PU M Tech Nano Sciences and Technology

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Ductile fracture is characterized by:-

- shiny appearance
- cup and cone structure
- with no plastic deformation
- subsurface cracks

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Cast iron known for its ---------- character.

- Brittle
- Ductile
- Toughness
- Low melting point

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The sample preparation process by which the structural features of a metallic sample is revealed in optical microscopy is known as:-

- implantation
- etching
- sputtering
- lithography

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112 PU_2015_305
For a cylindrical shaft of length 'L' and radius 'r', if torque 'M' operates then shear stress is given by:-

- $2/ M \pi r^3$
- $2M/\pi r^2$
- $2M/\pi r^3$
- $2/\pi M r^2$

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Among the following bonding types which exhibit high melting point:-

- covalent
- secondary
- metallic
- ionic

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For underground pipelines the commonly used joint is:-

- sleeve joint
- flange
- expansion joint
- coupling

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In a four stroke cycle, the minimum temperature inside the engine cylinder occurs at the:-

- end of exhaust stroke
- beginning of exhaust stroke
- beginning of suction stroke
- end of suction stroke

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The hardest material among the following:-

- sapphire
- gypsum
- apatite
- fluorite

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Generally used moderator in the nuclear power plant is:-

- beryllium
- cadmium
- lead
- graphite

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The bond formed by the transfer of one electron to the other is known as:-

- ionic
- metallic
- hydrogen
- covalent

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In non-destructive testing, the dye penetrant test is usually carried out to check the defects.

- core
- chemical
- elemental
- surface

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Which among the following notation represents the family of directions in a crystal?

- (111)
- <111>
- [111]
- {111}

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Which among the following has highest percentage of ionic character?

- MgO
- ZnS
- SiC
- NaCl

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The process by which consolidation of powder into solid dense mass is known as:-

- sintering
- diffusion
- infiltration
- pressing

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Which one among the following is not converted into non pollutant in a catalytic converter?

- unburnt hydrocarbon
- oxides of nitrogen
- carbon monoxide
- sulphur

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A completely aligned fiber reinforced composite consist – 40 vol% fiber with modulus of elasticity 69 GPa and 60 vol% matrix with the modulus of 3.4GPa. The modulus of the composite is:-

- 15 GPa

- 60 GPa
- 30 GPa
- 45 GPa

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When a material is stressed, the generation of electricity is known as:-

- piezoresistivity
- ferroelectricity
- thermoelectricity
- piezoelectricity

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On increasing the temperature:-

- the resistivity of a metal and a semiconductor increases
- the resistivity of a metal and a semiconductor decreases
- the resistivity of a metal increases while for a semiconductor decreases
- the resistivity of a metal decreases while for a semiconductor increases

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Identify the statement which is TRUE with respect to nanomaterials.

- For unit mass surface energy of the nanostructures are lower than the micron sized particles
- Surface energy of the nanostructures are zero
- For nanomaterials surface area to volume ratio is high
- For nanomaterials total number of atoms present on the surface is low

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Permanent magnetic moment in the absence of electric field is known as:-

- ferromagnetism
- diamagnetism
- paramagnetism
- giant magneto resistance

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Deuteron has only one bound state with spin parity 1^+, isospin 0 and electric quadrupole moment 0.286 efm^2. These data suggest that the nuclear forces are having:-

- only spin and isospin dependence
- spin dependence along with tensor components

- spin dependence but no tensor components
- Ono spin dependence and no tensor components

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The Hall coefficient, *RH*, of sodium depends on:-

- The charge carrier density only
- The effective charge carrier mass and carrier density
- The charge carrier density and relaxation time
- The effective charge carrier mass

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135 PU_2015_305

The ground state wave function of deuteron is in a superposition of s and d states. Which of the following is NOT true as a consequence?

- It has a non-zero quadruple moment
- The neutron-proton potential is non-central
- The Hamiltonian does not conserve the total angular momentum
- The orbital wavefunction is not spherically symmetric

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A magnetic field sensor based on the Hall Effect is to be fabricated by implanting Asintoa Si film of thickness 1 μm. The specifications require a magnetic field sensitivity of 500 mV/Tesla at an excitation current of 1 mA. The implantation dose is to be adjusted such that the average carrier density, after activation, is:-

- $1.25 \times 10^{22} m^{-3}$
- $1.25 \times 10^{26} m^{-3}$
- $4.1 \times 10^{21} m^{-3}$
- $4.1 \times 10^{20} m^{-3}$

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For a three-dimensional crystal having *N* primitive unit cells with a basis of p atoms, the number of optical branches is:-

- $3p$
- $3p - 3$
- $3N - 3p$
- 3

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A cavity contains blackbody radiation in equilibrium at temperature T. The specific heat per unit volume of the photon gas in the cavity is of the form $C_V = \gamma T^3$, where γ is a constant. The cavity is expanded to twice

its original volume and then allowed to equilibrate at the same temperature T. The new internal energy per unit volume is:-

- $\gamma T^4/4$
- γT^{-4}
- $2\gamma T^{4}$
- $4\gamma T^{4}$

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Choose the CORRECT statement from the following?

- Electron does not interact through weak interaction
- Neutron interacts through electromagnetic interaction
- Neutrino interacts through weak and electromagnetic interaction
- Quark interacts through strong interaction but not through weak interaction

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A proton is confined to a cubic box, whose sides have length 10^{-12} m. What is the minimum kinetic energy of the proton? The mass of proton is 1.67 x 10^{-27} *kg* and Planck's constant is 6.63 x 10^{-34}Js .

- 3.3 x $10^{-17}J$
- 9.9 x 10-17J
- 6.6 x 10-17 J
- 1.1 x $10^{-17}J$

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The excitations of a three-dimensional solid are bosonic in nature with their frequency ω and wave-number k are related by $\omega \propto k^2$ in the large wavelength limit. If the chemical potential is zero, the behaviour of the specific heat of the system at low temperature is proportional to:-

- $T^{3/2}$
- $T^{1/2}$
- T^{3}
- T

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The pressure of a nonrelativistic free Fermi gas in three-dimensions depends, at $T = 0$, on the density of fermions n as:-

- $n^{4/3}$
- $n^{2/3}$
- $n^{5/3}$
- $n^{1/3}$

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Consider a Maxwellian distribution of the velocity of the molecules of an ideal gas. Let *Vmp* and *Vrms* denote the most probable velocity and the root mean square velocity, respectively. The magnitude of the ratio *Vmp/ Vrmsis:*-

- 2/3
- $(2 / 3)^{1/2}$
- 1
- 3 / 2

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A gas of *N* non-interacting particles is in thermal equilibrium at temperature *T*. Each particle can be in any of the possible non-degenerate states of energy 0, 2ε and 4ε. The average energy per particle of the gas, when $\beta\varepsilon << 1$, is:-

- ε
- 2ε
- 3ε
- $2\varepsilon / 3$

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Bose condensation occurs in liquid He^4 kept at ambient pressure at 2.17 K. At whichtemperature will Bose condensation occur in He^4 in gaseous state, the density of which is 1000 times smaller than that of liquid He^4? (Assume that it is a perfect Bose gas.)

- 21.7 mK
- 21.7 μK
- 2.17 μK
- 2.17 mK

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Gas molecules of mass m are confined in a cylinder of radius R and height L(withR>>L) kept vertically in the Earth's gravitational field. The average energy of the gas at low temperatures (such that mgL>>kBT) is given by:-

- 2*NkBT*
- *NkBT*/ 2
- 5*NkBT* /
- 3*NkBT* / 2

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Let Δ*W* be the work done in a quasistatic reversible thermodynamic process. Which of the following statements about Δ*W* is correct?

- Δ*W* is always a perfect differential

- ΔW is a perfect differential if the process is adiabatic
- ΔW is a perfect differential if the process is isothermal
- ΔW cannot be a perfect differential

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A system of non-interacting spin-1/2 charged particles are placed in an external magnetic field. At low temperature T, the leading behavior of the excess energy above the ground state energy, depends on T as: (c is a constant)

- e^{-c} / T
- cT
- cT^3
- c (is independent of T)

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If the peak output voltage of a full wave rectifier is 10 V, its d.c. voltage is:-

- 3.18 V
- 6.36 V
- 10.0 V
- 7.07 V

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The pressure of a nonrelativistic free Fermi gas in three-dimensions depends, at T =0, on the density of fermions n as:-

- $n^{4/3}$
- $n^{1/3}$
- $n^{2/3}$
- $n^{5/3}$

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For the set of all Lorentz transformations with velocities along the x-axis consider the two statements given below:

P: If L is a Lorentz transformation then, L^{-1} is also a Lorentz transformation. Q: If $L1$ and $L2$ are Lorentz transformations then, $L1L2$ is necessarily a Lorentz transformation.

Choose the correct option.

- P is true and Q is false
- P is false and Q is true
- Both P and Q are true
- Both P and Q are false

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Two particles each of rest mass m collide head-on and stick together. Before collision, the speed of each mass was 0.6 times the speed of light in free space. The mass of the final entity is:-

- $2m$
- $5m / 2$
- $25\ m / 8$
- $5m / 4$

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Antibodies that recognize only one epitop derived from a single clone is called:-

- Bivalent antibodies
- Polyclonal antibodies
- Monoclonal antibodies
- Monovalent antibodies

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Relative amount of A, T, G and C in DNA were measured first by:-

- Ramachandran
- Watson and Crick
- Erwing Chargaff
- Peterson

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The enzymes used in polymerase chain reaction is:-

- Taq DNA polymerase
- Polymerase III
- DNA ligase
- RNA polymerase

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Guanosine nucleotide is held by the cytosine nucleotide by the number of H-bonds:-

- 4
- 2
- 1
- 3

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The first reaction involved in the carbohydrate metabolism is:-

- Formation of Acety Co-A
- Carboxylation
- Phosphorylation
- Hydrogenation

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In the melting point curve of DNA, Tm increases with increasing:-

- A + G content
- G + C content
- A + C content
- G + T content

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Suitable organism for use in recombinant vaccine is:-

- Influenza virus
- Vaccina virus
- Small pox virus
- Poliomyelitus virus

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The process of synthesis of protein from RNA is called:-

- Isolation
- Replication
- Transcription
- Translation

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When the idiotopes are used as vaccine to mimic antigen, the vaccine is known as:-

- Synthetic vaccine
- Recombinant vaccine
- Subunit vaccine
- Anti-idiotypic vaccine

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The technique of transfer of DNA molecules separated by gel electrophoresis to the nitrocellulose or nylon membrane is called:-

- Eastern blot
- Northern blot
- Southern blot
- Western blot

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Conjucal transfer of gene takes place in Bacteria by:-

- Fimbriae
- Sexpili
- Polymerized molecule
- Flagellae

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The pH of a buffer to be used for the separation of lysine and histidine in cation exchange column is:-

- 2
- 4
- 8
- 12

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The lethal gene ratio is:-

- 2:1
- 4:1
- 8:1
- 1:1

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α-helix is disrupted by certain aminoacids like:-

- Arginine
- Proline
- Histidine
- Lysine

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The recombinant DNA based human vaccine commercially available against:-

- Leprosy
- HIV
- Tuberculosis
- Hepatitis B

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The neutral aminoacid is:-

- Proline
- Histidine
- Leucine
- Serine

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All t-RNA molecules have a common CCA sequence at the:-

- 5' 3' terminal
- 3' terminal
- 5' terminal
- 3'5' terminal

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Keratin is synthesized from:-

- Glycine
- Proline
- Serine
- Methionine

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The shape of natural DNA strands cannot be:-

- Hairpin
- Interlocked
- Circular
- Linear

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The gene coding for VP1 is cloned in:-

- pUC 18
- pUC 19
- pMB 9
- pBR 322

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If in a frequently distribution, the mean and median are 21 and 22 respectively, then its mode is approximately:-

- 20.5
- 22.0
- 25.5
- 24.0

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The compound interest on Rs. 30,000 at 7% per annum is Rs. 4347. The period (in years) is:-

- 3
- 2
- 4
- 2.5

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In the first 10 overs of a cricket game, the run rate was only 3.2. What should be the run rate in the remaining 40 overs to reach the target of 282 runs?

- 7
- 6.5
- 6.75
- 6.25

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The area enclosed between the curve y = loge (x + e) and the coordinate axes is:-

- 4
- 3
- 2
- 1

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If cos-1(1/x) = θ, then tan θ =

- $\sqrt{(x^2 - 1)}$
- $\sqrt{(1 - x^2)}$
- $\sqrt{(x^2 + 1)}$
- $1/\sqrt{(x^2 - 1)}$

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A school committee consists of 2 teachers and 4 students. The number of different committees that can be formed from 5 teachers and 10 students is:-

- 10
- 15
- 2100
- 8

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The number of real roots of the equation $e^{sinx} - e^{-sinx} - 4 = 0$ are:-

- 3
- 1
- Infinite
- None

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The period of 2 sinxcosx is:-

- 4π
- $4\pi^2$
- 2π
- π

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In a single throw of two dice, the probability of getting more than 7 is:-

- 5/36
- 7/12
- 7/36
- 5/12

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Square of either of the two imaginary cube roots of unity will be:-

- Real root of unity
- Other imaginary cube root of unity
- Sum of two imaginary roots of unity
- None of these

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If in a triangle ABC, the altitudes from the vertices A, B, C on opposite sides are in H.P., then sin A, sin B, sin C are in:-

- H.P.
- Arithmetic − Geometric Progression
- A.P.
- G.P.

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The number of values of x in the interval $[0, 3\pi]$ satisfying the equation $2\sin 2x + 5\sin x - 3 = 0$ is:-

- 6
- 2
- 1
- 4

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The expression $(2 + \sqrt{2})^4$ has value, lying between.

- 134 and 135
- 135 and 136
- 136 and 137
- None of these

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The sum of 3 numbers in geometric progression is 38 and their product is 1728. The middle number is.

- 12
- 8
- 6
- 18

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Two circles have equations $x^2 + y^2 = 16$ and $(x - 2)^2 + y^2 = 4$. Which of the following correctly describes the relative position of the two circles.

- The two circles touch externally
- The two circles touch internally
- The circles do not touch or intersect
- The two circles intersect

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The degree and order of the differential equation of the family of all parabolas whose axis is x-axis, are respectively:-

- 2, 1
- 1, 2
- 2, 3
- 3, 2

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The ends of latus rectum of parabola $x^2 + 8y = 0$ are:-

- (-4, -2) and (4, -2)
- (4, 2) and (-4, 2)
- (4, -2) and (-4, 2)
- (-4, -2) and (4, 2)

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The points (0, 8/3), (1, 3) and (82, 30) are the vertices of:-

- A right angled triangle
- A right angled triangle
- An equilateral triangle
- None of these

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Which vector is perpendicular to the plane containing the three points P(2, 1, 5), Q(−1, 3, 4), and R(3, 0, 6)?

- $2i + 2j - k$
- $2i - j + k$
- $i + 2j + 2k$
- $i + 2j + k$

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If $^{12}P_r$, then r is equal to:-

- 3
- 2
- 4
- 5

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The condensation polymer among the following is:-

- Protein
- PVC
- Polythene
- Rubber

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The laws of electrolysis were proposed by:-

- Fritz Haber
- Friedrich Kohlrausch
- Michael Faraday
- Richard Abegg

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Which of the following electrolytic solutions has the least specific conductance?

- 0.02N
- 0.2N
- 0.002N
- 2N

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What is the electrochemical equivalent (in g coulomb^{-1}) of silver? (Ag = 108; F = Faraday)

- 108 F
- 1/108 F
- F/108
- 108/F

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During the process of electrolytic refining of copper, some metals present as impurity settle as 'anode mud' These are:-

- Sn and Ag
- Ag and Au
- Fe and Ni
- Pb and Zn

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Amongst the following the most basic compound is:-

- acetanilide
- p-nitroaniline
- aniline
- benzylamine

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The best way to prevent rusting of iron is:-

- putting it in an acidic solution
- making iron cathode
- both (A) and (B)
- neither (A) nor (B)

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The number and type of bonds between two carbon atoms in calcium carbide are:-

- One sigma, one pi
- Two sigma, one pi
- One sigma, two pi
- Two sigma, two pi

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The number of d-electrons in Fe^{2+} (Z = 26) is not equal to that of:-

- d-electrons in Fe (Z=26)
- p-electrons in Ne (Z=10)
- s-electrons in Mg (Z=12)
- p-electrons in Cl(Z=17)

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Which of the following is fully fluorinated polymer?

- PVC
- Teflon

- Neoprene
- Thiokol

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Which one of the following pairs of species have the same bond order?

- O^- and CN^-
- CN^- and NO^+
- NO^+ and CN^+
- CN^- and CN^+

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The number of moles of solute present in 1 kg of a solvent is called its:-

- Molarity
- Normality
- Molality
- Formality

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256 PU_2015_305

$(NH_4)_2Cr_2O_7$ On heating gives a gas which is also given by:-

- heating NH_4NO_2
- $Mg_3N_2 + H_2O$
- Na (comp.) + H_2O_2
- heating NH_4NO_3

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Which one of the following does not involve coagulation?

- Peptization
- Clotting of blood by the use of ferric chloride
- Formation of delta regions
- Treatment of drinking water by potash alum

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Which of the following factors is of no significance for roasting sulphide ores to the oxides and not subjecting the sulphide ores to carbon reduction directly?

- Metal sulphides are less stable than the corresponding oxides
- CO_2 is thermodynamically more stable than CS_2
- Metal sulphides are thermodynamically more stable than CS_2

- CO_2 is more volatile than CS_2

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The potential of a hydrogen electrode at pH = 10 is:-

- -0.59V
- 0.059V
- 0.00V
- 0.59V

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292 PU_2015_305

Phenol, when it first reacts with concentrated sulphuric acid and then with concentrated nitric acid, gives:-

- p-nitrophenol
- nitrobenzene
- o-nitrophenol
- 2,4,6-trinitrobenzene

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Which of the following arrangements does not represent the correct order of the property stated against it?

- $Co^{3}+< Fe^{3+}< Cr^{3+}< Sc^{3+}$: stability in aqueous solution
- Sc<Ti<Cr<Mn: number of oxidation states
- $V^{2+}< C^{r2}+< Mn^{2}+< Fe^{2+}$: paramagnetic behavior
- $Ni^{2}+< Co^{2+}< Fe^{2}+< Mn^{2+}$: ionic size

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Based on the first law of thermodynamics, which one of the following is correct?

- For an isochoric process, $\Delta U = \Delta q$
- For an adiabatic process, $\Delta U = \Delta w$
- For a cyclic process, $q = \Delta w$
- For an isothermal process, $q = +w$

100 of 100

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Reaction of one molecule of HBr with one molecule of 1,3-butadiene at 40°C gives predominantly.

- 3-bromobutene under kinetically controlled conditions
- 1-bromo-2-butene under thermodymically controlled conditions
- 1-bromo-2-butene under kinetically controlled conditions
- 3-bromobutene under thermodynamically controlled conditions