GYAN-VIGYAN SARITA: शिक्षा

A non-remunerative, non-commercial and non-political initiative to Democratize Education as a Personal Social Responsibility (PSR) 3rd Quarterly e-Bulletin dt 1st April'17





Devika.M

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Editor-शिक्षा e-Bulletin : Dr SB Dhar

Coordinator-ज्ञान विज्ञान सरिता : Dr Subhash Joshi

Graphics Designer: Devika Mathur

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Our Website: http://gyanvigyansarita.in/; E-mail: subhashjoshi2107@gmail.com



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

<u>संपादकीय</u>



मार्च-अप्रैल का महीना: तैयारियों का परीक्षण-काल

हर वर्ष मार्च-अप्रैल का महीना विद्यार्थियों के लिये उनके सालभर की पढ़ायी की समझ को परखने का महीना होता है। परखना एक कला है। अपने को परखने का साहस करना विकास की ओर जाने का रास्ता चुनना होता है। समय-समय पर अपने को परखते रहने से हमारे अंदर की कमी दूर होती जाती है, और कमी दूर होते रहने से नयी ऊर्जा मिलने लगती है।

पूरे साल के अध्ययन के आधार पर होने वाली परीक्षाओं में अच्छे अंक पाना हर विद्यार्थी का लक्ष्य रहता है। परीक्षा में पूछे गये प्रश्नों में से अधिक से अधिक प्रश्नों का सही उत्तर, निर्धारित समय की सीमा में, साफ-साफ लिखना हर विद्यार्थी की कोशिश होती है। ऐसा तभी हो पाता है जब विद्यार्थी अपनी तैयारी को परीक्षा से पहले परखे होते हैं। यही परखना परीक्षा का अभ्यास कहलाता है। नियमित अभ्यास करते रहने से प्रणाली का ज्ञान रहता है और उत्तर लिखने में समय बचता है। कम समय में सही उत्तर लिखने से आत्मविश्वास बढ़ता है।

इंजिनियरिंग, आर्किटेक्चर, मैथमेटिकल स्टेटिस्टिक्स, मेडिकल, होटल मैनेजमेंट, लॉ, डिजाइनिंग, चार्टर्ड एकाउंटेंसी, मैनेजमेंट, जर्नलिज्म, आदि विषयों में प्रवेश परीक्षाओं के माध्यम से भारतीय विश्वविद्यालयों में प्रवेश पाने की होड़ कक्षा 12 की परीक्षाओं के समाप्त होते ही शुरू हो जाती है और मई तक विद्यार्थी इन प्रवेश परीक्षाओं में व्यस्त रहते हैं। इनमें से कुछ KVPY, NTSE के द्वारा भी अध्ययन करना चाहते हैं।

भारतीय विद्यार्थियों के लिये विदेशों में अध्ययन के लिये TOEFL, IELTS, GRE, GMAT, SAT, MCAT, LSAT आदि परीक्षाओं में सफल होना जरूरी होता है जिससे विभिन्न देशों में वे अपनी इच्छा से विश्वविद्यालय चुनने में सक्षम हो जाते हैं।

परीक्षाओं में सफलता के लिये केवल विषय की जानकारी ही जरूरी नहीं होती है। सफलता के लिये जरूरी होती है अच्छी तैयारी। तैयारी में आती है-विषय की जानकारी, कम समय में सही उत्तर लिखने की शैली, आकर्षक तरीके से अपनी उत्तर पुस्तिका को पेश करने का तरीका आदि। विद्यार्थियों को तैयारी के तरीके जहां कहीं से मिले, वहीं से सीखना चाहिये। सीखना विद्यार्थी का उत्तरदायित्व होता है। सही तैयारी करना और उस तैयारी से सफलता पाना वह अपने प्रधानमंत्री श्री नरेन्द्र मोदी की कार्यशैली से भी सीख सकता है।

हाल के दिनों में उनकी कठिन मेहनत ने भारतीय जनता पार्टी को विधानसमा चुनावों में अच्छी सफलता दिलायी है। इसके लिये उन्होंने समयबद्ध कार्यक्रम बनाया, और बहुत से विकल्पों को सामने रखकर तैयारी किया, जिससे उनको सफलता मिली। हर बार वह सफलता के लिये एक ही तरीका नहीं अपनाते हैं अर्थात उनका मानना है कि हर बार एक ही तरीका अपनाकर मंजिल तक नहीं पहुंचा जा सकता है।

जब हमारी तैयारी में किसी भी तरह की बेईमानी नहीं रहती है, तब हमें सफलता मिलती है। जब व्यक्ति की साख दांव पर लगी होती है, तब वह सफलता को छोड़ना नहीं चाहता है। वह सफलता के लिये दूसरे प्रयास के बारे में नहीं सोचता है। वह हर हाल में पहले मौके पर ही सफल होना चाहता है। जिस प्रकार हम लड़ाई जीतने के लिये लड़ते हैं, ठीक उसी प्रकार हर तैयारी हमारी सफलता के लिये होनी चाहिये।

सबके पास काम करने के लिये 24 घंटों का समय ही रहता है, पर सफलता उसी को मिलती है जो इन 24 घंटों को 30 घंटों में बदल देता है। कितनी अजीब बात लगती है, यह सोचने और पढ़ने में, लेकिन वास्तविकता यही है कि यदि हम अपनी चाल बढ़ा दें तो समय सिकुड जाता है।

स्थिर इच्छा, कड़ी मेहनत, और दृढ़ संकल्प ही सफलता पाने का तरीका है। सफलता केवल प्रयास पर ही निर्भर नहीं रहती है, बल्कि सरल अनुशासन में रहते हुये प्रतियोगिता करने का साहस रखने से, सफलता मिलती है। सफल होने के लिये अपने पर विश्वास होना जरूरी है। हमें नहीं भूलना चाहिये कि सफलता बहाने नहीं चाहती है। यह भी नहीं भूलना चाहिये कि सफलता दुर्घटना नहीं होती है और सफलता संयोग भी नहीं होती है। सफलता उस तैयारी का परिणाम होती है जो सफल होने की नियत से की जाती है। जितनी छोटी-छोटी चीजों को एकत्र कर बड़ी तैयारी की जाती है, उतनी ही अधिक गर्मजोशी से सफलता को मनाने का जश्न होता है। यही जश्न, जीवन को और आगे बड़े लक्ष्यों की ओर ले जाता है। सच कहा है: अल्पनामपि वस्तूनां संहतिः कार्यसाधिका तृणैर्गुणतवमापन्नैर् बध्यन्ते मत्तदन्तिनः।

अर्थात् छोटी-छोटी वस्तुयें एकत्र करने से बड़े-बड़े काम भी हो सकते हैं, जैसे घास से बनायी ह्यी डोरी से मत्त हाथी बांधा जा सकता है।

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An Appeal: Gyan Vigyan Sarita

A non-organizational initiative of a small set of Co-passionate Persons

Philosophy: Personal Social Responsibility (PSR)

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

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

Operation:

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

Involvement:

a. 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,
- iv. Sponsor Website.

b. Facilitator -

- i. Provide space and infrastructure for **Online Mentoring Sessions (OMS)**, which is generally available, with a marginal add-on,
- ii. Garner support of elite persons to act as coordinators at a Learning Centre.

c. Participator -

- i. As a Mentor,
- ii. As Coordinator,
- iii. As Editor and or contributor of thought provoking articles for e-Bulletin, which are relevant to the initiative, and make it more purposeful and reachable to the target audience.
- iv. As author of Chapters for Mentors' Manual, being uploaded as a Free Web Resource,
- v. Anything else that you feel can add value to the mission and make it more purposeful.
- vi. Anything else that you consider to make this initiative to become more effective.

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

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

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

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

Presently, the OMS for a selected 25 Students at SOE, Jhabua, a tribal place. Shri Anurag Choudhary, IAS, Jhila Panchayat, and Shri Ashish Saxena,IAS, DM, are taking this initiative proactively. In addition, Two social organizations have prepared for extending the facility of OMS to target children.

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

Contact: Dr. Subhash Kumar Joshi, Coordinator - Gyan Vigyan Sarita.

Address: # 2487, Mahagun Moderne, Sector-78, NOIDA, UP – 201309, (R): 0120-4969970; (M):+91-9711061199,

e-Mail ID: subhashjoshi2107@gmail.com, Website: http://gyanvigyansarita.inABOUT US

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

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

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May like to congratulate our Editor:

We take pride in informing our esteemed readers that **Prof. S.B. Dhar**, *Editor of this e-Bulletin*, has recently released a book आखिर क्यों ? ISBN-13: 9781618136442. ISBN-10: 1618136445. This book is available both in print and e-book forms.



Available At:

flipkart

amazon

He is an eminent mentor, analyst and connoisseur of Mathematics 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: Handbook of Mathematics for IIT-JEE, A Textbook on Engineering Mathematics, Reasoning Ability, Lateral Wisdom, Progress in Mathematics (series for Beginner to Class VIII), Target PSA (series for class VI to class XII) and many more.

About the Book: It is a book that suggests the ways to protect ourselves from elimination and to foster to the accomplishment. The factual base of this book is

infibeam .---

bookscamel

the Indian epic Mahabharat written by Maharshi Vyas between the 8th and 9th centuries BCE. The story of Mahabharat tells us that nothing is ruined by itself. To abolish

customary things, one has to work hard. All the forces responsible for extermination are to be poised, summoned, and made to be organized till their tenacity is not over. The author has tried to explore the good things essential for the life and simultaneously identify the bad things one must restraint from. The human mind efforts at every moment are for being better. The fight is amongst the destruction and development. To gain and to move ahead, one has to conquer the evil powers. Duryodhan continued to be greedy for power and started involving himself into immoral acts. But the people responsible to train him properly could do nothing even after being highly learned and authoritative. The author investigates the reasons why these people could do nothing? If Bhishm, Dronacharya, or anyone else could have stood with Draupadi's side, then what would have happend? What could Duryodhan or anyone from his side do against Krishna who stood for the help of Draupadi? The book conveys the message to its readers to learn and comprehend that before everything is shattered or lost, they must realize the fault and amend it in time.

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Coordinator's Views



NEW ACADEMIC SESSION : Challenges and Opportunities

Confidence does not come

when you have all answers...;

but, it comes when you are

ready to face all questions....

"Confidence does not come when you have all answers...; but, it comes when you are ready to face all questions" – this famous quote is an explanation to perplexing scenario in respect of education in prevalent world. The technological advancement leading to rich resource of literature is good enough to provide answers most of the question one faces either in print or web-archive. These answers may tend to be close to a real life problem, but neither an exact solution nor its availability at a situation, where it is needed most, can be guaranteed.

This is where education, as a process and neither the

content nor subject matter, assumes importance to imbibe in students to identify problem, evolve possible remedies, choosing the best possible remedy and implement it. This process

goes in infusing confidence in young minds that are not only able to face questions, but question their own belief in search of truth and relevance of traditions and conventions, for a better tomorrow.

This Gyan Vigyan Sarita, initiative, in its offing, adopts an education process which is aligned to *groom competence to compete* to face all problems and questions, *among unprivileged children* who do not have access to either of good school, good literature, eworld and passionate-cum-dedicated teachers or lack of family support. This is the essence of *Democratization of Education*.

Generally, completion of every academic session leaves some questions unanswered. Transition from one session to other, during formal education, is a period which can be best utilized to introspect evaluate answers evolved. This is helpful in selfevaluation to be able to draw a path towards excellence. *Henry Ford* had said- "a man remains young so long he is learning and becomes old the moment learning stops". Eventually, academic sessions constitute a process of formal education. But, it is a process to evolve an intuitive thought process which lasts not only until last breadth, but it perpetuates much beyond. This notion cannot be better vouched than the words of *Albert Einstein* – "A hundred times a 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". It is quite satisfying to find that thoughts of Einstein have an echo in philosophy of the initiative – a sense of Personal Social Responsibility (PSR) discharged in a self-less, non-remunerative, non-commercial and non-political manner.

New academic session brings with it a new set of

questions which are deeper in context and are over a wider horizon. Competence of a student to face these new questions may not be discrete and disconnected from previous learning. This reminds of a phrase that "a strong attempt foundation"

castle is built on a strong foundation".

In our country April month marks beginning of new academic session in most of the schools. This beginning, nearly after One month, is followed by a long vacations of nearly Two months. It is observed that invariably schools burden students with vacations appointments which at times are spoiler of vacation thrill.

It is also seen that disconnect in prevalent Education system is so much that not only inter-academic session, even intra-academic session course portion for each subject is distinctly fragmented. This totally discounts the basic philosophy of learning that knowledge and competence is an incremental addition. In this context, pattern of IIT-JEE, a typical representative of the philosophy of testing integrated learning, needs to be applauded and adopted.

During learning in lower classes, to me, history has been a most repelling subject. But, as I grew in life, I realized that behavioral response of every individual, which changes with time, can be broadly predicted with the characteristics that one has preserved over the past, and is nothing but history of the person. So is equally true for societal behavior at large, despite exceptions being there due to individual differences. Nevertheless, changing the course does occur, but its extent, pace and direction is regulated by a hitting experience or extraneous compelling pressures; while in a normal course the extrapolation is valid. This is the reason that statistics has become an important tool in social sciences.

In present context, learning in previous session constitutes academic history, while new academic session is an incremental change, which cumulatively regulates the trends of students' progress.

In this initiative to groom competence to compete, children of elite families were not discriminated. But, it is experienced that these students, even more their parents were too possessed over-riding priorities, affecting their presence and working out assignments. Tendency of such parents, with a rare exception, to shield their children from facing the problems is a violation of the basic philosophy of education. Lack of thrill to learn, among this section of society is perhaps, due to the confidence that these children are bestowed with an assurance that their prospects, irrespective of competence. *Is it not a prevalence of an informal dynastic tradition*?

Experience with target children, from unprivileged families was quite different and is characterized as – **a)** Lack of awareness of opportunities, **b)** Lack of availability of proper guidance to gain requisite competence, **c)** Socio-economic culture not conducive in furtherance and perseverance of self-carving, and

d) Poor health conditions causing interruption in their learning. Eventually, these target children look for quick solution and easy gains which cause high drop outs.

In past there have been many social and

legislative initiatives to compensate the aforesaid retardants influencing growth of unprivileged children. It would be unfair to disclaim benefits of such initiatives, but this needs to be accepted that despite Seven decades of independence, demand of social and legislative support not only persists but has been projected as a political agenda, purely with logic of convenience.

It is never too late to introspect nation's history to determine deficiencies in efforts, if any, were in respect of -a) scale, **b**) intensity, **c**) intentions, or **d**) implementation.

It is seen that in blame game attention from core issues is diverted to success stories of other nations. This is moral dishonesty and total disregard to the fact that size, population, diversity, socio-economic disparity compounds complexities of the problem and its resolution have a major influence in each country. Nevertheless, camouflaging inability to normalize learning and growth opportunities or resort to complacence would be professional, intellectual, administrative and political dishonesty.

In this pursuit, education to all is a simplistic slogan. But, finding teachers with requisite passion, dedication, having them in a number in an astronomical number, and last but not least keeping them motivated is a much bigger challenge. This challenge compounds in context of the prevalent scenario of a race for name, fame and wealth. In such a commercial scenario it would be unrealistic to expect teachers, in pure academics, to preserve values.

We are abreast of these realities and Online Mentoring in this initiative is an endeavor to connect passionate teachers and deprived students. A systematic nonmonopolistic model has been evolved which does neither make teachers at school redundant nor it capitalizes distant learning with the video lectures. In addition it creates an environment where local teachers integreated to groom in them a competence.

This is envisaged to perpetuate the model like a chain reaction.

This integrated perspective unless implemented at right time, at a right place and in a right manner, shall succumb to systemic

aberrations. Four year's experience of mentoring target students through Chalk-N-Talk and One year through **Online Mentoring Sessions (OMS)**, was recapitulated to approach schools catering to target students and make a start in April that marks beginning of new academic session. In this new session it is targeted to integrate learning centers in a schedule which provide uniform pace of learning, as well as need based specific attention to students at each learning center. Thus it would help to optimize mentoring efforts as much as free connectivity across

A hundred times a 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. multiple nodes, a potential merit of OMS, which are otherwise wasted iteratively.

OMS being a remote effort creates a physical disconnect between mentor and students. Moreover, at schools academic schedule and multifarious activities conflict with the continuity and consistency aimed at. This aim is to regulate and reform learning process necessary for self-carving of target students and infuse in them requisite competence through a suitable environment outside school curriculum, while it complements and supplements academics. In its present form, it is relevant, because the model is yet to be received by a residential schools like Jawahar Navidaya Vidyalaya, school hostels etc

Schools in Digital India are in process of acquiring reasonable IT infrastructure and have a cluster of students. With passage of time this is expected to grow into a better data speed and capacity necessary for OMS. This is an essential technical requirement for continuity and continuity of OMS, but one does not have to wait for an ideal setup. *It is more relevant to start with whatever is available and aim at the best.*

In view of this efforts were started to motivate schools, institutes, social groups and individuals to start OMS

from April'17. This being an initiative, driven by selfless passion, neither rapid growth nor red-carpet welcome was expected. Nevertheless, few individuals have volunteered to complement the mentoring. One social group has

desired to renew association, while a new social group has prepared itself to make a start.

Three schools, Shivanand Mission School, Punjabi Bagh, Delhi, Adarsh Bal Niketan School at IIT Roorkee and Balak Mandir School at MPEB, Jabaplur were targeted. These schools, which could be approached, first being incidental while with other Two organizations I have a long and deep association. Each of them have state-of-the-art infrastructure and were required to organize and facilitate OMS, which is no big deal for the two organizations. These iconic schools had an opportunity to become torch bearer in a big reform. Despite, the flak that this selfless proposition has received from them, reflects only lack of sensitivity to the cause, among those who could make a difference. It is believed that such organizations would reconsider the proposition and respond to the need in times ahead.

envisaged that OMS, which has been It enthusiastically received by a few social initiatives and administration of Jhabua, a Tribal District of MP, would go forward to provide a platform where selected students would be subjected to intensive mentoring. The target students who tend to spill vacations, have an opportunity to bridge learning deficiencies of past and carve a way forward for new academic session. Progress and success of such selected target students would create an automatic emotional draft among lagging students and make them optimist to avail the opportunity coming to them at their door step. Incessant and sustainable efforts of OMS will, apparently, reduce the dropout rate among girls, who usually leave school due to various social problems. That would be one of the biggest achievement when girls carry forward the legacy of education.

This endeavor is translation of a philosophy into action, and is purely non-propriety. It is open to all to

consider, experience, take away, adopt or modify in a manner deemed fit by persons, social groups and or organizations so as to serve to the target students which democratizes education, with a sense of PSR, leading to a

I am impressed with the urgency of doing. Knowing is not enough, use it; being willing is not enough, do it.

better time.

Leonardo da Vinci, considered to be a man of alltime greatest intellect had said- "*I am impressed with the urgency of doing. Knowing is not enough, use it; being willing is not enough, do it*". Importance of education, competence and confidence to face problem need no further emphasis. Perpetuation of OMS to connect passionate teachers to target students needs to be addressed with this kind of urgency.

Words have no power to impress the mind without exquisite horror of the

reality

-Edgar Allan Poe

SUMMER SHOWERS

Sujata Sharma

The sun looked up this morning and smiled at me A dazzling smile that filled me with desires and glee Sunny days and summer showers are round the corner And so are mirthful days for me and my allies. The blue sky and green trees are always so warm They help us make stories and treasure them for long Stories of love and friendship of little men Stories of their buoyant dance, play, and song. Little man I am and I love to play And cherish the sprinkles of summer on my face It tickles my nose and it makes me think, What else, can make my summer tale more inspiring? Budding man I am and I take a vow To twist my summer chronicles this year round To play in the sunshine and dance in the rain And read some books and smudge some paint So the days to come will be fun, yet sane!

SUMMER VACATIONS : A NEW OPPORTUNITY SB Dhar

Morning sun smiled at me Filled desires, joy and glee Summer showers dribbling knee Reminded days of mirth you see. Blue sky and greenery so warm Helped me make the stories storm Love and friendship do no harm Play and dance make me charm. Little I am and love to play Cherish sprinkles on my way Tickling nose and saying all the day What else, can do giving fear a way. Budding I am and vowing again Twisting chronicles not in vain Singing in sunshine, dancing in rain Reading books letting summer not in-vain. Summer showers give me fun Shinning sun reminds me learn Best is to review needs to learn Never is an end on way to learn.



She has about 15 years of work experience including ITO sector and education sector. During my ITO career, she was a voice and accent trainer. For the last 5 years, she was teaching English, elocution, and dramatics in an ICSE board school in Bangalore. Her love of reading and writing that she has nestled inside for so many years, she has given up on regular job profile, and started working as freelance writer, of a book and also developing content for a Banglore based company, Textmercato, Writing short poems is a hobby that she has nurtured since childhood.

E-mail: sharma.sujata84@gmail.com

TEACHER vs GURU

Umesh Kulkarni

- 1. A **teacher** takes responsibility for your growth. A **guru** makes responsible for growth
- 2. A **teacher** gives you do not have and require. A **guru** takes away things you have and do not require.
- 3. A **teacher** answers your questions. A **guru** questions your answer.
- 4. A **teacher** requires obedience and discipline from pupil. A **guru** requires trust and humility from pupil.
- 5. A **teacher** clothes you and prepares you for the outer journey. A **guru** de-clothes you and prepares for the inner journey.
- 6. A **teacher** is a guide on the path. A **guru** is a pointer on the way.
- 7. A **teacher** sends you on the road to success. A **guru** sends on road to freedom.

- 8. A **teacher** explains the world and its nature to you. A **guru** explains yourself and your nature to you.
- 9. A **teacher** gives you knowledge and boosts your ego. A **guru** takes away your knowledge and punctures your ego.
- 10. A **teacher** instructs you. A **guru** constructs you.
- 11. A **teacher** sharpens your mind. A **guru** touches your spirit.
- 12. A **teacher** instructs you on how to solve the problem. A **guru** shows you how to resolve issues.
- 13. A **teacher** is a systematic thinker. A **guru** is lateral thinker.
- 14. One can always find a **teacher**. A **guru** has to find and accept you.
- 15. A **teacher** leads you by hand. A **guru** leads you by example.
- When teacher finishes with you, you celebrate.
 When guru finishes with you, life celebrates.

Let us honour both **teacher** and **guru** for being what we are.



Formerly Professor and Head - Project Engineering and Management at National Institute of Construction Management and Research at (NICMAR), Pune. He is BE (Mech) and MBA. He retired as General Manager from BHEL Bhopal and very active in professional dissemination.

E-mail ID: umesh.manisha@gmail.com

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Let us remember: One book, one pen, one child, and one teacher

can change the world

- Malala Yousafzai

Summertime is always the best of what might be

- Charles Bowden

Rashmi S. Mehta

BUILDING ACITVITIES BEYOND CURRICULUM

Teaching and learning are complex and multidimensional processes which involve continuous engagement of both, the learner and the teachers. It results in broadening of the mental faculties of learners and the teachers. It results in broadening of the mental faculties of learners as well as adaption of a set of important skills to widen intellectual horizon.

What are the attributes of a good teacher, Is it primarily providing knowledge? – Major knowledge of the subject matter is not enough, it is their capacity to formulate the instructions and teaching in such a way that make the students to learn and understand on their own and become independent thinkers.

Human beings are gifted naturally to be passionate, curious and intrigued. They try to connect the dots, fixed symmetries and patterns to establish the logic and sense in their experiences and happenings. Successful teachers capitalize on the students' interests and curiosity while designing the instructions or plan the lessons. They are able to feed that curiosity and satiate/facilitate the thirst. It is also very important to sustain the motivation level of learners as motivation is key to the success.

Disciplines such as science and mathematics when taught and learnt with passion and commitment go a long way in building the capacities of learners. Effective instructional strategies in these subjects foster the independent thinking, passion to succeed and motivation to work hard. Students pursuing these subjects sincerely and seriously not only succeed in academic achievements but tend to have very important set of skills, which play very crucial role in shaping their career choices and decision making.

These skills can be summarized as follows -

- Initiative and motivation,
- Analytical and critical thinking,

- Creativity and innovation,
- Reasoning and problem solving.

Initiative and Motivation: From a long term perspective, in order to carry out tasks diligently high level of self-motivation is essential. Generally, initiatives are taken by the individuals who are selfmotivated and ready to take challenges. Such people create unique position for themselves in organization as well as in the society.

Analytical and Critical Thinking: Word is passing through the era of ever changing information and data. Processing and assimilating information requires analytical and critical thinking. People endowed with these abilities perceive data, information and situations in many different dimensions and multiple views. They have proficiency in comparing, contrasting, evaluating, synthesizing and applying information with altogether different perspective which requires high level of competence and leads to growth.

Creativity and Innovation: Creativity is a vital outlet that inspires the individuals to innovate, excel and accomplish the task in hand in most efficient and 'out of box' approach. Creativity is manifestation of individuals' domain of thinking and it is unique for each individual. It is an important skill, the individual possess in this era of continuous changes in technology and innovation where roles demand continuous innovations and upgrades.

Reasoning and Problem Solving: These abilities and skills to understand, prioritise the complex situations, in depth and in a structured approach, to solve it goes a long a way. What is there in future, in store, what kind of complex situation arise cannot be perceived in present. Success of individuals depend on their capabilities to tackle and bring out unique, effective solution. Problem solvers are never Page **14** of 45

threatened by the level of difficulties and tend to be people with independent thinking f high caliber.

In short these skills are invaluable because they allow people to deal with varieties of problems in their professional and personal lives. They get empowered to make effective level headed decisions to bring success and balance in their lives.



Author is an educationist having an experience of traching Physics for more than 35 years. She is Postgraduate in Physics from Banaras Hindu University, was principal of a reputed Secondary and Higher Secondary School for more than 9 years at Vadodra. An avid reader having multiple interests

E-mail ID: <u>rashmi.s.mehta@gmail.com</u>

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Learning is not the product of teaching.

Learning is the product of the activities of learners

- John Holt

A dream does not become reality through magic; it takes sweat, determination and hard work

Colin Powell

A wise man will make more opportunities than he finds

- Francis Bacon

To live only for some future goal is shallow. It's the sides of the mountain that sustain life, not the top

Robert M Pirsig

MAKING INDIA A SPORTING NATION

Aarti Sharma

Sports is definitely one of the supreme creations of mankind due to its enormous outreach, unmatched popularity and strong base of positive values. It's also a dominant tool that breaks down all the barriers and divisions and helps us feel good about ourselves, both physically and mentally.

Sports is quite beneficial for children and youngsters alike. By playing sports children develop many skills and aptitude especially team spirit. They learn that the team efforts surpass individual accomplishments—that by working together as part of a group with a common goal, things can be accomplished that otherwise would be out of the reach of individuals.

Edusports i.e., sports education- a dynamic discipline : Need for coining this term arises because sports in itself comprehensive field of learning. Sports education is necessary as a sound mind resides only in a sound and healthy body and such a body type is not possible without sports. Sports education helps the children and the youth in enhancement of physical, moral and mental development skills. Besides, there are other positive attributes which reveal the true magnificence of sports.

Edusports encourages dealing with success and failure. Children can learn how to be proud of their successes without demeaning their opponents and without letting an attitude of superiority drive their feelings toward their opponents. Youngsters can also learn how to deal with failure—not winning the competition or accomplishing particular goals. They can be taught that any failure is just a temporary setback from which lessons can be learned in order to improve and have a better chance of success next time.

Sportsmanship helps in setting both individual and team goals and then striving for those goals by drawing a plan of action to achieve them. Likewise in life, youngsters are more likely to succeed if they are setting goals in school and other areas of lives. Sports education along with the academics ensures complete mental, moral and physical development of the students. **India's Demography and potential for sports :** With over 1.3 billion people, India is the second-most populous country in the world having more than 50% of its population below the age of 25 and more than 65% below the age of 35. Given this rich demographic dividend of enormous population of youth, there is an immense potential for developing sporting talent in the country.

Educational institutions have a lead role to play in nurturing this sports potential as they are the place where children and youth spend most of their active working hours. Theirs is the primary responsibility of embedding passion and commitment in the child towards sports right from the nascent stage which has been also been emphasized by various Education Boards from time to time.

Current Approach of education system towards sports : Against the envisioned role of the educational institutions, ground reality is starkly different. Educational institutions remain largely unconcerned towards sports as it has not been given due importance and recognition in the curriculum which places thrust only on academics for the development of the child.

Besides, a regressive societal and parental mindset which treats sports as an unnecessary burden impacting academics is also responsible for apathy towards sports. Due to these combined factors, no efforts are made in inculcating spirit of sports in the children. Both educationists and society at large have failed to realize that an education system based merely on scholastics cannot ensure all round development of the child.

Overall outcome of rejection of sports and sole focus on academics is the development of a young generation which, though professionally qualified, has a weak body and poor physique.

Laying the foundation of sports : Although current education system has sports as a compulsory subject. But it is yet to be given the seriousness and attention that it deserves. There is an imperative need to change this approach of negligence and indifference towards sports and imparting Sports education in the schools and colleges with fair amount of sincerity. In schools, sufficient amount of time should be devoted for sports. For that our sports should be taken to classrooms from the moment a child enters the education system i.e., at the kindergarten stage itself.

Every school should have adequate facilities for sports such as full-time coaches to train the budding talent, playgrounds as well as adequate training equipment. Teachers must make conscious efforts in spotting and promoting good sportspersons in schools and colleges. By providing adequate infrastructure and facilities for students to practice, many of them can even qualify for world competitions. Additionally, schools can also have designated areas for various sports to help children develop for promoting traditional team sports which are gaining popularity at international level such Kabbadi. as etc However, providing adequate infrastructure is not easy. This constraint, however, can be overcome by commitment and money, not just from educational institutions, but also from parents and other stakeholders. Crowd funding should be explored by the educational institutions in case they are facing shortage of funds in developing sports infrastructure.

Employment prospects in sports : Sports, which was traditionally considered a hobby especially in India, is now being taken seriously as a career option by the aspiring youth. It's just not cricket which is a rage among them. They are opting for various other sports such as wrestling, badminton, boxing, shooting, athletics, archery, Formula 1 racing etc. These are the fields where the country has been consistently giving medal winning performance in various international level competitions such as World

Championships, Asiad Games, commonwealth games, Olympic games, etc Professional leagues for various sports such as badminton, hockey, kabaddi, etc are also increasingly becoming popular. Educational institutions should take cue from the sports calendar of the country which now boasts of multifarious sporting events and earnestly try to develop some of the fields of sports in their respective institutions.

Besides games, there are many other areas that are gaining in popularity within the ambit of sports such as medicine, sports management, physiotherapy, clinics, fitness experts, sports nutrition etc. Schools and colleges are also encouraging sports among students.

Conclusion : It's high time that Educational institutions woke up to the potential, merits and opportunity in sports and encourage it as a field of study and career option to tap the vast budding potential the way other countries are doing. They need to have a sports policy and a sustained plan of action to implement it so as to encourage the participation of children into sports. This also requires shift in societal and parental approach which has never given sports its due recognition.

All three stakeholders should work hard to ensure that ample opportunities and facilities are provided to children to engage in multiple sports of their choice during their formative years itself so that they can also reckon it as a career option in future. The time to act and open that door of opportunity for children in this dynamic field should no longer be delayed.



Author is Senior Audit Officer working with the office of Comptroller & Auditor General of India. She is a regular writer on issues of diverse nature having impact on education, health, environment, and social psychology and dynamics. **E-mail ID:** aartiissaro4@gmail.com

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Sports is the toy department of human life.

- Howard Cosell

Women are the real architecture of society.

- Harriet B Stowe

CONTRIBUTION OF SOCIETY IN EDUCATION FOR WOMEN

Shipla Bhave

Education, a tool for self-empowerment. It is very significant for every child irrespective of the sex. In our country basic education is one of the fundamental rights, but even then the scenario, with respect to girl's education, is very dismal. An African proverb says, "*If we educate a boy, we educate one person. If we educate a girl, we educate a family – and a whole nation.*"

Female education is more imperative than male education, because:

- 1. An educated girl carries the vitality of education to next generations.
- 2. Cases of social crime against women would drop, as they become more alert and confident.
- 3. Socio-economic parameters of country would improve.
- 4. IMR (infant mortality rate) and MMR (maternal mortality rate) would decrease.
- 5. Women can play a dynamic role in politics and shaping the country's vision.

Contributions that a society can play in Girls' education are -

- Encouraging, motivating and more *importantly supporting girls studying*.
- Guaranteeing proximity between school and home.

- Assuring Toilet facilities in schools and on the way.
- Creating an environment in which mother gets a prominent role to play and come forward in support of her daughter's education.
- Increasing number of female teachers.
- Ensuring that curriculum is not gender biased.
- Taking care of gender budgeting.
- Awarding stipends and scholarships to compensate families for the loss of girls' household labor.
- Allowing flexible school hours so that they may help at home and then attend classes.
- Providing early childhood care so that they are capable of enhancing their self-esteem.
- Compelling parents for giving priority to daughter's education over her marriage.

Intellectually, girls have a competence comparable to their male counterparts; in addition their strength of emotional bondage which forms pedestal of a sound family, society and nation. When they are given an opportunity, they can do everything and anything from running a country to successfully completing space mission. Let us build such a society that respects inseparable and indispensable position of women in making of a society; after all society means we the people of India.



She hails from Bhopal, MP. She is M. Phil. (Sociology), with an experience of 5 Yrs of working in an NGO as Analyst. Currently as a home maker since last 14 years, she pursues her passion of sociological analysis of contemporary issues and socio-economic vision. Presently she is based at Delhi.

E-mail ID: shilpa2078@yahoo.in

Japan: Education System

Vaibhav Joshi

Japan is called the land of rising sun. The kanji script that makes up Japan name ($\exists \Rightarrow$) means "sun origin" and it can be read as ni (\exists) meaning "sun" and hon (\ddagger) meaning "origin". Living and working in Japan is a completely different experience. In my close to 8 months in Japan, I have observed and experienced Japanese way of life. Japanese people are polite, well mannered and hard working. Good habits and discipline are the key aspects. Be it travelling in metro trains, where everyone is silent and avoids talking to each other/on phone, or working in office, where people come on accurate time and work diligently. These good manners are probably the result of their education system.

In Japan, people take their education very seriously. Japan education system basically consists of six years of elementary school, three years of junior high school, three years of senior high school and four years of University. The schools are started in April and end in March the following year. The curriculum and course structure is same across Japan. Most schools have 10 weeks of vacations, which is less when it is compared with American or European schools. For the vacations, students are given homework to study independently and to utilize their time effectively. Some schools offer swimming and sports activities during summer breaks.



Students use public transport as a means to go to school. However, elementary or junior high school students go by walk or are dropped by parents to school. The school timings are from 9:00am to 3:30pm having 1 hour periods with lunch and 20 minutes morning break.

When students reach school, they wear indoor slippers - "Uwabaki" so as to avoid bring dirty shoes from outside in the classroom where they have to study and spend their entire day. These slippers are white in color and have different colored stripes (yellow, green, red, blue, white) for students in different grades. Yellow hat is to be worn when walking to school so that parents and teachers can see them from cars and buses. During physical education, the dressing is different, students wear red hats, white shirt and black shorts. In a way, different uniform teaches students to wear formal clothes in formal situations and casual clothes in informal situations.

Most schools offer food to their students and are taught to serve/eat in cafeteria or in classroom with the teacher. After lunch time, students clean their classroom. There are no janitors in school. Students use brooms, make a team of 4-5 people and clean toilets, floors, tables, chairs and trash the garbage in the dustbin.



Every student has a school issued journal that they are required to write on daily basis. In this journal, students are supposed to write their activities starting from waking up, to watching TV, playing games, study, travel etc. Teachers check these journals on daily basis to understand student behavior and state of mind. For the last ten minutes of every day, students are given a quiet time for self-reflection in which they put their head down and think about the day spent and how the remaining day is to be spent.

To summarize, Japan education system focuses on having good habits and discipline to achieve life goals. Doing simple things like respecting people privacy in metro trains, being punctual, being process oriented and systemic goes a long way. No wonder Japanese electronic products are considered to be one of the best system. in the world as a result of their strong education



Author is, a young enthusiastic professional, based out of Yokohama (Japan), a twin city of Tokyo. He has done engineering in Information Technology (IT) from Jabalpur Engineering College, Jabalpur. He is working in automotive electronics area. His hobbies include sports and music.

E-mail ID: vaibhav1284@gmail.com

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GROWING WITH CONCEPTS

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

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

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

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

This e-Bulletin covers – a) <u>Mathematics</u>, b) <u>Physics</u>, and c) <u>Chemistry</u>. 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, representative problems from contemporary text books and Question papers from various competitive examinations, it is contemplated to come up with solutions of different type of questions as a dynamic exercise to catalyse the conceptual thought process.

This column in next Supplementary e-Bulletin due on 1st April'17 shall contain **Progressions and Series** in Mathematics, **Waves and Motions** –**PartIII** containing to Light Waves and Geomretrical Optics in Physics and **Chemical Thermodynamics** in Chemistry.

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GROWING WITH CONCEPTS - Mathematics

PERMUTATIONS AND COMBINATIONS

The study of Permutations and Combinations is concerned with determination of the number of different ways of arrangements and selections of objects out of a given number of objects, without actually listing them.

Example:

If there are two things A and B, they can be arranged as AB or BA i.e. at first place A comes and at second place B comes, or in other case B comes at first place and A comes at second place.

It shows that two possibilities exist for these arrangements.

If we are to select these A and B at a time, then we can have any one of these arrangements i.e. only one way of selection is there.

Arrangements are called *Permutations* and selections are called *Combinations*. The number of arrangements is always more than the number of combinations.

FUNDAMENTAL THEOREM

If one operation can be performed in m ways, and another in n ways then the number of ways the two operations can be performed is $(m \times n)$.

Permutation

The arrangement of different (distinct) objects in a particular order is called Permutation.

Examples:

- (a) If there are 3 different letters *a,b,c* and they are to be put in a row, then they can be put like: *abc, or acb, or bac, or bca, or cab, or cba (i.e. 6 ways)*
- (b) The number of permutations for n things

taken *r* at a time is
$${}^{n}P_{r} = \frac{n!}{(n-r)!}$$

MULTIPLICATION THEOREM

If an operation can be performed in m ways and another in n ways, then the two operations in succession can be performed in $m \times n$ ways. Example: If a person can go by bus from Delhi to Gurgaon in three ways and from Gurgaon to Faridabad in two ways, then he can go to Faridabad via Gurgaon in 3 x 2 ways.

ADDITION THEOREM

If an operation can be performed in m ways and another independent operation can be performed in n ways, then either of the two can be performed in (m+n) ways.

Example:

If a person can go from Delhi to Ghaziabad in 2 ways by bus routes, 3 ways by metro routes and 1 way by rail route then he can reach Ghaziabad by either route in 2+3+1 ways.

Example:

Find the number of words, with or without meaning, that can be formed with the letters of the word CHALK.

Solution:

The word CHALK contains 5 letters, all different. Therefore, the number of words formed with or without meaning taking all together = 5!=5.4.3.2.1=120

Example:

Find the number of word, with or without meaning that can be formed with the letters of the word IITIAN.

Solution:

The word IITIAN contains not all different letters, but 3 I, 1A, 1N and 1T.

When the letters occur more than once in a word, we divide the factorial of the number of all letters by the factorial of the numbers repeating the letters. Hence

the number of words =
$$\frac{6!}{3 \times 1 \times 1 \times 1!} = 120$$

Example:

How many different words can be formed with the letters of the word SARITA such that the vowels are always together?

Solution:

The grouping of the letters will be S, R, T, (AAI).

Prof. SB DHAR

The letters AAI will be always together in the group

in $\frac{3!}{2 \times 1!} = 3$. The four letters S,R,T,(AAI) will be arranged in 4!=24. So the total ways of arrangements= $24 \times 3=72$.

Example:

Find the number of permutations of the letters of the word REMAINS such that the vowels always occur in odd places.

Solution:

REMAINS has seven letters, out of which E, A, I (three) are vowels and R, M, N, S (four) are consonants.

(1) (2) (3) (4) (5) (6) (7)

Vowel are to take place at (1), (3), (5), (7).

And at the rest places the consonants will appear.

3 vowels can be put in 4 different places in ${}^{4}P_{3}$ ways and rest 4 places can be filled by 4 different letters in

 ${}^{4}P_{4}$ ways. Hence the total number of ways = ${}^{4}P_{3} \times {}^{4}P_{4}$

Combination

The arrangements of different things without keeping a particular order in mind is called Combination.

Examples:

(a) For three letters *a,b,c*, the number of combinations for all together will be 1 (i.e. abc).

taken r at a time=
$${}^{n}C_{r} = \frac{n!}{r!(n-r)!}$$
.

Example:

In how many ways can a committee of 1 man and 3 women be formed from a group of 6 men and 5 women?

Solution:

1 man can be selected from 6 men in ${}^{6}C_{1}$ ways and 3 women from 5 women in ${}^{5}C_{3}$. So the total number of ways= ${}^{6}C_{1} \times {}^{5}C_{3}$.

Example:

There is a set of 5 black balls and 3 red balls. Selections of 5 balls are to be made such that at least 3 of them are black balls. Find the number of selections. Solution:

There may be following possibilities:

(a) 3B, and 2R or (b) 4B, and 1R or

(c) 5B, and oR

Hence the total selections

$$= {}^{3}C_{3} \times {}^{3}C_{2} + {}^{3}C_{4} \times {}^{3}C_{1} + {}^{3}C_{5} \times {}^{3}C_{0}$$

Properties to be memorized

(1) Factorial n is written as n!

(2)
$$n!=n(n-1)(n-2)(n-3).....3.2.1$$

(3) 0! = 1 (assumption)

(4)
$$\frac{1}{(-n)!} = 0$$

- (5) Factorial of proper fraction or negative integer is not defined.
- (6) If p is a prime number, n is a positive integer, then the greatest integer amongst 1,2,3,...,(n-1),n which is divisible by p is <a>[n]p
 p, where [.] represents the greatest integer less than or equal to n/p.
- (7) Greatest exponent of 3 in 180!, dividing it completely is calculated by $\left[\frac{180}{3}\right] + \left[\frac{180}{3^2}\right] + \left[\frac{180}{3^3}\right] + \left[\frac{180}{3^4}\right] + \left[\frac{180}{3^5}\right] + \dots$ $= 60 + 20 + 6 + 2 + 1 + 0 \dots 0 = 89.$
- (8) Exponent of 2 in 20.19.18....12.11= $\frac{20!}{10!}$ = Exponent of 2 in 20!- Exponent of 2 in 10!=18-8=10
- (9) Number of zeros at the end of (60!)= Exponent of 10 in (60!)= min {E₂ (60!).E₅(60!)}=E₅(60!)=14
- (10) One- one mapping of a finite set A onto itelf is also called a permutation of A. Hence total number of permutations of n membered set is = n!

- (11) ${}^{n}P_{r}$ represents the number of arrangements of r distinct things out of n distinct things.
- (12) ${}^{n}P_{r} = \frac{n!}{(n-r)!}$ where n is a natural number and $0 \le r \le n$.
- (13) ${}^{n}P_{r}$ is always a natural number.
- (14) $r.^{n-1}P_{r-1}$ represents the number of permutations of n different things taken r at a time, when one particular thing is always included.
- (15) $\frac{r!}{(r-p)!} P_{r-p}$ represents the number of permutations of n different things taken r at a time, when p particular things are always included.
- (16) $p![r-(p-1)]^{n-p}P_{r-p}$ represents the number of permutations of n different things taken r at a time, when p particular things are always together.
- (17) ${}^{n-p}P_r$ represents number of permutations of n different things, taken r at a time, when p particular things are not taken.
- (18) p!(n-p+1)! represents the number of permutations of n different things taken all at a time, when p particular things always occur together.
- (19) n![m!(n-m+1)!] represents the number of permutations of n different things, taken all at a time, when m particular things never occur together.
- (20) ${}^{n}C_{r}$ represents the number of selections of r distinct things out of n distinct things.

(21)
$${}^{n}C_{r} = \frac{n!}{r!(n-r)!}$$
 where n is natural number and $0 \le r \le n$.

- (22) ${}^{n}C_{r} + {}^{n}C_{r+1} = {}^{n+1}C_{r+1}$ (Pascal Law)
- (23) ${}^{n}C_{r} = {}^{n}C_{n-r}$ (Complementary Law)
- (24) If ${}^{n}C_{r} = {}^{n}C_{s}$ then either r = s or r + s = n.

(25)
$${}^{n}C_{r}$$
 is greatest when $r = \frac{n}{2}$, if n is even; $r = \frac{n+1}{2}$

or
$$\frac{n-1}{2}$$
 if n is odd.

- (26) Number of combinations of n distinct things taken r at a time, when k particular things always occur is ${}^{n-k}C_{r-k}$. $0 \le k \le r$
- (27) Number of combinations of n distinct things taken r at a time, when k particular things never occur is ${}^{n-k}C_r . 1 \le k \le r$
- (28) Number of total selections of one or more things from n distinct things is ${}^{n}C_{1} + {}^{n}C_{2} + {}^{n}C_{3} + \dots + {}^{n}C_{n} = 2^{n} - 1.$
- (29) Number of permutations of n things, taken all at a time, of which p are of one kind and q are of another kind = $\frac{n!}{p! \cdot q!}$.
- (30) Number of permutations of n things, taken all at a time, of which p₁ are of one kind, p₂ are of second kind, p₃ are of third kind, and so on.... p_r are of rth kind, such that p₁+p₂+p₃+...p_r = n is <u>n!</u>

$$p_1!.p_2!.p_3!...p_r!$$

(31) Number of permutations of n things, of which p are of one kind, q are of another kind and rest all

are distinct is given by
$$\frac{n!}{p!.q!}$$

(32) If r things are to be arranged allowing repetition. Assume p₁, p₂, p₃,..., p_r to be integers such that the first thing occurs exactly p₁ times, the second occurs exactly p₂ times, etc then the total number of Permutations of these r things is

given by
$$\frac{(p_1 + p_2 + ... p_r)!}{p_1! . p_2! p_r!}$$
.

(33) Number of circular permutations of n distinct things is (n-1)!. When the things are distinct, the arrangements in clock-wise and anti-clockwise orders are taken into account.

Note : If n persons are arranged in a straight line, there are n! different ways in which this can be done. If they are placed round a circular table, each arrangement will be repeated n times, so there are (n-1)! different arrangements. Or

We can regard any one person as 'head' and place (n-1) persons in (n-1)! different ways i.e. the number of ways of circular permutations of n different persons taken all at a time is (n-1)!.

- (34)Number of circular permutations of n things like beads, flowers etc where distinction is not possible is $\frac{(n-1)!}{2}$. When the things are not distinct, the arrangements in clock wise and anti-clockwise orders are not taken in account, they are considered to be same.
- (35) Number of circular permutations of n different things taken r at a time is $\frac{{}^{n}P_{r}}{r}$ when clockwise is different from the anticlockwise arrangement.
- (36) Number of circular permutations of n different things taken r at a time is $\frac{{}^{n}P_{r}}{2r}$ when clockwise

and anticlockwise are not different but considered same.

- (37) n non-concurrent and non-parallel lines cut in ${}^{n}C_{2}$ points.
- (38) If n points are there, out of which no three are collinear, then the number of lines= ${}^{n}C_{2}$.
- (39) If n points are there, out of which m are collinear, then the number of lines= ${}^{n}C_{2} {}^{m}C_{2} + 1$ as *m* points form one line only.
- (40) In a polygon of n sides out of which no three points are collinear, the number of diagonals is ${}^{n}C_{2} n$.
- (41) Number of triangles formed with n points out of which no three are collinear is ${}^{n}C_{3}$.
- (42) Number of triangles formed with n points out of which m points are collinear is ${}^{n}C_{3} {}^{m}C_{3}$.
- (43) Number of triangles formed with n points when none of the side is common to the side of the polygon is ${}^{n}C_{3} - {}^{n}C_{1} - {}^{n}C_{1}$. Explanation: (Total number of triangles from all n vertices taking 3 at a time) – (total number of triangles whose two sides are the consecutive sides of the polygon) – (total number of triangles whose only one side is the side of the polygon). Or, when no side of the triangle is the side of the polygon is formed by taking alternate vertices of the polygon.
- (44) Number of parallelograms with two sets of lines one containing m lines and the other containing n lines is ${}^{m}C_{2} \times {}^{n}C_{2}$.
- (45) Number of squares in two system of parallel lines one containing m lines and another containing n lines, perpendicular to each other is

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$$\sum_{r=1}^{m-1} (m-r)(n-r); (m < n)$$
 Note: In chess
board m = n = 9.

- (46) (n!+1) is not divisible by any number between 2 and n.
- (47) Number of hand-shakes by n persons = ${}^{n}C_{2}$
- (48) Number of ways of selecting r things out of n identical things is 1.
- (49) Number of ways of selecting zero or more i.e. at least one thing from a group of n identical things is (n+1).
- (50) Number of ways of selecting of some or all out of (p+q+r) things out of which p are alike, q are of second kind and rest are of third kind is [(p+1)(q+1)(r+1)]-1.
- (51) Number of ways of selecting one or more things from p identical things of one kind, q identical things of second kind, r identical things of third kind and n different things is $(p+1)(q+1)(r+1)2^n - 1$
- (52) The number of ways answering one or more of n questions= $2^n 1$
- (53) The number of ways of answering one or more of n questions when each question has an alternative= $3^n 1$.
- (54) The number of ways of answering all of n questions when each question has an alternative $= 2^{n}$.
- (55) If p₁, p₂, p₃,, p_k are distinct prime numbers and n₁, n₂, n₃,, n_k are positive integers, then the number of divisors of

$$A = p_1^{n_1} \cdot p_2^{n_2} \cdot p_3^{n_3} \dots \cdot p_k^{n_k},$$
 is
$$(n_1 + 1)(n_2 + 1)(n_3 + 1)\dots(n_k + 1).$$

- (56) Total number of proper divisors = $(n_1 + 1)(n_2 + 1)(n_3 + 1)...(n_k + 1) 2.$
- (57) Sum of all divisors= $(p_1^0 + p_1^1 + p_1^2 + ... + p_1^{n_1})$ $(p_2^0 + p_2^1 + p_2^2 + ... + p_2^{n_2})$ $(p_k^0 + p_k^1 + p_k^2 + ... + p_k^{n_k}).$
- (58) Number of ways in which (m+n) distinct items can be divided into two unequal groups containing m and n items = ${}^{m+n}C_m$
- (59) Number of ways in which (m+n+p) things are divided into unequal groups containing m,n,p things is ^{m+n+p}C_m×^{n+p}C_n.
- (60) Number of ways to distribute (m+n+p) things among 3 persons in groups containing m,n,p items is = (No. of ways to divide) × (No. of groups)= ^{m+n+p}C_m×^{n+p}C_n×3!.
- (61) Number of ways in which mn different things divided equally into m groups, each containing n things and the order of the groups is not important is $\left(\frac{(mn)!}{(n!)^m}\right)\frac{1}{m!}$.
- (62) Number of ways in which mn different things divided equally into m groups, each containing n things and the order of the groups is important

is
$$\left(\frac{(mn)!}{(n!)^m} \times \frac{1}{m!}\right) . m!$$
.

- (63) Number of ways of dividing n identical things among r persons, each one of whom, can receive 0,1,2, or more things is ${}^{n+r-1}C_{r-1}$. or, Number of ways of dividing n identical things into r groups, if blank groups are allowed is ${}^{n+r-1}C_{r-1}$.
- (64) Number of ways of dividing n identical things among r persons, each one of whom, can receive at least one thing is ${}^{n-1}C_{r-1}$. or,

Number of ways of dividing n identical things into r groups, if blank groups are not allowed is ${}^{n-1}C_{r-1}$.

- (65) Number of ways in which n identical things can be divided into r groups so that no group contains less than m things and more than k (m < k) is :
 Coefficient of xⁿ in the expansion of (x^m+x⁺¹+...+x^k)^r.
- (66) If n distinct things are arranged in a row, then the number of ways in which they can be dearranged so that none of them occupies its original place is 1 + 1 + 1 + 1 + 1 + 1 + 1 = 1

$$n!\left\{1-\frac{1}{1!}+\frac{1}{2!}-\frac{1}{3!}+\frac{1}{4!}-\ldots+(-1)^n\frac{1}{n!}\right\}.$$

- (67) If r things occupy the original places and none of the remaining (n-r) things occupies its original places, then the number of such ways is ${}^{n}C_{r}.(n-r)!\left\{1-\frac{1}{1!}+\frac{1}{2!}-..+(-1)^{n-r}\frac{1}{(n-r)!}\right\}$
- (68) Number of bijections from A to A, containing n elements, such that $f(x) \neq x$, for all $x \in A$ is,

$$n!\left\{1-\frac{1}{1!}+\frac{1}{2!}-\ldots+(-1)^n\,\frac{1}{n!}\right\}$$

(69) If $x_1 + x_2 + x_3 + x_4 + \dots + x_r = n$ where $x_1, x_2, x_3, x_4, \dots, x_r$ and n are non-negative integers, then total number of non-negative integral solutions = coefficient of x^n in $(x^o+x^1+\dots+x^n)^{-r}=(1-x)^{-r}={}^{n+r-1}C_{r-1}$.

- (70) To solve $x_1 + x_2 + x_3 + \dots + x_m \le n$ introduce a dummy variable $x_{m+1} \ge 0$ such that $x_1 + x_2 + x_3 + \dots + x_{m+1} = n$ and the solution shall be = ${}^{n+m+1-1}C_{m+1-1}$
- (71) Number of ways of getting a total of r when 2 dice are thrown is= coefficient of x^r in the expansion of $(x^1+x^2+x^3+...+x^6)^2$ when the dice

are numbered from 1 to 6. Or, (r-1) if $2 \le r \le 7$ and (13-r) if $8 \le r \le 12$.

(72) Number of ways of getting a total of r when three dice are thrown is= coefficient of x^{r} in the expansion of $(x^{1}+x^{2}+x^{3}+...+x^{6})^{3}$ when the dice are numbered from 1 to 6 Or $\frac{(r-1)(r-2)}{2}$ when $3 \le r \le 8$ and $\frac{(19-r)(20-r)}{2}$ when $13 \le r \le 18$

and 25 if
$$r = 9$$
 or 12 and 27 if $r = 10$ or 11.

- (73) Number of ways of getting a total of r in throw of n dice if they are *m*-faced = coefficient of x^r in the expansion of $(x^1+x^2+x^3+...+x^m)^n$.
- (74) Maximum number of points of intersection of n circles= ${}^{n}P_{2}$
- (75) The number of ways in which N can be resolved into two factors which are co-prime to each other is 2^{n-1} where n is the number of different factors in N.

Some solved examples:

1. There are 27 boys and 14 girls in a class. One boy and one girl are to be selected to represent the class for a function. In how many ways can the teacher make this selection?

Solution:

The teacher will have to perform two operations for this selection:

- (a) Selecting a boy from the 27 boys, and
- (b) Selecting a girl from the 14 girls.

One boy out of 27 boys can be selected in ${}^{27}C_1$ ways and one girl out of 14 girls can be selected in ${}^{14}C_1$ ways. This will be done one by one hence by the fundamental principle of counting, the required number of ways is ${}^{27}C_1 x {}^{14}C_1$.

2 If all permutations of the letters of the word AGAIN are arranged in the order as in a dictionary. What is the 49^{th} word?

Solution:

The dictionary starts with A, so let us Put A at the first place A x1, x2, x3, x4. Four letters A, G, I, N will be arranged in 4! Ways i.e. 24 ways. Next put G at the first place G, y1, y2, y3, y4. Four letters A, A, I, N will be arranged in $\frac{4!}{2 \times 1 \times 1!} = 12$ ways. Next step start with I at first place as I, z1, z2, z3, z4. Four letters A, A, G, N can be arranged in $\frac{4!}{2 \times 1 \times 1!} = 12$ ways.

The total of these arrangements is 24+12+12=48.

So the next arrangement will be the required word. It will start with N as first letter.

N, w1, w2, w3, w4. Where at second, third, fourth and fifth places will be filled by A, A, G, I as NAAGI.

3 Evaluate the number of permutations of n different things taken r at a time such that two specific things occur together.

Solution:

Two things are always together. It means, from the group of n things, 2 things are grouped as One. It means that 2 specific things are arranged in r places in (r-1) ways and those 2 things will be arranged in 2! ways i.e. 2!x (r-1) ways.

Now (n-2) things will be arranged in (r-2) places in ${}^{n-2}P_{r-2}$ ways.

So, the total number of ways is $2 (r-1) \times {}^{n-2}P_{r-2}$.

4 Find the number of signals that can be sent by 6 flags of different colours taking one or more at a time.

Solution:

Total number of ways of making signals= use of (1 flag+ 2 flags+ 3 flags+4 flags+5 flags+6 flags)

i.e.
$${}^{6}P_{1} + {}^{6}P_{2} + {}^{6}P_{3} + {}^{6}P_{4} + {}^{6}P_{5} + {}^{6}P_{6}$$

5 A man has 7 relatives, 4 of them are ladies and 3 gentlemen; his wife has 7 relatives and 3 of them are ladies and 4 gentlemen. In how many ways can they invite a dinner party of 3 ladies and 3 gentlemen so that there are 3 of man's relatives and 3 of wife's relatives?

Solution:

The possibilities may be

(a) 3 ladies from husband side and 3 gentlemen from wife side , i.e. ${}^{4}C_{3}$.

(b) 3 gentlemen from husband side and 3 ladies from wife side ie ${}^{3}C_{3}$.

(c) 2 ladies and 1 gentleman from husband side and 1 lady and 2 gentlemen from wife side i.e.(${}^{4}C_{2}, {}^{3}C_{1}$).(${}^{3}C_{1}, {}^{4}C_{2}$)

(d) 1 lady and 2 gentlemen from husband side and 2 ladies and 1 gentleman from wife side i.e.(${}^{4}C_{1}.{}^{3}C_{2}).({}^{3}C_{2}.{}^{4}C_{1})$

The total ways is the sum of all the numbers i.e. (a)+(b)+(c)+(d).

6 Two finite sets have m and n elements, the total number of subsets of the first set is 56 more than the total number of subsets of the second. Find the values of m and n.

Solution:

2^m= 56 + 2ⁿ, m=6, n=3

7 Five balls of different colours are to be placed in three boxes of different sizes. Each box can hold all five balls. In how many different ways can we place the balls so that no box remains empty?

Solution:

Obviously each box will contain at least one ball as no box is to be empty.

Two cases are possible.

Case I

 1^{st} box 1 ball; 2^{nd} box 1 ball and 3^{rd} box 3 balls.

This is possible in ${}^{5}C_{1}$. ${}^{4}C_{1}$. ${}^{3}C_{3}$. $({}^{3}C_{1})$ as in 1st box it will be any 1 ball out of 5 balls; in 2nd box out of 4 balls, any 1 will be put and in 3rd box any 3 balls from the remaining 3 balls will be put in.

Also note the box that contains 3 balls can be chosen in ${}^{3}C_{1}$ ways.

Case II

 1^{st} box 1 ball; 2^{nd} box 2 balls and 3^{rd} box 2 balls.

This will be done in ${}^{5}C_{1} {}^{4}C_{2} {}^{2}C_{2} {}^{(3}C_{2})$ ways as any 1 ball can be put in the 1st box; any 2 balls in the 2nd box and any 2 balls in the 3rd box from the remaining 2 balls.

Note the boxes that contain 2 balls can be chosen in ${}^{3}C_{2}$ ways.

The required number = sum of all the 2 cases.

8 A train going from Mumbai to Delhi at nine intermediate stations. Six persons enter the train during the journey with six different tickets of the same class. How many different sets of tickets may they have had?

Solution:

Assume Mumbai, s_1 , s_2 , s_3 , s_4 , s_5 , s_6 , s_7 , s_8 , s_9 , Delhi as all stations.

Find all possible different tickets available during the journey, i.e. at intermediate stations.

Obviously at s1, 9 different tickets will be available; at s2, 8 different tickets will be available and so on.

Total number of different tickets=9+8+...+1=45

Six different tickets will be from these 45.

Hence the required number of ways= ${}^{45}C_6$

9 Find the remainder obtained when 1! + 2! + 3! +....+ 200! Is divided by 14.

Solution:

n! is divisible by 14 if it is divisible by 2 and 7, and it is possible only when $n \ge 7$.

i.e. 7! + 8! + 9! +200! is divisible by 14.

But 1! + 2! + 3! + 4! +5! + 6! =873=14 x 62 + 5

i.e. the whole expression is when divided by 14 will leave remainder 5.

 $\begin{array}{ll} \text{10} & \text{Find the number of integral solutions for the} \\ \text{system of equations } x_1+x_2+x_3+x_4+x_5=\text{20 and } x_1+x_2=\text{15 where } x_i\geq \text{0 for } \text{ all } i=1,\,2,\,3,\,4,\,5. \end{array}$

Solution:

From the given equations

 $x_{1}+x_{2}$ = 15 \Rightarrow the number of solutions \quad = $^{15+2\text{--1}}C_{2\text{--1}}$, and

 $x_3 + x_4 + x_5 = 5 \Rightarrow$ the number of solutions = ${}^{5+3-1}C_{3-1}$

Hence the total number of solutions = product of the above twos.

11 One million people can be identified by 3 letters initials, then find the number of letters in the alphabet.

Solution:

Given $n \ge n \ge n = 10^6$

 \Rightarrow n=10² \Rightarrow n=100.

12 Find the number of negative terms of the sequence $\{x_n\} = \frac{n+4}{(n-2)} - \frac{143}{(n-2)}$.

sequence
$$\{x_n\} = \overline{(n+2)!} - \overline{4n!}$$
.

Solution:

Simplify $\{x_n\} = (4n^2 + 28n - 95)/4n!$

For negative terms, $4n^2+28n-95 < 0$ and this is possible for n=1 and 2 only hence only 2 negative terms are there.

13 Find the greatest number of points in which m straight lines and n circles can intersect.

Solution:

(i) 2 straight lines intersect in at most one point \Rightarrow m lines intersects in ${}^{m}C_{2} \times 1$ points.

(ii) 2 circles intersect in at most two points \Rightarrow n circles intersects in ${}^{n}C_{2} \times 2$ points.

(iii) a line intersects a circle in at most 2 points \Rightarrow m lines and n circles intersect in (mn) \times 2 points.

Hence the maximum number of points of intersection of m lines and n circles = sum of all above.



Dr S.B. Dhar, is **Editor of this Quartrerly e-Bulletin**. He is an eminent mentor, analyst and connoisseur of Mathematics from IIT for preparing aspirants of Competitive Examinations for Services & Admissions to different streams of study at Undergraduate and Graduate levels using formal methods of teaching shared with technological aids to keep learning at par with escalating standards of scholars and learners. He has authored numerous books – Handbook of Mathematics for IIT JEE, A Textbook on Engineering Mathematics, Reasoning Ability, Lateral Wisdom, Progress in Mathematics (series for Beginner to Class VIII), Target PSA (series for class VI to class XII) and many more. **e-Mail ID:** maths.iitk@gmail.com

Permutations and combinations are endless.

It's like a game of three-dimensional chess.

__00___

- Sherry B Jeffe

Eat food as your medicines. Otherwise you have to medicines as food. - Ratan Tata

No one saves us but ourselves.

No one can and no one may.

We ourselves must walk the path.

Buddha

Walking with a friend in dark is better than walking alone in the light

Helen Keller

CROSSWORD PUZZLE APRIL'17: PERMUTATIONS & COMBINATIONS Prof. SB. Dhar



ACROSS

- 2 An informal poll after voting
- 4 Founder father of indelible ink
- 11 Person who conducts poll at polling booth
- 13 Form of Government where people hold power
- 14 Person who appoints chief election commissioner

DOWN

- 1 None of the above option is called
- 2 Minimum age for voting
- 3 Process in which people vote
- 5 Lower house of parliament
- 6 Head of government at national level
- 7 Normal term of assembly
- 8 World's largest political party
- 9 Candidate not related to any political party
- 10 Who fights election to be voted
- 12 Form of Government in India
- 15 Term of chief election commissioner India

-00-

(Answer to this Crossword Puzzle shall be provided in Supplementary e-Bulletin Dt. 1st May'17)

GROWING WITH CONCEPTS- Physics

Waves and Motion: Part-II

Dr. Subhash Kumar Joshi

Sound Waves: Sound waves require medium for propagation, and a simple evidence of this fact is shown in

an experiment shown in figure. In this with air at atmospheric pressure in the jar, switch is closed to operate the bell, and sound of bell is heard. But, when vacuum pump is operated to evacuate air inside the jar, gradually sound of bell heard outside the jar becomes feeble. *Sound wave is basically mechanical in nature*. Parameters which regulate velocity of sound wave in solid and fluid, including gases, is elaborated in Part –I. The *longitudinal nature of sound wave* can be verified through another simplest experiment as shown in the figure. It comprises of a hollow box with one end





open and other end closed with a balloon, tightened with a rubber band. A small piece

of mirror is pasted on balloon such that a light ray through a slit creates a image on a wall. As the beating of drum starts at open end of hollow cylinder, the image starts dancing. The simple reason is the pressure waves create a vibration in diaphragm. This vibration changes position of image as per laws of reflection, to be elaborated in light waves. Beating drum sets in

longitudinal waves in the form of a pressure wave travelling through air. Velocity of sound waves in different material is shown for comparison.

Frequency of sound waves is ranges from 20 Hz to 20 kHz. Accordingly, waves below 20 Hz are called infrasonic waves and those above 20 kHz are called ultra-sonic waves.

Reflection of sound waves is a usual experience, sound of crackers or beating of drums heard coming in from a direction other than the that of source in acoustic galleries, domes etc. Reflection of sound is simplistically explained with Huygens Wave theory. A wavefront p-q approaching a reflecting surface is shown in the figure.



The wavefront on reaching the reflecting surface is in position a-b. The edge p-a takes another direction along the line 'ad', while the other edge q-b continues its unobstructed travel along line b-c, until it encounters reflecting surface. Since travel a-d and b-c are in the same medium, its velocity shall remain unchanged. After complete reflection the wavefront a-b shall take position c-d. Now, $\Delta abc \cong \Delta cda$, by RHS theorem since $\angle abc = \angle abc = 90^\circ$, diagonals 'ac' are common and 'ad'='bc' travel distance with uniform

velocity in same time. Accordingly, $\angle dac = \angle bca$ being corresponding angles, and conversely $\angle Nad = \angle N$ 'cb. The edges of wavefront remain parallel, travelling in same medium, and therefore, with application of plain geometry $\angle Nap = \angle Nad$, and $\angle N$ 'cb = $\angle N$ 'cr. This is summarized into **Laws of Reflection** as : i) Angle of incidence is equal to angle of reflection, ii) The incident wave, normal at the point of incidence and the reflected wave are in the same plane.

Reflection of mechanical waves, synonymous to sound waves at different type of boundary conditions is better explained with mathematical analysis of wave interference. Any incidence wave in an elastic medium is an energy and it continues to perpetuate until it encounter change of medium, eventually change of density. The displacement of particles of medium is mathematically represented as $y_i = A_i \sin(\omega t - k_i x - \varphi_i)$; here $k = \frac{\omega}{v_i}$,

and φ – is the phase difference. The frequency (*f*) of the wave is since decided by the source and hence $\omega = 2\pi f$ remains same. But, velocity of wave $\left(v = \sqrt{\frac{T}{\mu}}\right)$ is characteristic to mass per-unit length density (μ)of medium and tension in the string (*T*)in it. Accordingly, it is the wavelength $\lambda = \frac{v}{f}$, and not the frequency of wave that changes during propagation of wave through the change in medium. Now, it is pertinent to note that an incident wave encountering change of medium has two possibilities, **a**) transmission of wave represented by: $y_t = A_t \sin(\omega t - k_t x - \varphi_t)$ and **b**) reflection of wave represented by: $y_r = A_r \sin(\omega t - k_r x - \varphi_r)$.

At this point it is essential to introduce concept of **impedance** (**Z**), which shall be more elaborately dealt with in current electricity. $Z = \frac{\text{Force of Wave}}{\text{Velocity of Wave}} = \frac{T}{\sqrt{\frac{T}{\mu}}} = \sqrt{T\mu}$ and boundary there change of impedance.

At x = 0 the interface of the two strings where tension continues to be unaltered and hence the displacement of the particle from its mean position accordingly, $y(0_{-}, t) = y(0_{+}, t)$. This in terms of wave equation at the boundary shall be: $A_i \sin(\omega t - \varphi_i) + A_r \sin(\omega t - \varphi_r) = A_t \sin(\omega t - -\varphi_t)$. This equality necessitates that $\phi_{i+} \phi_{r} = \phi_t$, which leads to $A_i + A_r = A_t$.

Similar to collision of elastic bodies, behaviour of wave at a boundary satisfies two conditions: **a**) *Continuity of displacement* ($y_i + y_r = y_t$). *This can be represented as* $A_i = A_t + A_r$. This is in conformance with the Newton's Second Law of Motion at a boundary where no external force is coming into play, and **b**) *Conservation of energy in the elastic medium* ($E_i = E_t + E_r$). Energy of wave is expressed as $E = \frac{1}{2}Z\omega^2 A^2$.

Using these conditions and principle of interference wave equation and principle of shall be determined for the medium carrying incident wave as: $\frac{1}{2}Z_1\omega^2 A_i^2 = \frac{1}{2}Z_2\omega^2 A_t^2 + \frac{1}{2}Z_1\omega^2 A_r^2$; since reflected wave travels in the medium of incident wave and hence $Z_i = Z_r$. Accordingly, $Z_1(A_i^2 - A_r^2) = Z_2A_t^2$; $Z_1(A_i + A_r)(A_i - A_r) = Z_2A_t^2$. Combining this energy balance equation with continuity of displacement it leads to $Z_1(A_i - A_r) = Z_2A_t$, or $(A_i - A_r) = \frac{Z_2}{Z_1}A_t$. This is a case of simple simultaneous equation with two variables A_t and A_r in terms of A_i leading to $A_t = \frac{2Z_1}{Z_1 + Z_2}A_i$, and $A_r = \frac{Z_1 - Z_2}{Z_1 + Z_2}A_i$. Accordingly, different possibilities exist out of which only Two cases are being analysed to understand the phenomenon of wave reflection, and are as under:

Case 1 : $Z_2 \rightarrow \infty$; Rigid Boundary	Case 2: $Z_2 \rightarrow 0$; Boundary with Rarefied
	Medium
$A_t = 0, \ A_r = -A_i$	$A_t = 2A_i; \ A_r = A_i$
Analytical perspective: $y = A_i \sin \left[\omega \left(t - \frac{x}{v}\right)\right] - A_i \sin \left[\omega \left(t + \frac{x}{v}\right)\right]$	Analytical perspective: $y = A_i \sin \left[\omega \left(t - \frac{x}{v} \right) \right] +$
$= -2A_i \sin \frac{x}{v} \cos \omega t$ (Using	$A_i \sin\left[\omega\left(t+\frac{x}{v}\right)\right]$
trigonometric identities)	$=2A_i \cos{\frac{x}{v}} \sin \omega t$ (Using trigonometric
At boundary $(x = 0)$ displacement is zero. Negative sign indicates that resultant wave has a phase shift of 180° w r t	identities)
incident wave or conversely in $-r$ direction it is	At boundary $(x = 0)$ displacement is Doubled.
appetructive	Positive sign indicates that resultant wave is in phase
Machanian Devenantions. This hind of suffection is in	w.r.t. incident wave, it is constructive
conformance with Newton's Third I aw of Motion	Mechanics Perspective: When a pressure wave
conformatice with Newton's Third Law of Motion.	reaches free boundary, it passes by creating a
	rarefaction as a reflected wave

Magnitude of the resultant displacement is product of two components-

a) Displacement: as function position in the direction of propagation = $-2A_i \cos \frac{x}{x}$

b) Displacement as a function of ωt and is equal to $\sin \omega t$

c) These two components, together, change the combination of incident and reflected wave into a *stationary or standing wave*, where particles of medium perform SHM, but there is not transfer of energy.





Speed of Sound: Propagation of sound is in space and is unlike rectilinear motion in string, and hence it is referred to as *Speed of Sound* and not Velocity of Sound. Velocity of Sound in different typical medium are tabulated below:

Gaseous	Medium	Liquid M	ledium	Solid Medium			
Air at oºC	331 m/s	Air at o°C	1402 m/s	Aluminium	6420 m/s		
Air at 20°C	343 m/s	Air at 20°C	1482 m/s	Copper	3560 m/s		
Helium	965 m/s	Sea Water	1522 m/s	Steel	5941 m/s		
Hydrogen	1284 m/s			Granite	6000 m/s		
				Vulcanised Rubber	54 m/s		

Sound Beats: Analysis of interactions of different waves was of same frequency but with either a phase shift or travelling in opposite direction. But, two waves of different frequencies, with same magnitude when interact with each other it creates a different effect known as *Beats*, another manifestation if interference, and this too can be determined analytically and also explained graphically.



Let two signals, $y_1 = A \sin \omega_1 \left(t - \frac{x}{v}\right)$ and $y_2 = A \sin \omega_2 \left(t - \frac{x}{v}\right)$ be taken to be travelling along *x*-axis interfere with each other the resultant wave shall be $y = A \sin \omega_1 \left(t - \frac{x}{v}\right) + A \sin \omega_2 \left(t - \frac{x}{v}\right) = 2A \cos \frac{\omega_1 - \omega_2}{2} \left(t - \frac{x}{v}\right) \sin \frac{\omega_1 + \omega_2}{2} \left(t - \frac{x}{v}\right)$. This resultant wave has three distinct features: **a**) extrinsic amplitude of

> the envelop signal is 2A , b) Frequency of the envelop signal is $\frac{\omega_1 - \omega_2}{2}$, and **c)** the intrinsic signal of frequency $\frac{\omega_1 + \omega_2}{2}$ has varying amplitude. Interference of Two examples of the kind are shown in figure, one is of frequencies ω and 3ω



and other is of frequencies 4ω and 5ω . In the later example where relative frequency is small $\frac{\omega_1}{\omega_2} \rightarrow 1$ or $\frac{|\omega_1 - \omega_2|}{\omega_2} \rightarrow 0$, variation in amplitude of the signal along its cycle becomes distinct, and it causes variation loudness called

Beats. This is due to gradual variation in displacement or pressure during the cycle as the wave progresses. This superimposition principle is called **amplitude modulation** finds application in communication.

Characterization of Sound: There are certain parameters which are used to characterize sound viz. *Loudness* or *Intensity, Pitch* or *frequency, Quality* or *waveform*.

Pitch of Frequency of Sound: This helps to discriminate source if sound, viz sound of animals is of low Pitch, while male voice is of medium pitch, and female voice is of high pitch. Likewise, pitch of musical nodes and instruments are also different and help in discrimination by the listener.

Power of Sound Wave $(= 2\pi^2 \mu v A^2 v^2)$ is called intensity and, accordingly, *Reference Intensity* **of Sound** has been standardized as $I_0 =$ $10^{-12}Wm^{-2}$, and sound level (β) is expressed in **Decibel (dB)** such that $\beta = 10 \log_{10} \left(\frac{I}{I_0}\right)$. Typical sound levels are shown in the table.

Quality or Waveform: As in case of food plain or

(W-m ⁻²)	(dB)
1X10 ⁻¹²	0
1X10 ⁻¹⁰	20
1x10 ⁻⁹	30
1x10 ⁻⁷	50
1x10 ⁻⁶	60
1X10 ⁻¹	110
1	120
10	130
	Intensity (W-m ⁻²) 1x10 ⁻¹² 1x10 ⁻¹⁰ 1x10 ⁻⁹ 1x10 ⁻⁶ 1x10 ⁻¹ 1 10

Time

rice are not relished, unless they are supplemented with vegetable, dal, raita etc. Likewise, plain source having single frequency does not create an appeal. This is the reason each

musical instrument is designed to produce a mix of frequencies to create a compound waveform and musiccomposers use a mix of musical instruments to improve upon quality of their music. Quality (Waveform) of Two musical instruments Trumpet and Clarinet are



Waveform of Clarinet

waveform of Trumpet representative in nature, and similar waveforms, with a difference of degree exist for other musical instruments.

Diffraction of Sound: Propagation of sound **as** Huygens Wave theory is in the form of a spherical wavefront. This wavefrom tends to become plane as it travels away from the source and is substantiated with the principles of geometry radius of curvature $\left(=\frac{1}{r}\right) \rightarrow 0$ as $r \rightarrow \infty$. Nevertheless, wavefront changes shapes as and when it encounter obstacle. This is the reason, a person talking on one side of the wall is heard by the other

standing across the wall. Likewise, through a small hole it is possible to hear sound across a thick wall. Such bending of sound waves, which otherwise propagate radially in a straight line, is called *Diffraction*. Diffraction effect gets amplified with increase of frequency, or reduction in wavelength. Audible frequencies ranging from 20 Hz to 20 kHz its wavelength in air ranges from 16 m to 1.6 cm. Sound waves of larger wavelengths are more susceptible to diffraction. *This is more perceivable in light waves and shall be elaborated in that section to follow in a greater length*.

Musical Scale: Musical notes are defined with an Ocatve of Seven Notes as shown in the table. There are different standard notes, nevertheless, multiple of base frequencies are called scales of the notes and is pertinent to learning of music.

Acoustics: This is application of principles of sound waves to improve upon quality of audibility, which influenced by reflection of sound causing *echo*. It must have been experienced that in an empty hall, without furniture and incumbents, cause echo and reverberations. This echo gets reduced with furnishing, curtains and occupancy. Wooden furniture causes lower echo as compared to steel furniture or non-porous objects. This is the reason as to why ceiling, walls, are made of porous or perforated material and location of speakers and seating arrangements are designed and engineered, using the concepts elaborated above in a manner such that *reverberation of sound* from different reflecting surfaces is : **a**) at an

Musical Notes in Indian Music	Frequency		
सा	256 Hz		
रे	288 Hz		
ग	320 Hz		
ਸ	341.33 Hz		
Ч	384 Hz		
ध	426.33 Hz		
नी	480 Hz		
सा	512 Hz		

acceptable and **b**) uniform across the audience. Readers are welcome to raise their inquisitiveness, beyond the contents, through <u>*Contact Us*</u>.

Summary: In Part-I concepts of waves that were elaborated have been extended to theory of Sound and Light Waves. Part III of this series shall encompass Geometrical Optics. Theory of Wave and its application into sound and optics is an excellent example of integrating analytical methods into physical phenomenon, which are otherwise difficult to visualize. Nevertheless, readers are welcome to raise their inquisitiveness, beyond the contents, through <u>Contact Us</u>.

Examples, during elaborations, have been drawn from real life experiences help to build visualization and an insight into the phenomenon occurring around. Solving of problems, is an integral part of a deeper journey to make integration and application of concepts intuitive. This is absolutely true for any real life situations, which requires multi-disciplinary knowledge, in skill for evolving solution. Thus, problem solving process is more a conditioning of the thought process, rather than just learning the subject. Practice with wide range of problems is the only pre-requisite to develop proficiency and speed of problem solving, and making formulations more intuitive rather than a burden on memory, as much as overall personality of a person. References cited below provide an excellent repository of problems. Readers are welcome to pose their difficulties to solve any-problem from anywhere, but only after two attempts to solve. It is our endeavour to stand by upcoming student in their journey to become a scientist, engineer and professional, whatever they choose to be.

Looking forward, these articles are being integrated into Mentors' Manual. After completion of series of such articles on Physics, representative problems from contemporary text books and Question papers from various competitive examinations shall be drawn to come up with solutions of different type of questions as a dynamic exercise which is contemplated to catalyse the conceptual thought process.

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Author is Coordinator of this initiative Gyan-Vigyan Sarita, a non-organizational entity of copassionate persons who are dedicated to the selfless mission through **Online Mentoring** *Session (OMS)* to unprivileged children. He had his career as a power engineer, and after superannuation he did his Ph.D, from IIT Roorkee; soonafter this in 2012, he took a plunge into mentoring unprivileged children with Sarthak Prayash an NGO. The endeavour continued in different forms. Currently the thrust area, at the behest of District Administration, is School of Excellence, in Jhabua, a tribal District in MP.

e-Mail ID: subhashjoshi2107@gmail.com

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The winds and the waves are always on the side of the ablest navigators.

- Edward Gibbon

Education is the passport to the future, for tomorrow belongs to those who prepare for it today

Malcolm X

An Experomenter who does not know what he is looking for will not understand what he finds

- Claude Bernard

Life always offers second chance, it is tomorrow

Anone

It is not what we take up, but what we give up, that makes us rich.

- Henry Ward Beecher

SOLUTION TO THE PUZZLE-Mar'17: ON PROBABILITY

Prof. S.B. Dhar

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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:** \mathcal{RH}_{T} , and thus create a visibility of the concerns of this initiative. It gives them a feel that you care for them, and they are anxiously awaiting to read your contributions. We request you to please feel free to send your creation, by <u>20th of this month</u> to enable us to incorporate your contribution in next bulletin, <u>subhashjoshi2107@qmail.com</u>.

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

- > 1st Supplementary e- Bulletin of 3rd Quarterly e-Bulletin Gyan-Vigyan Sarita: 紀和 shall be brought out 1st April'17
- And this cycle monthly supplement to Quarterly e-Bulletin Gyan-Vigyan Sarita: 紀和 aimed to continue endlessly

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

GROWING WITH CONCEPTS - Chemistry

SHAPES OF ATOMIC ORBITALS

An orbital is the region of space around the nucleus within which the probability of finding an electron of given energy is maximum (about 90%). The probability at any point around the nucleus is calculated using Schrödinger wave equation and is represented by the density of the points. The shape of electron cloud thus obtained gives the shape of the orbital.

Shapes of s-orbital:- The probability of finding an electron belonging to s-orbital of any main shell is found to be identical in all directions at a given distance from the nucleus. Hence, s-orbital is spherical in shape which is symmetrical around the nucleus.

For s-orbital, azimuthal quantum number l=0. Hence, magnetic quantum number 'm' =0 i.e., it has only one value. Thus s-orbital has only one orientation. The intermediate region (a spherical shell) where the probability of finding the electron is zero is called a nodal surface or node. Thus, 2s orbital has one node within it. 3s orbital has two nodes. In general, any ns orbital has (n-1) nodes.

1s=no node, 1-1=0

2s=one node, 2-1=1

3s=two nodes, 3-1=2 1s,2s and 3s-orbital differ in their size and energy. These increase with increase in principal quantum number 'n' 1s<2s<3s



Shapes of p-orbitals:- On the basis of probability calculation, it is found that the probability of finding the p-electron is maximum in two lobes on the opposite sides of the nucleus. This gives rise to a dumb-bell shape for the p-orbital.



However, it may be noted that the probability of finding a particular p-electron is equal in both the lobes. Further, there is a plane passing through the nucleus on which the probability of finding the electron is almost zero. This is called a nodal plane. For p-orbital, l=1 hence, m=-1, 0, +1. Thus, p-orbital has three different orientations. These are designated as p_x , p_y , p_z depending upon whether the electron density is maximum along the x-axis, y-axis and z-axis respectively.



p-orbitals have directional characteristics and hence are helpful in predicting the shapes of molecules. Further, it may be mentioned that every energy level with principal quantum number greater than 1 has three p-orbitals. As principal quantum number increases, these p-orbitals become larger in size and have higher energies. However, the three p-orbitals belonging to a particular energy shell have equal energies and are called degenerate orbitals. Further, 2p has no node, 3p has one node, 4p has two nodes and so on.

Shapes of d-orbitals- For d-orbital, l=2. Hence, m=-2, -1, 0, +1, +2. There are five d-orbitals in each of the energy levels from n=3 onwards. On the basis of probability calculations, their shapes are shown in fig.

Kumud Bala



These are known as d_{xy} , d_{xz} , d_{yz} , $d_{x^2-y^2}$, d_{z^2} . The five dorbitals possess equal energies and differ only in their orientation. The three of the d-orbitals (d_{xy} , d_{xz} , d_{yz}) have four lobes of high electron density lying in xy, xz, yz planes. These lobes project in between the coordinate axes. Fourth d-orbital ($d_{x^2-y^2}$) has four lobes of high electron density in xy plane along xand y- axis. The fifth d-orbital (d_{z2}) has only two lobes lying along the z-axis with a ring of high electron density around the nucleus in xy plane. 3dorbital has no node while 4d and 5d have one and two nodes. Number of node in any orbital = n-l-1

REMEMBER- 1. The formula (n-l-1) is for finding the number of spherical/radial nodes only. It is interesting to point out that whereas s-orbitals have spherical nodes only, p and d-orbitals have spherical as well as planar nodes. For example, 2p orbital has one nodal plane passing through the nucleus at the origin. Similarly, d-orbitals have two nodal planes. The number of spherical nodes depends upon the value of 'n'.

Thus, the above results may be generalized as follows:

Number of spherical/radial nodes in any orbital = n-l-1

Number of planar nodes in any orbital=l

 \therefore Total number of nodes in any orbital=n-l. Note that all d-orbital have two nodal planes expect d_{z_2} which has no nodal plane.

2. Positive and negative signs shown inside the lobes of p and d-orbitals are for the wave function ψ and have nothing to do with the positive or negative

charge. However, the probability density, ψ^2 , is always positive.

3. The opposite lobes of p-orbitals have different signs (one +ve, the other –ve) but opposite lobes of d-orbitals have the same sign (two opposite lobes have +ve sign while the other two opposite lobes have –ve sign).

ELECTRONIC CONFIGURATION OF **ELEMENTS** – The distribution of electrons into different shells, subshells and orbitals of an atom is called its electronic configuration. Electronic configuration of any orbital can be simply represented by the notation, nl^x where n= number of the main or principal shell, l= symbol of the subshell or orbital (s, p, d, f) x= number of electrons present in that orbital. Thus, $4p^1$ means that the porbital of the 4^{th} main shell contains one electron. The filling of electrons into various orbitals in the ground state is determined by the following rules.

1. Aufbau Principle – The word 'aufbau 'in German means 'building up'. The building up of orbitals means the filling up of orbitals with electrons. The principle states as follow : In the ground state of the atoms, the orbitals are filled in order of their increasing energies. In other words, electrons first occupy the lowest- energy orbital available to them and enter into higher energy orbitals only when the lower energy orbitals are filled. The order in which the orbital are filled is as follow:

1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, 7p,

This order may be remembered by using method given in fig. starting from the top, the direction of the arrows gives the order of filling of orbitals. The order of increasing energies of the various orbitals can be calculated on the basis of Bohr Bury's rule (n+1), sum of the values of principal

quantum number (n) and the azimuthal quantum number (l). According to this rule- In neutral isolated atom, the lower the value of (n + l) for an orbital, lower is its energy. However, if the two different types of orbitals have the same value of (n + l), the orbital with lower value of n has lower energy.

To illustrate the (n + l) rule, different example are given in the table

TPYE OF	VALU	VALU	VALU	RELATIV
ORBITA	E OF n	E OF l	E OF n	Е
L			+ 1	ENERGY
18	1	0	1+0 =1	Lowest
				energy
25	2	0	2 +	Higher
			0=2	energy
				than 1s
				orbital
2p	2	1	2+1=3	
38	3	0	3+0=3	2p
				orbitals
				(n=2)
				lower
				energy
				than 2s
				(n=3)
				orbital
3p	3	1	3+1=4	
48	4	0	4+0=4	3р
				orbitals
				(n=3)
				have
				lower
				energy
				than 4s
				(n=4)
ad	0	0	010-5	orbital
30	3	2	3+2=5	ad orbital
4P	4	1	4+1=5	(n-2)
				have
				lower
				energy
				than ⊿n
				(n=4)
				orbital

2. Pauli Exclusion Principle- An orbital can accommodate maximum of two electrons and these two must have opposite spins. This means that an orbital can have 0,1 and 2 electrons. For

example, two electrons in an orbital can be represented by (i) and not by (ii).



Correct-electrons have opposite spins ----- (i)

15	2 <i>s</i>		2p	
[† †	11	† ↓		

I Incorrect- electrons must spin in opposite directions ----- (ii)

3. Hund's Rule of maximum multiplicity this rule deals with the filling of electrons into degenerate (equal energy) orbitals of the same sub-shell (p, d ,f). According to this rule: "Electron pairing in p, d, and f orbitals cannot occur until each orbital of a given sub-shell contains one electron each or is simply occupied with parallel spin". This is due to the fact that electron being identical in charge, repel each other when present in the same orbital. This repulsion can be minimized if two electrons move as far apart as possible by occupying different degenerate orbitals. Further, all the singly occupied orbitals will have parallel spins i.e., in direction (either clockwise same or anticlockwise). This is due to the fact that two electrons with parallel spin (in different orbitals) will encounter less inter-electronic repulsions in space than when they have opposite spins (while saving in different orbitals).

\uparrow	\downarrow	\uparrow
$\mathbf{p}_{\mathbf{x}}$	р	y pz

(a) Total spin of unpaired electrons = 1/2 - 1/2 + 1/2= 1/2

\uparrow	\uparrow	\uparrow
$\mathbf{p}_{\mathbf{x}}$	$p_y \\$	$\mathbf{p}_{\mathbf{z}}$

(b) Total spin of unpaired electrons =1/2 + 1/2 + 1/2 $=1\frac{1}{2}$

$\uparrow\downarrow$	\downarrow	
px	$\mathbf{p}_{\mathbf{y}}$	$\mathbf{p}_{\mathbf{z}}$

(c) Total spin =
$$1/2$$

In accordance with the Hund's rule, the configuration (a) in which the unpaired electrons do not have parallel spins is incorrect. The configuration (b) in which the three unpaired electrons occupying p_x, p_y, and p_z orbitals have all (either clockwise parallel spins or anticlockwise) is correct while the configuration (c) in which the pairing of the electrons has been shown in p_x orbital without putting the third electron in p_z orbital is also not consistent with the Hund's rule of maximum multiplicity. By the term maximum multiplicity, the total spin of unpaired electrons is maximum. For example, the total spin of the unpaired electron configuration (a), (b) and (c) are 1/2, $1\frac{1}{2}$ and 1/2. According to Hund's rule, configuration (b) with maximum multiplicity of $1\frac{1}{2}$ is correct.

Some examples

Element	Atomic Number (Z)	Number of Electrons	Electronic Configuration (nP Method)	Electronic Configuration (Orbital Diagram Method)
Hydrogen	1	1	1s ¹	1s
Helium	2	2	1s ²	1s 1
Lithium	3	3	1s ² 2s ¹	1s 28
Beryllium	4	4	1s ² 2s ²	15 28 1 1
Boron	5	5	1s ² 2s ² 2p _x ¹	1s 2s 2p, 2p, 2p, 1 1 1 1

Carbon	6	6	$1s^2 2s^2 2p_{x^1} 2p_{y^1}$	1s 2s 2p _x 2p _y 2p _z 1 1 1 1
Nitrogen	7	7	$1s^22s^22p_{x}{}^12p_{y}{}^12p_{z}{}^1$	1s 2s 2p _x 2p _y 2p _z 1 1 1 1 1
Oxygen	8	8	$1s^22s^22p_x{}^22p_y{}^12p_z{}^1$	1s 2s 2p _x 2p _y 2p _z 1 1 1 1 1
Fluorine	9	9	$1s^22s^22p_x{}^22p_y{}^22p_z{}^1$	1s 2s 2p _x 2p _y 2p _z 1 1 1 1 1
Neon	10	10	$1s^22s^22p_{x}^22p_{y}^22p_{z}^2$	1s 2s 2px 2py 2pz 1 1 1 1 1 1

Electronic configuration of elements with atomic numbers 11 to 20 $\,$

Element	Atomi		Electronic
	с	Electronic	configurat
	numb	configurat	ion using
	er	ion	noble gas

			core
Sodium (Na)	11	$1S^2$ $2S^2$ $2p^6$	[Ne] 3s ¹
		3S1	
Magnesium	12	$1S^2 2S^2 2D^6$	[Ne] 3s ²
(Mg)			[] 0.
Aluminium	12	15^2 25^2 $2n^6$	[Ne] 25 ² 2n ¹
(Al)	10	$2s^2 2n^1$	[110] 20 3P x
Silicon (Si)	14	3° 3° 3° 3°	[No] oc2 op1
Silicoli (SI)	14	$15^{-} 25^{-} 2p^{-}$	$[10e] 38^{-} 3p^{-}x$
D1 1		$3s^2 3p_x 3p_y$	$3p_y$
Phosphorus	15	$1S^2 \ 2S^2 \ 2p^6$	[Ne] $3s^2 3p_x^1$
		$3s^2$ $3p_x^1$	$3p_y^1 3p_z^1$
		$3p_{y}^{1}3p_{z}^{1}$	
Sulphur (S)	16	$1S^2$ $2S^22p^6$	[Ne] $3s^2 3p^2_x$
-		3S ²	$3p_v^13p_z^1$
		$3p^{2}x3p^{1}v3p^{1}z$	
Chlorine (Cl)	17	$1S^2 2S^2 2D^2$	[Ne] $3S^2 3D^2_x$
	7	$3S^2 3D^2 x 3D^2 y$	$3D^2v 3D^1z$
		20 ² 0F x 0F y	OF y OF 2
Argon (Ar)	18	$15^2 25^2 20^6$	
ingon (in)	10	$2S^2 2D^2 2D^2$	
		3° 3° 3° 2° 3°	
Potassium	10	3PZ	[Ar] del
1 0(a5510111	19	$10 \ 20^{-} \ 2p^{-}$	[71] 45
(C_1)		<u>38-3p-48</u>	
Calcium (Ca)	20	$18^2 \ 28^2 \ 2p^0$	[Ar] 4s ²
		$3s^2 3p^{\circ} 4s^2$	

The electron added in going from one element to the next is called the differentiating electron. It makes the configuration of the atom different from that of atom that precedes it. The differentiating electron is added in each step to the orbital of lowest energy available to it.

Exceptional Configurations- Stability of Completely filled and Exactly Half-filled Orbitals:

In certain elements when the two subshells differ slightly in their energies, an electron may shift from a subshell of lower energy to a subshell of higher energy only if such a shift results in the symmetrical distribution (either completely filled or exactly halffilled) of the electron in the various orbitals of the subshell of high energy. This is due to the following two reasons:-

1. **Symmetrical distribution**. It is well known fact symmetry leads to stability. Thus, the electronic configuration in which all the orbital of the same subshell are either completely filled or are exactly half-filled are more stable because of

symmetrical distribution of electrons. For example, the expected electronic configuration of chromium (Z=24) is as follow:

But if one of the 4s electrons shifts to vacant 3dorbital, the distribution of the electrons will become more symmetrical and this will impart extra stability. Therefore, the electronic configuration of Cr, as given above, is worng and the actual configuration is as follow :



Similarly, the expected electronic configuration of Cu(Z=29) is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9 4s^2$ is

Example:	copper
Following the Aufbau Principle:	What actually happens:
3d 4s 11 3p 11 11 11 3s 11 2p 11 11 11 2s 11 1s 11 Cu	L 3d 11 11 11 11 11 4s L 3p 11 11 11 3s 11 2p 11 11 11 2s 11 1s 11 Cu

But in this configuration, the distribution of electrons in the five 3d-orbital is not symmetrical. A shift of one electron from the lower energy 4s-orbital to higher energy 3d-orbital will make the distribution of electrons symmetrical and hence will impart more stability. Thus ,the actual electronic configuration of Cu is: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$

2. Exchange energy. The half-filled and completely filled electronic configuration are also stable due to large exchange of energy of stabilization. The exchange means the shifting of electrons from one orbital to another in the same sub-shell. The electrons with parallel spins present in the degenerate orbitals tend to exchange their position. The energy released during this exchange is called exchange energy. The number of exchanges that can take place is maximum when the degenerate orbitals are exactly half-filled or completely filled. As a result, the exchange energy is mximum and so is the stability.

The number of exchange that can take place in d⁴ configuration are as follow:-



Thus, in $3d^4$ arrangement electron exchanges are six which implies that there are six possible arrangements with parallel spin in $3d^4$ configuration.

The number of exchange that can take place in d⁵ configuration are as follows:-





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

e-Mail ID: kumud.bala@yahoo.com

SCIENCE QUIZ March'17

Kumud Bala

- **1.** The most radioactive alkali metal:
 - (a) Sodium (b) Francium
 - (c) Cesium (d) Lithium
- **2.** An organic liquid which bursts into flames on addition of conc. Nitric acid:
 - (a) Turpentine oil (b) Kerosene oil
 - (c) Olive oil (d) Coconut oil
- **3.** A metallic sulphide soluble in water:
 - (a) calcium sulphide (b) Potassium sulphide
 - (c) sodium sulphide (d) Iron sulphide.
- **4.** An explosive formed when ammonia reacts with excess of chlorine:
 - (a) Nitrogen trichloride
 - (b) Nitrogen pentachloride
 - (c) Ammonium chloride
 - (d) Hydrogen chloride
- 5. A gas having a pungent choking smell, used to bleach fruit juices:
 (a) CO₂ (b) NO₂ (c) SO₂ (d) Cl₂ gas
- 6. An unsaturated hydrocarbon formed by dehydration of ethyl alcohol with conc. Sulfuric acid:
 - (a) Ethene (b) Ethyne (c) Ethane (d) Methane
- **7.** A coloured metallic hydroxide insoluble in excess of sodium hydroxide but soluble in excess of ammonium hydroxide:
 - (a) KOH (b) LiOH (c) Cu(OH)₂ (d) Mg(OH)₂

- **8.** A salt which decomposes on heating to give a metal as residue:
 - (a) Lithium nitrate (b) Silver nitrate
 - (c) Copper nitrate (d) Sodium nitrate
- **9.** Name the gas which is liberated when conc. Sulphuric acid reacts with oxalic acid:
 - (a) Carbon dioxide (b) Sulphuric dioxide
 - (c) Oxygen (d) Hydrogen
- **10.** A coloured gas obtained from two colourless gases:

(a) CO₂
(b) SO₂
(c) NO₂
(d) Cl₂ gas
11. Name a metal which is extracted by reduction of its oxide with coke:

- (a) Zinc (b) Aluminium (c) Iron (d) Copper
- **12.** Which metal is used to cover underground telephone cable and wire system?
 - (a) Zinc (b) Lead (c) Iron (d) Aluminium
- **13.** Name a base or a alkali that is used as an antacid to neutralize the enhanced acidity:
 - (a) Sodium hydroxide
 - (b) Magnesium hydroxide
 - (c) Caluminium hydroxide
 - (d) Calcium hydroxide
- **14.** Name a fertilizer manufactured using sulphuric acid:

(a) Ammonium sulphate (b) Barium sulphate	(c) Ethane (d) Propene
 (c) Sodium sulphate (d) Calcium sulphate 15. Name a metal which is trivalent and forms an acidic oxide: 	17. Which solid evolves a coloured gas on prolonged exposure to air:
	(a) Sodium chloride (b) Iron chloride
(a) Chromium (b) Sodium	(c) Bleaching powder (d) Magnesium chloride
(c) Aluminium (d) Zinc	
16. Name the hydrocarbon which is linear molecule:	18. Which acidic gas tends to poison the catalyst in Haber's Process?
(a) Ethylene (b) Acetylene	(a) CO_2 (b) SO_2 (c) NO_2 (d) HCl gas

(Answers to this Science Quiz shall be provided in Supplementary e-Bulletin dt 1st May'17)

-00-

Answers to Science Quiz in 1st Supplementary dt 1st March Supplementary Quarterly e-Bulletin

Kumud Bala

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

-00-

A physicist is just an atom's way of looking at itself.

- Niels Bohr

To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science.

- Albert Einstein

Theme Song :

<u>PREMISE:</u> 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 of compassionate 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 हो ना हम चले नेक रस्ते पे हमसे, भूलकर भी कोई भूल हो ना ॥

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

इतनी शक्ति हमें देना दाता, मन का विश्वास कमजोर हो ना हम चले नेक रस्ते पे हमसे, भूलकर भी कोई भूल हो ना ॥

हम ना सोचें हमें क्या मिला है, हम ये सोचे किया क्या है अर्पण फूल खुशियों के बाँटे सभी को, सब का 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 हो ना हम चले नेक रस्ते पे हमसे, भूलकर भी कोई भूल हो ना ॥



Together Each Achieves More (TEAM)

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



