency both decrease
I-01	Light is energy and energy contained in a wave packet is exprssed by $e = hv$ … (1). Here h is Planck's constant and v is frequency expressed in Herts. As per the Principle of Conservation of Energy (PCE) of the refracted ray and incident ray is same as there is no loss of energy in the phenomenon. Further, $c = \lambda v$ …(2) Here, λ is wavelength. Accordingly each of the given option is vbeing examined – (a) If both wavelength and frequency increase, then energy of the wave should also change which contradics PCE which is not possible in refraction. **Thus option (a) is incorrect**. (b) During refraction when light travels from lighter to denser medium speed decreases. Given statement of frequency as constant conforms to (1) but contradicts (2) as per decrease of speed duruing refraction explained in this part, which is not possible.**Thus option (b) is also incorrect.** (c) As per (1) frequency is constant and is a part of statement is correct. Further since speed decreases and hence as per (2) wavelength would decrease is another part of the statement, is also correct. Thus both the parts of th statement are correct and **hence option (c) is correct.** (d) Second part of the statement contracdicts (1) and hence it is incorrect. Thus statement is correct if it is so in reach of ach of the part, which is not so. **Hence option (d) is incorrect**. **Thus correct answer is option (c).**
Q-02	The wavelengths of a light wave travelling in vacuum are given by $x + y + z = c$. The angle made by the direction of propagation of light with the X-axis is (a) 0^0 (b) 45^0 (c) 90^0 (d) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$
I-02	Equation of a line in space is $lx + my + nz = p$….(1)Here, direction ratios are $l = \cos\alpha, m = \cos\beta$, and $n = \cos\gamma$ …(2)where α, β and γ are angles made by the line with respect to X-axis, Y-axis and Z-axis such that $\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$ …(3). These direction ratios are components of unit length along the respective directions; in the instant case unit length is wavelength λ. These direction ratios are so related that $l^2 + m^2 + p^2 = 1$….(4) and $p > 0$ The problem states that $x + y + z = c$…(5). On comparing (1) and (5) we have $l = k, m = k, n = k$ and $p = k$….(6). Combining (2), (4) and (6) we have $k^2 + k^2 + k^2 = 1 \Rightarrow k = \frac{1}{\sqrt{3}}$. And $\cos\alpha = \frac{1}{\sqrt{3}} \Rightarrow \alpha = \cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$. This values matches with part (d). **Hence answer is part (d).** **N.B.:** This question requires concept of Three-Dimensional coordinate geometry.
Q-03	If the source of light used in a Young's double slit experiment is changed from red to violet, (a) The fringes will become brighter (b) Consecutive fringes will come closer (c) The fringe intensity of maxima will increase (d) The central bright fringe will become dark fringe
I-03	In Young's double slit experiment fringe width is defined by $\beta = \frac{\lambda D}{d}$…(1). Wavelength of red light is $\lambda_r = 620$ nm and that of violet light $\lambda_v = 380$ nm. With this information analyzing each option separately – **Option (a):** Intensity of light $I \propto A^2$, but in the problem there is no information on amplitude of the two clours. Hence, proposition in this part cannot be ascetrained.

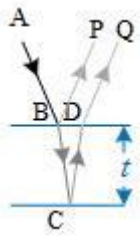
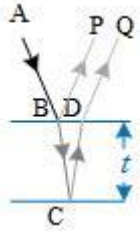
	Option (b): It is seen from (1) that $\beta \propto \lambda$ since separation between the slits d and distance of screen from the slits D remain unchanged. Therefore, in violet colour, which has shorter wavelength, fringe width will reduce. In other words fringes will come closer **hence answer is option (b).** **Option (c):** Based on analysis no inference can be drawn on intensity. **Option (d):** Proposition in this part is alo an inference on intesity of central fringe, which cannt be ascertained as per discussions in part (a). **Hence answer is option (b).**
Q-04	The wavelength of sodium light in air is 589 nm. (a) Find the its frequency in air. (b) Find its wavelength in water (refractive index = 1.33) (c) Find its frequency in water (d) Find its speed in water
I-05	Speed of light in air for all wavelengths is $c = 3 \times 10^8$ m/s. And $c = \lambda\nu \Rightarrow \nu = \frac{c}{\lambda}$…(1) here λ is wavelength and ν is frequency. Wavelengths visible to human eye are in rage $\lambda_{max} = 700$ nm and $\lambda_{min} = 400$ nm. Thus solution of each part is as under – **Part (a):** Frequency of light in air is $\nu = \frac{c}{\lambda} = \frac{3\times10^8}{589\times10^{-9}} = \mathbf{5.09 \times 10^{14}}$ **Hz is the answer of part (a).** **Part (b):** Refractive index of a medium $\mu = \frac{c}{c_m} \Rightarrow c_m = \frac{c}{\mu}$, here c_m is speed of light in the medium under consideration. It is given that for water $\mu = 1.33$. Wavelength in water is $\lambda_m = \frac{c_m}{\nu} \Rightarrow \lambda_m = \frac{c}{\mu\nu}$. Since frequency of light wave does not change with change of medium and hence $\lambda_m = \frac{3\times10^8}{1.33\times5.09\times10^{14}}$. It reduces to **443 nm is the answer of part (b).** **Part (c):** Since frequency of light wave does not change with change of medium and hence it would remain same as in part (a) i.e. $\mathbf{5.09 \times 10^{14}}$ **Hz is the answer of part (c).** **Part (d): Speed of light in water as discussed in part (b) is** $c_m = \frac{c}{\mu}$ and with the given data it is $c_m = \frac{3\times10^8}{1.33} = 2.255 \times 10^8$ m/s, say 2.255×10^8 m/s. is the answer of part (d). **Thus partwise answers are (a)** $\mathbf{5.09 \times 10^{14}}$ **Hz (b) 443 nm (c)** $\mathbf{5.09 \times 10^{14}}$ **Hz (d)** $\mathbf{2.25 \times 10^8}$ **m/s.** **N.B.:** Rounding in part (d) is based on principles of SDs**.**
Q-06	A narrow slit S transmitting light of wavelength λ is placed at a distance d above a large plane mirror as shown in figure. The light coming directly from the slit and that coming after reflection interfere at a screen Σ placed at a distance D from the slit. (a) What will be the intensity at a point just above the mirror, i.e. above O? (b) At what distance from O does the first maximum occur? 

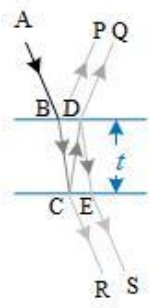
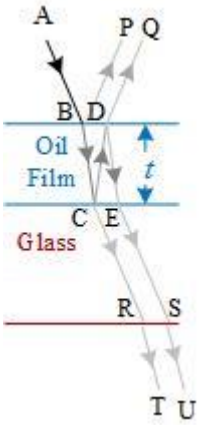
I-06	Point of interference P caused by two incident waves, one after reflection at A and other direct from the source is shown in the figure. Reflection phenomenon causes a change of phase by an angle π. This consideration is important in solving the problem. Each part is taken below separately.  **Part (a):** Determination of intensity on the screen at a point just above O would require consideration of reflection of wave incident on a point A very close to O, as shown in the figure. It is seen that as SA → SP the path length of the composite ray SA and AP tends to be SP. But, due to reflection a phase difference π has crept in. Thus  interference of the direct ray $r_1 = a\sin\omega\left(t-\frac{x}{v}\right)$ and the reflected ray $r_2 = a\sin\omega\left(t-\frac{x}{v}+\pi\right) \Rightarrow r_2 = -a\sin\omega\left(t-\frac{x}{v}\right)$. Accordingly, on superimposition if the two rays we get $r = r_1 + r_2 = a\sin\omega\left(t-\frac{x}{v}\right) - a\sin\omega\left(t-\frac{x}{v}\right) \Rightarrow \boldsymbol{r = 0}$ **is the answer of part (a)**,  **Part (b):** Determination of the occurrence of first bright fringe on the screen requires a path difference $\Delta x = \lambda$. This can be simulated by extending reflected ray coming from a image S' in the mirror of the source S. Thus, it is equivalent to a Young's double slit experiment where separation between the two sources is $d' = 2d$. Further, the requirement of phase difference is $\phi = 2\pi$. Since reflection has caused a phase difference $\phi_r = \pi$. Another phase difference of ϕ_p caused during propagation of rays optical path should meet the requirement $\phi = 2\pi = \phi_p + \phi_r \Rightarrow \phi_p = 2\pi - \phi_r \Rightarrow \phi_p = 2\pi - \pi = \pi$. In the experiment $D \gg 2d$ and hence $\frac{\Delta x}{2d} = \frac{y}{D} \Rightarrow y = \frac{\Delta x \times D}{2d}$…(1) Further, as $\phi_p = \pi$ the corresponding path difference $\Delta x = \frac{\lambda}{2}$…(2). Combining (1) and (2) we have $y = \frac{\lambda}{2}\times\frac{D}{2d} \Rightarrow \boldsymbol{y = \frac{\lambda D}{4d}}$ **is the answer of part (b).** **Thus answers are (a) Zero (b)** $\boldsymbol{\frac{D\lambda}{4d}}$**.** **N.B.:** This problem is an excellent blending of phenomenon of reflection phenomenon, interference and its application in Young's double slit experiment
Q-07	Two coherent point sources S_1 and S_2 vibrating in-phase emit light of wavelength λ. The separation between the sources is 2λ, Consider a line passing through S_2 and perpendicular to line joining S_1S_2. What is the smallest distance from S_2 where minimum intensity occurs?
I-07	Let distance of point P from source S_1 bex' and of the point from source S_2 be x. Difference in path length is $\Delta x = x' - x$. Wavelength of light waves from two sources is λ while distance between the two sources is $d = 2\lambda$. Geometrically, $x' = \sqrt{x^2 + (2\lambda)^2}$ therefore, $\Delta x = \sqrt{x^2 + (2\lambda)^2} - x$…(1). For minimum intensity at P it requires that $\Delta x = (2n+1)\frac{\lambda}{2}$ …(2), here $n \in W$.  Equating (1) and (2) we have $\sqrt{x^2 + (2\lambda)^2} - x = (2n+1)\frac{\lambda}{2} \Rightarrow x^2 + (2\lambda)^2 = \left(x + (2n+1)\frac{\lambda}{2}\right)^2$. It leads to $x^2 + (2\lambda)^2 = x^2 + (2n+1)^2\frac{\lambda^2}{4} + 2\times x \times (2n+1)\frac{\lambda}{2} \Rightarrow (2n+1)x\lambda = \left(4 - \frac{(2n+1)^2}{4}\right)\lambda^2$. It further resolves to $x = \frac{(16-(2n+1)^2)}{4(2n+1)}\lambda$. For smallest x possible search starts with n=0,1,2… and is as under. • n=0, $x = \frac{(16-1)}{4}\lambda = \frac{15}{4}\lambda$, possible • n=1, $x = \frac{(16-9)}{4\times3}\lambda = \frac{7}{12}\lambda$, possible

	• n=2, $x = \frac{(16-25)}{4\times5}\lambda = -\frac{9}{20}\lambda$, not possible and is true for all $n \geq 2$. Among the possible values of x minimum value $\frac{7}{12}\lambda$ **is the answer.** **N.B.:** Though, in light λ<< as compared to other length under consideration and hence in solution terms containing λ^2 are generally ignored. But, in the instant case terms with λ^2 have been retained since, in final form only terms contain only λ and we have a reachable solution.
Q-08	Figure shows three equidistant slits being illuminated by a monochromatic parallel beam of light. Let $BP_0 - AP_0 = \frac{\lambda}{3}$ and $D \gg \lambda$. (a) Show that in this case $d = \sqrt{\frac{2\lambda D}{3}}$ (b) Show that the intensity at P_0 is three times the intensity due to any of the three slits individually. 
I-08	The experimental setup is shown in the figure. Each part is illustrated separately-  **Part (a):** This part is purely geometrical. As per Pythagoras theorem we have $BP_0 = \sqrt{D^2 + d^2}$, and given that $\Delta x_1 = BP_0 - AP_0 = \frac{\lambda}{3}$, therefore, $\frac{\lambda}{3} = \sqrt{D^2 + d^2} - D \Rightarrow \sqrt{D^2 + d^2} = D + \frac{\lambda}{3}$. On squaring we get $D^2 + d^2 = D^2 + \frac{\lambda^2}{9} + \frac{2\lambda D}{3}$…(1) In light λ<< as compared to other length under consideration and hence in the solution of quadratic form terms containing λ^2 are ignored in (1). Thus, it resolves into $d^2 = \frac{2\lambda D}{3} \Rightarrow \boldsymbol{d = \sqrt{\frac{2\lambda D}{3}}}$ **is proved**. **Part (b):** In order to calculate change in path length wave through slit A is take as reference and similar to that in part (a) $\Delta x_2 = CP_0 - AP_0 = \sqrt{D^2 + (2d)^2} - D \Rightarrow \Delta x_2 = \sqrt{D^2 + 4 \times \frac{2\lambda D}{3}} - D$. It resolves to $\Delta x_2 = D\left[\left(1 + \frac{8\lambda}{3D}\right)^{\frac{1}{2}} - 1\right] \Rightarrow \Delta x_2 = D\left[\left(1 + \frac{1}{2} \times \frac{8\lambda}{3D} \ldots \text{higher order binomial terms}\right) - 1\right]$. It reduces to $\Delta x_2 = D\frac{4\lambda}{3D} \Rightarrow \Delta x_2 = \frac{4\lambda}{3}$. Resultant amplitude of the interference requires transformation of path difference into phase difference. We know $\Delta\emptyset = 2\pi\frac{\Delta x}{\lambda}$ accordingly with the given $\Delta x_1 = \frac{\lambda}{3}$ for wave along BP_0 we have $\Delta\emptyset_1 = 2\pi\frac{\Delta x_1}{\lambda} \Rightarrow \Delta\emptyset_1 = 2\pi\frac{\frac{\lambda}{3}}{\lambda} \Rightarrow \Delta\emptyset_1 = \frac{2\pi}{3}$. Likewise for wave along CP_0, $\Delta\emptyset_2 = 2\pi\frac{\Delta x_2}{\lambda}$, it leads to $\Delta\emptyset_2 = 2\pi\frac{\frac{4\lambda}{3}}{\lambda} \Rightarrow \Delta\emptyset_2 = \frac{8\pi}{3} = 2n\pi + \frac{2\pi}{3}$, here $n \in W$ and instant case $n = 1$. Trigonometrically, $2n\pi + \frac{2\pi}{3} \equiv \frac{2\pi}{3}$ and therefore $\Delta\emptyset_2 = \frac{2\pi}{3}$, thus waves along CP_0 and BP_0 are in phase with difference $\frac{2\pi}{3}$ w.r.t. to wave AP_0. Interference is a superimposition phenomenon and waves can be represented as vectors, therefore, resultant amplitude is $a_r = \sqrt{a^2 + (2a)^2 + 2 \times a \times 2a \times \cos\frac{2\pi}{3}} \Rightarrow a_r = \sqrt{5a^2 + 4a^2\left(-\frac{1}{2}\right)}$. It resolves to $a_r = \sqrt{3a^2} \Rightarrow a_r = \sqrt{3}\,a$. We know that intensity of light $I = a^2$ here a is the intensity of individual wave, therefore, intensity of the resultant wave is $I_r = \left(\sqrt{3}a\right)^2 \Rightarrow I_r = 3a^2 \Rightarrow \boldsymbol{I_r = 3I}$**, hence proved.** **N.B.:** In the problem intensity at P_0 is required to be three times that with any single ray. Accordingly, resultant amplitude due to interference has to be used to arrive at the required result.

Q-09	The linewidth of a bright fringe is sometimes defined as the separation between the points in the two sides of the central line where the intensity falls to half the maximum. Find line width if a fringe in a Young's double slit experiment in terms of λ, d and D where the symbols have their usual meanings.
I-09	The setup of Young's double slit experiment with central bright fringe B_0 and adjacent bright fringes above it is B_{+1} and the one below it is B_{-1}. Let a is the amplitude of each wave forming bright fringe at central line the resultant amplitude B_0 is $a_0 = 2a$. Further intensity of light at any point is $I \propto a^2$ …(1). Therefore $I_0 \propto (2a)^2$. Lines F_{+1} and F_{-1} are on two sides of B_0 where intensity of light is given to be $I_F = \frac{I_0}{2} \Rightarrow I_F \propto a_f^2$. Thus, $\frac{I_F}{I_0} = \frac{I_f^2}{4a^2} = \frac{1}{2} \Rightarrow a_f^2 = 2a^2$, or $a_f = \sqrt{2}a$.  Waves are vector and thus $a_f = \sqrt{2}a = \sqrt{2a^2 + 2a^2\cos\emptyset}$, Thus, it resolves into $1 = 1 + \cos\emptyset \Rightarrow \cos\emptyset = 0 \Rightarrow \emptyset = \frac{\pi}{2}$, Since, $\lambda \to 2\pi$ and hence $\frac{\Delta x}{\lambda} = \frac{\frac{\pi}{2}}{2\pi} \Rightarrow \Delta x = \frac{\lambda}{4}$. Further, in the experiment $y = \frac{\Delta x D}{d}$ and therefore $w' = \frac{\frac{\lambda}{4}D}{d} \Rightarrow w' = \frac{\lambda D}{4d}$. In the problem line-width of a bright fringe is defined as $u = 2w' \Rightarrow u = 2\left(\frac{\lambda D}{4d}\right) \Rightarrow u = \boldsymbol{\frac{\lambda D}{2d}}$ **is the answer.**
Q-10	Consider the situation shown in the figure. The slits S_1 and S_2 placed symmetrically around the central line are illuminated by a monochromatic light of wavelength λ. The separation between the slits is d. The light transmitted by the slits falls on a screen Σ_1, placed at a distance D from the slits. The slit S_3 is at the central line and slit S_4 is at a distance z from S_3. Another screen Σ_2 is placed a further distance D away from Σ_1 . Find the ratio of the maximum to minimum intensity observed on Σ_2 if z is equal to  (a) $z = \frac{\lambda D}{2d}$ (b) $z = \frac{\lambda D}{d}$ (c) $z = \frac{\lambda D}{4d}$
I-10	The experimental set up is extension of Young's double slit experiment in which screen Σ_1 is made an intermediate screen with slits S_3 and S_4 on it and screen Σ_2 is the ultimate screen on which fringe patterns are observed. The slit S_3 is on the central line of slits S_1 and S_2 therefore constructive interference would occur at it leading to a bright fringe having amplitude of wave $a_{s3} = 2a$. At any point above it say at a distance z path difference is $\Delta x = \frac{zd}{D}$. There are three possible values of Δx for which ratio of maximum and minimum intensities is asked which is $\frac{I_{max}}{I_{min}} = \frac{(a_{s3}+a_{s4})^2}{(a_{s3}-a_{s4})^2}$. Accordingly, the ratio for each of the value of z is being analyzed – **Case (a):** Given that $z = \frac{\lambda D}{2d}$, it leads to $\Delta x_{S4} = \frac{\frac{\lambda D}{2d}d}{D} \Rightarrow \Delta x_{S4} = \frac{\lambda}{2}$, this is a case of destructive interference of two coherent in-phase waves at and therefore $a_{s4} = a - a = 0$. Therefore, $\boldsymbol{\frac{I_{max}}{I_{min}}} = \frac{(2a+0)^2}{(2a-0)^2} =$ **1 is the answer in case (a).** **Case (b):** Given that $z = \frac{\lambda D}{d}$, it leads to $\Delta x = \frac{\frac{\lambda D}{d}d}{D} \Rightarrow \Delta x = \lambda$, this is a case of constructive interference of two coherent in-phase waves and therefore $a_{s4} = a + a = 2a$. Therefore, the required ratio is $\boldsymbol{\frac{I_{max}}{I_{min}}} = \frac{(2a+2a)^2}{(2a-2a)^2} = \boldsymbol{\frac{16a^2}{0}} = \infty$ **is the answer in case (b).** **Case (c):** Given that $z = \frac{\lambda D}{4d}$ it leads to $\Delta x = \frac{\frac{\lambda D}{4}d}{D} \Rightarrow \Delta x = \frac{\lambda}{4}$. Since $\lambda \to 2\pi \Rightarrow \frac{\theta_c}{2\pi} = \frac{\frac{\lambda}{4}}{\lambda} \Rightarrow \theta_c = \frac{\pi}{2}$. This leads to $a_{s4} = \sqrt{2a^2 + 2a^2\cos\theta_c} \Rightarrow a_{s4} = \sqrt{2a^2 + 2a^2\cos\frac{\pi}{2}} \Rightarrow a_{s4} = \sqrt{2}a$. Acc0rdingly, we have $a_{\Sigma 2-\max} = 2a + \sqrt{2}a = (2+\sqrt{2})a$ and $a_{\Sigma 2-\max} = 2a - \sqrt{2}a = (2-\sqrt{2})a$ case of

	constructive interference of two coherent in-phase waves and therefore $a_{s4} = a + a = 2a$. Therefore, the required ratio is $\frac{I_{max}}{I_{min}} = \frac{(2+\sqrt{2})^2 a^2}{(2-\sqrt{2})^2 a^2} = \frac{(2+\sqrt{2})^2}{(2-\sqrt{2})^2} = 33.94 \approx \mathbf{34}$ **is the answer in case (c).** **Thus answers are (a) 1 (b) ∞ (c) 34** **N.B.:** In the question only ratio of maximum and minimum intensities are asked and not the location. This makes solution straight and simple.
Q-11	Consider the arrangement shown in the figure. By some mechanism, the separation between the slits S_3 and S_4 can be changed. The intensity is measured at the point P which is at common perpendicular bisector of S_1S_2 and S_3S_4. When $z = \frac{\lambda D}{2d}$ the intensity measured at P is I. Find intensity when z is equal to (a) $\frac{\lambda D}{d}$ (b) $\frac{3\lambda D}{2d}$ (c) $\frac{2\lambda D}{d}$ 
I-11	Path difference at any point above central line is $\Delta x = \frac{yd}{D}$. Accordingly, $\Delta x_3 = \frac{\left(\frac{z}{2}\right)d}{D} \Rightarrow \Delta x_3 = \frac{zd}{2D}$; likewise, $\Delta x_4 = \frac{\left(\frac{z}{2}\right)d}{D} \Rightarrow \Delta x_4 = \frac{zd}{2D}$. With the given symmetry $\Delta x_3 = \Delta x_4 = \Delta x = \frac{zd}{2D}$.  Further, it is Given that when $z = \frac{\lambda D}{2d} \Rightarrow \Delta x = \frac{\left(\frac{3\lambda D}{2d}\right)d}{2D} \Rightarrow \Delta x = \frac{\lambda}{4}$. Also, $\lambda \to 2\pi \Rightarrow \frac{\theta}{2\pi} = \frac{\frac{\lambda}{4}}{\lambda} \Rightarrow \theta = \frac{\pi}{2}$ it leads to $a_{s3-4} = \sqrt{2a^2 + 2a^2 \cos\frac{3\pi}{2}} \Rightarrow a_{s3-4} = \sqrt{2a^2} \Rightarrow a_{s4} = \sqrt{2}a \Rightarrow I = I_p = (2a_{s3-4})^2$. It leads to $\boldsymbol{I} = \left(2\sqrt{2}a\right)^2 = \mathbf{8a^2}$**...(1)** In the problem three possible values of z are given and accordingly intensity at the P would be – **Case (a):** Given that $z = \frac{\lambda D}{d} \Rightarrow \Delta x = \frac{\left(\frac{\lambda D}{d}\right)d}{2D} \Rightarrow \Delta x = \frac{\lambda}{2}$. Thus amplitude at both the slits S3 and S4 is zero, it implies that no light will reach at P and hence intensity of the light at P is Zero. **Case (b):** Given that $z = \frac{3\lambda D}{2d} \Rightarrow \Delta x = \frac{\left(\frac{3\lambda D}{2d}\right)d}{2D} \Rightarrow \Delta x = \frac{3\lambda}{4}$. Since $\lambda \to 2\pi \Rightarrow \frac{\theta}{2\pi} = \frac{\frac{3\lambda}{4}}{\lambda} \Rightarrow \theta = \frac{3\pi}{2}$. Thus amplitude at the S3 and S4 is $a_{s3-4} = \sqrt{2a^2 + 2a^2 \cos\frac{3\pi}{2}} \Rightarrow a_{s3-4} = \sqrt{2a^2} \Rightarrow a_{s4} = \sqrt{2}a$. therefore intensity at P is $I_p = (2a_{s3-4})^2 \Rightarrow I_p = \left(2\sqrt{2}a\right)^2 = 8a^2$..(2). Combining (1) and (2), intensity at P is $\boldsymbol{I_p = I}$**, is the answer.** **Case (c):** Given that $z = \frac{2\lambda D}{d} \Rightarrow \Delta x = \frac{\left(\frac{2\lambda D}{d}\right)d}{2D} \Rightarrow \Delta x = \lambda$. Thus intensity at both the slits S3 and S4 is $a_{s3-4} = 2a$, and it implies that amplitude of two coherent and in-phase at P is $a_p = 2a_{s3-4} = 4a$. Accordingly, $I_p = a_p^2 \Rightarrow I_p = (4a)^2 \Rightarrow I_p = 16a^2 \Rightarrow \boldsymbol{I_p = 2I}$**, is the answer.** **Thus answer is (a) Zero (b)** $\boldsymbol{I}$ **(c)** $\boldsymbol{2I}$
Q-12	A soap film of thickness 0.0011 mm appears dark when seen by the reflected light of wavelength 580 nm. What is the index of refraction of the soap solution, if it is known to be between 1.2 and 1.5?

I-12	Phenomenon of reflection of light wave through film of a bubble is shown in the figure. Incident wave AB on transparent surface is subjected to partial refraction at outer surface of the bubble (as ray BC) and on the same surface partial reflection (as ray BP). The refracted ray BC again undergoes total reflection (as ray CD) at inner surface of the bubble at C as ray along CD. This reflected ray CD undergoes refraction at outer surface of the bubble along DQ.  Reflection of wave at B causes a phase shift $\pi \rightarrow \frac{\lambda}{2}$, since incident wave AB encounters denser medium at B, this cause crest reflected as crest and trough reflected as trough. But, ray BC in the film encounters rarer medium at C and hence crest reflected as trough and trough reflected as crest; hence there is continuity of wave without phase shift. Thus net optical path difference in reflected rays is caused by ray BC and CD which is equivalent to $\Delta x = \mu \times 2t + \frac{\lambda}{2}$…(1) Given that soap film appears dark and it requires $\Delta x = (2n+1)\frac{\lambda}{2}\Big|_{n\in \mathrm{N}}$…(2). Combining (1) and (2) we have $\mu \times 2\mu t + \frac{\lambda}{2} = (2n+1)\frac{\lambda}{2} \Rightarrow \mu \times 2\mu t$…(3) Given that thickness of the film is $t = 0.0011$mm or 1.1×10^{-6}m. Using the available data $n = \frac{2\mu t}{\lambda} = \frac{2\times\mu\times1.1\times10^{-6}}{580\times10^{-9}} = 3.793\mu$. With the $1.2 < \mu < 1.5$ and factor of μ is 3.793 the possible integral value $n = 5$. Thus, $3.793\mu = 5 \Rightarrow \mu = \frac{5}{3.793} \Rightarrow \boldsymbol{\mu = 1.32}$ **is the answer.** **N.B.:** In this case incident ray is are nearly perpendicular to the surface and hence BC = CD = t. However, angle of the incident ray is only for diagrammatic discrimination and convenience.
Q-13	A parallel beam of light of wavelength 560 nm falls on a thin film of oil (refractive index = 1.4). What should be the minimum thickness of the film so that it strongly reflects the light?
I-13	Phenomenon of reflection of light wave through a thin oil film is shown in figure. Incident wave AB on transparent surface is subjected to partial refraction at top surface of the film (as ray BC) and on the same surface partial reflection (as ray BP). The refracted ray BC again undergoes total reflection (as ray CD) at bottom surface of the film at C as ray along CD. This reflected ray CD undergoes refraction at outer surface of the oil film along DQ.  Reflection of wave at B causes a phase shift $\pi \rightarrow \frac{\lambda}{2}$, since incident wave AB encounters denser medium at B, this cause crest reflected as crest and trough reflected as trough. But, ray BC in the film encounters rarer medium at C and hence crest reflected as trough and trough reflected as crest; hence there is continuity of wave without phase shift. Thus net optical path difference in reflected rays is caused by ray BC and CD which is equivalent to $\Delta x = \mu \times 2t + \frac{\lambda}{2}$…(1) Given that soap film appears dark and this in case of reflection is opposite to the transmission and requires $\Delta x = (2n+1)\frac{\lambda}{2}\Big|_{n\in \mathrm{N}}$…(2). Combining (1) and (2) we have $\mu \times 2\mu t + \frac{\lambda}{2} = (2n+1)\frac{\lambda}{2} \Rightarrow \mu \times 2\mu t$…(3) Constructive interference would exhibit strongly reflected light for which minimum thickness of the oil film of refractive index $\mu = 1.4$ should be such that the reflected light is in phase with the incident light. Thus an additional phase shift during to-and-fro traversal of light through the oil film of minimum thickness t is such that $2t\mu = \frac{\lambda}{2} \Rightarrow t = \frac{\lambda}{4\mu}$. Using the given data $t = \frac{560\times10^{-9}}{4\times1.6} \Rightarrow \boldsymbol{t = 100}$ **nm is the answer.** **N.B.:** In this case incident ray is are nearly perpendicular to the surface and hence BC = CD = t. However, angle of the incident ray is only for diagrammatic discrimination and convenience.
Q-14	A parallel beam of white light is incident normally on a water film 1.0×10^{-4} cm thick., Find the wavelength in visible range (400 nm – 700 nm) which are strongly transmitted by the film. Refractive index of water is 1.33.

I-14	Phenomenon of reflection of light wave through water film is shown on the figure. Incident wave AB on transparent surface is subjected to partial refraction at top surface of the film (as ray BC) and on the same surface partial reflection (as ray BP). The refracted ray BC again undergoes total reflection (as ray CD) at bottom surface of the film at C as ray along CD. This reflected ray CD undergoes partial refraction at outer surface of the water film along DQ and remaining part of the wave is reflected at D and wave travels along DE. This reflected wave at E undergoes refraction along ES.  When a wave encounters denser medium, this causes crest reflected as crest and trough reflected as trough. Thus reflection of wave at denser medium causes phase shift $\pi \rightarrow \frac{\lambda}{2}$. But when a wave in denser medium encounter a lighter medium crest reflected as trough and trough reflected as crest. And hence there is no change of phase. Thus ray ES is a reflection of wave at B and E, , i.e. double reflection. While, the ray CR is not at all subjected to reflection. But, path BC of the ray BCR is common to BCDES. Thus net optical path difference in refracted rays is caused by ray CR and ES is equivalent to $\Delta x = \mu \times 2t$…(1). Given that through the water film there is bright transmission which is possible when $\Delta x = n\lambda|_{n\in N}$ …(2). Combining (1) and (2) we have $2\mu t = n\lambda$. It leads $2\mu t = m\lambda|_{n\in N}$. It leads to $\lambda = \frac{2\mu t}{m}$…(3). Using the given data $\lambda = \frac{2\times1.33\times1\times10^{-6}}{n} \Rightarrow \lambda = \frac{2.66\times10^{-6}}{n}$. Further it is given that $0.6\times10^{-6} < \lambda < 0.7\times10^{-6}$. It leads to $0.4\times10^{-6} < \frac{2.66\times10^{-6}}{n} < 0.7\times10^{-6} \Rightarrow 0.4 < \frac{2.66}{n} < 0.7 \Rightarrow 0.4\times n < 2.66 < 0.7\times n$. Thus, we have $n < \frac{2.66}{0.4}$ or $n < \frac{2.66}{0.4} \Rightarrow n < 6.65$ and $2.66 < 0.7\times n \Rightarrow \frac{2.66}{0.7} < n \Rightarrow 3.8 < n$. Since, $n \in N$ accordingly we have set M such that $n = \{k: 3.8 < k < 6.65; k \in N\} \Rightarrow n = \{4,5,6\}$. Accordingly, $\lambda = \left\{\frac{2.66\times10^{-6}}{4}, \frac{2.66\times10^{-6}}{5}, \frac{2.66\times10^{-6}}{6}\right\}$. It leads to $\lambda = \{443\times10^{-9}, 532\times10^{-9}, 666\times10^{-9}\}$meter, or $\boldsymbol{\lambda = \{443, 532, 666\}}$**nm is the answer.** **N.B.:** In this case incident ray is are nearly perpendicular to the surface and hence BC = CD = DE = t. However, angle of the incident ray is only for diagrammatic discrimination and convenience.
Q-15	A glass surface is coated by an oil film of uniform thickness 1.00×10^{-4}cm. The index of refraction of the oil is 1.25 and that of the glass is 1.50. find the wavelength if the light in the visible region (400 nm – 750 nm) which are completely transmitted by the oil film under normal incidence.
I-15	Given that thickness of a thin oil film is $t = 1.00\times10^{-4}$ cm or 10^{-6}, its refractive index $\mu = 1.25$. It is required to determine wavelengths in the range 0.400×10^{-6} m < $\lambda < 0.750\times10^{-6}$ m which would be completely transmitted.  This is the case of complete transmission of a ray through a compose medium out of which one is a thin oil thin film on glass a medium denser than that of the oil, and is shown in the conceptual figure. When a wave encounters denser medium, this causes crest reflected as crest and trough reflected as trough. Thus reflection of wave at denser medium causes phase shift $\pi \rightarrow \frac{\lambda}{2}$. But when a wave in denser medium encounter a lighter medium crest reflected as trough and trough reflected as crest. In the instant case traversal of ray along BC is common but physical distance CR and ED are equal, while reflection at E at boundary with lighter medium does not cause any phase difference. Thus optical path difference between transmitted rays RT and SU is caused (a) reflection from glass surface at C and traversal of ray in the film along CD and DE. Thus net path difference in refracted rays is caused by ray CR and ES is equivalent to $\Delta x = \mu \times 2t + \frac{\lambda}{2}$…(1). Given that through the water film there is bright transmission which is possible when $\Delta x = n\lambda|_{n\in N}$ …(2). Combining (1) and (2) we have $2\mu t + \frac{\lambda}{2} = n\lambda$. It leads $2\mu t = (2n-1)\frac{\lambda}{2}\Big|_{n\in N}$. It leads to $\lambda = \frac{4\mu t}{2n-1}$…(3).

	Using the given data $\lambda = \frac{4\times1.25\times1\times10^{-6}}{2n-1} \Rightarrow \lambda = \frac{5.00\times10^{-6}}{2n-1}$. Considering the range of wavelength stated in the problem we have $0.400\times10^{-6} < \frac{5.00\times10^{-6}}{2n-1} < 0.750\times10^{-6} \Rightarrow 0.400 < \frac{5.00}{2n-1} < 0.750$. It, further, resolves into $0.400\times(2n-1) < 5.00 < 0.750\times(2n-1)$. Resolving each limit separately, for lower limit we have $2n-1 < \frac{5.00}{0.400} \Rightarrow n < \frac{5.40}{0.8} \Rightarrow n < 6.75$ and on the upper limit $5.00 < 0.75\times(2n-1) \Rightarrow \frac{5.00}{0.75} < 2n-1$. It solves into $\frac{5.75}{0.75} < 2n \Rightarrow 3.83 < n$. Since, $n \in N$ accordingly we have set such that $n = \{k: 3.63 < k < 6.75; n \in N\} \Rightarrow n = \{4,5,6\} \Rightarrow 2n-1 = \{7,9,11\}$. Accordingly, $\lambda = \left\{\frac{5.00\times10^{-6}}{7}, \frac{5.00\times10^{-6}}{9}, \frac{5.00\times10^{-6}}{11}\right\}$. It leads to $\lambda = \{455\times10^{-9}, 556\times10^{-9}, 714\times10^{-9}\}$meter, or $\boldsymbol{\lambda = \{455, 556, 714\}}$**nm is the answer.** **N.B.:** In this case incident ray is are nearly perpendicular to the surface and hence all the path lengths in oil film and glass is taken to be t. However, angle of the incident ray is only for diagrammatic discrimination and convenience.
Q-16	A convex lens of diameter 8.0 cm is used to focus a parallel beam of light of wavelength 620 nm. If the light be focused at a distance of 20 cm from the lens, what would be the radius of the central bright spot formed?
I-16	This is the case of Fraunhfer diffraction by a circular aperture diffraction. In this case interference take place between rays form the diametrical points on the edge of the circular aperture. In this diameter of the convex lens serves diameter of the circular aperture accordingly $d = 8.0\times10^{-2}$m. The diffraction pattern is focused at a distance $D = 0.20$ m. Mathematically, radius of the central bright spot is approximated to $R = 1.22\frac{\lambda D}{d}$. Thus, $R = 1.22\times\frac{(620\times10^{-9})\times0.20}{8.0\times10^{-2}} = 1891\times10^{-9}$ cm and hence diameter of the central bright fringe is $D = 2R \Rightarrow \boldsymbol{D = 2\times1.9 = 3.8\,\mu m}$ **or** $\boldsymbol{3.8\times10^{-6}}$ **m is the answer.** **N.B.:** Illustration of formula $R = 1.22\frac{\lambda D}{d}$ is requires advanced mathematics involving Bessel's function and hence skipped here.
Q-17	White light is used to illuminate the two slits in a Young's double slit experiment. The separation between slits is b and the screen is at a distance $d(\gg b)$ from the slits. At a point on the screen directly in-front of one of the slits, certain wavelength are missing. Some of the missing wavelengths are – (a) $\lambda = \frac{b^2}{d}$ (b) $\lambda = \frac{2b^2}{d}$ (c) $\lambda = \frac{b^2}{3d}$ (d) $\lambda = \frac{2b^2}{3d}$
I-17	White light contains a spectrum of wavelengths. In Young's double slit experiment fringe width $w = \frac{n\lambda d}{b}$ or $n\lambda = \frac{wb}{d}$, here w is separation between bright fringes. Since. dark fringes are equally spaced between adjacent bright fringes and separation between a dark fringe with adjacent bright fringe is $w' = \frac{w}{2}$. It leads to $w' = \frac{(2n+1)\lambda d}{2b} \Rightarrow (2n+1)\lambda = \frac{2bw'}{d}$…(1), here $n \in W$, In the problem it is stated that the point which is being observed for missing fringes is in front of one of the slit. It implies that $w' = \frac{b}{2}$…(2). Combining (1) and (2) we have $(2n+1)\lambda = \frac{2b\left(\frac{b}{2}\right)}{d} \Rightarrow \lambda = \frac{b^2}{(2n+1)d}$. Since $n \in W$. Hence testing with a few values of n we have values of missing wavelengths as under – • $n = 0 \Rightarrow \boldsymbol{\lambda = \frac{b^2}{d}}$ **is the answer in option (a).** • $n = 1 \Rightarrow \lambda = \frac{b^2}{(2\times1+1)d} \Rightarrow \boldsymbol{\lambda = \frac{b^2}{3d}}$ **is the answer in option (c).** • $n = 2 \Rightarrow \lambda = \frac{b^2}{(2\times2+1)d} \Rightarrow \lambda = \frac{b^2}{5d}$ is not the answer in any of the given options. • This shall be true for all $n \geq 2$ **Hence answers are options (a) and (c).**

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Growing with Concepts: Chemistry

CARBON FAMILY

Kumud Bala

Carbon family (group 14) contains five elements. Elements are carbon, silicon, germanium, tin (stanum), and lead (plumbum).

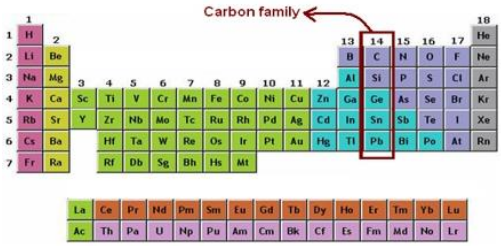
Carbon: Carbon occurs both as the free element and in the combined form. It is the essential constituent of all living organisms. Carbon is found as CO_2 in abundance in the sun, stars, comets and atmospheres of most planets. The atmosphere of Mars contains 96% CO_2. Carbon is found free in nature in three allotropic forms: amorphous, graphite and diamond. Graphite is one of the softest known materials while diamond is one of the hardest. Carbon is 17th in order of abundant in the earth's crust. It is strictly non-metallic character.
Uses: Coal is amorphous form of carbon. It is used as a fuel in boilers, engines for manufacture of coal gas, water gas, producer gas and synthetic petrol. Charcoal is used as an excellent adsorbent to purify and deodorize sugar to absorb poisonous gases in gas marks and for removing offensive odor from the air used in air- conditioning processes. Graphite is used for making electrodes, in steel manufacturing, metal foundries for crucibles, as a lubricant, in pencils and used as the moderator in the cores of gas cooled nuclear reactors to slow down neutrons.

Silicon: Silicon makes up 25.7% of the earth's crust by weight, and is the second most abundant element, exceeded only by oxygen (45.5%). It is found largely as silicon oxides such as sand (silica), quartz, rock crystal, agate, flint, jasper and opal. Silicon is found also in minerals such as asbestos, feldspar, clay and mica.
Uses: Silicon in very pure form is used in semiconductor devices, which is a basis for whole electronic industry. It is used as important component of ceramics, glass and cement.

Germanium: the metal is found in argyrodite, a sulfide of germanium. The element is commercially obtained from the dusts of smelter processing zinc ores, as well as recovered from combustion by-products of certain coals.
***Uses*:** The most common use of germanium is as a semiconductor. It is used as an alloying agent, as a phosphor in fluorescent lamps, and as a catalyst.

Tin (stanum): it is found chiefly in cassiterite (SnO_2). Most of the world's supply comes from Malaya, Bolivia, Indonesia, Zaire, Thailand, and Nigeria. It is obtained by reducing the ore with coal in a reverberatory furnace.
***Uses*:** Tin is used to coat other metals to prevent corrosion or other chemical action. Such tin plating over steel is used in the so-called tin can for preserving food. Tin foils are used for wrapping cigarettes and cans for food and drinks. SnO_2 is used as a glaze in ceramics. Alloy of tin are very important. Examples are: soft solder= (Pb=50%, Sn=50%), Pewter (Pb=20%, Sn=80%), copper bronze (Cu=80%, Zn=10%, Sn=10%), Gun metal (Cu= 90%, Sn=10%).

Lead: it is obtained chiefly from galena (PbS). Anglesite ($PbSO_4$) and cerussite ($PbCO_3$) are other common lead minerals.
***Uses*:** lead is used to make lead storage batteries. It is used in making pigments e.g. white lead ($PbCO_3$, $Pb(OH)_2$), red lead (Pb_3O_4), chrome yellow ($PbCrO_4$). Calcium plumbate (Ca_2PbO_4) is used for rust proofing of corrugated steel sheets. It is used for making tetra ethyl lead $Pb(C_2H_5)_4$ which is used as an anti knocking agent in petrol. It is used in making alloys such as solder, pewter and type metal.



Electronic configuration of group 14 elements:

There is a considerable change in the appearance between elements in the group 14 on descending the group. Carbon is a dull black color in the form of graphite, or hard and transparent in the form of diamond. Silicon and germanium are dull grey or black. Tin and lead are a shiny grey color.

Element (symbol)	Atomic number	Electronic configuration	With inert gas
Carbon (C)	6	$1s^2 2s^2 2p_x^1 2p_y^1$	$[He]2s^2 2p_x^1 2p_y^1$
Silicon (Si)	14	$1s^2 2s^2 2p^6 3s^2 3p_x^1 3p_y^1$	$[Ne]3s^2 3p_x^1 3p_y^1$
Germanium (Ge)	32	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p_x^1 4p_y^1$	$[Ar]3d^{10} 4s^2 4p_x^1 4p_y^1$
Tin (stanum) (Sn)	50	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p_x^1 5p_y^1$	$[Kr]4d^{10} 5s^2 5p_x^1 5p_y^1$
Lead (Pb) (plumbum)	82	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p_x^1 6p_y^1$	$[Xe]4f^{14} 5d^{10} 6s^2 6p_x^1 6p_y^1$

Physical properties:
Atomic Radii: The atomic radii of group 14 elements are less than group 13 elements. It is because when we move from group 13 to group 14 within the same period, the

effective nuclear charge increases, the outermost electrons are attracted more strongly towards the nucleus, hence atomic radii decreases. Atomic radii of group 14 elements regularly increase as we move down the group. It is due to addition of a new energy shell.

Atomic radius of	C	Si	Ge	Sn	Pb
In (pm)	77	118	122	140	146

Ionization Enthalpy **:** First ionization enthalpies of group 14 elements are higher than the corresponding group 13 elements. For example, Boron = 800kJ mol^{-1} , Carbon = 1086 kJ mol^{-1} . This is due to higher nuclear charge and smaller size of the atoms of group 14 elements. Ionization enthalpy decreases moving down the group from carbon to tin.

1st ionization enthalpy	Carbon	Silicon	Germa-nium	Tin	Lead
kJ mol^{-1}	1086	786	761	708	715

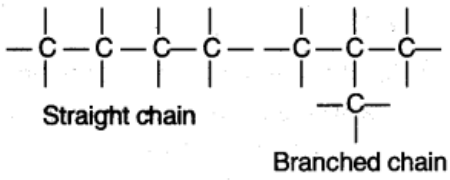
This is due to increase in atomic size and screening effect of the inner electrons. The outermost electrons, therefore, become less and less tightly held by the nucleus. Hence ionization enthalpy decreases. Slight increase in ionization enthalpy from tin to lead is due to poor shielding effect of d- and f-electrons in Pb.

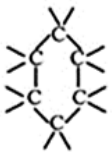
Oxidation States**:** The elements in group 14 have 4 electrons in the outermost shell. These elements can attain inert gas configuration either by losing or gaining 4 electrons forming M^{+4} or M^{-4} ions. C^{+4} ions do not exist because these are highly charged species and its formation requires high ionization enthalpy ($14.26X10^3 kJmol^{-1}$) which is usually not available in chemical reactions. Similarly C^{-4}(carbide ion) also does not exist. However, carbon forms some carbide such as Be_2C, CaC_2, SiC, and Al_4C_3 in which carbon is supposed to be present either as C_2^{-2} or C^{-4} ions. Silicon also shows +4 oxidation states. Germanium, tin, and lead show +4 and +2 oxidation states. On moving down the group, +2 oxidation states become more stable; Ge<Sn<Pb. For lead, +2 oxidation states are more predominant. This is due to inert pair effect. On moving down the group, ionic character increases. Compounds showing +4 oxidation states are covalent because of extremely small size. Compounds showing +2 oxidation states are ionic because of large size and small charge. For example, $SnCl_2$ is ionic solid and $SnCl_4$ is covalent liquid.

Metallic character**:** Group 14 elements are less metallic due to large ionization enthalpy. Metallic character decreases down the group. Carbon is a non-metal, silicon and germanium are metalloids and tin and lead are typical metals.

Allotropy**:** it is the existence of an element in two or more forms which have different physical properties but have similar chemical properties. All the elements of carbon family show allotropy except lead. Carbon exists in two important forms, amorphous and crystalline. Tin has two common allotropes. At room temperature the stable form is white tin. And below 286.2K the stable form is grey tin.

Catenation**:** This is the remarkable properties of carbon to form bond with itself. The ability of like atoms to link with one another through covalent bonds is due to small size and higher electro negativity of carbon atoms. On moving down the group catenation property decreases. This is due to decrease in M-M bond strength and increase in size of the atoms. Carbon forms long straight or branched C-C chains or rings of different sizes and lengths, C>>Si>Ge≈Sn>Pb.





Closed chain

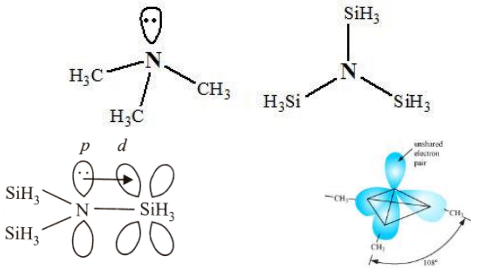
Bond	C-C	Si-Si	Ge-Ge	Sn-Sn
Bond energy ($kJmol^{-1}$)	353.3	225.7	167.2	154.7

Tendency to form multiple bonding: there are two types of multiple bonding (i) pπ-pπ multiple bonding (ii) dπ-pπ multiple bonding. Carbon has a strong tendency to form pπ-pπ multiple bonds either with itself (C=C, C≡C) or with other atoms of similar size as oxygen (C=O) and nitrogen (C=N, C≡N).

pπ-pπ multiple bonding is due to small size and high electro negativity. As we move down the group pπ-pπ multiple bonding decreases due to increase in size and decrease in electro negativity.

dπ-pπ multiple bonding: carbon does not have d-orbital and hence it does not form dπ-pπ multiple bonding. Silicon and other elements of the group 14 have vacant d-orbitals in their valence shell, tend to form dπ-pπ multiple bonds. This bond is formed by the donation of electron pair from the filled 2p orbitals of N or O to the vacant 3d orbital of Si. It is called back bonding. For example, Geometry around the nitrogen atom in $N(CH_3)_3$, tri methyl amine is pyramidal. The N-atoms involves sp^3 hybridization having one lone pair in one of its tetrahedral position. In $N(SiH_3)_3$, trisilyl amine is planar triangular. The N atoms involve sp^2 hybridization. The lone pair of electron in 2p orbital of N-atom overlaps with the empty d-orbitals of three Si- atoms to form dπ-pπ. N- Atom has

no longer a lone pair of electrons. The molecule does not have donor properties. Its structure is planar. Such type of dπ-pπ multiple bonding cannot occur in $N(CH_3)_3$, carbon does not have d-orbitals. Therefore, $N(SiH_3)_3$ is a weaker base and has planar triangular structure than $N(CH_3)_3$.



Chemical Reactivity:

Reactivity towards oxygen: all the elements of group 14 when heated in oxygen form oxides. These are mainly of two tpyes, i.e., monoxides (MO) and dioxides (MO_2). SiO exists only at high temperature where it is thought to be formed by reduction of SiO_2 with Si, i.e. $SiO_2 + Si \rightarrow 2SiO$

***Acid-base character*:** the oxides in higher oxidation state of the element are generally more acidic than those in the lower oxidation state. Further, as we move down the group acidic character decreases.

CO_2	SiO_2	GeO_2	SnO_2	PbO_2
Acidic	Less acidic	Lesser acidic	Amphoteric	Amphoteric

$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$

$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$

$SiO_2 + 2NaOH \rightarrow Na_2SiO_3 + H_2O$

$GeO_2 + 2NaOH \rightarrow Na_2GeO_3 + H_2O$

In contrast, SnO_2 and PbO_2 react with both acids and bases.

$SnO_2 + 2NaOH \rightarrow Na_2SnO_3$

$SnO_2 + 4HCl \rightarrow SnCl_4 + 2H_2O$

$PbO_2 + 2NaOH \rightarrow Na_2PbO_3 + H_2O$

$PbO_2 + 4HCl \rightarrow^{273K} PbCl_4 + H_2O$

Among monoxides, CO is neutral; GeO is distinctly acidic whereas SnO and PbO are amphoteric.

***Reducing-oxidizing power*:** Since +4 oxidation state of carbon is the most stable, therefore, among the monoxides of group 14, CO is the strongest reducing agent. Therefore, it is used in the extraction of many metals from their oxides.

$Fe_2O_3 + 3CO \rightarrow^{\Delta} 2Fe + 3CO_2$

$ZnO + CO \rightarrow^{\Delta} Zn + CO_2$

Since due to inert pair effect, +2 oxidation state of Pb is the most stable, therefore, among dioxides of group 14, PbO_2 is a powerful oxidizing agent.

$2PbO_2 + 4HNO_3 \rightarrow 2Pb(NO_3)_2 + 2H_2O + O_2$

$2PbO_2 + 2H_2SO_4 \rightarrow 2PbSO_4 + 2H_2O + CO_2$

Reactivity towards water: Carbon, silicon and germanium do not decompose water at all. Tin decomposes steam to form tin dioxide and dihydrogen gas.

$Sn(s) + 2H_2O(g) \rightarrow^{\Delta} SnO_2(s) + 2H_2O$

Lead is not affected by water probably because of formation of a protective film of lead oxide on its surface.

Reactivity towards halogens: The elements of group 14 form halides of the formula MX_4 and MX_2 (X = F, Cl, Br, I). Except carbon all other elements react directly with halogen under suitable conditions.

(a) Tetra Halides:-

(i) All the elements of group 14 form tetra halides of the formula MX_4.

(ii) Most of the tetra halides are covalent in nature. The central atom in these halides undergoes sp^3 – hybridization and the molecule is tetrahedral in shape. Exceptions are SnF_4 and PbF_4, which are ionic in nature.

(iii) The thermal stability and ionic character of these halides decreases with the increasing atomic number or the size of the halogen atom. Thus, $PbCl_4$ is stable; $PbBr_4$ is unstable while PbI_4 is unknown. The non-existence of PbI_4 is probably due to the strong oxidizing power of Pb (+4) and strong reducing power of I^-. Similarly instability of $PbBr_4$ may be due to the strong oxidizing power of Pb (+4) and weak reducing power of Br^- ion. The non-existence of PbI_4 may also be explained as follow: the Pb-I bond initially formed during the reaction does not release enough energy to unpaired $6s^2$ electrons and excite one of them to 6p-orbital to have four unpaired electrons around lead atom.

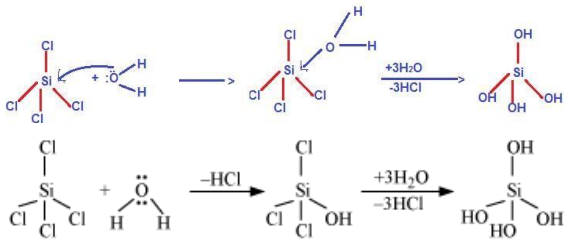
(iv) The tetrachloride of carbon (CCl_4) is not hydrolyzed by water because carbon does not have d-orbitals and hence cannot expand its coordination number beyond four. However, silicon can expand its octet (coordination number beyond four) due to the availability of energetically suitable vacant d-orbitals in its atom.

$CCl_4 + H_2O \rightarrow$ no reaction

$SiCl_4 + 4H_2O \rightarrow Si(OH)_4 + 4HCl$

The mechanism of hydrolysis of $SiCl_4$ involves the following two steps:

(a) the first step involves the nucleophilic attack by lone pair of electrons present on the oxygen atom of water molecule on the metal atom forming a coordinate bond between the metal and oxygen atom of water.



(b) The second step involves the loss of HCl. During this step, one Cl atom of silicon in $SiCl_4$ is replaced by an OH-group. This process continues till all the four Cl-atoms are replaced by OH-groups yielding $Si(OH)_4$, i.e., silicic acid. However, tetrahalides of all the remaining elements are easily hydrolyzed.

(v) The tetrahalides of carbon do not form complexes because carbon does not have vacant d-orbitals in its valence shell and hence cannot increase its coordination number beyond four. Tetrahalides of other elements form complexes due to the availability of vacant d-orbitals in their respective vacant shells. Therefore, these can increase their coordination number to six. Tetrahalides of Ge, Sn and Pb behave as lewis acids but tetrahalides of carbon do not. For example:

$SiF_4 + 2HF \rightarrow H_2SiF_6$ (hydrofluorosilicic acid)

$SnCl_4 + 2Cl^- \rightarrow SnCl_6^{2-}$ (Hexachlorostannate ion)

(b) Dihalides: Except carbon and silicon, all other elements of group14 (germanium, Sn and Pb) form dihalides(MX_2). The stability of these dihalides increases steadily due to inert pair effect as we move down the group from Ge to Pb, i.e., $GeX_2 << SnX_2 < PbX_2$. Considering the thermal and chemical stability, GeX_4 is more stable than GeX_2 whereas PbX_2 is more stable than PbX_4.

Assignment

1. Carbon forms a large number of compounds because it has -------
(A) variable valency
(B) low electron affinity
(C) no d-orbital in valence shell
(D) property of catenation

2. An inert pair effect is predominant in -------
(A) Si (B) Pb (C) Ge (D) Sn

3. Which of the following oxidation states are the most characteristic for lead and tin respectively?
(A) +2, +2 (B) +4, +2
(C) +2, +4 (D) +4,+4

4. Which of the following species does not exist?
(A) $[SnCl_6]^{-2}$ (B) $[SiCl_6]^{-2}$
(C) $[CCl_6]^{-2}$ (D) $[GeCl_6]^{-2}$

5. Among the following ions pπ-dπ overlap could be present in -----
(A) NO_3^- (B) PO_4^{-3}
(C) CO_3^{-2} (D) NO_2^-

6. Which of the following oxide is amphoteric in character?
(A) CaO (B) CO_2
(C) SiO_2 (D) SnO_2

7. When PbO_2 reacts with conc.HNO_3, the gas evolved is-------
(A) NO_2 (B) O_2
(C) N_2 (D) N_2O

8. A metal M forms two chlorides in its +2 and +4 oxidation states. Which of the following statements about these chlorides is correct?
(A) MCl_2 is more soluble in anhydrous ethanol than MCl_4
(B) MCl_2 is more ionic than MCl_4
(C) MCl_2 is more easily hydrolysed than MCl_4
(D) MCl_2 is more volatile than MCl_4

9. The stability of the dihalides of Si, Ge, Sn, and Pb increases steadily in the sequence:
(A) $SiX_2 << GeX_2 << PbX_2 << SnX_2$

(B) $SiX_2 << GeX_2 << SnX_2 << PbX_2$
(C) $PbX_2 << SnX_2 << GeX_2 << SnX_2$
(D) $GeX_2 << SiX_2 << SnX_2 << PbX_2$

10. Which of the following is not hydrolyzed easily?
(A) CCl_4 (B) $SiCl_4$
(C) $GeCl_4$ (D) $SnCl_4$

11. Which of the following has least tendency to undergo catenation?
(A) C (B) Si (C) Ge (D) Sn

12. The stable bivalency of Pb and trivalency of Bi is ----------
(A) due to d- orbital contraction in Pb and Bi
(B) due to relativistic contraction of the 6s-orbitals of Pb and Bi, leading to inert pair effect
(C) due to screening effect
(D) due to attainment of noble configuration.

13. The oxide which is the strongest acid is --------
(A) Tl_2O_3 (B) PbO_2
(C) CO_2 (D) SnO_2

14. Unlike $PbCl_4$, PbI_4 and $PbBr_4$ are not found because ----------
(A) chlorine is more electropositive
(B) iodine and bromine are of large size
(C) iodine and bromine are unable to oxidize Pb to Pb^{+4}
(D) the statement is wrong

15. Which of the following statement is not correct?
(A) $PbCl_4$ is less stable than $SnCl_4$ but $PbCl_2$ is more stable than $SnCl_2$
(B) PbO_2 is stronger oxidant than SnO_2
(C) $(SiH_3)_3N$ is stronger base than $(CH_3)_3N$
(D) Sn (II) is a reducing agent but Pb (II) is not

Answers

1. (D) 2. (B) 3. (C) 4. (C) 5. (B) 6. (D) 7. (B) 8. (B) 9. (B) 10. (A) 11. (D) 12. (B) 13. (C) 14. (C) 15. (C)

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The value of a college education is not the learning of many facts but the training of mind to think.

\- ***Albert Einstein***

—00—

We are about to sacrifice our civilization for the opportunity of a very small number of people to continue to make enormous amount of money...
But it is the sufferings of the many which pay for the luxuries if the few...
You say that you love your children above everything else. And yet you are stealing their future.

\- ***Greta Thumnberg***

—00—

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

SCIENCE QUIZ : March'2020

Kumud Bala

1. Friction force between two rough surfaces can be ------by using lubricant.
(A) increased (B) decreased
(C) removed (D) kept same

2. Which of the following is not true regarding friction?
(A) friction wears down machine parts
(B) friction helps us walk
(C) friction helps a ship move through waterv
(D) friction produces heat.

3. The force of friction between two bodies is ------
(A) parallel (B) perpendicular
(C) inclined at 30° (D) inclined at 60°

4. Ball bearing are used in bicycles, cars, etc, because ------
(A) the actual area of contact between the wheel and axle is increased
(B) the effective area of contact between the wheel and axle is increased
(C) the effective area of contact between the wheel and axle is reduced
(D) none of the above

5. The fluid friction depends on ------
(A) speed of object with respect to fluid
(B) size of object
(C) shape of object
(D) all of above

6. Whenever the surfaces in contact tend to move or move with respect to each other, the force of friction comes into play ---------
(A) only if the object are solid
(B) only if one of the two object is liquid
(C) only if one of the two objects is gaseous
(D) irrespective of whether the objects are solids, liquid or gases.

7. To sharpen the blade of a knife by rubbing it against a surface, which of the following will be most suitable?
(A) stone (B) plastic block
(C) wooden block (D) glass block

8. A toy car released with the same initial speed will travel farthest on ------
(A) muddy surface
(B) polished marble surface
(C) cemented surface
(D) brick surface

9. If we apply oil on door hinges, the friction will ----
(A) increase
(B) decrease
(C) disappear altogether
(D) will remain unchanged.

10. Which of the following statements is incorrect?
(A) friction acts on a ball rolling along the ground
(B) friction acts on a boat moving on water
(C) friction acts on a bicycle moving on a smooth road
(D) friction does not act on a ball moving through air

11. A boy rolls a rubber ball on a wooden surface. The ball travels a short distance before coming to rest. To make the same, ball travel longer distance before coming to rest, he may -------
(A) spread a carpet on the wooden surface
(B) cover the ball with a piece of cloth
(C) sprinkle talcum powder on the wooden surface
(D) sprinkle sand on the wooden surface.

12. In a large commercial complex there are four ways to reach the main road. One of the paths has loose soil, the second is laid with polished marble, the third is laid with bricks and the fourth has gravel surface. It is raining heavily and a boy wishes to reach the main road. The path on which he is least likely to slip is ---------
(A) loose soil (B) polished marble
(C) bricks (D) gravel

13. Four children were asked to arrange forces due to rolling, static and sliding frictions in decreasing order. Their arrangements are given below. Choose the correct arrangement.
(A) rolling, static, sliding
(B) rolling, sliding, static
(C) static, sliding, rolling
(D) sliding, static, rolling.

14. Sapna runs her toy car on a dry marble floor, wet marble floor, newspaper and towel spread on the floor. The force of friction acting on the car on different surfaces in increasing order will be –
(A) wet marble floor, dry marble floor, newspaper and towel
(B) newspaper, towel, dry marble floor, wet marble floor

(C) towel, newspaper, dry marble floor, wet marble floor
(D) wet marble floor, dry marble floor, towel, newspaper

15. Suppose your writing desk is tilted a little. A book kept on it starts sliding down. What is the direction of frictional force acting on it?
(A) frictional force will act upward
(B) frictional force will act downward
(C) no frictional force will act on the book.

16. Friction, that exists between two surfaces in contact, when there is no relative motion between them is called ------
(A) sliding friction (B) static friction
(C) viscous drag (D) rolling friction

17. The energy required to overcome friction is mainly converted into -----
(A) sound energy (B) heat energy
(C) light energy (D) chemical energy

18. Out of the following, the better lubricant to be used in the moving parts of a machine.
(A) water (B) air
(C) chalk powder (D) turpentine oil

19. Force of friction is more in ------
(A)marble tiles (B) wooden floor
(C) play ground (D) glass table

20. These days we use suitcase with wheels because ------
(A) they look smart
(B) they are easy to carry and reduce friction
(C) they make less noise
(D) none of these.

21. Tyres have cut grooves in them ------
(A) to increase friction
(B) to decrease friction
(C) to make them attractive
(D) to save rubber

22. Why sportsman use shoes with spikes?
(A) to increase the friction between shoes and the surface
(B) to decrease the friction between shoes and the surface
(C) sole of shoes wear out due to friction
(D) none of these

23. Which are factors on which the frictional force in fluids depends?
(A) the speed of object with respect to the fluid
(B) the shape of the object
(C) nature of the fluid
(D) all the above

24. What are harmful effects of friction?
(A) friction generates heat
(B) friction causes wear and tear of the rubbing surfaces
(C) friction reduces the speed of the body and increase the consumption of energy
(D) all the above

25. To whom has nature provided streamlined body?
(A) nature has given birds and fish streamlined bodies
(B) nature has given aero planes and boats streamlined bodies
(C) nature has given missiles and rockets streamlined bodies
(D) none of these

(Answers to this Science Quiz shall be provided inMonthly e-Bulletin)

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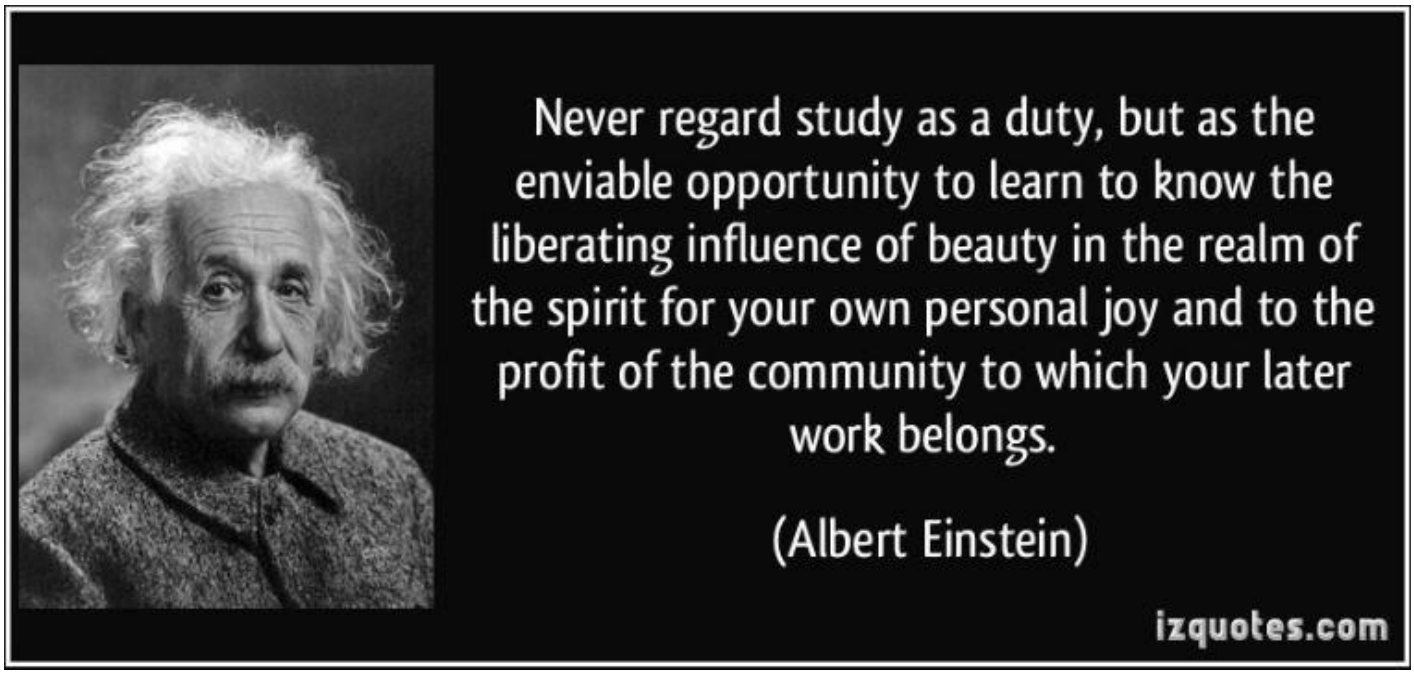
A hundred times every day I remind myself that my inner and outer life are based on the labors of other men, living and dead, and that I must exert myself in order to give in the same measure as I have received and am still receiving.

Albert Einstein



—00—

Nature is a beautiful integration of different entities. Mathematics and science only discover them.

Euler's Identity $0 = 1 + e^{j\pi}$ ***is an excellent example of integration. Each of the constituent was discovered independently, by different mathematicians, at different point of time.***

Yet they all complement each other.

Lest it not be there whole nature shall have to rediscovered

—00—

Education breeds confidence.

Confidence breeds hope.

Hope breeds peace.

- Confucius

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

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