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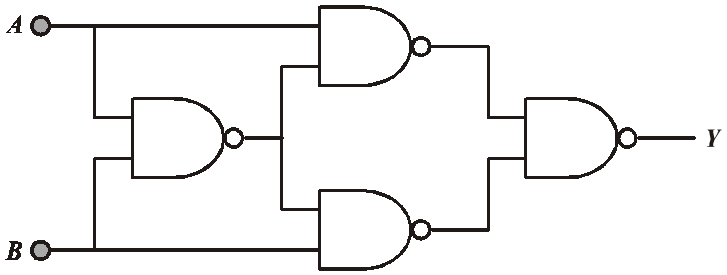
QUESTIONS & SOLUTIONS OF AIEEE 2012

PART A : PHYSICS

1. Truth table for system of four NAND gates as shown in figure is :



(1)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

(2)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

(3)

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	1

(4)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

Sol.(2)

A	B	P	U = $\overline{P.A}$	V = $\overline{P.B}$	$\overline{U.V}$
0	0	1	1	1	0
0	1	1	1	0	1
1	0	1	0	1	1
1	1	0	1	1	0

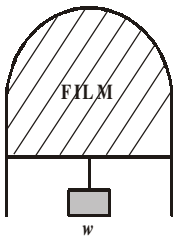
2. A thin liquid film formed between a U-shaped wire and a light slider supports a weight of $1.5\times10^{-2}\,N$ (see figure). The length of the slider is $30\,cm$ and its weight negligible. The surface tension of the liquid film is :

(1) $0.025\,Nm^{-1}$

(2) $0.0125\,Nm^{-1}$

(3) $0.1\,Nm^{-1}$

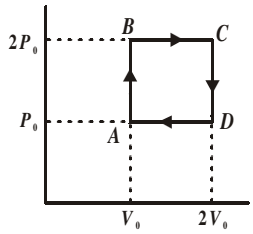
(4) $0.05\,Nm^{-1}$



Sol.(1) $105 \text{ x } 10^{-2} = S \text{ x } 6.0 \text{ x } 10^{-2}$

$$S = \frac{1.5}{60} = 0.025\,N/m$$

3. Helium gas goes through a cycle $ABCDA$ (consisting of two isochoric and two isobaric lines) as shown in figure. Efficiency of this cycle is nearly : (Assume the gas to be close to ideal gas)



(1) 12.5%

(2) 15.4%

(3) 9.1%

(4) 10.5%

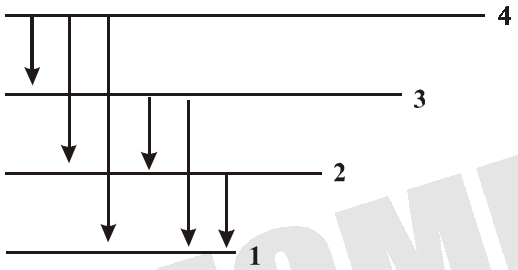
Sol.(2) $W = P_0V_0$ and $Q = \frac{13}{2}P_0V_0$

$$\eta = \frac{W}{Q} = \frac{2}{13} \times 100 = 15.4\%$$

4. Hydrogen atom is excited from ground state to another state with principal quantum number equal to 4. Then the number of spectral lines in the emission spectra will be :

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

Sol.(1)



$n = 6$

5. A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to the magnetic lines of force. When a current is passed through the coil it starts oscillating; it is very difficult to stop. But if an aluminium plate is placed near to the coil, it stops. This is due to :

(1) electromagnetic induction in the aluminium plate giving rise to electromagnetic damping.

(2) developement of air current when the plate is placed

(3) induction of electrical charge on the plate

(4) shielding of magnetic lines of force as aluminium is a paramagnetic material

Sol.(1)

6. A spectrometer gives the following reading when used to measure the angle of a prism.

Main scale reading : 58.5 degree

Vernier scale reading : 09 ivisions

Given that 1 division on main scale corresponds to 0.5 degree. Total divisions on the vernier scale is 30 and match with 29 divisions of the main scale. The angle of the prism from the above data :

(1) 59 degree (2) 58.59 degree (3) 58.77 degree (4) 58.65 degree

Sol.(4) $MSR = 58.5^0$

$VSR = 09$ division

$TR = MSR + VSR \text{ x } LC$

$LC = 1\,MSD - 1VSD = 0.5^0 - \frac{29}{30} \text{ x } 0.5^0 = \frac{1}{30} \text{ X } 0.5^0$

$TR = 58.5^0 + 9 \text{ x } \frac{1}{30} \text{ x } 0.5^0 = 58.65^0$

7. In Young's double slit experiment, one of the slit is wider than other, so that the amplitude of the light from one slit is double of that from other slit. If I_m be the maximum intensity, the resultant intensity I when they interfere at phase difference ϕ is given by :

(1) $\frac{I_m}{9}\left(1+8\cos^2\frac{\phi}{2}\right)$ (2) $\frac{I_m}{9}\left(4+5\cos^2\phi\right)$

(3) $\frac{I_m}{3}\left(1+2\cos^2\frac{\phi}{2}\right)$ (4) $\frac{I_m}{5}\left(1+4\cos^2\frac{\phi}{2}\right)$

Sol.(1) $a_1 = a, a_2 = 2a$

$I_m = k\,(a+2a)^2$

$I_m = k.9a^2$.....(1)

$A = \sqrt{a^2+4a^2+2.a.a.\cos\phi}$

$I = k.(5a^2+4a^2\cos\phi)$

$= k\left\{5.\frac{I_m}{9k}+4\cos\phi.\frac{I_m}{9k}\right\} = \frac{I_m}{9}\{1+4+4\cos\phi\} = \frac{I_m}{9}\{4(1+\cos\phi)+1\}$

$= \frac{I_m}{9}\left\{4.2\cos^2\frac{\phi}{2}+1\right\} = \frac{I_m}{9}\left\{1+8\cos^2\frac{\phi}{2}\right\}$

8. Proton, Deuteron and Alpha particle of the same kinetic energy are moving in circular trajectories in a constant magnetic field. The radii of proton, deuteron and alpha particle are respectively r_p, r_d and r_α. Which one of the following relations is correct ?

(1) $r_\alpha = r_d > r_p$ (2) $r_\alpha = r_p = r_d$ (3) $r_\alpha = r_p < r_d$ (4) $r_\alpha > r_d > r_p$

Sol.(3) $R_P = \frac{\sqrt{2mK}}{qB}$

$R_d = \frac{\sqrt{2.2mK}}{qB}$

$$R_\alpha = \frac{\sqrt{2.4mK}}{2qB}$$

$$R_P : R_d : R_\alpha = 1 : \sqrt{2} : 1$$

9. An object $2.4\,m$ in front of a lens forms a sharp image on a film $12\,cm$ behind the lens. A glass plate $1\,cm$ thick, of refractive index 1.50 is interposed between lens and film with its plane faces parallel to film. At what distance (from lens) should object be shifted to be in sharp focus on film ?

(1) $5.6\,m$ (2) $7.2\,m$ (3) $2.4\,m$ (4) $3.2\,m$

Sol.(4) $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{12} - \frac{1}{-240} \Rightarrow f = \frac{240}{21}$

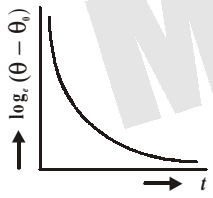
$\because \Delta x = \left(\frac{1}{3}cm\right) \quad \therefore v = \frac{35}{3}cm$

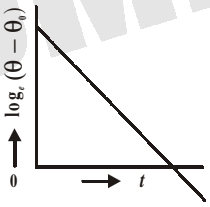
$$\frac{3}{35} - \frac{1}{u} = \frac{21}{240}$$

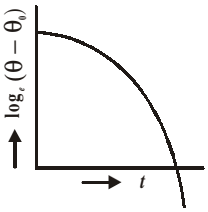
$$u = 560cm$$

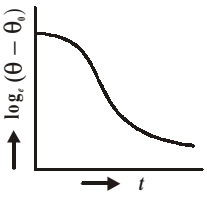
$$x = 560 - 240 = 320\,cm$$

10. A liquid in a beaker has temperature $\theta(t)$ at time t and θ_0 is temperature of surroundings, then according to Newton's law of cooling the correct graph between $\log_e(\theta - \theta_0)$ and t is :

(1) 

(2) 

(3) 

(4) 

Sol.(2) $\frac{d\theta}{dt} = -k(\theta - \theta_0)$

$$\int \frac{d\theta}{\theta - \theta_0} = \int -kdt$$

$$ln(\theta - \theta_0) = -kt$$

11. This question has statement 1 and statement 2. Of the four choices given after the statements, choose the one that best describes the two statements.

If two springs S_1 and S_2 of force constants k_1 and k_2, respectively, are streched by the same force, it is found that more work is done on spring S_1 than on spring S_2.

Statement 1 : If stretched by the same amount, work done on S_1, will be more than that on S_2.

Statement 2 : $k_1 < k_2$

(1) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1.

(2) Statement 1 is flase, Statement 2 is true

(3) Statement 1 is true, Statement 2 is false

(4) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1

Sol.(2) $S_1 \rightarrow F = k_1 x_1 \Rightarrow W_1 = \frac{1}{2} k_1 x_1^2$

$S_2 \rightarrow F = k_2 x_2 \Rightarrow W_2 = \frac{1}{2} k_2 x_2^2$

$\because \frac{W_1}{W_2} = \frac{k_1 x_1^2}{k_2 x_2^2} = \frac{k_1 x_1 . x_1}{k_2 x_2 . x_2} = \frac{x_1}{x_2}$

Given $W_1 > W_2$

$\Rightarrow \frac{w_1}{w_2} > 1 \therefore \frac{x_1}{x_2} > 1 \Rightarrow x_1 > x_2$

$k_1 x_1 = k_2 x_2 \Rightarrow \frac{k_1}{k_2} = \frac{x_2}{x_1} < 1 \Rightarrow k_1 < k_2$

12. This question has statement 1 and Statement 2 Of the four choices given after the Statements, choose the one that best describes the two Stateements.

Statement 1 : Davisson-Germer experiment established the wave nature of electrons.

Statement 2 : If electrons have wave nature, they can interfere and show diffraction.

(1) Statement 1 is true, Statement 2 is true, Statement 2 is not the correct explanation of Statement 1

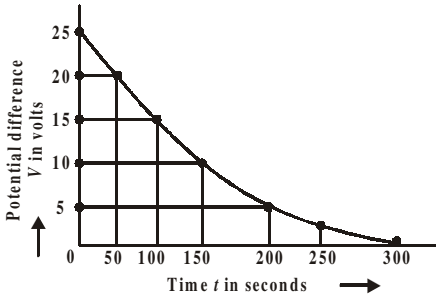
(2) Statement 1 is false, Statement 2 is true

(3) Statement 1 is true, Statement 2 is false

(4) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1

Sol.(1)

13. The figure shows an experimental plot for discharging of a capacitor in an R-C circuit. The time constant τ of this circuit lies between :



(1) 100sec and 150sec (2) 150sec and 200sec

(3) 0sec and 50sec (4) 50sec and 100sec

Sol.(1) $T_{1/2} = 100s = \tau \ln 2$

$\tau = 144.3\ s$

14. Resistance of a given wire is obtained by measuring the current flowing in it and the voltage difference applied across it. If the percentage errors in the measuremtnt of the current and the voltage ifference are 3% each, then error in the value of resistance of the wire is :

(1) 3% (2) 6% (3) zero (4) 1%

Sol.(2) $\frac{\Delta R}{R} \text{ x } 100 = \frac{\Delta V}{V} \text{x} 100 + \frac{\Delta I}{I} \text{x} 100$

$= 3\% + 3\% = 6\%$

15. A Carnot engine, whose efficiency is 40%, takes in heat from a source maintained at a temperature of $500\,K$. It is desired to have an engine of efficiency 60%. Then, the intake temperature for the same exhaust (sink) temperature must be :

(1) $600\,K$

(2) efficiency of Carnot engine cannot be made larger than 50%

(3) $1200\,K$

(4) $750\,K$

Sol.(4) $\frac{2}{5} = 1 - \frac{T_2}{500}$

$\frac{T_2}{500} = \frac{3}{5}$

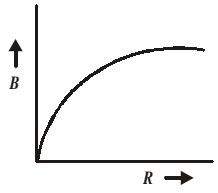
$T_2 = 300K.$

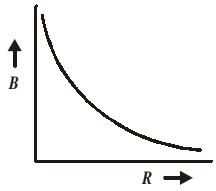
$\frac{3}{5} = 1 - \frac{300}{T_1}$

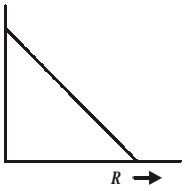
$\frac{300}{T_1} = \frac{2}{5}$

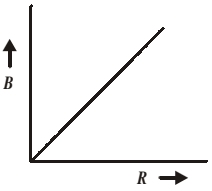
$T_1 = 750K.$

16. A charge Q is uniformly distributed over the surface of non-conducting disc of radius R. The disc-rotates about an axis perpendicular to its plane and passing through its centre with an angular velocity ω. As a result of this rotation a magnetic field of induction B is obtained at the centre of the disc. If we keep both the amount of charge placed on the disc and its angular velocity to be constant and vary the radius of the disc then the variation of the magnetic induction at the centre of the disc will be represented by the figure :

(1) 

(2) 

(3) 

(4) 

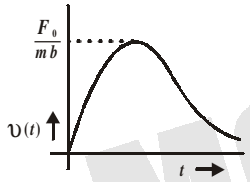
Sol.(2) $B \propto \frac{1}{R}$

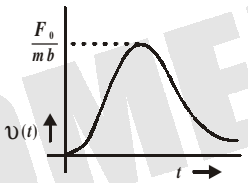
17. A radar has a power of $1kW$ and is operating at a frequency of $10GHz$. It is located on a mountain top of height $500m$. The maximum distance upto which it can detect object located on the surface of the earth (Radius of earth $= 6.4 \times 10^6 m$) is :

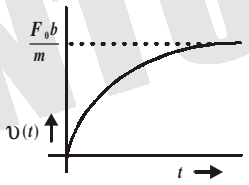
(1) $64km$ (2) $80km$ (3) $16km$ (4) $40km$

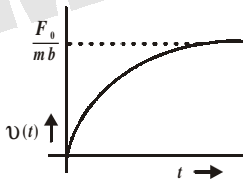
Sol.(2) $d = \sqrt{2Rh} = \sqrt{2 \text{ x } 6.4 \text{ x } 10^6 \text{ x } 500} = 80km$

18. A particle of mass m is at rest at the origin at time $t = 0$. It is subjected to a force $F(t) = F_0 e^{-bt}$ in the x-direction. Its speed $v(t)$ is depicted by which of the following curves ?

(1) 

(2) 

(3) 

(4) 

Sol.(1) $F = F_0 e^{-bt}$

$$a = \frac{F_0}{m} e^{-bt}$$

$$\frac{dv}{dt} = \frac{F_o e^{-bet}}{m}$$

$$\int dv = \frac{F_0}{m} . \int e^{-bt} dt$$

$$v = \frac{F_0}{m} . \frac{e^{-bt}}{-b} = \frac{-F_0}{mb} e^{-bt}$$

19. A cylindrical tube, open at both ends, has a fundamental frequency, f, in air. The tube is dipped vertically in water so that half of it is in water. The fundamental frequency of the air-column is now:

(1) $2f$ (2) f (3) $f/2$ (4) $3f$

Sol.(2) $f=\frac{v}{2l}$.....(1)

$f'=\frac{v}{4.\frac{l}{2}}$ .....(2)

$f = f^1$

20. The mass of a spaceship is 1000 kg. It is to be launched from the earth's surface out into free space. The value of 'g' and 'R' (radius of earth) are $10\,m/s^2$ and 6400 km respectively. Teh required energy for this work will be:

(1) $6.4 \text{ x } 10^{10}$ Joules (2) $6.4 \text{ x } 10^{11}$ Joules (3) $6.4 \text{ x } 10^{8}$ Joules (4) $6.4 \text{ x } 10^{9}$ Joules

Sol.(1) $E=\frac{1}{2}m.\ 2gR=10^3 \text{x } 10 \text{ x } 6.4 \text{ x } 10^6=6.4 \text{ x } 10^{10}\ J.$

21. A boy can throw a stone up to a maximum height of $10\,m$. The maximum horizontal distance that the boy can throw the same stone up to will be:

(1) $20\,m$ (2) $20\sqrt{2}\,m$ (3) $10\,m$ (4) $10\sqrt{2}\,m$

Sol.(1) Maximum hight = $10=\frac{u^2}{2g}$

and maximum range = $R=\frac{u^2}{g}=20m$

22. If a simple pendulum has significane amplitude (up to a factor of 1/e of original only in the period between $t=0s$ to $t=\tau s$ then τ may be called the average life of the pendulum. When the spherical bob of the pendulum sufferes a retardation (due to viscous drag) proportional to its velocity with 'b' as the constant of proportionality the average life time of the pendulum is (assuming damping is small) in seconds:

(1) $\frac{2}{b}$ (2) $\frac{0.693}{b}$ (3) b (4) $\frac{1}{b}$

Sol.(1) Displacment of equation of pendulam under damped oscillation is given by

$x=A\bar{e}^{bt/2m}\cos\left(\omega' t+\phi\right)$

$\tau=\frac{2m}{b}$

23. An electromagnetic wave in vacuum has the electric and magnetic fields $\vec{E}$ and $\vec{B}$, which are always perpendicular to each other. The direction of polarization is given by $\vec{X}$ and that of wave propagation by $\vec{k}$. Then:

(1) $\vec{X} \parallel \vec{E}$ and $\vec{K} \parallel \vec{B} \text{ x } \vec{E}$ (2) $\vec{X} \parallel \vec{B}$ and $\vec{K} \parallel \vec{B} \text{ x } \vec{E}$

(3) $\vec{X} \parallel \vec{E}$ and $\vec{K} \parallel \vec{E} \text{ x } \vec{E}$ (4) $\vec{X} \parallel \vec{B}$ and $\vec{K} \parallel \vec{E} \text{ x } \vec{B}$

Sol.(3) $\vec{E}$ will be polarized therefor $\vec{X} \parallel \vec{E}$ and $\hat{k} \parallel \vec{E} \times \vec{B}$

24. This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements.

An insulating solid sphere of radius R has a uniformly positive charge density ρ. As a result of this uniform charge distribution there is a finite value of electric potential at the centre of the fsphere, at the surface of the sphere and also at a point out side the sphere. Teh electric potential at infinity is zero.

Statement 1: When a charge 'q' is taken from the centre to the surface of the sphere, its potential energy changes by $\frac{q\rho}{3\varepsilon_0}$

Statement 2 : The electric field at a distance $r\,(r<R)$ from the centre of the sphere is $\frac{\rho r}{3\varepsilon_0}$

(1) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.

(2) Statement 1 is true, Statement 2, is true; Statement 2 is not the correct explanation of Statement 1.

(3) Statement 1 is true Statement 2 is false.

(4) Statement 1 is false Statement 2 is true.

Sol.(4) $\rho = \frac{3Q}{4\pi R^3}$

$3Q = 4\pi \times R^3$

$Q = \frac{4\pi}{3} R^3.\rho$

$V_C = \frac{3Q}{8\pi_0 R} = \frac{3}{8\pi\varepsilon_0 R} \times \frac{4\pi}{3} R^3\rho = \frac{\rho R^2}{2\varepsilon_0}$

$V_S = \frac{1}{4\pi\varepsilon_0}.\frac{Q}{R} = \frac{1}{4\pi\varepsilon_0}.\frac{4\pi}{3} R^3\rho = \frac{PR^2}{3\varepsilon_0}$

$\Delta V = \frac{\rho R^2}{\varepsilon_0}\left(\frac{1}{3}-\frac{1}{2}\right) = \frac{-PR^2}{6\varepsilon_0}$

$\Delta U = \frac{-q\rho R^2}{6\varepsilon_0}$ and $E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2} = \frac{1}{4\pi\varepsilon_0 r^2}.\frac{4\pi}{3} r^3\rho = \frac{\rho r}{3\varepsilon_0}$

25. A diatomic molecule is made of two masses m_1 and m_2 which are separated by a distance r. If we calculate its rotational energy by applying Bohr's rule of angular momentum quantization, its energy will be given by: (n is an integar)

(1) $\frac{(m_1+m_2)n^2h^2}{2m_1m_2r^2}$ (2) $\frac{(m_1+m_2)^2n^2h^2}{2m_1^2m_2^2r^2}$ (3) $\frac{n^2h^2}{2(m_1+m_2)r^2}$ (4) $\frac{2n^2h^2}{(m_1+m_2)r^2}$

Sol.(1) $I\omega = \frac{nh}{2n}$

$I = \mu r^2 = \frac{m_1 m_2}{m_1 m_2}.r^2 \qquad \therefore \omega = \frac{nh(m_1+m_2)}{2\pi . m_1 m_2 r^2} \qquad \therefore R.K.E = \frac{1}{2} IW^2 = \frac{1}{2} x \frac{m_1 m_2}{m_1+m_2} r^2$

$= \frac{n^2h^2(m_1+m_2)^2}{m_1 m_2 . r^2} = \frac{1}{2}\frac{n^2h^2(m_1+m_2)}{m_1 m_2 . r^2}$

26. Two cars of masses m_1 and m_2 are moving in circles of radii r_1 and r_2, respectively. Their speeds are such that they make complete circles in the same time t. The ratio of their centripetal acceleration is :

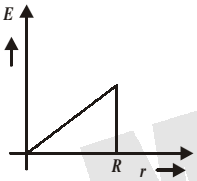
(1) $1:1$ (2) $m_1 r_1 : m_2 r_2$ (3) $m_1 : m_2$ (4) $r_1 : r_2$

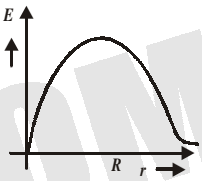
Sol.(4) $\omega_1 = \omega_2 = \omega$

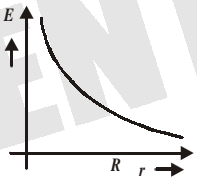
$a_1 = \omega^2 . r_1$ and $a_2 = \omega^2 . r_2$

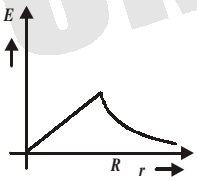
$a_1 : a_2 = r_1 : r_2$

27. In a uniformly charged sphere of total charge Q and radius R, the electric field E is plotted as a function of istance from the centre. The graph which would correspond to the above will be :

(1) 

(2) 

(3) 

(4) 

Sol.(4) $E = \frac{1}{4\pi\varepsilon_0}\frac{Qr}{R^3}; r < R$

$E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^3}; r > R$

28. Assume that a neutron breaks into a proton and an electron. The energy released during this process is :

(mass of neutron $= 1.6725 \times 10^{-27} kg$, Mass of proton $= 1.6725 \times 10^{-27} kg$, Mass of electron $= 9 \times 10^{-31} kg$)

(1) $5.4\,MeV$ (2) $0.73\,MeV$ (3) $7.10\,MeV$ (4) $6.30\,MeV$

Sol.(2) $E = \Delta mc^2 = 0.0009 \text{ x } 10^{-27} c^2 = \frac{0.009 \text{ x } 10^{-27}}{1.67 \text{ x } 10^{-27}} \text{ x } 931.5 \text{ MeV} = 0.73\,MeV$

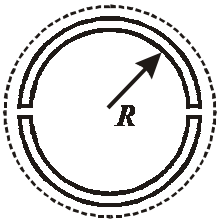
29. A wooden wheel of radium R is made of two semicircular parts (see figure). The two parts are held together by a ring made of a metal strip of cross sectional area S and length L. L is slightly less than $2\pi R$. To fit the ring on the wheel, it is heated so that its temperature rises by ΔT and it just stedps over the wheel. As it cools down to surrounding temperature, it presses the semicircular parts together. If the coefficient of linear expansion of the metal is α, and its Youngs' modulus is Y, the force that one part of the wheel applies on the other part is:

(1) $2\pi\, SY\alpha\Delta T$

(2) $\pi\, SY\alpha\Delta T$

(3) $SY\alpha\Delta T$

(4) $2\, SY\alpha\Delta T$



Sol.(3) $\frac{\Delta l}{L} = \alpha\, \Delta T$

$$Y = \frac{F/S}{\Delta l/L}$$

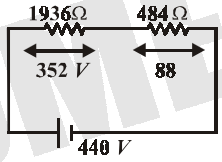
$$F = Y\, S \propto \Delta T$$

30. Two electric bulbs marked $25W - 220V$ and $100W - 220V$ are connected in series to a $440V$ supply. Which of the bulbs will fuse ?

(1) neither (2) both (3) $100W$ (4) $25W$

Sol.(4) $R_{25W} = R_1 = \frac{48400}{25} = 1936\Omega$

$$R_{100W} = R_2 = \frac{48400}{100} = 484\Omega$$



PART B : CHEMISTRY

31. Which of the following compounds can be detected by Molisch's test ?

(1) Primary alcohols (2) Nitro compounds (3) Sugars (4) Amines

31.(3) Molish Test is Test of Carbohydrates

32. The increasing order of the ionic radii of the given isoelectronic species is :

(1) $K^+, S^{2-}, Ca^{2+}, Cl^-$ (2) $Cl^-, Ca^{2+}, K^+, S^{2-}$

(3) $S^{2-}, Cl^-, Ca^{2+}, K^+$ (4) $Ca^{2+}, K^+, Cl^-, S^{2-}$

32.(4) $Ca^{+2}, K^+, Cl^-, S^{-2}$

33. Which one of the following statements is **correct** ?

(1) All amino acids except glutamic acid are optically active

(2) All amino acids except lysine are optically active

(3) All amino acids are optically active

(4) All amino acids except glycine are optically active

33.(4) Glycine $H_2N - CH_2 - \overset{\overset{O}{\|}}{C} - OH$

34. 2-Hexyne gives trans-2-Hexene on treatment with :

(1) Li / AlH_4 (2) Pt / H_2 (3) Li / NH_3 (4) $Pd / BaSO_4$

34.(3) $\underset{\text{Hexyne-2}}{CH_3 - CH_2 - CH_2 - C \equiv C - CH_3} \xrightarrow[\text{Birch reduction}]{Li/NH_3} \underset{\text{2-Hexene (Trans)}}{CH_3 - CH_2 - CH_2 - \overset{H}{\underset{|}{C}} = \overset{H}{\underset{|}{C}} - CH_3}$

35. The species which can best serve as an initiator for the cationic polymerization is :

(1) $BuLi$ (2) $LiAlH_4$ (3) HNO_3 (4) $AlCl_3$

35.(3) Cationic polymerisation is initiated by acids.

36. The standard reduction potentials for Zn^{2+} / Zn , Ni^{2+} / Ni and Fe^{2+} / Fe are $-0.76, -0.23$ and $-0.44V$ respectively. The reaction $X + Y^2 \rightarrow X^{2+} + Y$ will be spontaneous when :

(1) $X = Zn, Y = Ni$ (2) $X = Ni, Y = Fe$ (3) $X = Ni, Y = Zn$ (4) $X = Fe, Y = Zn$

36.(1) $X = Zn \rightarrow$ Anode $\rightarrow$ oxidation

$Y = Ni \rightarrow$ cathode $\rightarrow$ reduction

37. Lithium forms body centred cubic structure. The length of the side of its unit cell is 351pm. Atomic radius of the lithium will be :

(1) 152 pm (2) 75 pm (3) 300 pm (4) 240 pm

37.(1) For B.C. C.

$\sqrt{3}a = 4r$

$r = \frac{\sqrt{3}a}{4} = \frac{\sqrt{3} \times 351}{4} = 151.9 = 152PM$

38. The electrons identified by quantum numbers n and l :

(a) $n = 4, l = 1$ (b) $n = 4, l = 0$ (c) $n = 3, l = 2$ (d) $n = 3, l = 1$

can be placed in order of increasing energy as :

(1) $(a) < (c) < (b) < (d)$ (2) $(c) < (d) < (b) < (a)$

(3) $(d) < (b) < (c) < (a)$ (4) $(b) < (d) < (a) < (c)$

38.(3) $(n + l) \propto$ energy

When $(n + l)$ are same for two orbitals then $n \propto$ energy.

so order is $d < b < c < a$

39. According to Freundlich adsorption isotherm which of the following is **correct** ?

(1) $\frac{x}{m} \propto P^0$

(2) $\frac{x}{m} \propto P^1$

(3) $\frac{x}{m} \propto P^{1/n}$

(4) All the above are correct for different ranges of pressure

39.(4) $\frac{x}{m} = KP^{1/n}$

all the above statements are correct.

40. The density of a solution prepared by dissolving 120g of urea (mol mass= $60u$) in 1000g of water is $1.15g/mL$ .The molarity of this solution is :

(1) 2.05 M (2) 0.50 M (3) 1.78 M (4) 1.02 M

40.(1) $W_1 = 120$, $M_1 = 60$, $d = 1.15 g/ml$, $W_2 = 1000\, g$

$$m = \frac{W_1}{M_1 \cdot W_2} \Rightarrow m = \frac{120}{60 \times 1} = 2$$

$$\boxed{m = \frac{1000\, M}{1000\, d - MM_1}}$$

$$\boxed{M = 2.05}$$

41. The pH of a 0.1 molar solution of the acid HQ is 3. The value of the ionization constant, Ka of this acid is

(1) 1×10^{-7} (2) 3×10^{-1} (3) 1×10^{-3} (4) 1×10^{-5}

41.(4) $\left[H^+\right] = \sqrt{K_a \cdot C}$

$$K_a = \frac{\left[H^+\right]^2}{C} = \frac{10^{-6}}{10^{-1}} = 10^{-5}$$

42. The **incorrect** expression among the following is :

(1) $K = e^{-\Delta G^\circ / RT}$

(2) $\frac{\Delta G_{system}}{\Delta S_{total}} = -T$

(3) In isothermal process $w_{reversible} = -nRT \ln \frac{V_f}{V_i}$

(4) $\ln K = \frac{\Delta H^\circ - T\Delta S^\circ}{RT}$

42.(4) because correct relation

$\Rightarrow \Delta G^0 = -RT \ln k$

$$\ln k = -\frac{\Delta G^0}{RT}$$

$$\ln k = \frac{-\left[\Delta H^\circ - T\Delta S^0\right]}{RT}$$

43. Iodoform can be prepared from all except :

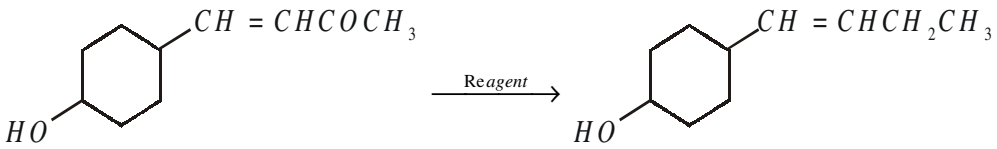
(1) Isobutyl alcohol (2) Ethyl methyl ketone

(3) Isopropyl alcohol (4) 3-Methyl-2-butanone

43.(1) Isobutyl alcohol cannot form Iodoform.

$$CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}} - CH_2 - OH$$

44. In the given transformation which of the following is the most appropriate reagent ?



(1) $NaBH_4$ (2) $NH_2NH_2, \overset{\ominus}{O}H$ (3) $Zn-Hg/HCl$ (4) $Na, liq.NH_3$

44.(2) $NH_2/NH_2/OH^{\ominus}$ - Wolf kishner. In clemmenson's reduction $(Zn/Hg+HCl)$ $OH-$ group will also be protonated.

45. Very pure hydrogen (99.9%) can be made by which of the following processes ?

(1) Reaction of salt like hydrides with water

(2) Reaction of methane with steam

(3) Mixing natural hydrocarbons of high molecular weight

(4) Electrolysis of water

45.(1) Factual question

46. Which among the following will be named as dibromidobis (ethylene diamine) chromium (III) bromide ?

(1) $\left[Cr(en)Br_2\right]Br$ (2) $\left[Cr(en)_3\right]Br_3$ (3) $\left[Cr(en)_2Br_2\right]Br$ (4) $\left[Cr(en)Br_4\right]$

46.(3) $\left[Cr(en)_2Br_2\right]Br$

47. Ortho-Nitrophenol is less soluble in water than $p-$ and $m-$ nitrophenols because :

(1) Melting point of $o-$ Nitrophenol is lower than those of $m-$ and $p-$ isomers.

(2) $o-$ Nitrophenol is more volatile in steam than those of $m-$ and $p-$ isomers

(3) $o-$ Nitrophenol shows intramolecular H-bonding

(4) $o-$ Nitrophenol shows intermolecular H-bonding

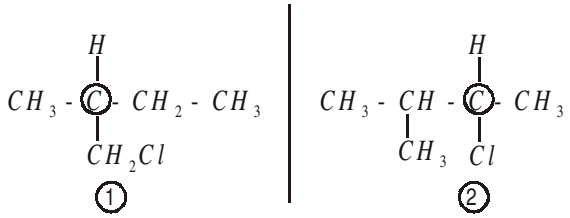
47.(3) Ortho nitrophenol has intramolecular H -bonding.

48. How many chiral compounds are possible on monochlorination of 2-methyl butane ?

(1) 6 (2) 8 (3) 2 (4) 4

48.(4) $CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_3 \longrightarrow$ 2 Methyl butane

Monochlorinated Product



Because these (2) can form d & l isomers hence total chiral products are 4.

49. Iron exhibit +2 and +3 oxidation states. Which of the following statements about iron is **incorrect**?

(1) Ferrous compounds are more easily hydrolysed than the corresponding ferric compounds

(2) Ferrous oxide is more basic in nature than the ferric oxide

(3) Ferrous compounds are relatively more ionic than the corresponding ferric compounds

(4) Ferrous compounds are less volatile than the corresponding ferric compounds

49.(1)

50. What is DDT among the following :

(1) Non-biodegradable pollutant (2) Greenhouse gas

(3) A fertilizer (4) Biodegradable pollutant

50.(1) Non biodegradable pollutant

51. K_f for water is $1.86 K\, kg\, mol^{-1}$. If your automobile radiator holds $1.0\, kg$ of water, how many grams of ethylene glycol $(C_2H_6O_2)$ must you add to get the freezing point of the solution lowered to $-2.8°C$?

(1) 27 g (2) 72 g (3) 93 g (4) 39 g

51.(3) $W_1 = ?, M_1 = 62, W_2 = 1kg, \Delta T_f = 2.8^0 C, K_f = 1.86$

$$\Delta T_f = K_f m$$

$$m = \frac{\Delta T_f}{K_f}$$

$$m = 1.5$$

$$m = \frac{W_1}{M_1 \cdot W_2} \quad \boxed{W_1 = 93g}$$

52. Which method of purification represented by the following equation :

$$Ti(s)+2I_2(g)\xrightarrow{523K}TiI_4(g)\xrightarrow{1700K}Ti(s)+2I_2(g)$$

(1) Van Arkel (2) Zone refining (3) Cupellation (4) Poling

52.(1) Ti, Zr, Hf, Si refined by Van arkel process.

53. Which branched chain isomer of the hydrocarbon with molecular mass $72u$ gives only isomer of mono substituted alkyl halide ?

(1) Neohexane (2) Tertiary butyl chloride

(3) Neopentane (4) Isohexane

53.(3) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3 \longrightarrow$ Neopentane

Only 1^0 Hydrogen is present in Neopentane hence only one mono substituted alkyl halide formed.

54. The equilibrium constant (K_c) for the reaction $N_2(g)+O_2(g)\rightarrow 2NO(g)$ at temperature T is 4×10^{-4}. The value of K_c for the reaction, $NO(g)\rightarrow 1/2N_2(g)+1/2O_2(g)$ at the same temperature is

(1) 50.0 (2) 0.02 (3) 2.5×10^2 (4) 4×10^{-4}

54.(1) $N_2+O_2 \rightleftharpoons 2NO;\ K_c=4\times10^{-4}$

$$NO \rightleftharpoons \frac{1}{2}N_2+\frac{1}{2}O_2;\ K_c=\sqrt{\frac{1}{4\times10^{-4}}}=50$$

55. For a first order reaction $(A)\rightarrow$ products the concentration of A changes from $0.1M$ to $0.025M$ in 40 minutes. The rate of reaction when the concentration of A is $0.01M$ is

(1) $1.73\times10^{-4}M/\min$ (2) $1.73\times10^{-5}M/\min$

(3) $3.47\times10^{-4}M/\min$ (4) $3.47\times10^{-5}M/\min$

55.(3) A changes from $0.1M\rightarrow0.025M$ in 40 min means 2 half lifes

$$t_{1/2}=20\min\ :\ K=\frac{0.693}{t_{1/2}}=\frac{0.693}{20}=0.0347$$

$$r=k[A]$$

$$r=0.0347[0.01] \qquad =347\times10^{-6}=3.47\times10^{-4}$$

56. Aspirin is known as :

(1) Methyl salicylic acid

(2) Acetyl salicylic acid

(3) Phenyl salicylate

(4) Acetyl salicylate

56.(2) Aspirin is Acetyl salicylic acid.

57. The molecule having smallest bond angle is :

(1) PCl_3 (2) NCl_3

(3) $AsCl_3$ (4) $SbCl_3$

57.(4) E N of central atom α Bond angle

E. N. is in the order $N > P > As > Sb > Bi$

58. The compressibility factor for a real gas at high pressure is :

(1) $1 - pb/RT$ (2) $1 + RT/pb$

(3) 1 (4) $1 + pb/RT$

58.(4) At high pressure

$$Z = 1 + \frac{Pb}{RT}[Z > 1]$$

59. Which of the following on thermal decomposition yields a basic as well as an acidic oxide ?

(1) NH_4NO_3 (2) $NaNO_3$

(3) $KClO_3$ (4) $CaCO_3$

59.(4) $CaCO_3 \longrightarrow \underbrace{CaO}_{\text{Basic}} + \underbrace{CO_2}_{\text{Acidic}}$

60. In which of the following pairs the two species are **not** isostructural ?

(1) AlF_6^{3-} and SF_6 (2) CO_3^{2-} and NO_3^-

(3) PCl_4^+ and $SiCl_4$ (4) PF_5 and BrF_5

60.(4) PBr_5 (sp^3d^2 ; square pyramidal) & BrF_5 (sp^3d ; Trigonal bipyramidal)

PART C : MATHEMATICS

61. Statement 1 : The sum of the series

$1+(1+2+4)+(4+6+9)+(9+12+16)+.....+(361+380+400)$ is 8000

Statement 2 : $\sum_{k=1}^{n}\left(k^3-(k-1)^3\right)=n^3$ for any natural number n.

61. Both Assertion and Reason are true and Reason is the correct explanation of 'Assertion'

General term of series

$$\sum_{k=1}^{n}\left(k^3-(k-1)^3\right)=\sum_{k=1}^{n}\left(3k^2-3k+1\right)$$

$$\Rightarrow 3\sum_{k=1}^{n}k^2-3\sum_{k=1}^{n}k+\sum_{k=1}^{n}1=\frac{3\cdot(n)(n+1)(2n+1)}{6}-\frac{3(n)(n+1)}{2}+n=\frac{(n)(n+1)}{2}[2n+1-3]+n$$

$$=\frac{(n)(n+1)}{2}(2n-2)+n=(n^2-1)(n)+n=n^3$$

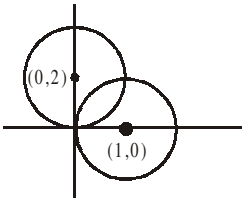
Statement (1) is true

Statement (2) is true (4)

62. An ellipse is drawn by taking a diameter of the circle $(x-1)^2+y^2=1$ as its semiminor axis and a diameter of the circle $x^2+(y-2)^2=4$ as its semi-major axis. If the centre of the ellipse is at the origin and its axes are the coordinate axes, then the equation of the ellipse is :

(1) $x^2+4y^2=16$ (2) $4x^2+y^2=4$ (3) $x^2+4y^2=8$ (4) $4x^2+y^2=8$

62.(1)

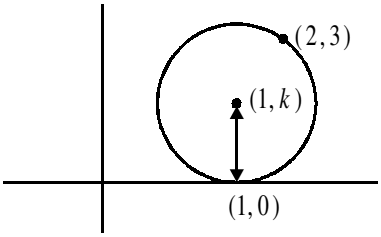


$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1\Rightarrow\frac{x^2}{4^2}+\frac{y^2}{2^2}=1\Rightarrow\frac{x^2}{16}+\frac{y^2}{4}=1\Rightarrow 4x^2+16y^2=16xy\Rightarrow x^2+4y^2=16$$

63. The length of the diameter of the circle which touches the x-axis at the point $(1,0)$ and passes through the point $(2,3)$ is :

(1) $\frac{5}{3}$ (2) $\frac{10}{3}$ (3) $\frac{3}{5}$ (4) $\frac{6}{5}$

63.(2)



$(x-1)^2+(y-k)^2=k^2 \Rightarrow 1^2+(3-k)^2=k^2 \Rightarrow 9+k^2-6k+1=k^2 \Rightarrow k=\frac{10}{6}$

$\therefore$ diameter $\Rightarrow \frac{10}{3}$

64. Let P and Q be 3×3 matrices with $P\neq Q$. If $P^3=Q^3$ and $P^2Q=Q^2P$, then determinant of (P^2+Q^2) is equal to :

(1) -1 (2) -2 (3) 1 (4) 0

64.(4)

65. If n is a positive integer, then $\left(\sqrt{3}+1\right)^{2n}-\left(\sqrt{3}-1\right)^{2n}$ is :

(1) a rational number other than positive integers

(2) an irrational number

(3) an odd positive integer

(4) an even positive integer

65.(2) $\left(\sqrt{3}+1\right)^{2n}-\left(\sqrt{3}-1\right)^{2n}$ Put $n=1$

$\left(\sqrt{3}+1\right)^2-\left(\sqrt{3}-1\right)^2.\left(2\sqrt{3}\right)(2)=4\sqrt{3}$

66. **Statement -1** : An equation of a common tangent to the parabola $y^2=16\sqrt{3}x$ and the ellipse $2x^2+y^2=4$ is $y=2x+2\sqrt{3}$.

Statement -2 : If the line $y=mx+\frac{4\sqrt{3}}{m},(m\neq0)$ is a common tangent to the parabola $y^2=16\sqrt{3}x$ and the ellipse $2x^2+y^2=4$, then m satisfies $m^4+2m^2=24$.

66. Both Assertion and Reason are true and Reason is the correct explanation of 'Assertion'

$y^2=16\sqrt{3}x$ i.e. $y^2=4\left(4\sqrt{3}\right)x$; eq. of tangent is $y=2x+\frac{4\sqrt{3}}{2}\Rightarrow y=2x+2\sqrt{3}$

Now, $2x^2 + y^2 = 4$

$\frac{x^2}{2} + \frac{y^2}{4} = 1$

eqn. of tangent, $y = 2x \pm \sqrt{2 \cdot 4 + 4} \implies y = 2x \pm 2\sqrt{3}$

Statement (1) is true

$\frac{4\sqrt{3}}{m} = \sqrt{2 \cdot m^2 + 4}$

Saring, $\frac{48}{m^2} = 2m^2 + 4$

$2m^4 + 4m^2 = 48$

$m^4 + 2m^2 = 24 \Rightarrow (m^2)^2 + 2(m^2) - 24 = 0 \Rightarrow (m^2 + 6)(m^2 - 4) = 0 \Rightarrow m = \pm 2$

Statement (2) is correct

67. Three numbers are chosen at random without replacement from $\{1, 2, 3, ...8\}$. The probability that their minimum is 3, given that their maximum is 6, is :

(1) $\frac{2}{5}$ (2) $\frac{3}{8}$ (3) $\frac{1}{5}$ (4) $\frac{1}{4}$

67.(3) $A =$ min is 3, $B =$ max is 6

$\therefore \; P(A/B) = \frac{P(A \cap B)}{P(B)} = \frac{2C_1}{5C_2} = \frac{2}{10} = \frac{1}{5}$

68. If $g(x) = \int_0^x \cos 4t dt$, then $g(x + \pi)$ equals :

(1) $g(x).g(\pi)$ (2) $\frac{g(x)}{g(\pi)}$ (3) $g(x) + g(\pi)$ (4) $g(x) - g(\pi)$

68. (3) $g(x + \pi) = \int_0^{x+\pi} \cos 4t dt = \int_0^x \cos 4t dt + \int_x^{x+\pi} \cos 4t dt$

$g(x + \pi) = g(x) + \int_0^{\pi} \cos 4t dt \Rightarrow g(x + \pi) = g(x) + g(\pi)$

69. Assuming the balls to be identical except for difference in colours, the number of ways in which one or more balls can be selected from 10 white, 9 green and 7 black balls is :

(1) 879 (2) 880 (3) 629 (4) 630

69.(1) $10 - w$

$9 - g$

$7-B$ $\Rightarrow$ Total ways

$\Rightarrow$ $(11)(10)(8)-1$

$\Rightarrow$ 879

70. If 100 times the 100^{th} term of an AP with non zero common difference equals the 50 times its 50^{th} term, then the 150^{th} term of this AP is :

(1) zero (2) -150

(3) 150 times its 50^{th} term (4) 150

70. (1) $100(a+99d)=50(a+49)d \Rightarrow 50a+7450d=0 \Rightarrow (a+149d)=0 \Rightarrow T_{150}=0$ Ans. (2)

71. The area bounded between the parabolas $x^2=\frac{y}{4}$ and $x^2=9y$, and the straight line $y=2$

(1) $10\sqrt{2}$ (2) $20\sqrt{2}$ (3) $\frac{10\sqrt{2}}{3}$ (4) $\frac{20\sqrt{2}}{3}$

71.(3) $\int_0^2 3\sqrt{y}\,dy-\int_0^2 \frac{1}{2}\sqrt{y}\,dy = \left(3\frac{2}{3}y^{\frac{3}{2}}\right)_0^2-\left(\frac{1}{2}\frac{2}{3}y^{\frac{3}{2}}\right)_0^2=\left(2-\frac{1}{3}\right)\left(2\sqrt{2}\right)=\frac{10}{3}\sqrt{2}$ Ans. (4)

72. An equation of a plane parallel to the plane $x-2y+2z-5=0$ and at a unit distance from the origin is :

(1) $x-2y+2z+5=0$ (2) $x-2y+2z-3=0$

(3) $x-2y+2z+1=0$ (4) $x-2y+2z-1=0$

72. (2)

73. The equation $e^{\sin x}-e^{-\sin x}-4=0$ has :

(1) exactly four real roots (2) infinite number of real roots

(3) no real roots (4) exactly one real root

73. (3)

74. The negation of the statement

"If I become a teacher, then I will open a school" is :

(1) I will not become a teacher or I will open a school

(2) I will become a teacher and I will not open a school

(3) Either I will not become a teacher or I will not open a school .

(4) Neither I will become a teacher nor I will open a school

74.(3) $p \rightarrow q$

$\therefore\ (\overline{p} \vee q) = p \wedge \overline{q}$

75. The population $p(t)$ at time t of a certain mouse species satisfies the differential equation $\frac{dp(t)}{dt} = 0.5p(t) - 450$. If $p(0) = 850$, then the time at which the population becomes zero is :

(1) $\ln 18$ (2) $2\ln 18$ (3) $\ln 9$ (4) $\frac{1}{2}\ln 18$

75. (2) $\frac{dy}{dt} - \frac{1}{2}y = -450$. Now $I.F = e^{\int -\frac{1}{2}dt} = e^{-\frac{1}{2}t}$

then $ye^{-\frac{t}{2}} = \int (-450)e^{-\frac{t}{2}}dx + C$

$ye^{-\frac{t}{2}} = -450(-2)e^{-\frac{t}{2}} + C \Rightarrow (y-900)e^{-\frac{t}{2}} = C \Rightarrow c = -50e^{-\frac{t}{2}} \Rightarrow P(t) = 50e^{\frac{t}{2}} + 900$

$\Rightarrow P(t) = 0 \Rightarrow \Rightarrow e^{\frac{t}{2}} = \frac{900}{50} \Rightarrow \Rightarrow \frac{t}{2} = \log e\frac{900}{50} \Rightarrow t = 2\ln 18$ Ans. (3)

76. If the integral $\int \frac{5\tan x}{\tan x - 2}dx = x + a\ln|\sin x - 2\cos x| + k$ then a is equal to :

(1) 2 (2) -1

(3) -2 (4) 1

76. (1) $\int \frac{5\tan x}{\tan x - 2} = \int \frac{5\sin x}{\sin x - 2\cos x}dx = \int \frac{\sin x - 2\cos x}{\sin x - 2\cos x} + \int \frac{4\sin x + 2\cos x}{\sin x - 2\cos x}$

$= x + 2\int \frac{(\cos x + 2\sin x)}{\sin x - 2\cos x}dx = x + 2\ln|\sin x - 2(\cos x)| + C$

$\therefore a = 2$

77. Let $\hat{a}$ and $\hat{b}$ be two unit vectors. If the vectors $\vec{c} = \hat{a} + 2\hat{b}$ and $\vec{d} = 5\hat{a} - 4\hat{b}$ are perpendicular to each other, then the angle between $\hat{a}$ and $\hat{b}$ is :

(1) $\frac{\pi}{4}$ (2) $\frac{\pi}{6}$ (3) $\frac{\pi}{2}$ (4) $\frac{\pi}{3}$

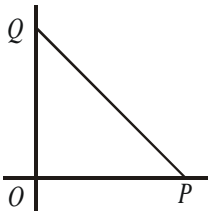
77. (4) $\vec{c}.\vec{d} = 0 \ \therefore (a+2b)(5a-4b) = 0 \Rightarrow 5a^2 + 10a.b - 4a.b - 8b^2 = 0 \Rightarrow 5 + 6a.b - 8 = 0$

$\Rightarrow |a||b|\cos\theta = \frac{3}{6} = \frac{1}{2} \Rightarrow \theta = \left(\frac{\pi}{3}\right)$

78. A line is drawn through the point $(1,2)$ to meet the coordinate axes at P and Q such that it forms a triangle OPQ, where O is the origin. If the area of the triangle OPQ is least, then the slope of the line PQ is :

(1) $-\frac{1}{2}$ (2) $-\frac{1}{4}$ (3) -4 (4) -2

78. (4)



$$y-2=m(x-1) \Rightarrow mx-y=m-2 \Rightarrow \frac{x}{\frac{m-2}{m}}+\frac{y}{2-m}=1$$

$$\text{Area}=\frac{1}{2}\left(\frac{m-2}{m}\right)(m-2)=\frac{m^2-4m+4}{2m} \Rightarrow A=\frac{(m-2)^2}{2m}$$

$$\Rightarrow \frac{dA}{dm}=\frac{1}{2}\frac{m_2(m-2)-(m-2)^2\cdot 1}{m^2}=\frac{(m-2)(m+2)}{m^2}=0 \Rightarrow m=-2$$

79. Let $X=\{1,2,3,4,5\}$. The number of different ordered pairs (Y,Z) that can be formed such that $Y\subseteq X, Z\subseteq X$ and $Y\cap Z$ is empty is :

(1) 5^3 (2) 5^2 (3) 3^5 (4) 2^5

79. (3) $X=\{1,2,3,4,5\}$

element (1) can be given to y or z or no one = 3
element (2) can be given to y or z or no one = 3
element (3) can be given to y or z or no one = 3
element (4) can be given to y or z or no one = 3
element (5) can be given to y or z or no one = 3 $\Rightarrow 3^5$

80. Let $ABCD$ be a parallelogram such that $\overrightarrow{AB}=\vec{q}, \overrightarrow{AD}=\vec{p}$ and $\angle BAD$ be an acute angle. If $\vec{r}$ is the vectors that coincides with the altitude directed from the vertex B to the side AD then $\vec{r}$ is given by :

(1) $\vec{r}=-3\vec{q}+\frac{3(\vec{p}.\vec{q})}{(\vec{p}.\vec{p})}\vec{p}$ (2) $\vec{r}=3\vec{q}-\frac{3(\vec{p}.\vec{q})}{(\vec{p}.\vec{p})}\vec{p}$

(3) $\vec{r} = -\vec{q} + \frac{(\vec{p}.\vec{q})}{(\vec{p}.\vec{p})}\vec{p}$ (4) $\vec{r} = \vec{q} - \frac{(\vec{p}.\vec{q})}{(\vec{p}.\vec{p})}\vec{p}$

80.(3)

81. If the line $2x + y = k$ passes through the point which divides the line segment joining the point $(1,1)$ and $(2,4)$ in the ratio $3:2$ then k equals :

(1) $\frac{11}{5}$ (2) $\frac{29}{5}$ (3) 5 (4) 6

81.(4)

82. In a ΔPQR, if $3\sin P + 4\cos Q = 6$ and $4\sin Q + 3\cos P = 1$, then the angle R is equal to :

(1) $\frac{3\pi}{4}$ (2) $\frac{5\pi}{6}$ (3) $\frac{\pi}{6}$ (4) $\frac{\pi}{4}$

82.(3)

83. Let $A = \begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 2 & 1 \end{pmatrix}$. If u_1 and u_2 are column matrices such that $Au_1 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$ and $Au_2 = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$, then $u_1 + u_2$ is equal to :

(1) $\begin{pmatrix} 1 \\ -1 \\ -1 \end{pmatrix}$ (2) $\begin{pmatrix} -1 \\ 1 \\ 0 \end{pmatrix}$ (3) $\begin{pmatrix} -1 \\ 1 \\ -1 \end{pmatrix}$ (4) $\begin{pmatrix} -1 \\ -1 \\ 0 \end{pmatrix}$

83. (1) $Au_1 = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$ and $Au_2 = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$

$\therefore A(u_1 + u_2) = \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$

$$\begin{pmatrix}1&0&0\\2&1&0\\3&2&1\end{pmatrix}(u_1+u_2)=\begin{pmatrix}1\\1\\0\end{pmatrix}\Rightarrow\begin{pmatrix}1&0&0\\2&1&0\\3&2&1\end{pmatrix}\begin{pmatrix}A\\B\\C\end{pmatrix}=\begin{pmatrix}1\\1\\0\end{pmatrix}$$

$A=1;\ 2A+B=1 \qquad \Rightarrow B=-1$

$3A+2B+C=0\Rightarrow C=-1$ i.e. $\begin{pmatrix}1\\-1\\-1\end{pmatrix}$

84. If $f:R\to R$ is a function defined by $f(x)=[x]\cos\left(\frac{2x-1}{2}\right)\pi$ where $[x]$ denotes the greatest integer function, then f is :

(1) continuous only at $x=0$

(2) continuous for every real x

(3) discontinuous only at $x=0$

(4) discontinuous only at non-zero integral values of x

84.(2)

85. A spherical balloon is filled with 4500π cubic meters of helium gas. If a leak in the balloon causes the gas to escape at the rate of 72π cubic meters per minute, then the rate (in meters per minute) at which the radius of the balloon decreases 49 minutes after the leakage began is :

(1) $\frac{9}{2}$ (2) $\frac{9}{7}$ (3) $\frac{7}{9}$ (4) $\frac{2}{9}$

85. (4) $V=49\times72\pi=3528\pi$. Remaining $V=972\pi$

then $972\pi=\frac{4}{3}\pi r^3\Rightarrow\frac{972\times3}{4}=r^3 \Rightarrow r^3=243\times3=3^6\Rightarrow r=9$

$\frac{dV}{dt}=4\pi r^2\frac{dr}{dt}\Rightarrow 72\pi=4\pi r^2\frac{dr}{dt}\Rightarrow\frac{18}{81}=\frac{dr}{dt}\Rightarrow\frac{dr}{dt}=\frac{2}{9}$

86. Let $a,b\in R$ be such that the function f given by $f(x)=\ln|x|+bx^2+ax, x\neq0$ has extreme values at $x=-1$ and $x=2$

Statement -1 : f has local maximum at $x=-1$ and at $x=2$

Statement 2 : $a=\frac{1}{2}$ and $b=\frac{-1}{4}$.

Ans : Both Assertion and Reason are true and Reason is not the correct explanation of 'Assertion'

86. (1) $f'(x)=\frac{1}{x}+2bx+a$

$f'(-1)=0 \quad \therefore\ a-2b-1=0$

$f'(2)=0 \quad \therefore\ a+4b+\frac{1}{2}=0 \qquad ...(1)$

$\therefore 6b+\frac{3}{2}=0 \quad \Rightarrow\ b=\frac{-3}{2\cdot 6}=-\frac{1}{4}$

$\therefore\ a=1+2b=1-\frac{1}{2}=\frac{1}{2}$

Statement (2) is true

$f'(x)=\frac{1}{x}-\frac{1}{2}x+\frac{1}{2} \Rightarrow\ f''(x)=\frac{-1}{x^2}-\frac{1}{2}=-\left(\frac{1}{x^2}+\frac{1}{2}\right)$

$\therefore$ Local max at $x=-1$ & 2

87. If $z\neq 1$ and $\frac{z^2}{z-1}$ is real, then the point represented by the complex number z lies :

(1) on the imaginary axis

(2) either on the real axis or on a circle passing through the origin

(3) on a circle with centre at the origin.

(4) either on the real axis or on a circle not passing through the origin.

87. (2) $\frac{(x^2-y^2)+2ixy}{(x-1)+iy}\cdot\frac{(x-1)-iy}{(x-1)-iy}$

Under condition $2xy(x-1)-y(x^2-y^2)=0 \ \Rightarrow y(2x^2-2x-x^2+y^2)=0 \ \Rightarrow y=0$ or $x^2+y^2-2x=0$

i.e. either on the real axis or on a circle passing through the origin Ans. (3)

88. Consider the function $f(x)=|x-2|+|x-5|, x\in R$.

Statement -1 : $f'(4)=0$

Statement -2 : f is continuous in $[2,5]$, differentiable in $(2,5)$ and $f(2)=f(5)$

Ans : Both Assertion and Reason are true and Reason is the correct explanation of 'Assertion'

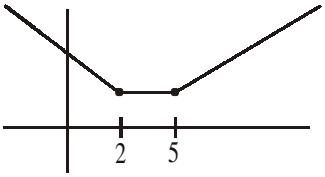
88. (1) $f(x)=|x-2|+|x-5|$

Statement (1) $f'(4)=0$

Statement (2) Conti. [2, 5]

diff. in (2, 5) & $f(2) = f(5)$

$$f(x) = \begin{cases} 2x-7 & x>5 \\ 3 & 2<x<5 \\ 7-2x & x<2 \end{cases}$$



Statement (1) is correct

Statement (2) is correct

89. Let $x_1, x_2, ...x_n$ be n observation and let $\bar{x}$ be their arithmetic mean and σ^2 be their variance

Statement -1 : Variance of $2x_1, 2x_2, ..., 2x_n$ is $4\sigma^2$.

Statement -2 : Arithmetic mean of $2x_1, 2x_2, ..., 2x_n$ is $4\bar{x}$.

Ans : Assertion is true but Reason is false

89. (3)

90. If the lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$ and $\frac{x-3}{1} = \frac{y-k}{2} = \frac{z}{1}$ intersect than k is equal to :

(1) 0 (2) -1 (3) $\frac{2}{9}$ (4) $\frac{9}{2}$

90. (4) $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$

$\frac{x-3}{1} = \frac{y-k}{2} = \frac{z}{1}$

Intersect

$$\therefore \begin{vmatrix} 2 & k+1 & -1 \\ 2 & 3 & 4 \\ 1 & 2 & 1 \end{vmatrix} = 0$$

$2(3-8)-(k+1)(-2)-1(1)=0$

$-10+2K+2-1=0$

$k = \frac{9}{2}$