

# SOLUTION TO AIEEE-2005

## PHYSICS

1. A projectile can have the same range  $R$  for two angles of projection. If  $t_1$  and  $t_2$  be the times of flights in the two cases, then the product of the two time of flights is proportional to

- (1)  $R^2$  (2)  $1/R^2$   
(3)  $1/R$  (4)  $R$

1. (4)

$$t_1 t_2 = \frac{2u^2 \sin 2\theta}{g^2} = \frac{2R}{g}$$

2. An annular ring with inner and outer radii  $R_1$  and  $R_2$  is rolling without slipping with a uniform angular speed. The ratio of the forces experienced by the two particles situated on the inner and outer parts of the ring,  $F_1/F_2$  is

- (1)  $\frac{R_2}{R_1}$  (2)  $\left(\frac{R_1}{R_2}\right)^2$   
(3) 1 (4)  $\frac{R_1}{R_2}$

2. (4)

$$\frac{F_1}{F_2} = \frac{R_1 \omega^2}{R_2 \omega^2} = \frac{R_1}{R_2}$$

3. A smooth block is released at rest on a  $45^\circ$  incline and then slides a distance  $d$ . The time taken to slide is  $n$  times as much to slide on rough incline than on a smooth incline. The coefficient of friction is

- (1)  $\mu_k = 1 - \frac{1}{n^2}$  (2)  $\mu_k = \sqrt{1 - \frac{1}{n^2}}$   
(3)  $\mu_s = 1 - \frac{1}{n^2}$  (4)  $\mu_s = \sqrt{1 - \frac{1}{n^2}}$

3. (1)

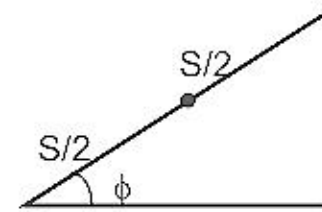
$$d = \frac{1}{2} \frac{g}{\sqrt{2}} t_1^2$$

$$d = \frac{1}{2} \frac{g}{\sqrt{2}} (1 - \mu_k) t_2^2$$

$$\frac{t_2^2}{t_1^2} = n^2 = \frac{1}{1 - \mu_k}$$

4. The upper half of an inclined plane with inclination  $\phi$  is perfectly smooth while the lower half is rough. A body starting from rest at the top will again come to rest at the bottom if the coefficient of friction for the lower half is given by

4. (3)  
 $mg s \sin \phi = \mu mg \cos \phi \cdot \frac{s}{2}$



5. A bullet fired into a fixed target loses half of its velocity after penetrating 3 cm. How much further it will penetrate before coming to rest assuming that it faces constant resistance to motion?

- (1) 3.0 cm (2) 2.0 cm  
 (3) 1.5 cm (4) 1.0 cm

5. (4)  
 $F \cdot 3 = \frac{1}{2}mv^2 - \frac{1}{2}m\frac{v^2}{4}$

$$F(3+x) = \frac{1}{2}mv^2$$

$$x = 1 \text{ cm}$$

6. Out of the following pair, which one does NOT have identical dimensions is

- (1) angular momentum and Planck's constant  
 (2) impulse and momentum  
 (3) moment of inertia and moment of a force  
 (4) work and torque

6. (3)  
 Using dimension

7. The relation between time  $t$  and distance  $x$  is  $t = ax^2 + bx$  where  $a$  and  $b$  are constants. The acceleration is

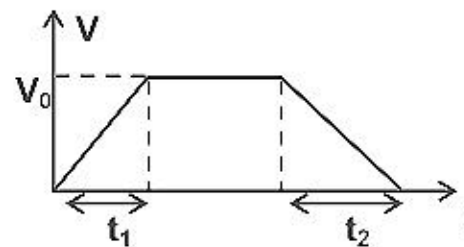
- (1)  $-2abv^2$  (2)  $2bv^3$   
 (3)  $-2av^3$  (4)  $2av^2$

7. (3)  
 $t = ax^2 + bx$   
 by differentiating acceleration =  $-2av^3$

8. A car starting from rest accelerates at the rate  $f$  through a distance  $S$ , then continues at constant speed for time  $t$  and then decelerates at the rate  $f/2$  to come to rest. If the total distance traversed is  $15S$ , then

- (1)  $S = ft$  (2)  $S = 1/6 ft^2$   
 (3)  $S = 1/2 ft^2$  (4)  $S = 1/4 ft^2$

8. (none)  
 $S = \frac{ft_1^2}{2}$   
 $v_0 = \sqrt{2Sf}$   
 During retardation  
 $S_2 = 2S$



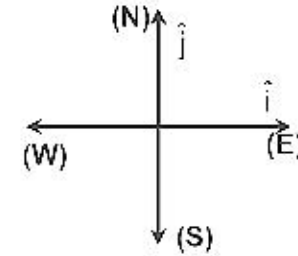
$$\Rightarrow S = \frac{ft^2}{72}$$

9. A particle is moving eastwards with a velocity of 5 m/s in 10 seconds the velocity changes to 5 m/s northwards. The average acceleration in this time is

- (1)  $\frac{1}{\sqrt{2}}$  m/s<sup>2</sup> towards north-east      (2)  $\frac{1}{2}$  m/s<sup>2</sup> towards north.  
 (3) zero      (4)  $\frac{1}{\sqrt{2}}$  m/s<sup>2</sup> towards north-west

9. (4)

$$\begin{aligned} \bar{a} &= \frac{\vec{V}_f - \vec{V}_i}{t} \\ &= \frac{5\hat{j} - 5\hat{i}}{10} = \frac{1}{2}(\hat{j} - \hat{i}) \\ \therefore a &= \frac{1}{\sqrt{2}} \text{ ms}^{-2} \text{ towards north west} \end{aligned}$$



10. A parachutist after bailing out falls 50 m without friction. When parachute opens, it decelerates at 2 m/s<sup>2</sup>. He reaches the ground with a speed of 3 m/s. At what height, did he bail out?

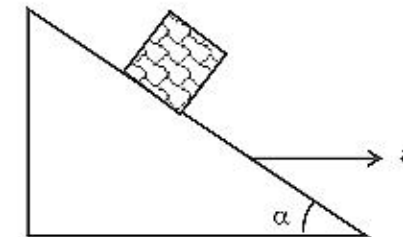
- (1) 91 m      (2) 182 m  
 (3) 293 m      (4) 111 m

10. (3)

$$\begin{aligned} s &= 50 + \left( \frac{3^2 - (2 \times 10 \times 50)}{2(-2)} \right) \\ &= 293 \text{ m.} \end{aligned}$$

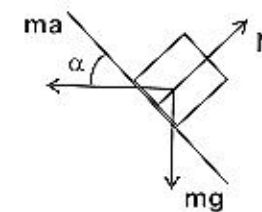
11. A block is kept on a frictionless inclined surface with angle of inclination  $\alpha$ . The incline is given an acceleration  $a$  to keep the block stationary. Then  $a$  is equal to

- (1)  $g/\tan\alpha$       (2)  $g \operatorname{cosec}\alpha$   
 (3)  $g$       (4)  $g \tan\alpha$



11. (4)

$$\begin{aligned} mg \sin\alpha &= ma \cos\alpha \\ \therefore a &= g \tan\alpha \end{aligned}$$



12. A spherical ball of mass 20 kg is stationary at the top of a hill of height 100 m. It rolls down a smooth surface to the ground, then climbs up another hill of height 30 m and finally rolls down to a horizontal base at a height of 20 m above the ground. The velocity attained by the ball is

- (1) 40 m/s      (2) 20 m/s  
 (3) 10 m/s      (4)  $10\sqrt{30}$  m/s



$$v = \sqrt{2gh}$$

$$= \sqrt{2 \times 10 \times 80} = 40 \text{ m/s}$$

13. A body A of mass M while falling vertically downwards under gravity breaks into two parts; a body B of mass  $\frac{1}{3}M$  and a body C of mass  $\frac{2}{3}M$ . The centre of mass of bodies B and C taken together shifts compared to that of body A towards
- (1) depends on height of breaking                      (2) does not shift  
 (3) body C    (4) body B

13. (2)  
 No horizontal external force is acting

$$\therefore a_{cm} = 0$$

since  $v_{cm} = 0$

$$\therefore \Delta x_{cm} = 0$$

14. The moment of inertia of a uniform semicircular disc of mass M and radius r about a line perpendicular to the plane of the disc through the centre is

- (1)  $\frac{1}{4}Mr^2$     (2)  $\frac{2}{5}Mr^2$   
 (3)  $Mr^2$     (4)  $\frac{1}{2}Mr^2$

14. (4)

$$2I = 2M \frac{R^2}{2}$$

$$\therefore I = \frac{MR^2}{2}$$

15. A particle of mass 0.3 kg is subjected to a force  $F = -kx$  with  $k = 15 \text{ N/m}$ . What will be its initial acceleration if it is released from a point 20 cm away from the origin?

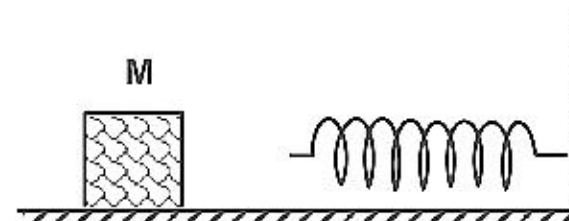
- (1)  $3 \text{ m/s}^2$     (2)  $15 \text{ m/s}^2$   
 (3)  $5 \text{ m/s}^2$     (4)  $10 \text{ m/s}^2$

15. (4)

$$a = \frac{kx}{m} = 10 \text{ m/s}^2$$

16. The block of mass M moving on the frictionless horizontal surface collides with a spring of spring constant K and compresses it by length L. The maximum momentum of the block after collision is

- (1)  $\sqrt{MK}L$     (2)  $\frac{KL^2}{2M}$   
 (3) zero    (4)  $\frac{ML^2}{K}$



16. (1)

$$\frac{1}{2}KL^2 = \frac{P^2}{2m} \quad \therefore P = \sqrt{MK}L$$

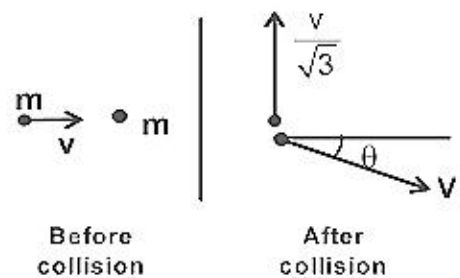


collision the 1<sup>st</sup> mass moves with velocity  $v/\sqrt{3}$  in a direction perpendicular to the initial direction of motion. Find the speed of the 2<sup>nd</sup> mass after collision



- (1)  $v$  (2)  $\sqrt{3} v$   
 (3)  $2v/\sqrt{3}$  (4)  $v/\sqrt{3}$

17. (3)  
 $mv = mv_1 \cos \theta$   
 $0 = \frac{mv}{\sqrt{3}} - mv_1 \sin \theta$   
 $\therefore v_1 = \frac{2}{\sqrt{3}} v$



18. A 20 cm long capillary tube is dipped in water. The water rises up to 8 cm. If the entire arrangement is put in a freely falling elevator the length of water column in the capillary tube will be

- (1) 8 cm (2) 10 cm  
 (3) 4 cm (4) 20 cm

18. (4)  
 Water will rise to the full length of capillary tube

19. If  $S$  is stress and  $Y$  is Young's modulus of material of a wire, the energy stored in the wire per unit volume is

- (1)  $2S^2Y$  (2)  $S^2/2Y$   
 (3)  $2Y/S^2$  (4)  $S/2Y$

19. (2)  
 $U = \frac{1}{2} \text{stress} \times \text{strain} = \frac{S^2}{2Y}$

20. Average density of the earth  
 (1) does not depend on  $g$   
 (3) is directly proportional to  $g$

- (2) is a complex function of  $g$   
 (4) is inversely proportional to  $g$

20. (3)  
 $g = \frac{G4\pi}{3} \rho_{av} R$

21. A body of mass  $m$  is accelerated uniformly from rest to a speed  $v$  in a time  $T$ . The instantaneous power delivered to the body as a function time is given by

- (1)  $\frac{mv^2}{T^2} \cdot t$  (2)  $\frac{mv^2}{T^2} \cdot t^2$   
 (3)  $\frac{1}{2} \frac{mv^2}{T^2} \cdot t$  (4)  $\frac{1}{2} \frac{mv^2}{T^2} \cdot t^2$

21. (1)  
 $P = (ma) \cdot v$

$$= \frac{1}{T^2}$$

22. Consider a car moving on a straight road with a speed of 100 m/s. The distance at which car can be stopped is  $[\mu_k = 0.5]$
- (1) 800 m (2) 1000 m  
(3) 100 m (4) 400 m

22. (2)

$$\mu_k mgs = \frac{1}{2} mu^2$$

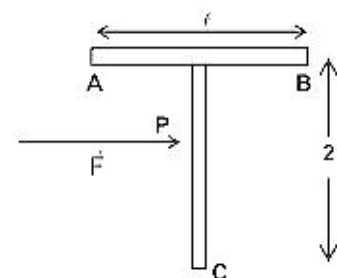
$$s = \frac{u^2}{2\mu_k g} = 1000\text{m}$$

23. Which of the following is incorrect regarding the first law of thermodynamics?
- (1) It is not applicable to any cyclic process  
(2) It is a restatement of the principle of conservation of energy  
(3) It introduces the concept of the internal energy  
(4) It introduces the concept of the entropy

23. (none)

More than one statements are incorrect

24. A 'T' shaped object with dimensions shown in the figure, is lying on a smooth floor. A force  $F$  is applied at the point  $P$  parallel to  $AB$ , such that the object has only the translational motion without rotation. Find the location of  $P$  with respect to  $C$



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

24. (3)

$P$  will be the centre of mass of system

25. The change in the value of  $g$  at a height ' $h$ ' above the surface of the earth is the same as at a depth ' $d$ ' below the surface of earth. When both ' $d$ ' and ' $h$ ' are much smaller than the radius of earth, then which one of the following is correct?

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

25. (3)

$$\frac{GM}{(R+h)^2} = \frac{GM}{R^3} (R-d)$$

$$\Rightarrow d = 2h$$

and radius 10 cm. Find the work to be done against the gravitational force between them to take the particle far away from the sphere  
(you may take  $G = 6.67 \times 10^{-11} \text{ Nm}^2 / \text{kg}^2$ )

- (1)  $13.34 \times 10^{-10} \text{ J}$  (2)  $3.33 \times 10^{-10} \text{ J}$   
(3)  $6.67 \times 10^{-9} \text{ J}$  (4)  $6.67 \times 10^{-10} \text{ J}$

26. (4)  
 $w = GMm / R = 6.67 \times 10^{-10} \text{ J}$

27. A gaseous mixture consists of 16 g of helium and 16 g of oxygen. The ratio  $\frac{C_p}{C_v}$  of the mixture is  
(1) 1.59 (2) 1.62  
(3) 1.4 (4) 1.54

27. (2)  
$$C_v = \frac{n_1 c_{v1} + n_2 c_{v2}}{n_1 + n_2} = \frac{29R}{18}$$
  
$$C_p = \frac{47R}{18}, \quad \frac{C_p}{C_v} = 1.62$$

28. The intensity of gamma radiation from a given source is  $I$ . On passing through 36 mm of lead, it is reduced to  $\frac{I}{8}$ . The thickness of lead which will reduce the intensity to  $\frac{I}{2}$  will be  
(1) 6 mm (2) 9 mm  
(3) 18 mm (4) 12 mm

28. (4)  
Use  $I = I_0 e^{-\mu x}$

29. The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 2480 nm is incident on it. The band gap in (eV) for the semiconductor is  
(1) 1.1 eV (2) 2.5 eV  
(3) 0.5 eV (4) 0.7 eV

29. (3)  
 $E_g = \frac{hc}{\lambda} = 0.5 \text{ eV}$

30. A photocell is illuminated by a small bright source placed 1 m away. When the same source of light is placed  $\frac{1}{2}$  m away, the number of electrons emitted by photo cathode would  
(1) decrease by a factor of 4 (2) increase by a factor of 4  
(3) decrease by a factor of 2 (4) increase by a factor of 2



$$I \propto \frac{1}{r^2}$$

31. Starting with a sample of pure  $^{66}\text{Cu}$ ,  $7/8$  of it decays into Zn in 15 minutes. The corresponding half-life is
- (1) 10 minutes (2) 15 minutes  
 (3) 5 minutes (4)  $7\frac{1}{2}$  minutes

31. (3)

$$N_0 \xrightarrow{t_{1/2}} \frac{N_0}{2} \xrightarrow{t_{1/2}} \frac{N_0}{4} \xrightarrow{t_{1/2}} \frac{N_0}{8}$$

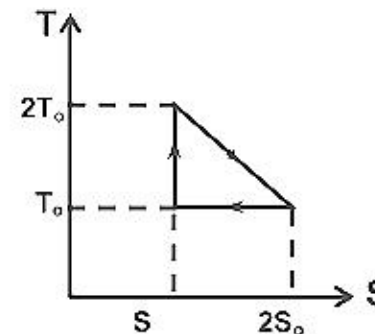
$$3t_{1/2} = 15 \therefore t_{1/2} = 5$$

32. If radius of  $^{27}_{13}\text{Al}$  nucleus is estimated to be 3.6 Fermi then the radius  $^{125}_{52}\text{Te}$  nucleus be nearly
- (1) 6 fermi (2) 8 fermi  
 (3) 4 fermi (4) 5 fermi

32. (1)

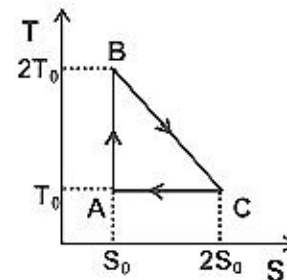
$$\frac{R}{3.6} = \left(\frac{125}{27}\right)^{\frac{1}{3}} \Rightarrow R = 6 \text{ fermi}$$

33. The temperature-entropy diagram of a reversible engine cycle is given in the figure. Its efficiency is
- (1)  $1/2$  (2)  $1/4$   
 (3)  $1/3$  (4)  $2/3$

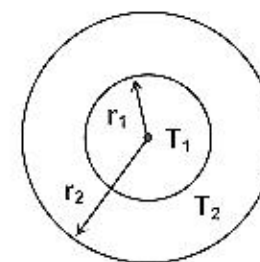


33. (3)

$$\eta = \frac{\Delta W}{Q_{BC}} = \frac{\frac{S_0 T_0}{2}}{\frac{3S_0 T_0}{2}} = 1/3$$



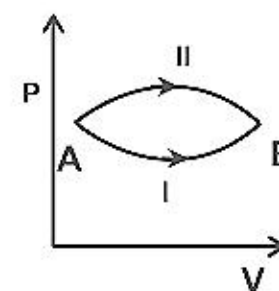
34. The figure shows a system of two concentric spheres of radii  $r_1$  and  $r_2$  and kept at temperatures  $T_1$  and  $T_2$  respectively. The radial rate of flow of heat in a substance between the two concentric sphere is proportional to



- (1)  $\frac{r_2 - r_1}{r_1 r_2}$  (2)  $\ln\left(\frac{r_2}{r_1}\right)$   
 (3)  $\frac{r_1 r_2}{r_2 - r_1}$  (4)  $\ln(r_2 - r_1)$

$$\left(\frac{dQ}{dt}\right) = (T_1 - T_2) \frac{4\pi r_1 r_2 K}{(r_2 - r_1)}$$

35. A system goes from A to B via two processes I and II as shown in the figure. If  $\Delta U_1$  and  $\Delta U_2$  are the changes in internal energies in the processes I and II respectively, the



- (1)  $\Delta U_1 = \Delta U_2$   
 (2) relation between  $\Delta U_1$  and  $\Delta U_2$  can not be determined  
 (3)  $\Delta U_2 > \Delta U_1$   
 (4)  $\Delta U_2 < \Delta U_1$

35. (1)  
 Internal energy is state function

36. The function  $\sin^2(\omega t)$  represents  
 (1) a periodic, but not simple harmonic motion with a period  $2\pi/\omega$   
 (2) a periodic, but not simple harmonic motion with a period  $\pi/\omega$   
 (3) a simple harmonic motion with a period  $2\pi/\omega$   
 (4) a simple harmonic motion with a period  $\pi/\omega$ .

36. (4)  

$$y = \frac{(1 - \cos 2\omega t)}{2}$$

37. A Young's double slit experiment uses a monochromatic source. The shape of the interference fringes formed on a screen is

- (1) hyperbola (2) circle  
 (3) straight line (4) parabola

37. (3)  
 Straight line  
**Note:** If instead of young's double slit experiment, young's double hole experiment was given shape would have been hyperbola.

38. Two simple harmonic motions are represented by the equation  $y_1 = 0.1 \sin\left(100\pi t + \frac{\pi}{3}\right)$  and  $y_2 = 0.1 \cos\pi t$ . The phase difference of the velocity of particle 1 w.r.t. the velocity of the particle 2 is

- (1)  $-\pi/6$  (2)  $\pi/3$   
 (3)  $-\pi/3$  (4)  $\pi/6$

38. (1)  
 Phase difference  $(\phi) = 99\pi t + \pi/3 - \pi/2$   
 at  $t = 0$   $\phi = -\pi/6$ .

39. A fish looking up through the water sees the outside world contained in a circular horizon. If the refractive index of water is  $4/3$  and the fish is 12 cm below the surface, the radius of this circle in cm is

- (1)  $36\sqrt{7}$  (2)  $36/\sqrt{7}$   
 (3)  $36\sqrt{5}$  (4)  $4\sqrt{5}$

$$r = \frac{h}{\sqrt{\mu^2 - 1}} = \frac{36}{\sqrt{7}}$$

40. Two point white dots are 1 mm apart on a black paper. They are viewed by eye of pupil diameter 3 mm. Approximately, what is the maximum distance at which these dots can be resolved by the eye? [ Take wavelength of light = 500 nm ]
- (1) 5 m (2) 1m  
(3) 6 m (4) 3m

40. (1)

$$\frac{1.22\lambda}{(3\text{mm})} = \text{Resolution limit} = \frac{(1\text{mm})}{R}$$

$\therefore R = 5 \text{ m}$

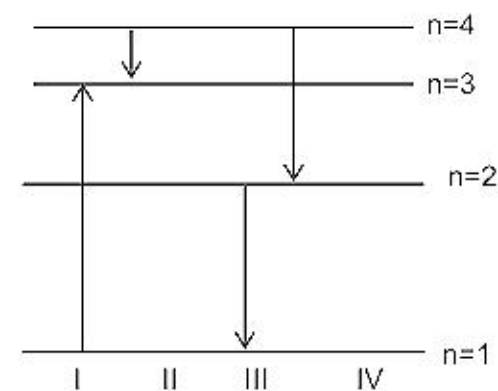
41. A thin glass (refractive index 1.5) lens has optical power of - 5D in air. Its optical power in a liquid medium with refractive index 1.6 will be
- (1) 1 D (2) -1D  
(3) 25 D (4) - 25 D

41. (none)

$$\frac{P_m}{P_{air}} = \frac{\left(\frac{\mu_l}{\mu_a} - 1\right)}{\left(\frac{\mu_g}{\mu_m} - 1\right)}$$

$P_m = 5/8 \text{ D}$

42. The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy ?
- (1) III (2) IV  
(3) I (4) II



42. (1)

$$\Delta E \propto \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

43. If the kinetic energy of a free electron doubles. Its deBroglie wavelength changes by the factor

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

43. (3)

$$\lambda = \frac{h}{\sqrt{2Km}}$$



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

44. (3)

No phase difference between input and output signal.

45. In a full wave rectifier circuit operating from 50 Hz mains frequency, the fundamental frequency in the ripple would be

- (1) 50 Hz (2) 25 Hz  
 (3) 100 Hz (4) 70.7 Hz

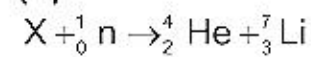
45. (3)

frequency = 2 (frequency of input signal).

46. A nuclear transformation is denoted by  $X(n, \alpha) {}_3^7\text{Li}$ . Which of the following is the nucleus of element X ?

- (1)  ${}^{12}_6\text{C}$  (2)  ${}^{10}_5\text{B}$   
 (3)  ${}^8_3\text{B}$  (4)  ${}^{11}_4\text{Be}$

46. (2)



47. A moving coil galvanometer has 150 equal divisions. Its current sensitivity is 10 divisions per milliampere and voltage sensitivity is 2 divisions per millivolt. In order that each division reads 1 volt, the resistance in ohms needed to be connected in series with the coil will be

- (1)  $10^3$  (2)  $10^5$   
 (3) 99995 (4) 9995

47. (4)

$$I_g = 15\text{mA} \quad V_g = 75\text{mV}$$

$$R = \frac{V}{I} - \frac{V_g}{I_g}$$

48. Two voltmeters one of copper and another of silver, are joined in parallel. When a total charge q flows through the voltmeters, equal amount of metals are deposited. If the electrochemical equivalents of copper and silver are  $z_1$  and  $z_2$  respectively the charge which flows through the silver voltmeter is

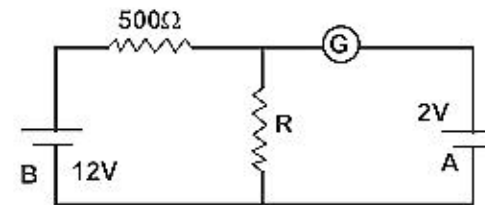
- (1)  $\frac{q}{1 + \frac{z_1}{z_2}}$  (2)  $\frac{q}{1 + \frac{z_2}{z_1}}$   
 (3)  $q \frac{z_1}{z_2}$  (4)  $q \frac{z_2}{z_1}$

48. (2)

$$q_1 z_1 = q_2 z_2$$

$$q = q_1 + q_2$$

49. In the circuit, the galvanometer G shows zero deflection. If the batteries A and B have negligible internal resistance, the value of the resistor R will be



- (1) 200 Ω (2) 100 Ω  
(3) 500 Ω (4) 1000 Ω

49. (2)

$$\frac{12R}{500+R} = 2$$

50. Two sources of equal emf are connected to an external resistance R. The internal resistance of the two sources are  $R_1$  and  $R_2$  ( $R_2 > R_1$ ). If the potential difference across the source having internal resistance  $R_2$  is zero, then

- (1)  $R = R_2 \times (R_1 + R_2) / (R_2 - R_1)$  (2)  $R = R_2 - R_1$   
(3)  $R = R_1 R_2 / (R_1 + R_2)$  (4)  $R = R_1 R_2 / (R_2 - R_1)$

50. (2)

$$I = \frac{2E}{R_1 + R_2 + R}$$

$$E - R_2 I = 0$$

$$\Rightarrow R = R_2 - R_1$$

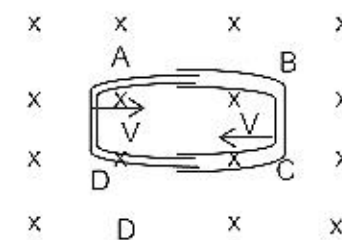
51. A fully charged capacitor has a capacitance 'C' it is discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat capacity 's' and mass 'm'. If the temperature of the block is raised by ' $\Delta T$ '. The potential difference V across the capacitance is

- (1)  $\sqrt{\frac{2mC\Delta T}{s}}$  (2)  $\frac{mC\Delta T}{s}$   
(3)  $\frac{ms\Delta T}{C}$  (4)  $\sqrt{\frac{2ms\Delta T}{C}}$

51. (4)

Dimensionally only 4<sup>th</sup> option is correct.

52. One conducting U tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube moves towards the other at a constant speed V, then the emf induced in the circuit in terms of B,  $\ell$  and V where  $\ell$  is the width of each tube will be



- (1)  $B\ell V$  (2)  $-B\ell V$   
(3) zero (4)  $2B\ell V$

52. (4)

$$\left| \frac{d\phi}{dt} \right| = 2B\ell v$$



The heat generated will now be

- (1) doubled (2) four times  
(3) one fourth (4) halved

53. (1)

$$H = \frac{V^2 \Delta t}{R}$$

$$H' = \frac{V^2}{R'} \Delta t \quad \text{Given } R' = R/2$$

54. Two thin, long parallel wires separated by a distance 'd' carry a current of 'i' A in the same direction. They will

- (1) attract each other with a force of  $\mu_0 i^2 / (2\pi d)$   
(2) repel each other with a force of  $\mu_0 i^2 / (2\pi d)$   
(3) attract each other with a force of  $\mu_0 i^2 / (2\pi d^2)$   
(4) repel each other with a force of  $\mu_0 i^2 / (2\pi d^2)$

54. (1)

Using the definition of force per unit length due to two long parallel wires carrying currents.

55. When an unpolarized light of intensity  $I_0$  is incident on a polarizing sheet, the intensity of the light which does not get transmitted is

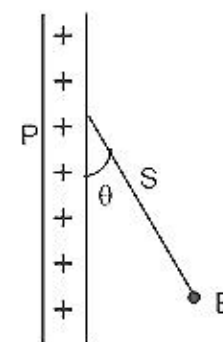
- (1)  $\frac{1}{2} I_0$  (2)  $\frac{1}{4} I_0$   
(3) zero (4)  $I_0$

55. (1)

When unpolarised light of intensity  $I_0$  is incident on a polarizing sheet, only  $I_0/2$  is transmitted.

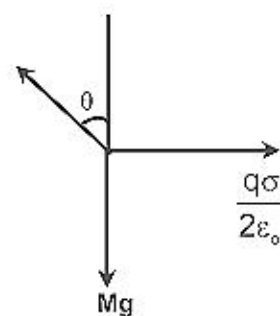
56. A charged ball B hangs from a silk thread S which makes an angle  $\theta$  with a large charged conducting sheet P, as show in the figure. The surface charge density  $\sigma$  of the sheet is proportional to

- (1)  $\cos \theta$  (2)  $\cot \theta$   
(3)  $\sin \theta$  (4)  $\tan \theta$



56. (4)

$$\tan \theta = \frac{q\sigma}{(2\epsilon_0)mg}$$



57. Two point charges  $+8q$  and  $-2q$  are located at  $x = 0$  and  $x = L$  respectively. The location of a point on the x axis at which the net electric field due to these two point charges is zero is

- (1)  $2L$  (2)  $L/4$



57. (1)

$$-\frac{k2q}{(x-L)^2} + \frac{k8q}{x^2} = 0$$

$$\Rightarrow x = 2L$$

58. Two thin wires rings each having a radius  $R$  are placed at a distance  $d$  apart with their axes coinciding. The charges on the two rings are  $+q$  and  $-q$ . The potential difference between the centres of the two rings is

- (1)  $QR/4\pi\epsilon_0 d^2$  (2)  $\frac{Q}{2\pi\epsilon_0} \left[ \frac{1}{R} - \frac{1}{\sqrt{R^2 + d^2}} \right]$   
(3) zero (4)  $\frac{Q}{4\pi\epsilon_0} \left[ \frac{1}{R} - \frac{1}{\sqrt{R^2 + d^2}} \right]$

58. (2)

$$V_1 = \frac{kq}{R} - \frac{kq}{\sqrt{R^2 + d^2}}$$

$$V_2 = \frac{-kq}{R} + \frac{kq}{\sqrt{R^2 + d^2}}$$

59. A parallel plate capacitor is made by stacking  $n$  equally spaced plates connected alternatively. If the capacitance between any two adjacent plates is  $C$  then the resultant capacitance is

- (1)  $(n-1)C$  (2)  $(n+1)C$   
(3)  $C$  (4)  $nC$

59. (1)

$$C_{eq} = (n-1)C \quad (\because \text{all capacitors are in parallel})$$

60. When two tuning forks (fork 1 and fork 2) are sounded simultaneously, 4 beats per second are heard. Now, some tape is attached on the prong of the fork 2. When the tuning forks are sounded again, 6 beats per seconds are heard. If the frequency of fork 1 is 200 Hz, then what was the original frequency of fork 2?

- (1) 200 Hz (2) 202 Hz  
(3) 196 Hz (4) 204 Hz

60. (3)

$$|f_1 - f_2| = 4$$

Since mass of second tuning fork increases so  $f_2$  decrease and beats increase so  $f_1 > f_2$

$$\Rightarrow f_2 = f_1 - 4 = 196$$

61. If a simple harmonic motion is represented by  $\frac{d^2x}{dt^2} + \alpha x = 0$ , its time period is

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

$$\omega = \sqrt{\alpha}$$

$$T = \frac{2\pi}{\sqrt{\alpha}}$$

62. The bob of a simple pendulum is a spherical hollow ball filled with water. A plugged hole near the bottom of the oscillation bob gets suddenly unplugged. During observation, till water is coming out, the time period of oscillation would  
 (1) first increase and then decrease to the original value.  
 (2) first decreased then increase to the original value.  
 (3) remain unchanged.  
 (4) increase towards a saturation value.
62. (1)  
 First CM goes down and then comes to its initial position.
63. An observer moves towards a stationary source of sound, with a velocity one fifth of the velocity of sound. What is the percentage increase in the apparent frequency?  
 (1) zero. (2) 0.5%  
 (3) 5% (4) 20%
63. (4)  
 $f = \frac{v + v/5}{v} f = \frac{6f}{5}$   
 % increase in frequency = 20%
64. If  $I_0$  is the intensity of the principal maximum in the single slit diffraction pattern, then what will be its intensity when the slit width is doubled?  
 (1)  $2I_0$  (2)  $4I_0$   
 (3)  $I_0$  (4)  $I_0/2$
64. (3)  
 Maximum intensity is independent of slit width.
65. Two concentric coils each of radius equal to  $2\pi$  cm are placed at right angles to each other. 3 Ampere and 4 ampere are the currents flowing in each coil respectively. The magnetic induction in Weber/m<sup>2</sup> at the centre of the coils will be ( $\mu_0 = 4\pi \times 10^{-7}$  Wb/A-m)  
 (1)  $12 \times 10^{-5}$  (2)  $10^{-5}$   
 (3)  $5 \times 10^{-5}$  (4)  $7 \times 10^{-5}$
65. (3)  
 $B = \frac{\mu_0}{2r} \sqrt{I_1^2 + I_2^2}$   
 $B = \frac{4\pi \times 10^{-7}}{2 \times 2\pi \times 10^{-2}} \times 5$   
 $B = 5 \times 10^{-5}$
66. A coil of inductance 300 mH and resistance  $2\Omega$  is connected to a source of voltage 2V. The current reaches half of its steady state value in  
 (1) 0.05 s (2) 0.1 s

66. (2)

$$I = I_0 \left( 1 - e^{-\frac{R}{L}t} \right)$$

$$0.693 = \frac{R}{L}t$$

$$t = \frac{.3 \times 0.693}{2} = 0.1 \text{ sec}$$

67. The self inductance of the motor of an electric fan is 10 H. In order to impart maximum power at 50 Hz, it should be connected to a capacitance of

- (1)  $4 \mu\text{F}$  (2)  $8 \mu\text{F}$   
(3)  $1 \mu\text{F}$  (4)  $2 \mu\text{F}$

67. (3)

$$f = \frac{1}{2\pi\sqrt{LC}}$$

$$C = \frac{1}{4 \times \pi^2 f^2 \times 10}$$

$$C = 1 \mu\text{F}$$

68. An energy source will supply a constant current into the load of its internal resistance is

- (1) equal to the resistance of the load.  
(2) very large as compared to the load resistance.  
(3) zero.  
(4) non-zero but less than the resistance of the load.

68. (2)

$$I = \frac{E_0}{R+r} \approx \frac{E}{r} \text{ if } R \ll r$$

69. A circuit has a resistance of  $12 \Omega$  and an impedance of  $15 \Omega$ . The power factor of the circuit will be

- (1) 0.8 (2) 0.4  
(3) 1.25 (4) 0.125

69. (1)

$$\cos \phi = \frac{R}{Z} = \frac{12}{15} = \frac{4}{5} = 0.8$$

70. The phase difference between the alternating current and emf is  $\pi/2$ . Which of the following cannot be the constituent of the circuit?

- (1) C alone (2) R.L  
(3) L. C (4) L alone

70. (2)

$0 < \text{phase difference for R-L circuit} < \pi/2$



with a certain velocity then

- (1) its velocity will decrease. (2) its velocity will increase.  
(3) it will turn towards right of direction of motion. (4) it will turn towards left of direction of motion.

71. (1)

$$\vec{F} = -e[\vec{E} + \vec{v} \times \vec{B}] = -e\vec{E}$$

$$\vec{a} = -\frac{e\vec{E}}{m}$$

$$v(t) = v_0 - \frac{eE}{m}t$$

72. A charged particle of mass  $m$  and charge  $q$  travels on a circular path of radius  $r$  that is perpendicular to a magnetic field  $B$ . The time taken by the particle to complete one revolution is

(1)  $\frac{2\pi mq}{B}$

(2)  $\frac{2\pi q^2 B}{m}$

(3)  $\frac{2\pi q B}{m}$

(4)  $\frac{2\pi m}{qB}$

72. (4)

$$m\omega^2 r = Bq\omega r$$

$$\omega = Bq/m$$

$$T = \frac{2\pi m}{qB}$$

73. In a potentiometer experiment the balancing with a cell is at length 240 cm. On shunting the cell with a resistance of  $2\Omega$  the balancing length becomes 120 cm. The internal resistance of the cell is

(1)  $1\Omega$

(2)  $0.5\Omega$

(3)  $4\Omega$

(4)  $2\Omega$

73. (4)

$$r = R \left[ \frac{\ell_1}{\ell_2} - 1 \right] = 2 \left[ \frac{240}{120} - 1 \right] = 2\Omega$$

74. The resistance of hot tungsten filament is about 10 times the cold resistance. What will be the resistance of 100 W and 200 V lamp when not in use?

(1)  $40\Omega$

(2)  $20\Omega$

(3)  $400\Omega$

(4)  $200\Omega$

74. (1)

$$R_{\text{hot}} = \frac{V^2}{P} = \frac{200 \times 200}{100} = 400\Omega$$

$$\text{cold resistance} = R_{\text{hot}}/10 = 400/10 = 40\Omega$$

75. A magnetic needle is kept in a non-uniform magnetic field. It experiences

(1) a torque but not a force

(2) neither a force nor a torque

(3) a force and a torque.

(4) a force but not a torque.

In non uniform magnetic field, dipole experiences both force and torque.

# SOLUTION TO AIEEE-2005

## CHEMISTRY

76. Which of the following oxides is amphoteric in character?  
(1) CaO (2) CO<sub>2</sub>  
(3) SiO<sub>2</sub> (4) SnO<sub>2</sub>
76. (4)  
CaO → basic  
SiO<sub>2</sub> & CO<sub>2</sub> → acidic  
SnO<sub>2</sub> → amphoteric
77. Which one of the following species is diamagnetic in nature?  
(1) He<sup>1</sup><sub>2</sub> (2) H<sub>2</sub>  
(3) H<sup>+</sup><sub>2</sub> (4) H<sup>-</sup><sub>2</sub>
77. (2)  
H<sub>2</sub> σ1s<sup>2</sup> σ\*1s<sup>0</sup>, no unpaired so diamagnetic
78. If α is the degree of dissociation of Na<sub>2</sub>SO<sub>4</sub>, the vant Hoff's factor (i) used for calculating the molecular mass is  
(1) 1 + α (2) 1 - α  
(3) 1 + 2α (4) 1 - 2 α
78. (3)  
$$\text{Na}_2\text{SO}_4 \rightleftharpoons 2\text{Na}^+ + \text{SO}_4^{-2}$$
$$1 - \alpha \qquad 2\alpha \quad \alpha$$
Total moles = 1+2α
79. The oxidation state of Cr in [Cr(NH<sub>3</sub>)<sub>4</sub>Cl<sub>2</sub>]<sup>+</sup> is  
(1) +3 (2) +2  
(3) +1 (4) 0
79. (1)  
(Cr(NH<sub>3</sub>)<sub>4</sub>Cl<sub>2</sub>)<sup>+</sup>  
X + 4×0 + 2×-1 = 1  
X = +3
80. Hydrogen bomb is based on the principle of  
(1) Nuclear fission (2) Natural radioactivity  
(3) Nuclear fusion (4) Artificial radioactivity
80. (3)
81. An ionic compound has a unit cell consisting of A ions at the corners of a cube and B ions on the centres of the faces of the cube. The empirical formula for this compound would be  
(1) AB (2) A<sub>2</sub>B  
(3) AB<sub>3</sub> (4) A<sub>3</sub>B
81. (3)  
A =  $\frac{1}{8} \times 8 = 1$   
(Corner)



∠  
(Face centre)

∴ AB<sub>3</sub>

82. For a spontaneous reaction the  $\Delta G$ , equilibrium constant (K) and  $E_{\text{cell}}^{\circ}$  will be respectively

(1) -ve, >1, +ve

(2) +ve, >1, -ve

(3) -ve, <1, -ve

(4) -ve, >1, -ve

82. (1)

83. Which of the following is a polyamide?

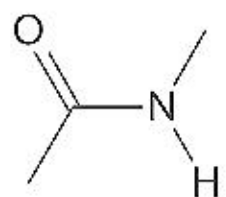
(1) Teflon

(3) Nylon – 66

(3) Terylene

(4) Bakelite

83 (2)



Amide → Nylon 66

84. Which one of the following types of drugs reduces fever?

(1) Analgesic

(2) Antipyretic

(3) Antibiotic

(4) Tranquiliser

84. (2)

85. Due to the presence of an unpaired electron, free radicals are:

(1) Chemically reactive

(2) Chemically inactive

(3) Anions

(4) Cations

85. (1)

86. Lattice energy of an ionic compounds depends upon

(1) Charge on the ion only

(2) Size of the ion only

(3) Packing of ions only

(4) Charge on the ion and size of the ion

86. (4)

87. The highest electrical conductivity of the following aqueous solutions is of

(1) 0.1 M acetic acid

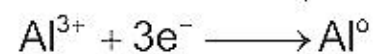
(2) 0.1 M chloroacetic acid

(3) 0.1 M fluoroacetic acid

(4) 0.1 M difluoroacetic acid

87. (4)

88. Aluminium oxide may be electrolysed at 1000°C to furnish aluminium metal (Atomic mass = 27 amu; 1 Faraday = 96,500 Coulombs). The cathode reaction is



To prepare 5.12 kg of aluminium metal by this method would require

(1)  $5.49 \times 10^7$  C of electricity

(2)  $1.83 \times 10^7$  C of electricity

(3)  $5.49 \times 10^4$  C of electricity

(4)  $5.49 \times 10^1$  C of electricity

88. (1)

$$Q = \frac{mFZ}{M} = \frac{5.12 \times 10^5 \times 96500 \times 3}{27}$$

$$= 5.49 \times 10^7 \text{ C}$$

for the backward and forward reactions, respectively. In general

- (1)  $E_b < E_f$
- (2)  $E_b > E_f$
- (3)  $E_b = E_f$
- (4) There is no definite relation between  $E_b$  and  $E_f$

89.

(1)

$$\Delta H = E_f - E_b$$

For  $\Delta H = \text{Positive}$ ,  $E_b < E_f$

90.

Consider the reaction:  $N_2 + 3H_2 \longrightarrow 2NH_3$  carried out at constant temperature and pressure. If  $\Delta H$  and  $\Delta U$  are the enthalpy and internal energy changes for the reaction, which of the following expressions is true?

- (1)  $\Delta H = 0$
- (2)  $\Delta H = \Delta U$
- (3)  $\Delta H < \Delta U$
- (4)  $\Delta H > \Delta U$

90.

(3)

$$\Delta H = \Delta U + \Delta nRT$$

$$\Delta n = -2$$

$$\Delta H = \Delta U - 2RT$$

$$\Delta H < \Delta U$$

91.

Which one of the following statements is NOT true about the effect of an increase in temperature on the distribution of molecular speeds in a gas?

- (1) The most probable speed increases
- (2) The fraction of the molecules with the most probable speed increases
- (3) The distribution becomes broader
- (4) The area under the distribution curve remains the same as under the lower temperature

91.

(2)

Most probable velocity increase and fraction of molecule possessing most probable velocity decreases.

92.

The volume of a colloidal particle,  $V_c$  as compared to the volume of a solute particle in a true solution  $V_s$ , could be

- (1)  $\frac{V_c}{V_s} = 1$
- (2)  $\frac{V_c}{V_s} = 10^{23}$
- (3)  $\frac{V_c}{V_s} = 10^{-3}$
- (4)  $\frac{V_c}{V_s} = 10^3$

92.

(4)

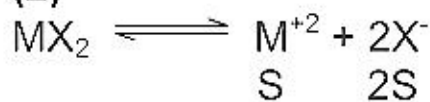
93.

The solubility product of a salt having general formula  $MX_2$ , in water is:  $4 \times 10^{-12}$ . The concentration of  $M^{2+}$  ions in the aqueous solution of the salt is

- (1)  $2.0 \times 10^{-6} \text{ M}$
- (2)  $1.0 \times 10^{-4} \text{ M}$
- (3)  $1.6 \times 10^{-4} \text{ M}$
- (4)  $4.0 \times 10^{-10} \text{ M}$

93.

(2)



$$K_{sp} = 4s^3, S = \sqrt[3]{\frac{K_{sp}}{4}} = 1 \times 10^{-4}$$



benzene is 75 torr and that of toluene is 22 torr. The partial vapour pressure of benzene at 20°C for a solution containing 78 g of benzene and 46 g of toluene in torr is

- (1) 50 (2) 25  
(3) 37.5 (4) 53.5

94. (1)

$$P_B = P_B^\circ \times B = 75 \times \frac{1}{1.5} = 50 \text{ torr}$$

95. The exothermic formation of  $\text{ClF}_3$  is represented by the equation:



Which of the following will increase the quantity of  $\text{ClF}_3$  in an equilibrium mixture of  $\text{Cl}_2$ ,  $\text{F}_2$  and  $\text{ClF}_3$ ?

- (1) Increasing the temperature (2) Removing  $\text{Cl}_2$   
(3) Increasing the volume of the container (4) Adding  $\text{F}_2$

95. (4)

$$M_3V_3 = M_1V_1 + M_2V_2$$

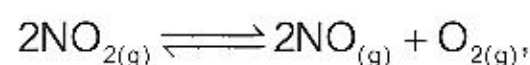
$$M = \frac{480(1.5) + 520(1.2)}{1000} = 1.344\text{M}$$

96. Two solutions of a substance (non electrolyte) are mixed in the following manner. 480 ml of 1.5 M first solution + 520 mL of 1.2 M second solution. What is the molarity of the final mixture?

- (1) 1.20 M (2) 1.50 M  
(3) 1.344 M (4) 2.70 M

96. (3)

97. For the reaction



$$(K_c = 1.8 \times 10^{-6} \text{ at } 184^\circ\text{C})$$

$$(R = 0.0831 \text{ kJ / (mol.K)})$$

When  $K_p$  and  $K_c$  are compared at  $184^\circ\text{C}$ , it is found that

- (1)  $K_p$  is greater than  $K_c$   
(2)  $K_p$  is less than  $K_c$   
(3)  $K_p = K_c$   
(4) Whether  $K_p$  is greater than, less than or equal to  $K_c$  depends upon the total gas pressure

97. (1)

$$K_p = K_c RT^{\Delta n}, \quad \Delta n = 1$$

$$K_p > K_c$$

98. Hydrogen ion concentration in mol / L in a solution of pH = 5.4 will be

- (1)  $3.98 \times 10^8$  (2)  $3.88 \times 10^6$   
(3)  $3.68 \times 10^{-6}$  (4)  $3.98 \times 10^{-6}$

98. (4)

$$p^H = -\log (H^+)$$

99. A reaction involving two different reactants can never be

- (1) Unimolecular reaction (2) First order reaction  
(3) second order reaction (4) Bimolecular reaction



100. If we consider that  $\frac{1}{6}$ , in place of  $\frac{1}{12}$ ; mass of carbon atom is taken to be the relative atomic mass unit, the mass of one mole of a substance will
- (1) Decrease twice
  - (2) Increase two fold
  - (3) Remain unchanged
  - (4) Be a function of the molecular mass of the substance

100. (3)

101. In a multi – electron atom, which of the following orbitals described by the three quantum numbers will have the same energy in the absence of magnetic and electric fields?

- (a)  $n = 1, l = 0, m = 0$
- (b)  $n = 2, l = 0, m = 0$
- (c)  $n = 2, l = 1, m = 1$
- (d)  $n = 3, l = 2, m = 1$
- (e)  $n = 3, l = 2, m = 0$

(1) (a) and (b)

(2) (b) and (c)

(3) (c) and (d)

(4) (d) and (e)

101. (4)

$n = \text{same}$

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

(1) Sn and Ag

(2) Pb and Zn

(3) Ag and Au

(4) Fe and Ni

102. (3)

Electrolyte	KCl	KNO <sub>3</sub>	HCl	NaOAc	NaCl
$\Lambda^{\infty}(\text{S cm}^2\text{mol}^{-1})$	149.9	145.0	426.2	91.0	126.5

Calculate  $\Lambda_{\text{HOAc}}^{\infty}$  Using appropriate molar conductances of the electrolytes listed above at infinite dilution in H<sub>2</sub>O at 25°C

(1) 517.2

(2) 552.7

(3) 390.7

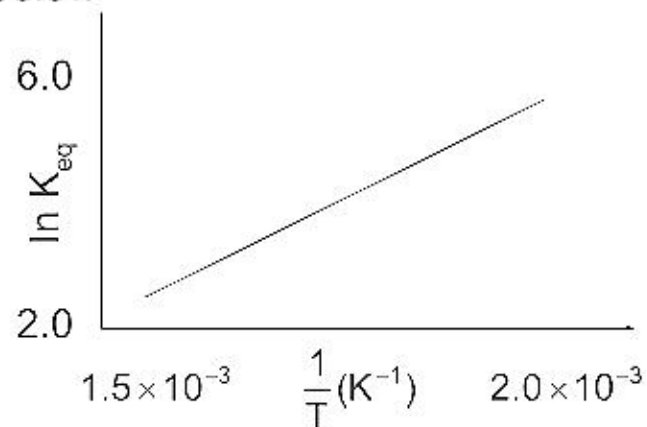
(4) 217.5

103. (3)

$$\Lambda_{\text{AcOH}}^{\infty} = \Lambda_{\text{HCl}}^{\infty} + \Lambda_{\text{AcONa}}^{\infty} - \Lambda_{\text{NaCl}}^{\infty}$$

$$= 390.7$$

104. A schematic plot of  $\ln K_{\text{eq}}$  versus inverse of temperature for a reaction is shown below



The reaction must be

- temperature
104. (1)  

$$K_{eq} = A e^{-\frac{\Delta H}{RT}}$$
105. The disperse phase in colloidal iron (III) hydroxide and colloidal gold is positively and negatively charged, respectively, which of the following statements is NOT correct?  
 (1) magnesium chloride solution coagulates, the gold sol more readily than the iron (III) hydroxide sol.  
 (2) sodium sulphate solution causes coagulation in both sols  
 (3) mixing the sols has no effect  
 (4) coagulation in both sols can be brought about by electrophoresis
105. (3)
106. Based on lattice energy and other considerations which one of the following alkali metal chlorides is expected to have the highest melting point.  
 (1) LiCl (2) NaCl  
 (3) KCl (4) RbCl
106. (2)  
 Although lattice energy of LiCl higher than NaCl but LiCl is covalent in nature and NaCl ionic there after , the melting point decreases as we move NaCl because the lattice energy decreases as a size of alkali metal atom increases (lattice energy  $\propto$  to melting point of alkali metal halide)
107. Heating mixture of  $\text{Cu}_2\text{O}$  and  $\text{Cu}_2\text{S}$  will give  
 (1)  $\text{Cu} + \text{SO}_2$  (2)  $\text{Cu} + \text{SO}_3$   
 (3)  $\text{CuO} + \text{CuS}$  (4)  $\text{Cu}_2\text{SO}_3$
107. (1)  

$$2\text{Cu}_2\text{O} + \text{Cu}_2\text{S} \longrightarrow 6\text{Cu} + \text{SO}_2$$
108. The molecular shapes of  $\text{SF}_4$ ,  $\text{CF}_4$  and  $\text{XeF}_4$  are  
 (1) the same with 2,0 and 1 lone pairs of electrons on the central atom, respectively  
 (2) the same with 1, 1 and 1 lone pair of electrons on the central atoms, respectively  
 (3) different with 0, 1 and 2 lone pair of electrons on the central atoms, respectively  
 (4) different with 1, 0 and 2 lone pairs of electron on the central atoms respectively
- 108 (4)
109. The number and type of bonds between two carbon atoms in calcium carbide are  
 (1) One sigma, one pi (2) One sigma, two pi  
 (3) Two sigma, one pi (4) Two sigma, two pi
109. (2)  

$$\text{CaC}_2 \quad \text{Ca}^{+2} \begin{array}{c} \text{C}^- \\ ||| \\ \text{C}^- \end{array}$$
  
 One  $\sigma$   
 Two  $\pi$
110. The oxidation state of chromium in the final product formed by the reaction between KI and acidified potassium dichromate solution is  
 (1) +4 (2) +6  
 (3) +2 (4) +3
110. (4)

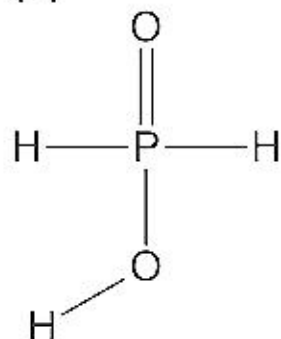




111. The number of hydrogen atom(s) attached to phosphorus atom in hypophosphorous acid is

- (1) zero (2) two  
(3) one (4) three

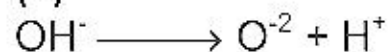
111. (2)



112. What is the conjugate base of  $\text{OH}^-$ ?

- (1)  $\text{O}_2$  (2)  $\text{H}_2\text{O}$   
(3)  $\text{O}^-$  (4)  $\text{O}^{2-}$

112. (4)



113. The correct order of the thermal stability of hydrogen halides ( $\text{H}-\text{X}$ ) is

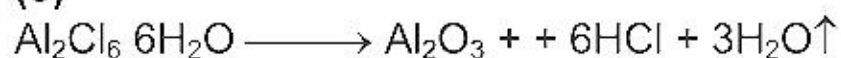
- (1)  $\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$  (2)  $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$   
(3)  $\text{HCl} < \text{HF} > \text{HBr} < \text{HI}$  (4)  $\text{HI} > \text{HCl} < \text{HF} < \text{HBr}$

113. (2)

114. Heating an aqueous solution of aluminium chloride to dryness will give

- (1)  $\text{AlCl}_3$  (2)  $\text{Al}_2\text{Cl}_6$   
(3)  $\text{Al}_2\text{O}_3$  (4)  $\text{Al}(\text{OH})\text{Cl}_2$

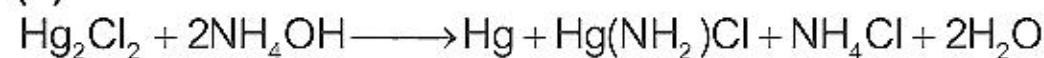
114. (3)



115. Calomel ( $\text{Hg}_2\text{Cl}_2$ ) on reaction with ammonium hydroxide gives

- (1)  $\text{HgNH}_2\text{Cl}$  (2)  $\text{NH}_2-\text{Hg}-\text{Hg}-\text{Cl}$   
(3)  $\text{Hg}_2\text{O}$  (4)  $\text{HgO}$

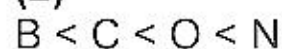
115. (1)



116. In which of the following arrangements the order is NOT according to the property indicated against it?

- (1)  $\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^+ < \text{F}^-$   
Increasing ionic size  
(2)  $\text{B} < \text{C} < \text{N} < \text{O}$   
Increasing first ionization enthalpy  
(3)  $\text{I} < \text{Br} < \text{F} < \text{Cl}$   
Increasing electron gain enthalpy (with negative sign)  
(4)  $\text{Li} < \text{Na} < \text{K} < \text{Rb}$   
Increasing metallic radius

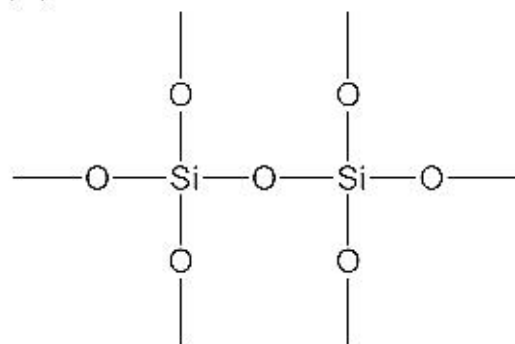
116. (2)





- (1) Each silicon atom is surrounded by four oxygen atoms and each oxygen atom is bonded to two silicon atoms  
 (2) Each silicon atom is surrounded by two oxygen atoms and each oxygen atom is bonded to two silicon atoms  
 (3) Silicon atoms is bonded to two oxygen atoms  
 (4) there are double bonds between silicon and oxygen atoms

117. (1)



118. Of the following sets which one does NOT contain isoelectronic species?

- (1)  $\text{PO}_4^{-3}, \text{SO}_4^{-2}, \text{ClO}_4^-$  (2)  $\text{CN}^-, \text{N}_2, \text{C}_2^{-2}$   
 (3)  $\text{SO}_3^{-2}, \text{CO}_3^{-2}, \text{NO}_3^-$  (4)  $\text{BO}_3^{-3}, \text{CO}_3^{-2}, \text{NO}_3^-$

118. (3)

119. The lanthanide contraction is responsible for the fact that

- (1) Zr and Y have about the same radius (2) Zr and Nb have similar oxidation state  
 (3) Zr and Hf have about the same radius (4) Zr and Zn have the same oxidation

119. (3)

Due to Lanthanide contraction.

120. The IUPAC name of the coordination compound  $\text{K}_3[\text{Fe}(\text{CN})_6]$  is

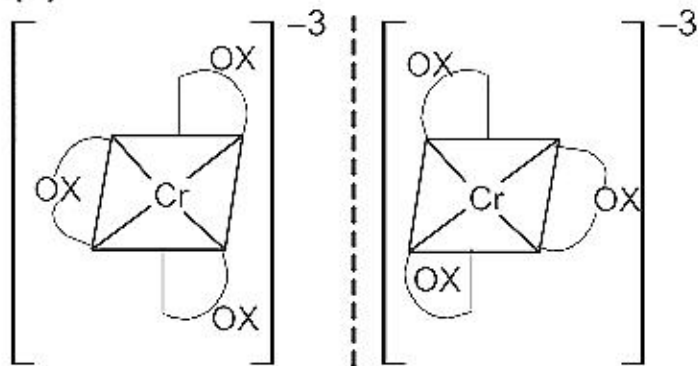
- (1) Potassium hexacyanoferrate (II) (2) Potassium hexacyanoferrate (III)  
 (3) Potassium hexacyanoiron (II) (4) tripotassium hexacyanoiron (II)

120. (2)

121. Which of the following compounds shows optical isomerism?

- (1)  $[\text{Cu}(\text{NH}_3)_4]^{+2}$  (2)  $[\text{ZnCl}_4]^{-2}$   
 (3)  $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{-3}$  (4)  $[\text{Co}(\text{CN})_6]^{-3}$

121. (3)



122. Which one of the following cyano complexes would exhibit the lowest value of paramagnetic behaviour?

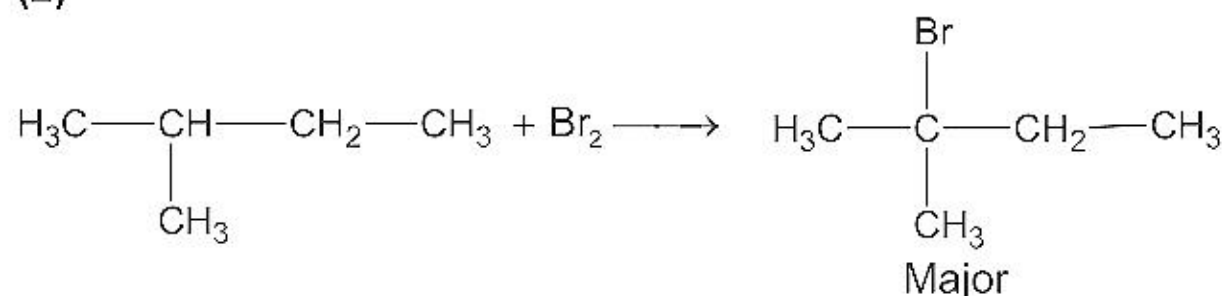
- (1)  $[\text{Cr}(\text{CN})_6]^{-3}$  (2)  $[\text{Mn}(\text{CN})_6]^{-3}$   
 (3)  $[\text{Fe}(\text{CN})_6]^{-3}$  (4)  $[\text{Co}(\text{CN})_6]^{-3}$   
 (At. No. Cr = 24, Mn = 25, Fe = 26, Co = 27)

122. (4)

- (1) 1-bromo-2-methylbutane  
 (3) 2-bromo-3-methylbutane

- (2) 2-bromo-2-methylbutane  
 (4) 1-bromo-3-methylbutane

123. (2)



124. The photon of hard gamma radiation knocks a proton out of  $^{24}_{12}\text{Mg}$  nucleus to form  
 (1) the isotope of parent nucleus  
 (2) the isobar of parent nucleus  
 (3) the nuclide  $^{23}_{11}\text{Na}$   
 (4) the isobar of  $^{23}_{11}\text{Na}$

124. (3)

125. The best reagent to convert pent-3-en-2-ol into pent-3-en-2-one is  
 (1) Acidic permanganate  
 (2) Acidic dichromate  
 (3) Chromic anhydride in glacial acetic acid  
 (4) Pyridinium chloro-chromate

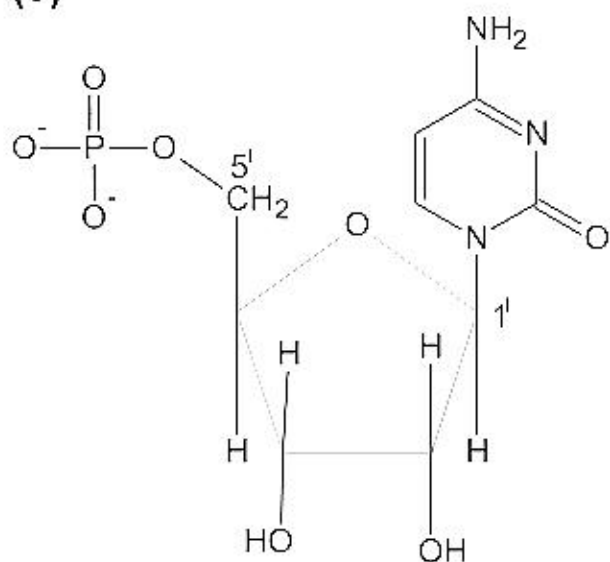
125. (3)

126. Tertiary alkyl halides are practically inert to substitution by  $\text{S}_{\text{N}}^2$  mechanism because of  
 (1) insolubility  
 (2) instability  
 (3) inductive effect  
 (4) steric hindrance

126. (4)

127. In both DNA and RNA, heterocyclic base and phosphate ester linkages are at-  
 (1)  $\text{C}_5'$  and  $\text{C}_2'$  respectively of the sugar molecule  
 (2)  $\text{C}_2'$  and  $\text{C}_5'$  respectively of the sugar molecule  
 (3)  $\text{C}_1'$  and  $\text{C}_5'$  respectively of the sugar molecule  
 (4)  $\text{C}_5'$  and  $\text{C}_1'$  respectively of the sugar molecule

127. (3)



128. Reaction of one molecule of HBr with one molecule of 1,3-butadiene at 40°C gives predominantly  
 (1) 3-bromobutene under kinetically controlled conditions  
 (2) 1-bromo-2-butene under thermodynamically controlled conditions  
 (3) 3-bromobutene under thermodynamically controlled conditions  
 (4) 1-bromo-2-butene under kinetically controlled conditions

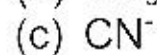
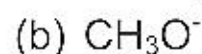
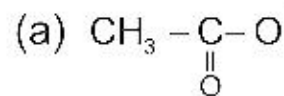


129. Among the following acids which has the lowest  $pK_a$  value?

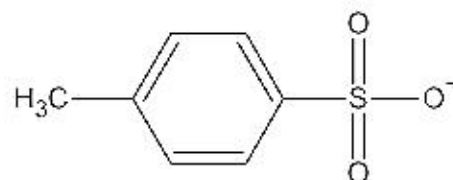
- (1)  $\text{CH}_3\text{COOH}$
- (2)  $\text{HCOOH}$
- (3)  $(\text{CH}_3)_2\text{COOH}$
- (4)  $\text{CH}_3\text{CH}_2\text{COOH}$

129. (2)

130. The decreasing order of nucleophilicity among the nucleophiles



(d)



(1) (a), (b), (c), (d)

(2) (d), (c), (b), (a)

(3) (b), (c), (a), (d)

(4) (c), (b), (a), (d)

130. (4)

131. Which one of the following methods is neither meant for the synthesis nor for separation of amines?

- (1) Hinsberg method
- (2) Hofmann method
- (3) Wurtz reaction
- (4) Curtius reaction

131. (3)

132. Which of the following is fully fluorinated polymer?

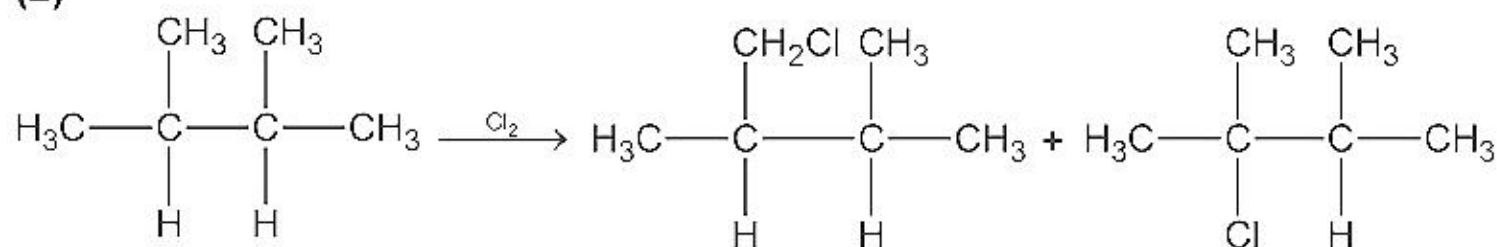
- (1) Neoprene
- (2) Teflon
- (3) Thiokol
- (4) PVC

132. (2)

133. Of the five isomeric hexanes, the isomer which can give two monochlorinated compounds is

- (1) n-hexane
- (2) 2, 3-dimethylbutane
- (3) 2,2-dimethylbutane
- (4) 2-methylpentane

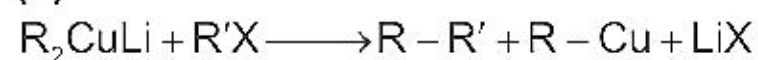
133. (2)



134. Alkyl halides react with dialkyl copper reagents to give

- (1) alkenes
- (2) alkyl copper halides
- (3) alkanes
- (3) alkenyl halides

134. (3)



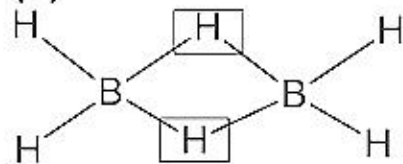


- (2) secondary or tertiary alcohol  
 (3) mixture of primary and secondary alcohols  
 (4) mixture of secondary and tertiary alcohols
- 135. (4)**
136. Amongst the following the most basic compound is  
 (1) benzylamine (2) aniline  
 (3) acetanilide (4) p-nitroaniline
- 136. (1)**  
 -NH<sub>2</sub> group is not linked with benzene ring.
137. Which types of isomerism is shown by 2,3-dichlorobutane?  
 (1) Diastereo (2) Optical  
 (3) Geometric (4) Structural
- 137. (2)**
- 
138. The reaction
- $$\begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C} \\ | \\ \text{X} \end{array} + \text{Nu}^{\ominus} \longrightarrow \begin{array}{c} \text{O} \\ \parallel \\ \text{R}-\text{C} \\ | \\ \text{Nu} \end{array} + \text{X}^{\ominus}$$
- is fastest when X is  
 (1) Cl (2) NH<sub>2</sub>  
 (3) OC<sub>2</sub>H<sub>5</sub> (4) OCOR
- 138. (1)**  
 Conjugated acid of Cl<sup>-</sup> is a stronger acid i.e. HCl.
139. Elimination of bromine from 2-bromobutane results in the formation of-  
 (1) equimolar mixture of 1 and 2-butene (2) predominantly 2-butene  
 (3) predominantly 1-butene (4) predominantly 2-butyne
- 139. (2)**  
 Saytzeffs product.
140. Equimolar solutions in the same solvent have  
 (1) Same boiling point but different freezing point  
 (2) Same freezing point but different boiling point  
 (3) Same boiling and same freezing points  
 (4) Different boiling and different freezing points
- 140. (3)**
141. Which of the following statements in relation to the hydrogen atom is correct?  
 (1) 3s orbital is lower in energy than 3p orbital  
 (2) 3p orbital is lower in energy than 3d orbital  
 (3) 3s and 3p orbitals are of lower energy than 3d orbital  
 (4) 3s, 3p and 3d orbitals all have the same energy
- 141. (4)**

- (1) four 2c-2e bonds and two 3c-2e bonds  
 (2) two 2c-2e bonds and four 3c-2e bonds  
 (3) two 2c-2e bonds and two 3c-3e bonds  
 (4) four 2c-2e bonds and four 3c-2e bonds

142.

(1)



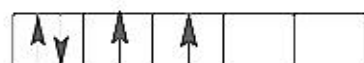
143.

The value of the 'spin only' magnetic moment for one of the following configurations is 2.84 BM. The correct one is

- (1)  $d^4$  (in strong ligand field)  
 (2)  $d^4$  (in weak ligand field)  
 (3)  $d^3$  (in weak as well as in strong fields)  
 (4)  $d^5$  (in strong ligand field)

143.

(1)



$d^4$  in strong field, so unpaired electrons = 2.

144.

Which of the following factors may be regarded as the main cause of lanthanide contraction?

- (1) Poor shielding of one of 4f electron by another in the subshell  
 (2) Effective shielding of one of 4f electrons by another in the subshell  
 (3) Poorer shielding of 5d electrons by 4f electrons  
 (4) Greater shielding of 5d electrons by 4f electrons

144.

(1)

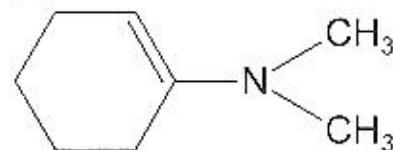
145.

Reaction of cyclohexanone with dimethylamine in the presence of catalytic amount of an acid forms a compound if water during the reaction is continuously removed. The compound formed is generally known as

- (1) a Schiff's base  
 (2) an enamine  
 (3) an imine  
 (4) an amine

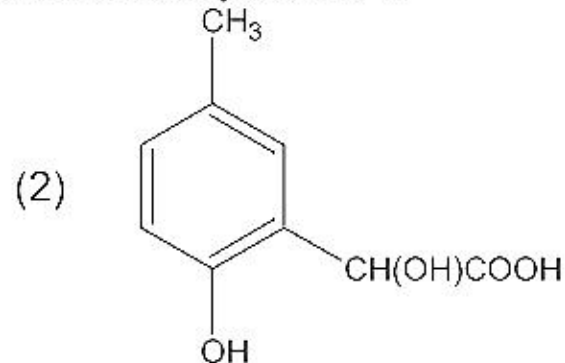
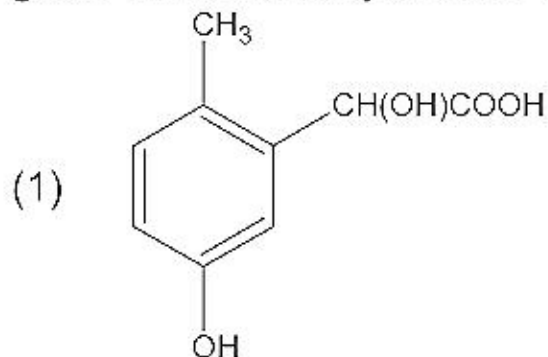
145.

(2)

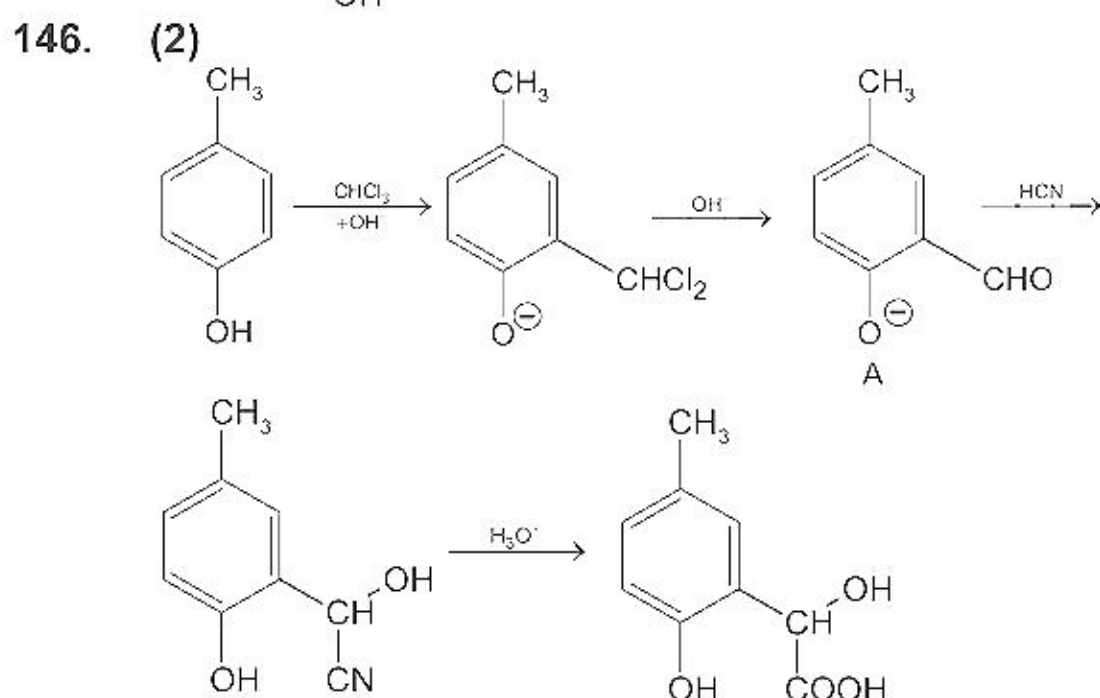
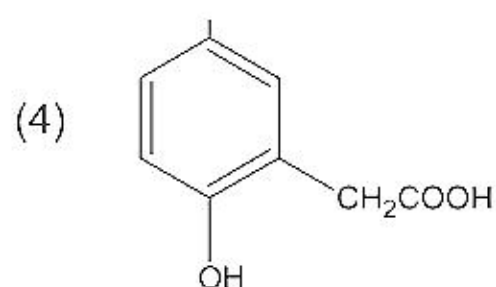
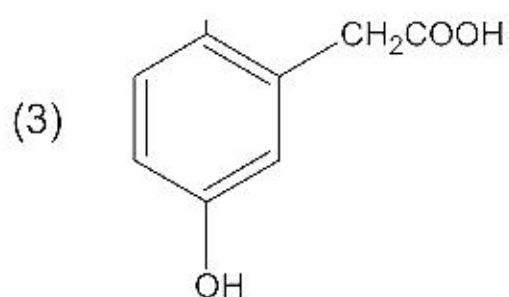


146.

p-cresol reacts with chloroform in alkaline medium to give the compound A which adds hydrogen cyanide to form, the compound B. The latter on acidic hydrolysis gives chiral carboxylic acid. The structure of the carboxylic acid is







147. An organic compound having molecular mass 60 is found to contain C = 20%, H = 6.67% and N = 46.67% while rest is oxygen. On heating it gives  $\text{NH}_3$  along with a solid residue. The solid residue give violet colour with alkaline copper sulphate solution. The compound is

- (1)  $\text{CH}_3\text{NCO}$   
 (3)  $(\text{NH}_2)_2\text{CO}$

- (2)  $\text{CH}_3\text{CONH}_2$   
 (4)  $\text{CH}_3\text{CH}_2\text{CONH}_2$

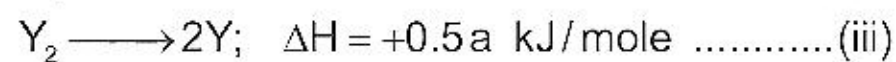
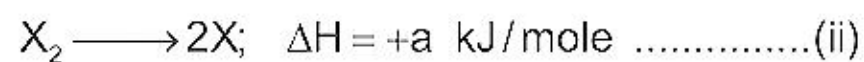
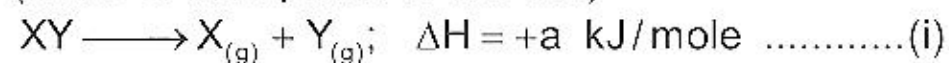
147. (3)

148. If the bond dissociation energies of  $\text{XY}$ ,  $\text{X}_2$  and  $\text{Y}_2$  (all diatomic molecules) are in the ratio of 1:1:0.5 and  $\Delta_f H$  for the formation of  $\text{XY}$  is  $-200 \text{ kJ mole}^{-1}$ . The bond dissociation energy of  $\text{X}_2$  will be

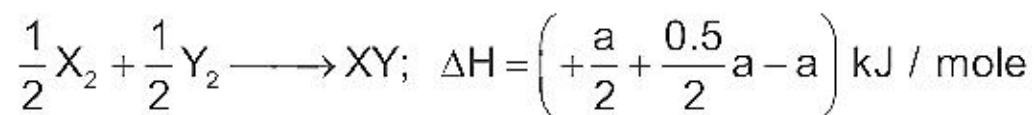
- (1)  $100 \text{ kJ mol}^{-1}$  (2)  $200 \text{ kJ mol}^{-1}$   
 (3)  $300 \text{ kJ mol}^{-1}$  (4)  $400 \text{ kJ mol}^{-1}$

148. -

(None of the options is correct.)



$\frac{1}{2} \times (\text{ii}) + \frac{1}{2} \times (\text{iii}) - (\text{i})$ , Gives



$$+\frac{a}{2} + \frac{0.5a}{2} - a = -200$$

$$a = 800.$$



its initial value. If the rate constant for a first order reaction is K, the written as

$t_{1/4}$  can be

(1)  $0.10 / K$

(2)  $0.29 / K$

(3)  $0.69 / K$

(4)  $0.75 / K$

149. (2)

$$t_{1/4} = \frac{2.303}{K} \log \frac{1}{1 - \frac{1}{4}} = \frac{0.29}{K}$$

150. An amount of solid  $\text{NH}_4\text{HS}$  is placed in a flask already containing ammonia gas at a certain temperature and 0.50 atm. Pressure. Ammonium hydrogen sulphide decomposes to yield  $\text{NH}_3$  and  $\text{H}_2\text{S}$  gases in the flask. When the decomposition reaction reaches equilibrium, the total pressure in the flask rises to 0.84 atm. The equilibrium constant for  $\text{NH}_4\text{HS}$  decomposition at this temperature is

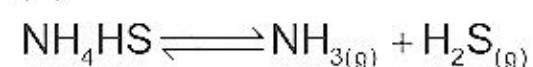
(1) 0.30

(2) 0.18

(3) 0.17

(4) 0.11

150. (4)



a            0.5 atm

a - x            0.5 + x    x

Total pressure = 0.5 + 2x = 0.84

i.e., x = 0.17

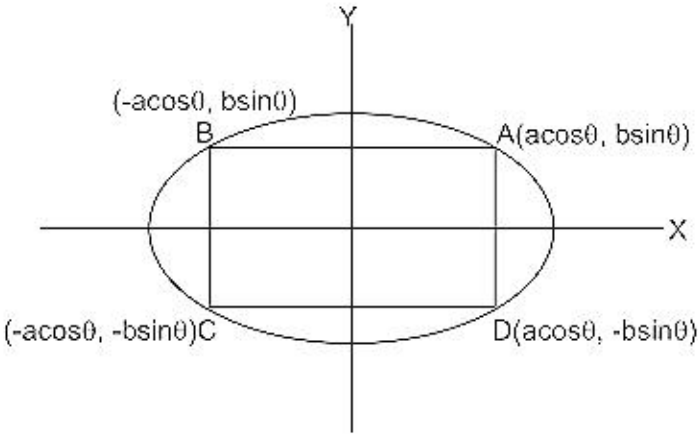
$K_p = p_{\text{NH}_3} \cdot p_{\text{H}_2\text{S}}$

= (0.67). (0.17)

= 0.1139.

# SOLUTION TO AIEEE-2005

## MATHEMATICS

1. If  $A^2 - A + I = 0$ , then the inverse of A is  
 (1)  $A + I$  (2)  $A$   
 (3)  $A - I$  (4)  $I - A$
1. **(4)**  
 Given  $A^2 - A + I = 0$   
 $A^{-1}A^2 - A^{-1}A + A^{-1}I = A^{-1} \cdot 0$  (Multiplying  $A^{-1}$  on both sides)  
 $\Rightarrow A - I + A^{-1} = 0$  or  $A^{-1} = I - A$ .
2. If the cube roots of unity are  $1, \omega, \omega^2$  then the roots of the equation  $(x - 1)^3 + 8 = 0$ , are  
 (1)  $-1, -1 + 2\omega, -1 - 2\omega^2$  (2)  $-1, -1, -1$   
 (3)  $-1, 1 - 2\omega, 1 - 2\omega^2$  (4)  $-1, 1 + 2\omega, 1 + 2\omega^2$
2. **(3)**  
 $(x - 1)^3 + 8 = 0 \Rightarrow (x - 1) = (-2)(1)^{1/3}$   
 $\Rightarrow x - 1 = -2$  or  $-2\omega$  or  $-2\omega^2$   
 or  $x = -1$  or  $1 - 2\omega$  or  $1 - 2\omega^2$ .
3. Let  $R = \{(3, 3), (6, 6), (9, 9), (12, 12), (6, 12), (3, 9), (3, 12), (3, 6)\}$  be a relation on the set  $A = \{3, 6, 9, 12\}$  be a relation on the set  $A = \{3, 6, 9, 12\}$ . The relation is  
 (1) reflexive and transitive only (2) reflexive only  
 (3) an equivalence relation (4) reflexive and symmetric only
3. **(1)**  
 Reflexive and transitive only.  
 e.g.  $(3, 3), (6, 6), (9, 9), (12, 12)$  [Reflexive]  
 $(3, 6), (6, 12), (3, 12)$  [Transitive].
4. Area of the greatest rectangle that can be inscribed in the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  is  
 (1)  $2ab$  (2)  $ab$   
 (3)  $\sqrt{ab}$  (4)  $\frac{a}{b}$
4. **(1)**  
 Area of rectangle ABCD =  $(2a \cos \theta)(2b \sin \theta) = 2ab \sin 2\theta$   
 $\Rightarrow$  Area of greatest rectangle is equal to  $2ab$   
 when  $\sin 2\theta = 1$ .
- 
5. The differential equation representing the family of curves  $y^2 = 2c(x + \sqrt{c})$ , where  $c > 0$ , is a parameter, is of order and degree as follows:  
 (1) order 1, degree 2 (2) order 1, degree 1

$$y^2 = 2c(x + \sqrt{c}) \quad \dots(i)$$

$$2yy' = 2c \cdot 1 \text{ or } yy' = c \quad \dots(ii)$$

$$\Rightarrow y^2 = 2yy' (x + \sqrt{yy'}) \quad [\text{on putting value of } c \text{ from (ii) in (i)}]$$

On simplifying, we get

$$(y - 2xy')^2 = 4yy'^3 \quad \dots(iii)$$

Hence equation (iii) is of order 1 and degree 3.

6.  $\lim_{n \rightarrow \infty} \left[ \frac{1}{n^2} \sec^2 \frac{1}{n^2} + \frac{2}{n^2} \sec^2 \frac{4}{n^2} + \dots + \frac{1}{n^2} \sec^2 1 \right]$  equals

(1)  $\frac{1}{2} \sec 1$

(2)  $\frac{1}{2} \operatorname{cosec} 1$

(3)  $\tan 1$

(4)  $\frac{1}{2} \tan 1$

6. (4)

$\lim_{n \rightarrow \infty} \left[ \frac{1}{n^2} \sec^2 \frac{1}{n^2} + \frac{2}{n^2} \sec^2 \frac{4}{n^2} + \frac{3}{n^2} \sec^2 \frac{9}{n^2} + \dots + \frac{1}{n} \sec^2 1 \right]$  is equal to

$$\lim_{n \rightarrow \infty} \frac{r}{n^2} \sec^2 \frac{r^2}{n^2} = \lim_{n \rightarrow \infty} \frac{1}{n} \cdot \frac{r}{n} \sec^2 \frac{r^2}{n^2}$$

$$\Rightarrow \text{Given limit is equal to value of integral } \int_0^1 x \sec^2 x^2 dx$$

$$\text{or } \frac{1}{2} \int_0^1 2x \sec x^2 dx = \frac{1}{2} \int_0^1 \sec^2 t dt \quad [\text{put } x^2 = t]$$

$$= \frac{1}{2} (\tan t)_0^1 = \frac{1}{2} \tan 1.$$

7. ABC is a triangle. Forces  $\vec{P}$ ,  $\vec{Q}$ ,  $\vec{R}$  acting along IA, IB and IC respectively are in equilibrium, where I is the incentre of  $\triangle ABC$ . Then  $P : Q : R$  is

(1)  $\sin A : \sin B : \sin C$

(2)  $\sin \frac{A}{2} : \sin \frac{B}{2} : \sin \frac{C}{2}$

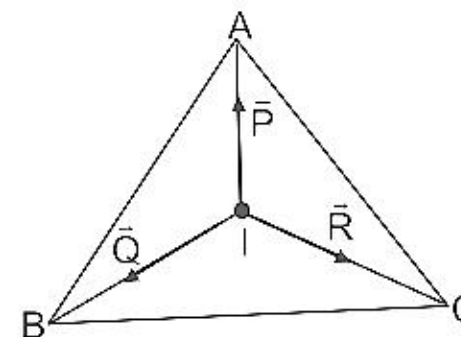
(3)  $\cos \frac{A}{2} : \cos \frac{B}{2} : \cos \frac{C}{2}$

(4)  $\cos A : \cos B : \cos C$

7. (3)

Using Lami's Theorem

$$\therefore P : Q : R = \cos \frac{A}{2} : \cos \frac{B}{2} : \cos \frac{C}{2}$$



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

(1) 22.0

(2) 20.5

(3) 25.5

(4) 24.0

8. (4)

$$\text{Mode} + 2\text{Mean} = 3 \text{ Median}$$

$$\Rightarrow \text{Mode} = 3 \times 22 - 2 \times 21 = 66 - 42 = 24.$$



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

$$(3) x^2 + 4y + 2 = 0$$

$$(2) y^2 + 4x + 2 = 0$$

$$(4) x^2 - 4y + 2 = 0$$

9.

(1)

$$P = (1, 0)$$

$$Q = (h, k) \text{ such that } k^2 = 8h$$

Let  $(\alpha, \beta)$  be the midpoint of PQ

$$\alpha = \frac{h+1}{2}, \quad \beta = \frac{k+0}{2}$$

$$2\alpha - 1 = h \quad 2\beta = k.$$

$$(2\beta)^2 = 8(2\alpha - 1) \Rightarrow \beta^2 = 4\alpha - 2$$

$$\Rightarrow y^2 - 4x + 2 = 0.$$

10.

If C is the mid point of AB and P is any point outside AB, then

$$(1) \vec{PA} + \vec{PB} = 2\vec{PC}$$

$$(2) \vec{PA} + \vec{PB} = \vec{PC}$$

$$(3) \vec{PA} + \vec{PB} + 2\vec{PC} = 0$$

$$(4) \vec{PA} + \vec{PB} + \vec{PC} = 0$$

10.

(1)

$$\vec{PA} + \vec{AC} + \vec{CP} = 0$$

$$\vec{PB} + \vec{BC} + \vec{CP} = 0$$

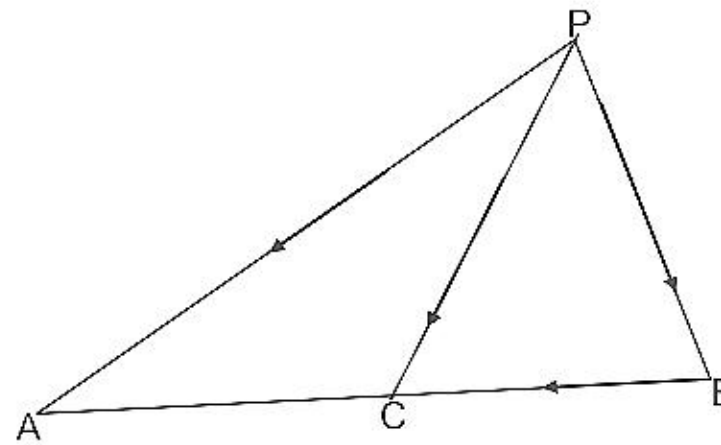
Adding, we get

$$\vec{PA} + \vec{PB} + \vec{AC} + \vec{BC} + 2\vec{CP} = 0$$

$$\text{Since } \vec{AC} = -\vec{BC}$$

$$\& \vec{CP} = -\vec{PC}$$

$$\Rightarrow \vec{PA} + \vec{PB} - 2\vec{PC} = 0.$$



11.

If the coefficients of  $r$ th,  $(r+1)$ th and  $(r+2)$ th terms in the binomial expansion of  $(1+y)^m$  are in A.P., then  $m$  and  $r$  satisfy the equation

$$(1) m^2 - m(4r-1) + 4r^2 - 2 = 0$$

$$(2) m^2 - m(4r+1) + 4r^2 + 2 = 0$$

$$(3) m^2 - m(4r+1) + 4r^2 - 2 = 0$$

$$(4) m^2 - m(4r-1) + 4r^2 + 2 = 0$$

11.

(3)

Given  ${}^m C_{r-1}$ ,  ${}^m C_r$ ,  ${}^m C_{r+1}$  are in A.P.

$$2 {}^m C_r = {}^m C_{r-1} + {}^m C_{r+1}$$

$$\Rightarrow 2 = \frac{{}^m C_{r-1}}{{}^m C_r} + \frac{{}^m C_{r+1}}{{}^m C_r}$$

$$= \frac{r}{m-r+1} + \frac{m-r}{r+1}$$

$$\Rightarrow m^2 - m(4r+1) + 4r^2 - 2 = 0.$$

12.

In a triangle PQR,  $\angle R = \frac{\pi}{2}$ . If  $\tan\left(\frac{P}{2}\right)$  and  $\tan\left(\frac{Q}{2}\right)$  are the roots of

$$ax^2 + bx + c = 0, a \neq 0 \text{ then}$$

$$(1) a = b + c$$

$$(2) c = a + b$$

$$(3) b = c$$

$$(4) b = a + c$$

12.

(2)

$\tan\left(\frac{P}{2}\right)$ ,  $\tan\left(\frac{Q}{2}\right)$  are the roots of  $ax^2 + bx + c = 0$

$$\tan\left(\frac{P}{2}\right) + \tan\left(\frac{Q}{2}\right) = -\frac{b}{a}$$

$$\frac{\tan\left(\frac{P}{2}\right) + \tan\left(\frac{Q}{2}\right)}{1 - \tan\left(\frac{P}{2}\right)\tan\left(\frac{Q}{2}\right)} = \tan\left(\frac{P}{2} + \frac{Q}{2}\right) = 1$$

$$\Rightarrow \frac{-\frac{b}{a}}{1 - \frac{c}{a}} = 1 \Rightarrow -\frac{b}{a} = \frac{a}{a} - \frac{c}{a} \Rightarrow -b = a - c$$

$$c = a + b.$$

13. The system of equations

$$\alpha x + y + z = \alpha - 1,$$

$$x + \alpha y + z = \alpha - 1,$$

$$x + y + \alpha z = \alpha - 1$$

has no solution, if  $\alpha$  is

(1) -2

(3) not -2

(2) either -2 or 1

(4) 1

13.

(1)

$$\alpha x + y + z = \alpha - 1$$

$$x + \alpha y + z = \alpha - 1$$

$$x + y + z\alpha = \alpha - 1$$

$$\Delta = \begin{vmatrix} \alpha & 1 & 1 \\ 1 & \alpha & 1 \\ 1 & 1 & \alpha \end{vmatrix}$$

$$= \alpha(\alpha^2 - 1) - 1(\alpha - 1) + 1(1 - \alpha)$$

$$= \alpha(\alpha - 1)(\alpha + 1) - 1(\alpha - 1) - 1(\alpha - 1)$$

$$\Rightarrow (\alpha - 1)[\alpha^2 + \alpha - 1 - 1] = 0$$

$$\Rightarrow (\alpha - 1)[\alpha^2 + \alpha - 2] = 0$$

$$[\alpha^2 + 2\alpha - \alpha - 2] = 0$$

$$(\alpha - 1)[\alpha(\alpha + 2) - 1(\alpha + 2)] = 0$$

$$(\alpha - 1) = 0, \alpha + 2 = 0 \Rightarrow \alpha = -2, 1; \text{ but } \alpha \neq 1.$$

14. The value of  $\alpha$  for which the sum of the squares of the roots of the equation

$$x^2 - (a - 2)x - a - 1 = 0 \text{ assume the least value is}$$

(1) 1

(2) 0

(3) 3

(4) 2

14.

(1)

$$x^2 - (a - 2)x - a - 1 = 0$$

$$\Rightarrow \alpha + \beta = a - 2$$

$$\alpha\beta = -(a + 1)$$

$$\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$$

$$= a^2 - 2a + 6 = (a - 1)^2 + 5$$

$$\Rightarrow a = 1.$$

15. If roots of the equation  $x^2 - bx + c = 0$  be two consecutive integers, then  $b^2 - 4c$  equals

(1) -2

(2) 3

Let  $\alpha, \alpha + 1$  be roots  
 $\alpha + \alpha + 1 = b$   
 $\alpha(\alpha + 1) = c$   
 $\therefore b^2 - 4c = (2\alpha + 1)^2 - 4\alpha(\alpha + 1) = 1.$

16. If the letters of word SACHIN are arranged in all possible ways and these words are written out as in dictionary, then the word SACHIN appears at serial number

- (1) 601 (2) 600  
 (3) 603 (4) 602

16. (1)

Alphabetical order is

A, C, H, I, N, S

No. of words starting with A – 5!

No. of words starting with C – 5!

No. of words starting with H – 5!

No. of words starting with I – 5!

No. of words starting with N – 5!

SACHIN – 1

601.

17. The value of  ${}^{50}C_4 + \sum_{r=1}^6 {}^{56-r}C_3$  is

- (1)  ${}^{55}C_4$  (2)  ${}^{55}C_3$   
 (3)  ${}^{56}C_3$  (4)  ${}^{56}C_4$

17. (4)

$$\begin{aligned} & {}^{50}C_4 + \sum_{r=1}^6 {}^{56-r}C_3 \\ \Rightarrow & {}^{50}C_4 + [{}^{55}C_3 + {}^{54}C_3 + {}^{53}C_3 + {}^{52}C_3 + {}^{51}C_3 + {}^{50}C_3] \\ = & ({}^{50}C_4 + {}^{50}C_3) + {}^{51}C_3 + {}^{52}C_3 + {}^{53}C_3 + {}^{54}C_3 + {}^{55}C_3 \\ \Rightarrow & ({}^{51}C_4 + {}^{51}C_3) + {}^{52}C_3 + {}^{53}C_3 + {}^{54}C_3 + {}^{55}C_3 \\ \Rightarrow & {}^{55}C_4 + {}^{55}C_3 = {}^{56}C_4. \end{aligned}$$

18. If  $A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$  and  $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ , then which one of the following holds for all  $n \geq 1$ , by

the principle of mathematical induction

- (1)  $A^n = nA - (n-1)I$  (2)  $A^n = 2^{n-1}A - (n-1)I$   
 (3)  $A^n = nA + (n-1)I$  (4)  $A^n = 2^{n-1}A + (n-1)I$

18. (1)

By the principle of mathematical induction (1) is true.

19. If the coefficient of  $x^7$  in  $\left[ax^2 + \left(\frac{1}{bx}\right)\right]^{11}$  equals the coefficient of  $x^{-7}$  in  $\left[ax^2 - \left(\frac{1}{bx}\right)\right]^{11}$ ,

then a and b satisfy the relation

- (1)  $a - b = 1$  (2)  $a + b = 1$   
 (3)  $\frac{a}{b} = 1$  (4)  $ab = 1$

19. (4)



$$= {}^{11}C_r (a)^{11-r} (b)^{-r} (x)^{22-2r-r}$$

$$\Rightarrow 22 - 3r = 7 \Rightarrow r = 5$$

$$\therefore \text{coefficient of } x^7 = {}^{11}C_5 (a)^6 (b)^{-5} \dots\dots(1)$$

Again  $T_{r+1}$  in the expansion  $\left[ ax - \frac{1}{bx^2} \right]^{11} = {}^{11}C_r (ax)^{11-r} \left( -\frac{1}{bx^2} \right)^r$

$$= {}^{11}C_r a^{11-r} (-1)^r \times (b)^{-r} (x)^{-2r} (x)^{11-r}$$

Now  $11 - 3r = -7 \Rightarrow 3r = 18 \Rightarrow r = 6$

$$\therefore \text{coefficient of } x^{-7} = {}^{11}C_6 a^5 \times 1 \times (b)^{-6}$$

$$\Rightarrow {}^{11}C_5 (a)^6 (b)^{-5} = {}^{11}C_6 a^5 \times (b)^{-6}$$

$$\Rightarrow ab = 1.$$

20. Let  $f : (-1, 1) \rightarrow B$ , be a function defined by  $f(x) = \tan^{-1} \frac{2x}{1-x^2}$ , then  $f$  is both one-one and onto when  $B$  is the interval

- |  |  |
|--|--|
| (1) $\left(0, \frac{\pi}{2}\right)$              | (2) $\left[0, \frac{\pi}{2}\right)$              |
| (3) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ | (4) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ |

20. (4)

Given  $f(x) = \tan^{-1} \left( \frac{2x}{1-x^2} \right)$  for  $x \in (-1, 1)$

clearly range of  $f(x) = \left( -\frac{\pi}{2}, \frac{\pi}{2} \right)$

$\therefore$  co-domain of function =  $B = \left( -\frac{\pi}{2}, \frac{\pi}{2} \right)$ .

21. If  $z_1$  and  $z_2$  are two non-zero complex numbers such that  $|z_1 + z_2| = |z_1| + |z_2|$  then  $\arg z_1 - \arg z_2$  is equal to

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

21. (3)

$|z_1 + z_2| = |z_1| + |z_2| \Rightarrow z_1$  and  $z_2$  are collinear and are to the same side of origin; hence  $\arg z_1 - \arg z_2 = 0$ .

22. If  $\omega = \frac{z}{z - \frac{1}{3}i}$  and  $|\omega| = 1$ , then  $z$  lies on

- |                     |                 |
|---------------------|-----------------|
| (1) an ellipse      | (2) a circle    |
| (3) a straight line | (4) a parabola. |

22. (3)

$$z - \frac{i}{3} \quad |z - \frac{i}{3}|$$

$(0, \frac{1}{3})$  is same hence  $z$  lies on bisector of the line joining points  $(0, 0)$  and  $(0, 1/3)$ .

Hence  $z$  lies on a straight line.

23. If  $a^2 + b^2 + c^2 = -2$  and  $f(x) = \begin{vmatrix} 1+a^2x & (1+b^2)x & (1+c^2)x \\ (1+a^2)x & 1+b^2x & (1+c^2)x \\ (1+a^2)x & (1+b^2)x & 1+c^2x \end{vmatrix}$  then  $f(x)$  is a

polynomial of degree

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

23.

(4)

$$f(x) = \begin{vmatrix} 1+(a^2+b^2+c^2+2)x & (1+b^2)x & (1+c^2)x \\ 1+(a^2+b^2+c^2+2)x & 1+b^2x & (1+c^2)x \\ 1+(a^2+b^2+c^2+2)x & (1+b^2)x & 1+c^2x \end{vmatrix}, \text{ Applying } C_1 \rightarrow C_1 + C_2 + C_3$$

$$= \begin{vmatrix} 1 & (1+b^2)x & (1+c^2)x \\ 1 & 1+b^2x & (1+c^2)x \\ 1 & (1+b^2)x & 1+c^2x \end{vmatrix} \because a^2+b^2+c^2+2=0$$

$$f(x) = \begin{vmatrix} 0 & x-1 & 0 \\ 0 & 1-x & x-1 \\ 1 & (1+b^2)x & 1+c^2x \end{vmatrix}; \text{ Applying } R_1 \rightarrow R_1 - R_2, R_2 \rightarrow R_2 - R_3$$

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

Hence degree = 2.

24. The normal to the curve  $x = a(\cos\theta + \theta \sin\theta)$ ,  $y = a(\sin\theta - \theta \cos\theta)$  at any point ' $\theta$ ' is such that

- (1) it passes through the origin  
(2) it makes angle  $\frac{\pi}{2} + \theta$  with the x-axis  
(3) it passes through  $(a\frac{\pi}{2}, -a)$

24.

(4)

Clearly  $\frac{dy}{dx} = \tan\theta \Rightarrow$  slope of normal =  $-\cot\theta$

Equation of normal at ' $\theta$ ' is

$$y - a(\sin\theta - \theta \cos\theta) = -\cot\theta(x - a(\cos\theta + \theta \sin\theta))$$

$$\Rightarrow y \sin\theta - a \sin^2\theta + a \theta \cos\theta \sin\theta = -x \cos\theta + a \cos^2\theta + a \theta \sin\theta \cos\theta$$

$$\Rightarrow x \cos\theta + y \sin\theta = a$$

Clearly this is an equation of straight line which is at a constant distance ' $a$ ' from origin.

Interval	Function
(1) $(-\infty, \infty)$	$x^3 - 3x^2 + 3x + 3$
(2) $[2, \infty)$	$2x^3 - 3x^2 - 12x + 6$
(3) $\left(-\infty, \frac{1}{3}\right]$	$3x^2 - 2x + 1$
(4) $(-\infty, -4]$	$x^3 + 6x^2 + 6$

25.

(3)

Clearly function  $f(x) = 3x^2 - 2x + 1$  is increasing when

$$f'(x) = 6x - 2 \geq 0 \Rightarrow x \in [1/3, \infty)$$

Hence (3) is incorrect.

26. Let  $\alpha$  and  $\beta$  be the distinct roots of  $ax^2 + bx + c = 0$ , then  $\lim_{x \rightarrow \alpha} \frac{1 - \cos(ax^2 + bx + c)}{(x - \alpha)^2}$  is

equal to

(1)  $\frac{a^2}{2}(\alpha - \beta)^2$

(2) 0

(3)  $-\frac{a^2}{2}(\alpha - \beta)^2$

(4)  $\frac{1}{2}(\alpha - \beta)^2$

26.

(1)

$$\begin{aligned} \text{Given limit} &= \lim_{x \rightarrow \alpha} \frac{1 - \cos a(x - \alpha)(x - \beta)}{(x - \alpha)^2} = \lim_{x \rightarrow \alpha} \frac{2 \sin^2 \left( a \frac{(x - \alpha)(x - \beta)}{2} \right)}{(x - \alpha)^2} \\ &= \lim_{x \rightarrow \alpha} \frac{2}{(x - \alpha)^2} \times \frac{\sin^2 \left( a \frac{(x - \alpha)(x - \beta)}{2} \right)}{a^2 (x - \alpha)^2 (x - \beta)^2} \times \frac{a^2 (x - \alpha)^2 (x - \beta)^2}{4} \\ &= \frac{a^2 (\alpha - \beta)^2}{2} \end{aligned}$$

27. Suppose  $f(x)$  is differentiable  $x = 1$  and  $\lim_{h \rightarrow 0} \frac{1}{h} f(1+h) = 5$ , then  $f'(1)$  equals

(1) 3

(2) 4

(3) 5

(4) 6

27.

(3)

$$f'(1) = \lim_{h \rightarrow 0} \frac{f(1+h) - f(1)}{h}; \text{ As function is differentiable so it is continuous as it is given}$$

$$\text{that } \lim_{h \rightarrow 0} \frac{f(1+h)}{h} = 5 \text{ and hence } f(1) = 0$$

$$\text{Hence } f'(1) = \lim_{h \rightarrow 0} \frac{f(1+h)}{h} = 5$$

Hence (3) is the correct answer.

28. Let  $f$  be differentiable for all  $x$ . If  $f(1) = -2$  and  $f'(x) \geq 2$  for  $x \in [1, 6]$ , then

(1)  $f(6) \geq 8$

(2)  $f(6) < 8$

(3)  $f(6) < 5$

(4)  $f(6) = 5$



Applying Lagrange's mean value theorem

$$\frac{f(6) - f(1)}{5} = f'(c) \geq 2$$

$$\Rightarrow f(6) \geq 10 + f(1)$$

$$\Rightarrow f(6) \geq 10 - 2$$

$$\Rightarrow f(6) \geq 8.$$

29. If  $f$  is a real-valued differentiable function satisfying  $|f(x) - f(y)| \leq (x - y)^2$ ,  $x, y \in \mathbb{R}$  and  $f(0) = 0$ , then  $f(1)$  equals

(1) -1

(2) 0

(3) 2

(4) 1

29. (2)

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$|f'(x)| = \lim_{h \rightarrow 0} \left| \frac{f(x+h) - f(x)}{h} \right| \leq \lim_{h \rightarrow 0} \left| \frac{(h)^2}{h} \right|$$

$$\Rightarrow |f'(x)| \leq 0 \Rightarrow f'(x) = 0 \Rightarrow f(x) = \text{constant}$$

$$\text{As } f(0) = 0 \Rightarrow f(1) = 0.$$

30. If  $x$  is so small that  $x^3$  and higher powers of  $x$  may be neglected, then

$$\frac{(1+x)^{3/2} - \left(1 + \frac{1}{2}x\right)^3}{(1-x)^{1/2}} \text{ may be approximated as}$$

(1)  $1 - \frac{3}{8}x^2$

(2)  $3x + \frac{3}{8}x^2$

(3)  $-\frac{3}{8}x^2$

(4)  $\frac{x}{2} - \frac{3}{8}x^2$

30. (3)

$$(1-x)^{1/2} \left[ 1 + \frac{3}{2}x + \frac{3}{2} \left( \frac{3}{2} - 1 \right) x^2 - 1 - 3 \left( \frac{1}{2}x \right) - 3(2) \left( \frac{1}{2}x \right)^2 \right]$$

$$= (1-x)^{1/2} \left[ -\frac{3}{8}x^2 \right] = -\frac{3}{8}x^2.$$

31. If  $x = \sum_{n=0}^{\infty} a^n$ ,  $y = \sum_{n=0}^{\infty} b^n$ ,  $z = \sum_{n=0}^{\infty} c^n$  where  $a, b, c$  are in A.P. and  $|a| < 1$ ,  $|b| < 1$ ,  $|c| < 1$ ,

then  $x, y, z$  are in

(1) G.P.

(2) A.P.

(3) Arithmetic - Geometric Progression

(4) H.P.

31. (4)

$$x = \sum_{n=0}^{\infty} a^n = \frac{1}{1-a} \quad a = 1 - \frac{1}{x}$$

$$y = \sum_{n=0}^{\infty} b^n = \frac{1}{1-b} \quad b = 1 - \frac{1}{y}$$

$$\frac{1-c}{n-0} \quad \angle$$

a, b, c are in A.P.

$$2b = a + c$$

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

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

$\Rightarrow$  x, y, z are in H.P.

32. In a triangle ABC, let  $\angle C = \frac{\pi}{2}$ . If r is the inradius and R is the circumradius of the triangle ABC, then  $2(r + R)$  equals

(1) b + c (2) a + b

(3) a + b + c (4) c + a

32. (2)

$$2r + 2R = c + \frac{2ab}{(a+b+c)} = \frac{(a+b)^2 + c(a+b)}{(a+b+c)} = a+b \quad (\text{since } c^2 = a^2 + b^2).$$

33. If  $\cos^{-1} x - \cos^{-1} \frac{y}{2} = \alpha$ , then  $4x^2 - 4xy \cos \alpha + y^2$  is equal to

(1)  $2 \sin 2\alpha$  (2) 4

(3)  $4 \sin^2 \alpha$  (4)  $-4 \sin^2 \alpha$

33. (3)

$$\cos^{-1} x - \cos^{-1} \frac{y}{2} = \alpha$$

$$\cos^{-1} \left( \frac{xy}{2} + \sqrt{(1-x^2)\left(1-\frac{y^2}{4}\right)} \right) = \alpha$$

$$\cos^{-1} \left( \frac{xy + \sqrt{4 - y^2 - 4x^2 + x^2 y^2}}{2} \right) = \alpha$$

$$\Rightarrow 4 - y^2 - 4x^2 + x^2 y^2 = 4 \cos^2 \alpha + x^2 y^2 - 4xy \cos \alpha$$

$$\Rightarrow 4x^2 + y^2 - 4xy \cos \alpha = 4 \sin^2 \alpha.$$

34. 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

(1) G.P. (2) A.P.

(3) Arithmetic – Geometric Progression (4) H.P.

34. (2)

$$\Delta = \frac{1}{2} p_1 a = \frac{1}{2} p_2 b = \frac{1}{2} p_3 c$$

$p_1, p_2, p_3$  are in H.P.

$$\Rightarrow \frac{2\Delta}{a}, \frac{2\Delta}{b}, \frac{2\Delta}{c} \text{ are in H.P.}$$

$$\Rightarrow \frac{1}{a}, \frac{1}{b}, \frac{1}{c} \text{ are in H.P.}$$

$\Rightarrow$  a, b, c are in A.P.

$\Rightarrow$   $\sin A, \sin B, \sin C$  are in A.P.

35. If  $I_1 = \int_0^1 2^{x^2} dx$ ,  $I_2 = \int_0^1 2^{x^3} dx$ ,  $I_3 = \int_1^2 2^{x^2} dx$  and  $I_4 = \int_1^2 2^{x^3} dx$  then
- (1)  $I_2 > I_1$  (2)  $I_1 > I_2$   
 (3)  $I_3 = I_4$  (4)  $I_3 > I_4$

35. (2)

$$I_1 = \int_0^1 2^{x^2} dx, I_2 = \int_0^1 2^{x^3} dx, I_3 = \int_1^2 2^{x^2} dx, I_4 = \int_1^2 2^{x^3} dx$$

$$\forall 0 < x < 1, x^2 > x^3$$

$$\Rightarrow \int_0^1 2^{x^2} dx > \int_0^1 2^{x^3} dx$$

$$\Rightarrow I_1 > I_2.$$

36. The area enclosed between the curve  $y = \log_e(x + e)$  and the coordinate axes is
- (1) 1 (2) 2  
 (3) 3 (4) 4

36. (1)

$$\text{Required area (OAB)} = \int_{1-e}^0 \ln(x + e) dx$$

$$= \left[ x \ln(x + e) - \int \frac{1}{x + e} x dx \right]_{1-e}^0 = 1.$$

37. The parabolas  $y^2 = 4x$  and  $x^2 = 4y$  divide the square region bounded by the lines  $x = 4$ ,  $y = 4$  and the coordinate axes. If  $S_1, S_2, S_3$  are respectively the areas of these parts numbered from top to bottom; then  $S_1 : S_2 : S_3$  is
- (1) 1 : 2 : 1 (2) 1 : 2 : 3  
 (3) 2 : 1 : 2 (4) 1 : 1 : 1

37. (4)

$$y^2 = 4x \text{ and } x^2 = 4y \text{ are symmetric about line } y = x$$

$$\Rightarrow \text{area bounded between } y^2 = 4x \text{ and } y = x \text{ is } \int_0^4 (2\sqrt{x} - x) dx = \frac{8}{3}$$

$$\Rightarrow A_{S_2} = \frac{16}{3} \text{ and } A_{S_1} = A_{S_3} = \frac{16}{3}$$

$$\Rightarrow A_{S_1} : A_{S_2} : A_{S_3} :: 1 : 1 : 1.$$

38. If  $x \frac{dy}{dx} = y (\log y - \log x + 1)$ , then the solution of the equation is

(1)  $y \log\left(\frac{x}{y}\right) = cx$

(2)  $x \log\left(\frac{y}{x}\right) = cy$

(3)  $\log\left(\frac{y}{x}\right) = cx$

(4)  $\log\left(\frac{x}{y}\right) = cy$

38. (3)

$$\frac{x dy}{dx} = y (\log y - \log x + 1)$$

$$\frac{dy}{dx} = \frac{y}{x} \left( \log\left(\frac{y}{x}\right) + 1 \right)$$

$$\text{Put } y = vx$$



$$\Rightarrow v + \frac{xdv}{dx} = v(\log v + 1)$$

$$\frac{xdv}{dx} = v \log v$$

$$\Rightarrow \frac{dv}{v \log v} = \frac{dx}{x}$$

$$\text{put } \log v = z$$

$$\frac{1}{v} dv = dz$$

$$\Rightarrow \frac{dz}{z} = \frac{dx}{x}$$

$$\ln z = \ln x + \ln c$$

$$z = cx$$

$$\log v = cx$$

$$\log\left(\frac{y}{x}\right) = cx.$$

39. The line parallel to the x-axis and passing through the intersection of the lines  $ax + 2by + 3b = 0$  and  $bx - 2ay - 3a = 0$ , where  $(a, b) \neq (0, 0)$  is

(1) below the x-axis at a distance of  $\frac{3}{2}$  from it

(2) below the x-axis at a distance of  $\frac{2}{3}$  from it

(3) above the x-axis at a distance of  $\frac{3}{2}$  from it

(4) above the x-axis at a distance of  $\frac{2}{3}$  from it

39. (1)

$$ax + 2by + 3b + \lambda(bx - 2ay - 3a) = 0$$

$$\Rightarrow (a + b\lambda)x + (2b - 2a\lambda)y + 3b - 3\lambda a = 0$$

$$a + b\lambda = 0 \Rightarrow \lambda = -a/b$$

$$\Rightarrow ax + 2by + 3b - \frac{a}{b}(bx - 2ay - 3a) = 0$$

$$\Rightarrow ax + 2by + 3b - ax + \frac{2a^2}{b}y + \frac{3a^2}{b} = 0$$

$$y\left(2b + \frac{2a^2}{b}\right) + 3b + \frac{3a^2}{b} = 0$$

$$y\left(\frac{2b^2 + 2a^2}{b}\right) = -\left(\frac{3b^2 + 3a^2}{b}\right)$$

$$y = \frac{-3(a^2 + b^2)}{2(b^2 + a^2)} = \frac{-3}{2}$$

$$y = -\frac{3}{2} \text{ so it is } \frac{3}{2} \text{ units below x-axis.}$$

which the thickness of ice decreases, is

- (1)  $\frac{1}{36\pi}$  cm/min (2)  $\frac{1}{18\pi}$  cm/min  
 (3)  $\frac{1}{54\pi}$  cm/min (4)  $\frac{5}{6\pi}$  cm/min

40.

(2)  
 $\frac{dv}{dt} = 50$   
 $4\pi r^2 \frac{dr}{dt} = 50$   
 $\Rightarrow \frac{dr}{dt} = \frac{50}{4\pi(15)^2}$  where  $r = 15$   
 $= \frac{1}{16\pi}$

41.  $\int \left\{ \frac{(\log x - 1)}{(1 + (\log x)^2)} \right\}^2 dx$  is equal to

- (1)  $\frac{\log x}{(\log x)^2 + 1} + C$  (2)  $\frac{x}{x^2 + 1} + C$   
 (3)  $\frac{xe^x}{1 + x^2} + C$  (4)  $\frac{x}{(\log x)^2 + 1} + C$

41.

(4)  
 $\int \frac{(\log x - 1)^2}{(1 + (\log x)^2)^2} dx$   
 $= \int \left[ \frac{1}{(1 + (\log x)^2)} - \frac{2\log x}{(1 + (\log x)^2)^2} \right] dx$   
 $= \int \left[ \frac{e^t}{1 + t^2} - \frac{2t e^t}{(1 + t^2)^2} \right] dt$  put  $\log x = t \Rightarrow dx = e^t dt$   
 $\int e^t \left[ \frac{1}{1 + t^2} - \frac{2t}{(1 + t^2)^2} \right] dt$   
 $= \frac{e^t}{1 + t^2} + c = \frac{x}{1 + (\log x)^2} + c$

42. Let  $f : \mathbb{R} \rightarrow \mathbb{R}$  be a differentiable function having  $f(2) = 6$ ,  $f'(2) = \left(\frac{1}{48}\right)$ . Then

$\lim_{x \rightarrow 2} \int_6^{f(x)} \frac{4t^3}{x-2} dt$  equals

- (1) 24 (2) 36  
 (3) 12 (4) 18

$$\lim_{x \rightarrow 2} \int_0^{4x} \frac{1}{x-2} dt$$

Applying L Hospital rule

$$\begin{aligned} \lim_{x \rightarrow 2} [4f(x)^2 f'(x)] &= 4f(2)^3 f'(2) \\ &= 4 \times 6^3 \times \frac{1}{48} = 18. \end{aligned}$$

43. Let  $f(x)$  be a non-negative continuous function such that the area bounded by the curve  $y = f(x)$ ,  $x$ -axis and the ordinates  $x = \frac{\pi}{4}$  and  $x = \beta > \frac{\pi}{4}$

is  $\left(\beta \sin \beta + \frac{\pi}{4} \cos \beta + \sqrt{2}\beta\right)$ . Then  $f\left(\frac{\pi}{2}\right)$  is

- (1)  $\left(\frac{\pi}{4} + \sqrt{2} - 1\right)$  (2)  $\left(\frac{\pi}{4} - \sqrt{2} + 1\right)$   
 (3)  $\left(1 - \frac{\pi}{4} - \sqrt{2}\right)$  (4)  $\left(1 - \frac{\pi}{4} + \sqrt{2}\right)$

43. (4)

Given that  $\int_{\pi/4}^{\beta} f(x) dx = \beta \sin \beta + \frac{\pi}{4} \cos \beta + \sqrt{2}\beta$

Differentiating w. r. t  $\beta$

$$f(\beta) = \beta \cos \beta + \sin \beta - \frac{\pi}{4} \sin \beta + \sqrt{2}$$

$$f\left(\frac{\pi}{2}\right) = \left(1 - \frac{\pi}{4}\right) \sin \frac{\pi}{2} + \sqrt{2} = 1 - \frac{\pi}{4} + \sqrt{2}.$$

44. The locus of a point  $P(\alpha, \beta)$  moving under the condition that the line  $y = \alpha x + \beta$  is a tangent to the hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$  is

- (1) an ellipse (2) a circle  
 (3) a parabola (4) a hyperbola

44. (4)

Tangent to the hyperbola  $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$  is

$$y = mx \pm \sqrt{a^2 m^2 - b^2}$$

Given that  $y = \alpha x + \beta$  is the tangent of hyperbola

$$\Rightarrow m = \alpha \text{ and } a^2 m^2 - b^2 = \beta^2$$

$$\therefore a^2 \alpha^2 - b^2 = \beta^2$$

Locus is  $a^2 x^2 - y^2 = b^2$  which is hyperbola.

45. If the angle  $\theta$  between the line  $\frac{x+1}{1} = \frac{y-1}{2} = \frac{z-2}{2}$  and the plane  $2x - y + \sqrt{\lambda}z + 4 = 0$

is such that  $\sin \theta = \frac{1}{3}$  the value of  $\lambda$  is

- (1)  $\frac{5}{3}$  (2)  $\frac{-3}{5}$



45.

(1)

Angle between line and normal to plane is

$$\cos\left(\frac{\pi}{2} - \theta\right) = \frac{2 - 2 + 2\sqrt{\lambda}}{3 \times \sqrt{5 + \lambda}} \quad \text{where } \theta \text{ is angle between line \& plane}$$

$$\Rightarrow \sin\theta = \frac{2\sqrt{\lambda}}{3\sqrt{5 + \lambda}} = \frac{1}{3}$$

$$\Rightarrow \lambda = \frac{5}{3}.$$

46.

The angle between the lines  $2x = 3y = -z$  and  $6x = -y = -4z$  is(1)  $0^\circ$ (2)  $90^\circ$ (3)  $45^\circ$ (4)  $30^\circ$ 

46.

(2)

Angle between the lines  $2x = 3y = -z$  &  $6x = -y = -4z$  is  $90^\circ$ Since  $a_1a_2 + b_1b_2 + c_1c_2 = 0$ .

47.

If the plane  $2ax - 3ay + 4az + 6 = 0$  passes through the midpoint of the line joining the centres of the spheres

$$x^2 + y^2 + z^2 + 6x - 8y - 2z = 13 \text{ and}$$

$$x^2 + y^2 + z^2 - 10x + 4y - 2z = 8, \text{ then } a \text{ equals}$$

(1)  $-1$ (2)  $1$ (3)  $-2$ (4)  $2$ 

47.

(3)

Plane

 $2ax - 3ay + 4az + 6 = 0$  passes through the mid point of the centre of spheres

$$x^2 + y^2 + z^2 + 6x - 8y - 2z = 13 \text{ and } x^2 + y^2 + z^2 - 10x + 4y - 2z = 8 \text{ respectively}$$

centre of spheres are  $(-3, 4, 1)$  &  $(5, -2, 1)$ Mid point of centre is  $(1, 1, 1)$ 

Satisfying this in the equation of plane, we get

$$2a - 3a + 4a + 6 = 0 \Rightarrow a = -2.$$

48.

The distance between the line  $\vec{r} = 2\hat{i} - 2\hat{j} + 3\hat{k} + \lambda(\hat{i} - \hat{j} + 4\hat{k})$  and the plane

$$\vec{r} \cdot (\hat{i} + 5\hat{j} + \hat{k}) = 5 \text{ is}$$

(1)  $\frac{10}{9}$ (2)  $\frac{10}{3\sqrt{3}}$ (3)  $\frac{3}{10}$ (4)  $\frac{10}{3}$ 

48.

(2)

Distance between the line

$$\vec{r} = 2\hat{i} - 2\hat{j} + 3\hat{k} + \lambda(\hat{i} - \hat{j} + 4\hat{k}) \text{ and the plane } \vec{r} \cdot (\hat{i} + 5\hat{j} + \hat{k}) = 5 \text{ is}$$

equation of plane is  $x + 5y + z = 5$  $\therefore$  Distance of line from this plane= perpendicular distance of point  $(2, -2, 3)$  from the plane

$$\text{i.e. } \left| \frac{2 - 10 + 3 - 5}{\sqrt{1 + 5^2 + 1}} \right| = \frac{10}{3\sqrt{3}}.$$

49. (1)  $3a^2$  (2)  $a^2$   
 (3)  $2a^2$  (4)  $4a^2$   
**(3)**

Let  $\vec{a} = x\hat{i} + y\hat{j} + z\hat{k}$

$\vec{a} \times \hat{i} = z\hat{j} - y\hat{k}$

$\Rightarrow (\vec{a} \times \hat{i})^2 = y^2 + z^2$

similarly  $(\vec{a} \times \hat{j})^2 = x^2 + z^2$

and  $(\vec{a} \times \hat{k})^2 = x^2 + y^2 \Rightarrow (\vec{a} \times \hat{i})^2 = y^2 + z^2$

similarly  $(\vec{a} \times \hat{j})^2 = x^2 + z^2$

and  $(\vec{a} \times \hat{k})^2 = x^2 + y^2$

$\Rightarrow (\vec{a} \times \hat{i})^2 + (\vec{a} \times \hat{j})^2 + (\vec{a} \times \hat{k})^2 = 2(x^2 + y^2 + z^2) = 2a^2$ .

50. If non-zero numbers a, b, c are in H.P., then the straight line  $\frac{x}{a} + \frac{y}{b} + \frac{1}{c} = 0$  always

passes through a fixed point. That point is

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

50. **(3)**  
 a, b, c are in H.P.

$\Rightarrow \frac{2}{b} - \frac{1}{a} - \frac{1}{c} = 0$

$\frac{x}{a} + \frac{y}{b} + \frac{1}{c} = 0$

$\Rightarrow \frac{x}{-1} = \frac{y}{2} = \frac{1}{-1} \quad \therefore x = 1, y = -2$

51. If a vertex of a triangle is (1, 1) and the mid-points of two sides through this vertex are (-1, 2) and (3, 2), then the centroid of the triangle is

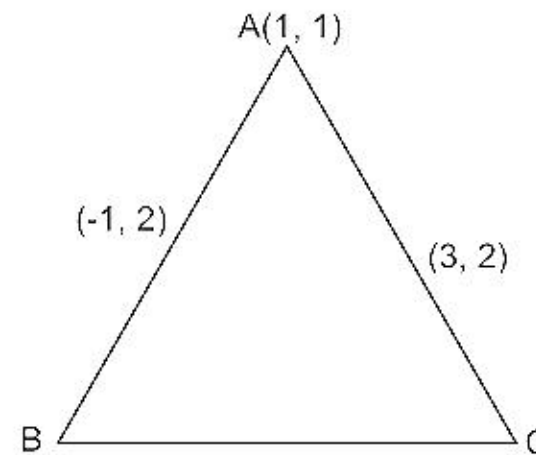
- (1)  $(-1, \frac{7}{3})$  (2)  $(\frac{-1}{3}, \frac{7}{3})$   
 (3)  $(1, \frac{7}{3})$  (4)  $(\frac{1}{3}, \frac{7}{3})$

51. **(3)**  
 Vertex of triangle is (1, 1) and midpoint of sides through this vertex is (-1, 2) and (3, 2)

$\Rightarrow$  vertex B and C come out to be (-3, 3) and (5, 3)

$\therefore$  centroid is  $\frac{1-3+5}{3}, \frac{1+3+3}{3}$

$\Rightarrow (1, 7/3)$





distinct points P and Q then the line  $5x + by - a = 0$  passes through P and Q for  
 (1) exactly one value of a (2) no value of a  
 (3) infinitely many values of a (4) exactly two values of a

52. (2)

$$S_1 = x^2 + y^2 + 2ax + cy + a = 0$$

$$S_2 = x^2 + y^2 - 3ax + dy - 1 = 0$$

Equation of radical axis of  $S_1$  and  $S_2$

$$S_1 - S_2 = 0$$

$$\Rightarrow 5ax + (c - d)y + a + 1 = 0$$

Given that  $5x + by - a = 0$  passes through P and Q

$$\Rightarrow \frac{a}{1} = \frac{c-d}{b} = \frac{a+1}{-a}$$

$$\Rightarrow a + 1 = -a^2$$

$$a^2 + a + 1 = 0$$

No real value of a.

53. A circle touches the x-axis and also touches the circle with centre at (0, 3) and radius 2. The locus of the centre of the circle is

- (1) an ellipse (2) a circle  
 (3) a hyperbola (4) a parabola

53. (4)

Equation of circle with centre (0, 3) and radius 2 is

$$x^2 + (y - 3)^2 = 4.$$

Let locus of the variable circle is  $(\alpha, \beta)$

$\therefore$  It touches x-axis.

$$\therefore \text{Its equation } (x - \alpha)^2 + (y - \beta)^2 = \beta^2$$

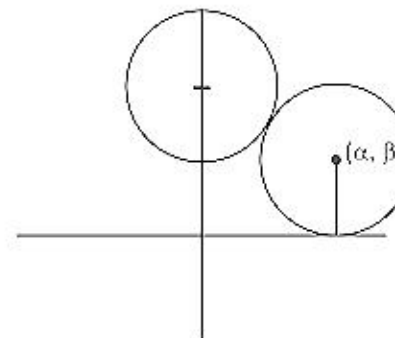
Circles touch externally

$$\therefore \sqrt{\alpha^2 + (\beta - 3)^2} = 2 + \beta$$

$$\alpha^2 + (\beta - 3)^2 = \beta^2 + 4 + 4\beta$$

$$\alpha^2 = 10(\beta - 1/2)$$

$\therefore$  Locus is  $x^2 = 10(y - 1/2)$  which is parabola.



54. If a circle passes through the point (a, b) and cuts the circle  $x^2 + y^2 = p^2$  orthogonally, then the equation of the locus of its centre is

- (1)  $x^2 + y^2 - 3ax - 4by + (a^2 + b^2 - p^2) = 0$  (2)  $2ax + 2by - (a^2 - b^2 + p^2) = 0$   
 (3)  $x^2 + y^2 - 2ax - 3by + (a^2 - b^2 - p^2) = 0$  (4)  $2ax + 2by - (a^2 + b^2 + p^2) = 0$

54. (4)

Let the centre be  $(\alpha, \beta)$

$\therefore$  It cut the circle  $x^2 + y^2 = p^2$  orthogonally

$$2(-\alpha) \times 0 + 2(-\beta) \times 0 = c_1 - p^2$$

$$c_1 = p^2$$

$$\text{Let equation of circle is } x^2 + y^2 - 2\alpha x - 2\beta y + p^2 = 0$$

$$\text{It pass through } (a, b) \Rightarrow a^2 + b^2 - 2\alpha a - 2\beta b + p^2 = 0$$

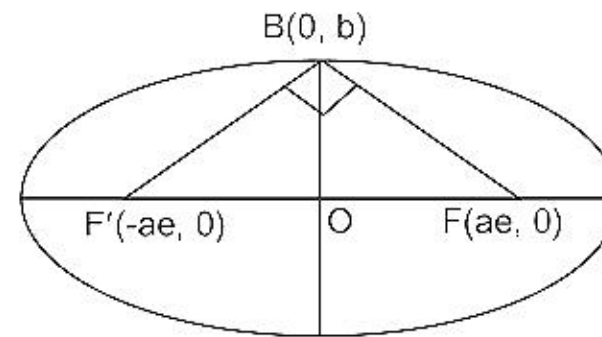
$$\text{Locus } \therefore 2ax + 2by - (a^2 + b^2 + p^2) = 0.$$

55. An ellipse has OB as semi minor axis, F and F' its foci and the angle FBF' is a right angle. Then the eccentricity of the ellipse is

- (1)  $\frac{1}{\sqrt{2}}$  (2)  $\frac{1}{2}$



55. (1)  
 $\therefore \angle FBF' = 90^\circ$   
 $\therefore (\sqrt{a^2e^2 + b^2})^2 + (\sqrt{a^2e^2 + b^2})^2 = (2ae)^2$   
 $\Rightarrow 2(a^2e^2 + b^2) = 4a^2e^2$   
 $\Rightarrow e^2 = b^2/a^2$   
 Also  $e^2 = 1 - b^2/a^2 = 1 - e^2$   
 $\Rightarrow 2e^2 = 1, e = \frac{1}{\sqrt{2}}$



56. Let a, b and c be distinct non-negative numbers. If the vectors  $a\hat{i} + a\hat{j} + c\hat{k}$ ,  $\hat{i} + \hat{k}$  and  $c\hat{i} + c\hat{j} + b\hat{k}$  lie in a plane, then c is  
 (1) the Geometric Mean of a and b  
 (2) the Arithmetic Mean of a and b  
 (3) equal to zero  
 (4) the Harmonic Mean of a and b

56. (1)  
 Vector  $a\hat{i} + a\hat{j} + c\hat{k}$ ,  $\hat{i} + \hat{k}$  and  $c\hat{i} + c\hat{j} + b\hat{k}$  are coplanar  

$$\begin{vmatrix} a & a & c \\ 1 & 0 & 1 \\ c & c & b \end{vmatrix} = 0 \Rightarrow c^2 = ab$$
  
 $\therefore a, b, c$  are in G.P.

57. If  $\vec{a}, \vec{b}, \vec{c}$  are non-coplanar vectors and  $\lambda$  is a real number then  
 $[\lambda(\vec{a} + \vec{b}) \lambda^2\vec{b} \lambda\vec{c}] = [\vec{a} \vec{b} + \vec{c} \vec{b}]$  for  
 (1) exactly one value of  $\lambda$   
 (2) no value of  $\lambda$   
 (3) exactly three values of  $\lambda$   
 (4) exactly two values of  $\lambda$

57. (2)  
 $[\lambda(\vec{a} + \vec{b}) \lambda^2\vec{b} \lambda\vec{c}] = [\vec{a} \vec{b} + \vec{c} \vec{b}]$   

$$\begin{vmatrix} \lambda & \lambda & 0 \\ 0 & \lambda^2 & 0 \\ 0 & 0 & \lambda \end{vmatrix} = \begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 0 \end{vmatrix}$$
  
 $\Rightarrow \lambda^4 = -1$   
 Hence no real value of  $\lambda$ .

58. Let  $\vec{a} = \hat{i} - \hat{k}$ ,  $\vec{b} = x\hat{i} + \hat{j} + (1-x)\hat{k}$  and  $\vec{c} = y\hat{i} + x\hat{j} + (1+x-y)\hat{k}$ . Then  $[\vec{a}, \vec{b}, \vec{c}]$  depends on  
 (1) only y  
 (2) only x  
 (3) both x and y  
 (4) neither x nor y

58. (4)  
 $\vec{a} = \hat{i} - \hat{k}$ ,  $\vec{b} = x\hat{i} + \hat{j} + (1-x)\hat{k}$  and  $\vec{c} = y\hat{i} + x\hat{j} + (1+x-y)\hat{k}$   
 $[\vec{a} \vec{b} \vec{c}] = \vec{a} \cdot (\vec{b} \times \vec{c})$

$$\mathbf{b} \times \mathbf{c} = \begin{vmatrix} x & 1 & 1-x \\ y & x & 1+x-y \end{vmatrix} = i(1+x-x-x^2) - j(x+x^2-xy-y+xy) + k(x^2-y)$$

$$\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c}) = 1$$

which does not depend on x and y.

59. Three houses are available in a locality. Three persons apply for the houses. Each applies for one house without consulting others. The probability that all the three apply for the same house is

- (1)  $\frac{2}{9}$  (2)  $\frac{1}{9}$   
 (3)  $\frac{8}{9}$  (4)  $\frac{7}{9}$

59. (2)  
 For a particular house being selected

$$\text{Probability} = \frac{1}{3}$$

$$\text{Prob(all the persons apply for the same house)} = \left(\frac{1}{3} \times \frac{1}{3} \times \frac{1}{3}\right) 3 = \frac{1}{9}.$$

60. A random variable X has Poisson distribution with mean 2. Then  $P(X > 1.5)$  equals

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

60. (3)

$$P(x = k) = e^{-\lambda} \frac{\lambda^k}{k!}$$

$$P(x \geq 2) = 1 - P(x = 0) - P(x = 1)$$

$$= 1 - e^{-\lambda} - e^{-\lambda} \left(\frac{\lambda}{1!}\right)$$

$$= 1 - \frac{3}{e^2}.$$

61. Let A and B be two events such that  $P(\overline{A \cup B}) = \frac{1}{6}$ ,  $P(A \cap B) = \frac{1}{4}$  and  $P(\overline{A}) = \frac{1}{4}$ ,

where  $\overline{A}$  stands for complement of event A. Then events A and B are

- (1) equally likely and mutually exclusive  
 (2) equally likely but not independent  
 (3) independent but not equally likely  
 (4) mutually exclusive and independent

61. (3)

$$P(\overline{A \cup B}) = \frac{1}{6}, P(A \cap B) = \frac{1}{4} \text{ and } P(\overline{A}) = \frac{1}{4}$$

$$\Rightarrow P(A \cup B) = 5/6 \quad P(A) = 3/4$$

$$\text{Also } P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$\Rightarrow P(B) = 5/6 - 3/4 + 1/4 = 1/3$$

$$P(A) P(B) = 3/4 \times 1/3 = 1/4 = P(A \cap B)$$

62. A lizard, at an initial distance of 21 cm behind an insect, moves from rest with an acceleration of  $2 \text{ cm/s}^2$  and pursues the insect which is crawling uniformly along a straight line at a speed of  $20 \text{ cm/s}$ . Then the lizard will catch the insect after
- (1) 20 s (2) 1 s  
(3) 21 s (4) 24 s

62. (3)  

$$\frac{1}{2} 2t^2 = 21 + 20t$$

$$\Rightarrow t = 21.$$

63. Two points A and B move from rest along a straight line with constant acceleration  $f$  and  $f'$  respectively. If A takes  $m$  sec. more than B and describes 'n' units more than B in acquiring the same speed then

(1)  $(f - f')m^2 = ff'n$  (2)  $(f + f')m^2 = ff'n$   
 (3)  $\frac{1}{2}(f + f')m = ff'n^2$  (4)  $(f' - f)n = \frac{1}{2}ff'm^2$

63. (4)  

$$v^2 = 2f(d + n) = 2f'd$$

$$v = f'(t) = (m + t)f$$
 eliminate  $d$  and  $m$  we get  

$$(f' - f)n = \frac{1}{2}ff'm^2.$$

64. A and B are two like parallel forces. A couple of moment  $H$  lies in the plane of A and B and is contained with them. The resultant of A and B after combining is displaced through a distance

(1)  $\frac{2H}{A - B}$  (2)  $\frac{H}{A + B}$   
 (3)  $\frac{H}{2(A + B)}$  (4)  $\frac{H}{A - B}$

64. (2)  

$$(A + B)d = H$$

$$d = \left( \frac{H}{A + B} \right).$$

65. The resultant  $R$  of two forces acting on a particle is at right angles to one of them and its magnitude is one third of the other force. The ratio of larger force to smaller one is

(1) 2 : 1 (2)  $3 : \sqrt{2}$   
 (3) 3 : 2 (4)  $3 : 2\sqrt{2}$

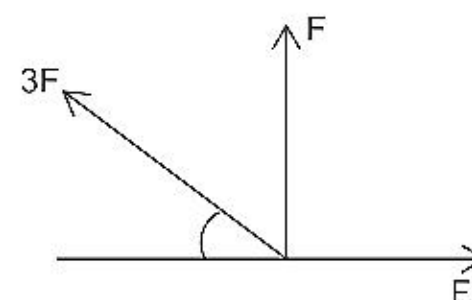
65. (4)  

$$F' = 3F \cos \theta$$

$$F = 3F \sin \theta$$

$$\Rightarrow F' = 2\sqrt{2} F$$

$$F : F' :: 3 : 2\sqrt{2}.$$





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

66.

(4)

$$\frac{e^x + e^{-x}}{2} = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + \dots$$

putting  $x = 1/2$  we get

$$\frac{e+1}{2\sqrt{e}}$$

67.

The value of  $\int_{-\pi}^{\pi} \frac{\cos^2 x}{1+a^x} dx$ ,  $a > 0$ , is

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

67.

(2)

$$\int_{-\pi}^{\pi} \frac{\cos^2 x}{1+a^x} dx = \int_0^{\pi} \cos^2 x dx = \frac{\pi}{2}$$

68.

The plane  $x + 2y - z = 4$  cuts the sphere  $x^2 + y^2 + z^2 - x + z - 2 = 0$  in a circle of radius

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

68.

(2)

Perpendicular distance of centre  $\left(\frac{1}{2}, 0, -\frac{1}{2}\right)$  from  $x + 2y - z = 4$ 

$$\frac{\left|\frac{1}{2} + \frac{1}{2} - 4\right|}{\sqrt{6}} = \frac{\sqrt{3}}{2}$$

$$\text{radius} = \sqrt{\frac{5}{2} - \frac{3}{2}} = 1.$$

69.

If the pair of lines  $ax^2 + 2(a+b)xy + by^2 = 0$  lie along diameters of a circle and divide the circle into four sectors such that the area of one of the sectors is thrice the area of another sector then

- (1)  $3a^2 - 10ab + 3b^2 = 0$  (2)  $3a^2 - 2ab + 3b^2 = 0$   
 (3)  $3a^2 + 10ab + 3b^2 = 0$  (4)  $3a^2 + 2ab + 3b^2 = 0$

69.

(4)

$$\frac{2\sqrt{(a+b)^2 - ab}}{a+b} = 1$$

$$\Rightarrow (a+b)^2 = 4(a^2 + b^2 + ab)$$

$$\Rightarrow 3a^2 + 3b^2 + 2ab = 0.$$

possible value of  $n$  among the following is

- (1) 15 (2) 18  
 (3) 9 (4) 12

70. (2)

$$\frac{\sum x_i^2}{n} \geq \left( \frac{\sum x_i}{n} \right)^2$$

$$\Rightarrow n \geq 16.$$

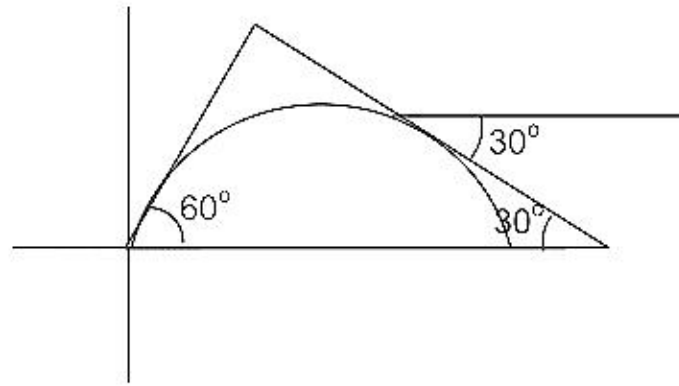
71. A particle is projected from a point  $O$  with velocity  $u$  at an angle of  $60^\circ$  with the horizontal. When it is moving in a direction at right angles to its direction at  $O$ , its velocity then is given by

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

71. (4)

$$u \cos 60^\circ = v \cos 30^\circ$$

$$v = \frac{4}{\sqrt{3}}.$$



72. If both the roots of the quadratic equation  $x^2 - 2kx + k^2 + k - 5 = 0$  are less than 5, then  $k$  lies in the interval

- (1)  $(5, 6]$  (2)  $(6, \infty)$   
 (3)  $(-\infty, 4)$  (4)  $[4, 5]$

72. (3)

$$\frac{-b}{2a} < 5$$

$$f(5) > 0$$

$$\Rightarrow k \in (-\infty, 4).$$

73. If  $a_1, a_2, a_3, \dots, a_n, \dots$  are in G.P., then the determinant

$$\Delta = \begin{vmatrix} \log a_n & \log a_{n+1} & \log a_{n+2} \\ \log a_{n+3} & \log a_{n+4} & \log a_{n+5} \\ \log a_{n+6} & \log a_{n+7} & \log a_{n+8} \end{vmatrix} \text{ is equal to}$$

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

73. (2)

$$C_1 - C_2, C_2 - C_3$$

two rows becomes identical

Answer: 0.

74. A real valued function  $f(x)$  satisfies the functional equation  $f(x - y) = f(x) f(y) - f(a - x) f(a + y)$  where  $a$  is a given constant and  $f(0) = 1$ ,  $f(2a - x)$  is equal to

- (1)  $-f(x)$  (2)  $f(x)$   
 (3)  $f(a) + f(a - x)$  (4)  $f(-x)$

$$= -f(x) \left[ \because x=0, y=0, f(0) = f^2(0) - f^2(a) \Rightarrow f^2(a) = 0 \Rightarrow f(a) = 0 \right].$$

75. If the equation  $a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x = 0$ ,  $a_1 \neq 0$ ,  $n \geq 2$ , has a positive root  $x = \alpha$ , then the equation  $na_n x^{n-1} + (n-1)a_{n-1} x^{n-2} + \dots + a_1 = 0$  has a positive root, which is

- (1) greater than  $\alpha$  (2) smaller than  $\alpha$   
 (3) greater than or equal to  $\alpha$  (4) equal to  $\alpha$

75. **(2)**  
 $f(0) = 0, f(\alpha) = 0$   
 $\Rightarrow f'(k) = 0$  for some  $k \in (0, \alpha)$ .