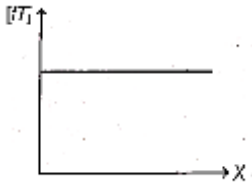
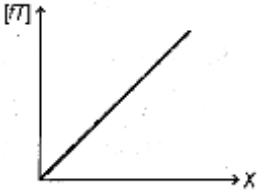
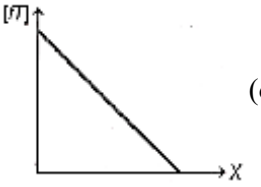
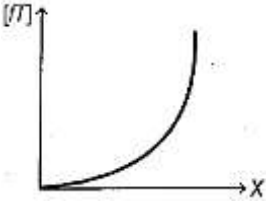
Physics

1. In a simple harmonic motion, let f be the acceleration and T be the time period. If x denotes the displacement, then $|fT|$ vs. x graph will look like,

(a) 

(b) 

(c) 

(d) 

2. The displacement of a plane progressive wave in a medium, travelling towards positive X-axis with velocity $4\ \mathrm{m/s}$ at $t = 0$ is given by $y = 3\sin 2\pi\left(-\frac{x}{3}\right)$. Then the expression for the displacement at a later time $t = 4\ \mathrm{s}$ will be.

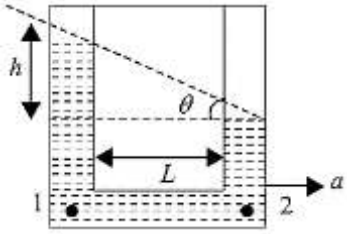
(a) $y = 3\sin 2\pi\left(-\frac{x-16}{3}\right)$

(b) $y = 3\sin 2\pi\left(\frac{-x-16}{3}\right)$

(c) $y = 3\sin 2\pi\left(\frac{-x+1}{3}\right)$

(d) $y = 3\sin 2\pi\left(\frac{-x-1}{3}\right)$

3. As shown in the figure, a liquid is at same levels in two arms of a U-tube of uniform cross-section when at rest. If the U-tube moves with an acceleration f towards right, the difference between liquid heights between two arms of the U-tube will be, (acceleration due to gravity $= g$)



(a) $\frac{f}{g}a$ (b) $\frac{g}{f}a$

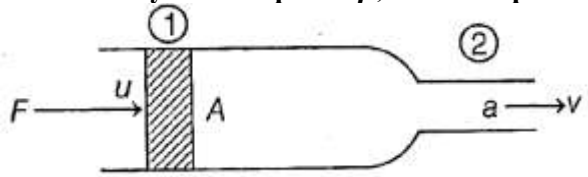
(c) a (d) 0

4. Six molecules of an ideal gas have velocities $1, 3, 5, 5, 6$ and $5\ \mathrm{m/s}$ respectively. At any given temperature, if $\bar{v}$ and v_{rms} represent average and rms speed of the molecules, then.

(a) $\bar{v} = 5\ \mathrm{m/s}$ (b) $v_{\mathrm{rms}} > \bar{v}$

(c) $v_{\mathrm{rms}}^2 < \bar{v}^2$ (d) $v_{\mathrm{rms}} = \bar{v}$

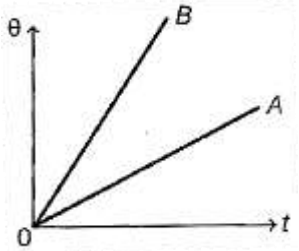
5. As shown in the figure, a pump is designed as horizontal cylinder with a piston having area A and an outlet orifice having an area a. The piston moves with a constant velocity under the action of force F. If the density of the liquid is ρ, then the speed of the liquid emerging from the orifice is, (assume $A \gg a$).



(a) $\sqrt{\frac{F}{\rho A}}$ (b) $\frac{a}{A}\sqrt{\frac{F}{\rho A}}$

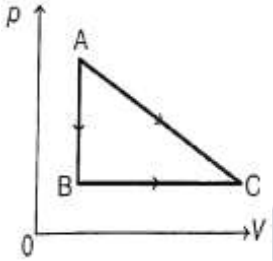
(c) $\sqrt{\frac{2F}{\rho A}}$ (d) $\frac{A}{a}\sqrt{\frac{2F}{\rho A}}$

6. Two substances A and B of same mass are heated at constant rate. The variation of temperature θ of the substances with time t is shown in the figure. Choose the correct statement.



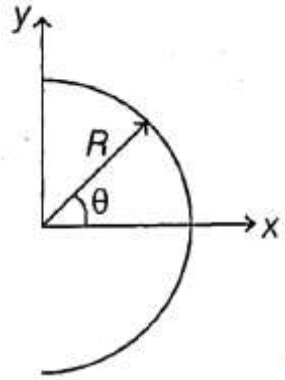
(a) Specific heat of A is greater than that of B.
(b) Specific heat of B is greater than that of A.
(c) Both have same specific heat.
(d) None of the above is true.

7. A given quantity of gas is taken from A to C in two ways; (a) directly from $A \rightarrow C$ along a straight line and (b) in two steps, from $A \rightarrow B$ and then from $B \rightarrow C$. Work done and heat absorbed along the direct path $A \rightarrow C$ is 200 J and 280 J respectively.
If the work done along $A \rightarrow B \rightarrow C$ is 80 J , then heat absorbed along this path is,



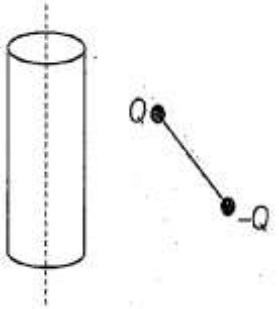
(a) 80 J (b) 0
(c) 160 J (d) 50 J

8. A thin glass rod is bent in a semicircle of radius R. A charge is non-uniformly distributed along the rod with a linear charge density $\lambda = \lambda_0 \sin\theta$ (λ_0 is a positive constant). The electric field at the centre P of the semicircles is.



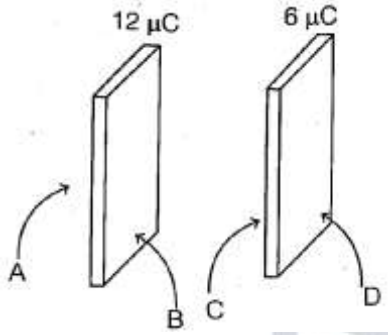
(a) $-\frac{\lambda_0}{8\pi\varepsilon_0 R}\hat{\mathbf{j}}$ (b) $\frac{\lambda_0}{8\pi\varepsilon_0 R}\hat{\mathbf{j}}$
(c) $\frac{\lambda_0}{8\pi\varepsilon_0 R}\hat{\mathbf{i}}$ (d) $-\frac{\lambda_0}{8\pi\varepsilon_0 R}\hat{\mathbf{i}}$

9. Consider a positively charged infinite cylinder with uniform volume charge density $\rho > 0$.
An electric dipole consisting of $+Q$ and - Q charges attached to opposite ends of a massless rod is oriented as shown in the figure. At the instant as shown in the figure, the dipole will experience



(a) a force to the left and no torque.
(b) a force to the right and a clockwise torque.
(c) a force to the right and a counter clockwise torque.
(d) no force but only a clockwise torque.

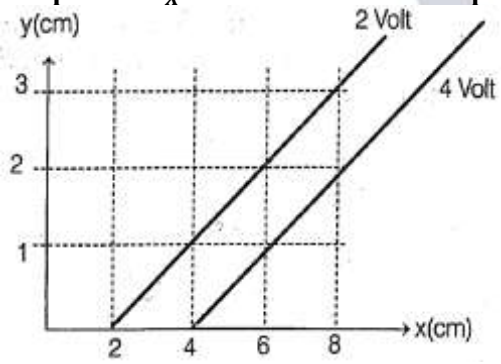
10. 12μC and 6μC charges are given to the two conducting plates having same cross-sectional area and placed face to face close to each other as shown in the figure.
The resulting charge distribution in μC on surfaces A, B, C and D are respectively,



(a) $9,3,-3,9$ (b) $3,9,-9,3$
(c) $6,6,-6,12$ (d) $6,6,3,3$

11. A wire carrying a steady current I is kept in the $X-Y$ plane along the curve $y = A\sin\left(\frac{2\pi}{\lambda}x\right)$. A magnetic field B exists in the z-direction. The magnitude of the magnetic force in the portion of the wire between $x = 0$ and $x = \lambda$ is.
(a) 0 (b) $2I\lambda B$
(c) $I\lambda B$ (d) $I\lambda B/2$

12. The figure represents two equipotential lines in $X-Y$ plane for an electric field. The x-component E_X of the electric field in space between these equipotential lines is.



(a) 100 V/m (b) -100 V/m
(c) 200 V/m (d) -200 V/m

13. An electric dipole of dipole moment p is placed at the origin of the co-ordinate system along the Z-axis. The amount of work required to move a charge q from the point $(a, 0, 0)$ to the point $(0, 0, a)$ is.
(a) $\frac{pq}{4\pi\varepsilon_0 a}$ (b) 0
(c) $\frac{-pq}{4\pi\varepsilon_0 a^2}$ (d) $\frac{pq}{4\pi\varepsilon_0 a^2}$

14. The electric field of plane electromagnetic wave of wave number $\hat{k}$ and angular frequency

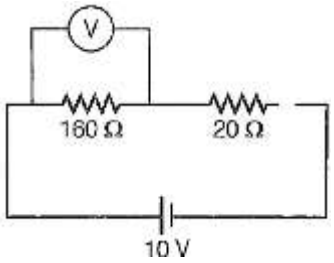
ω is given by $E = E_0(\hat{i} + \hat{j})\sin(kz - \omega t)$. Which of the following gives the direction of the associated magnetic field B ?

(a) $\hat{k}$ (b) $-\hat{i} + \hat{j}$
(c) $-\hat{i} - \hat{j}$ (d) $\hat{i} - \hat{k}$

15. A charged particle in a uniform magnetic field $B = B_0\hat{k}$ starts moving from the origin with velocity $v = 3\hat{i} + 4\hat{k}$ m/s. The trajectory of the particle and the time t at which it reaches 2 m above $X - Y$ plane are.

(a) circular path, $1/2$ s
(b) helical path, $1/2$ s
(c) circular path, $2/3$ s
(d) helical path, $2/3$ s

16. In an experiment on a circuit as shown in the figure, the voltmeter shows 8 V reading. The resistance of the voltmeter is

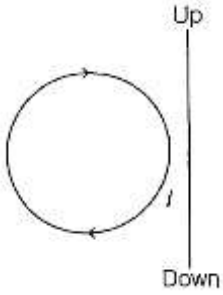


(a) 20Ω (b) 320Ω
(c) 160Ω (d) $1.44k\Omega$

17. An interference pattern is obtained with two coherent sources of intensity ratio n: 1. The ratio $\frac{I_{max} - I_{min}}{I_{max} + I_{min}}$ will be maximum if.

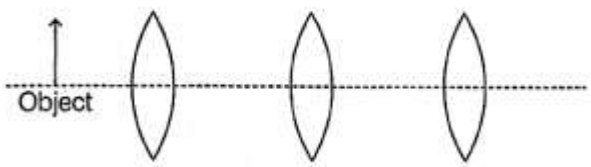
(a) $n = 1$ (b) $n = 2$
(c) $n = 3$ (d) $n = 4$

18. A circular coil is placed near a current carrying conductor, both lying on the plane of the paper. The current is flowing through the conductor in such a way that the induced current in the loop is clockwise as shown in the figure. The current in the wire is



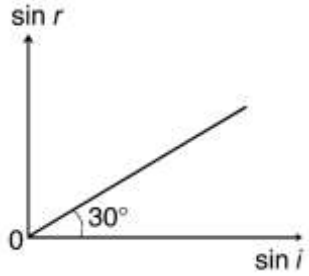
(a) time dependent and downward
(b) steady and upward
(c) time dependent and upward
(d) an alternating current

19. Three identical convex lenses each of focal length f are placed in a straight line separated by a distance f from each other. An object is located at $f/2$ in front of the leftmost lens. Then,



(a) final image will be at $f/2$ behind the rightmost lens and its magnification will be -1 . .
(b) final image will be at $f/2$ behind the rightmost lens and its magnification will be +1 .
(c) final image will be at f behind the rightmost lens and its magnification will be -1 .
(d) final image will be at f behind the rightmost lens and its magnification will be +1 .

20. A ray of monochromatic light is incident on the plane surface of separation between two media X and Y with angle of incidence i in medium X and angle of refraction r in medium Y. The given graph shows the relation between $\sin i$ and $\sin r$. If v_X and v_Y are the velocities of the ray in media X and Y respectively, then which of the following is true?

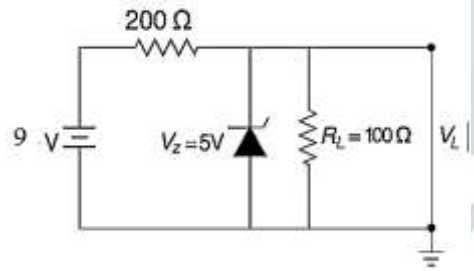


(a) $v_X = \frac{1}{\sqrt{3}} v_Y$
(b) $v_X = \sqrt{3} v_Y$
(c) Total internal reflection can happen when the light is incident in medium X.
(d) $v_X = \sqrt{3} v_Y$ where v_X and v_Y are frequencies of the light in medium X and Y respectively.

21. If the potential energy of a hydrogen atom in the first excited state is assumed to be zero then the total energy of $n = \infty$ state is.

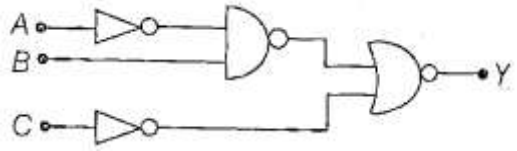
(a) 3.4 eV (b) 6.8 eV
(c) 0 (d) ∞

22. In the given circuit, find the voltage drop V_L in the load resistance R_L.



(a) 5 V (b) 3 V
(c) 9. V (d) 6 V

23. Consider the logic circuit with inputs A, B, C and output Y. How many combinations of A, B and C gives the output $Y = 0$?

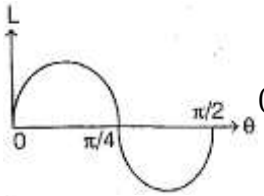


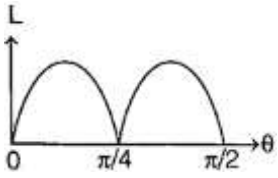
(a) 8 (b) 5
(c) 7 (d) 1

24. X-rays of wavelength λ gets reflected from parallel planes of atoms in a crystal with spacing d between two planes as shown in the figure. If the two reflected beams interfere constructively, then the condition for maxima will be, (n is the order of interference fringe).

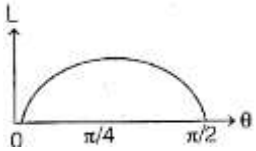
(a) $d\tan\theta = n\lambda$ (b) $d\sin\theta = n\lambda$
(c) $2d\cos\theta = n\lambda$ (d) $2d\sin\theta = n\lambda$

25. A particle of mass m is projected at a velocity u, making an angle θ with the horizontal (X –axis). If the angle of projection θ is varied keeping all other parameters same, then magnitude of angular momentum (L) at its maximum height about the point of projection varies with θ as.

(a) 

(b) 

(c) 

(d) 

26. **A body of mass 2 kg moves in a horizontal circular path of radius 5 m . At an instant, its speed is $2\sqrt{5}$ m/s and is increasing at the rate of 3 m/s^2. The magnitude of force acting on the body at that instant is.**

(a) 6 N (b) 8 N
(c) 14 N (d) 10 N

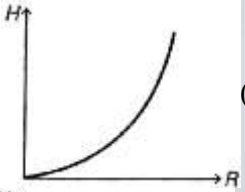
27. **In an experiment, the length of an object is measured to be 6.50 cm . This measured value can be written as 0.0650 m . The number of significant figures on 0.0650 m is.**

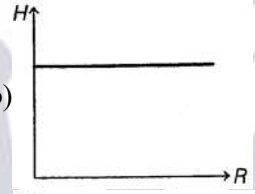
(a) 3 (b) 4
(c) 2 (d) 5

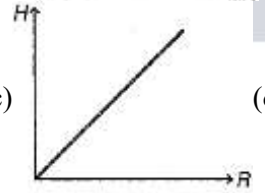
28. **A mouse of mass m jumps on the outside edge of a rotating ceiling fan of moment of inertia I and R. The fractional loss of angular velocity of the fan as a result is.**

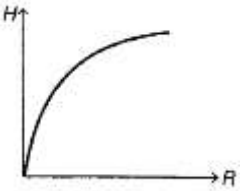
(a) $\frac{mR^2}{I+mR^2}$ (b) $\frac{1}{1+mR^2}$
(c) $\frac{I-mR^2}{I}$ (d) $\frac{1-mR^2}{1+mR^2}$

29. **Acceleration due to gravity at a height H from the surface of a planet is the same as that as a depth of H below the surface. If R be the radius of the planet, then H vs. R graph for different planets will be.**

(a) 

(b) 

(c) 

(d) 

30. **A uniform rope of length 4 m and mass 0.4 kg is held on a frictionless table in such a way that 0.6 m of the rope is hanging over the edge. The work done to pull the hanging part of the rope on to the table is (Assume $g = 10$ m/s^2)**

(a) 0.36 J (b) 0.24 J
(c) 0.12 J (d) 0.18 J

31. **There are n elastic balls placed on a smooth horizontal plane. The masses of the balls are $m, \frac{m}{2}, \frac{m}{2^2}, \ldots \frac{m}{2^{n-1}}$, respectively. If the first ball hits the second ball with velocity v_0, then the velocity of the nth ball will be.**

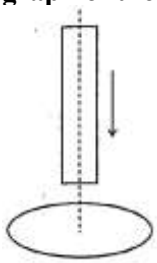
(a) $\frac{4}{3}v_0$. (b) $\left(\frac{4}{3}\right)^n v_0$
(c) $\left(\frac{4}{3}\right)^{n-1} v_0$ (d) v_0

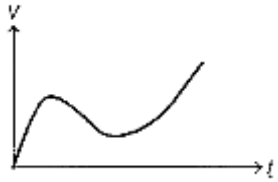
32. **An Earth's satellite near the surface of the earth takes about 90 min per revolution. A satellite orbitting the moon also takes about 90 min per revolution. Then which of the following is true?**

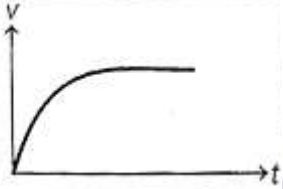
(a) $\rho_m < \rho_e$
(b) $\rho_m > \rho_e$

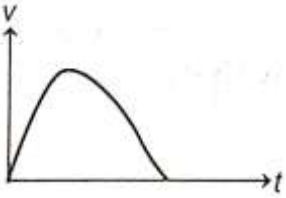
(c) $\rho_m = \rho_e$
(d) No conclusion can be made about the densities. [Where, ρ_m is the density of the moon and ρ_e is density of the Earth].

33. A bar magnet falls from rest under gravity through the center of a horizontal ring of conducting wire as shown in figure. Which of the following graph best represents the speed (v) versus, time (t) graph of the bar magnet?



(a) 

(d) 

(c) 

(d) 

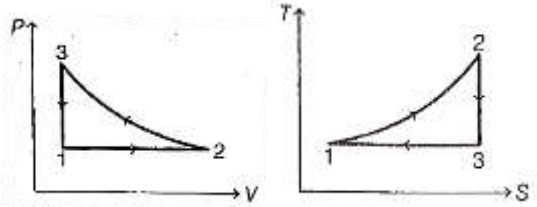
34. An amount of charge Q passes through a coil of resistance R. If the current in the coil decreases to zero at a uniform rate during time T, then the amount of heat generated in the coil will be.

(a) $\frac{4Q^2R}{3T}$ (b) $\frac{2QR}{3T}$
(c) $\frac{Q^2T}{4R}$ (d) Q^2RT

35. A modified gravitational potential is given by $V = -\frac{GM}{r} + \frac{A}{r^2}$. If the constant A is expressed in terms of gravitational constant (G), mass (M) and velocity of light (c), then from dimensional analysis, A is.

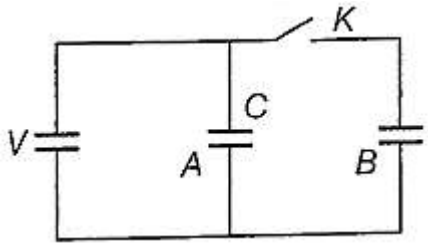
(a) $\frac{G^2M^2}{c^2}$ (b) $\frac{GM}{c^2}$
(c) $\frac{1}{c^2}$ (d) dimensionless

36. A cyclic process is shown in $p - V$ diagram and T-S diagram. Which of the following statements) is/are true?



(a) 1 → 2 : Isobaric, 2 → 3 : Isothermal.
(b) 3 → 1 : Isochoric, 2 → 3 : adiabatic.
(c) Work done by the system in the complete cyclic process is non-zero.
(d) The heat absorbed by the system in the complete cyclic process is non-zero.

37. The figure shows two identical parallel plate capacitors A and B of capacitances C connected to a battery. The key K is initially closed. The switch is now opened and the free spaces between the plates of the capacitors are filled with a dielectric constant 3.



Then, which of the following statement(s) is/are true?
(a) When the switch is closed, total energy stored in the two capacitors is CV^2.
(b) When the switch is opened, no charge is stored in the capacitor B.
(c) When the switch is opened, energy stored in capacitor B is $\frac{3}{2}CV^2$
(d) When the switch is opened, total energy stored in two capacitors is $\frac{5}{3}CV^2$.

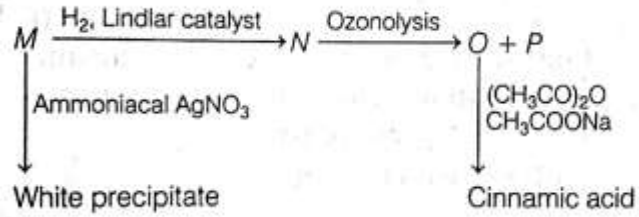
38. A charged particle of charge q and mass m is placed at a distance $2R$ from the center of a vertical cylindrical region of radius R where magnetic field varies as $\mathbf{B} = (4t^2 - 2t + 6)\hat{\mathbf{k}}$, where t is time. Then which of the following statement(s) is/are true?
(a) Induced electric field lines form closed loops.
(b) Electric field varies linearly with r if $r < R$, where r. is the radial distance from the centerline of the cylinder.
(c) The charged particle will move in clockwise direction when viewed from top.
(d) Acceleration of the charged particle is $\frac{7q}{2m}$ when $t = 2$ s.

39. A uniform magnetic field B exists in a region. An electron of charge q and mass m moving with velocity v enters the region in a direction perpendicular to the magnetic field. Considering Bohr angular momentum quantisation, which of the following statement(s) is/are true?
(a) The radius of n^{th} orbit $r_n \propto \sqrt{n}$.
(b) The minimum velocity of the electron is $\frac{\sqrt{qBh}}{m}$
(c) Energy of the n^{th} level $E_n \propto n$.
(d) Transition frequency ω between two successive levels is independent of n.

40. A train is moving along the tracks at a constant speed u. A girl on the train throws a ball of mass m straight ahead along the direction of motion of the train with speed v with respect to herself. Then,
(a) kinetic energy of the ball as measured by the girl on the train is $\frac{mv^2}{2}$.
(b) work done by the girl in throwing the ball is $\frac{mv^2}{2}$.
(c) work done by the train is mvu.
(d) the gain in kinetic energy of the ball as measured by a person standing by the rail track . is $\frac{mv^2}{2}$.

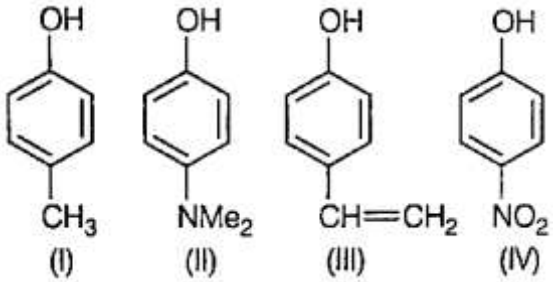
Chemistry

41. The correct order of boiling points of N -ethylethanamine (I), ethoxyethane (II) and butan-2-ol (III) is.
(a) III < II < 1 (b) II < III < I
(c) II < I < III (d) III < I < II

42. 

Structure of M is.
(a) $\mathrm{Ph-C\equiv CH}$ (b) $\mathrm{Ph-C\equiv C-CH_3}$
(c) $\mathrm{H_3C-C=CH}$ (d) $\mathrm{H_3C-C=CH_3}$

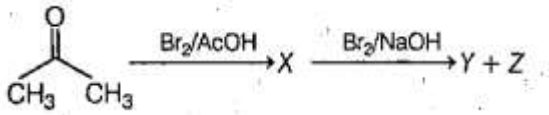
43.



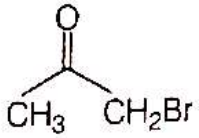
The correct order of acidity of above compounds is.

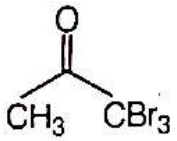
(a) II > IV > I > III (b) III > IV > II < I
(c) IV > II > III > I (d) IV > III > I > II

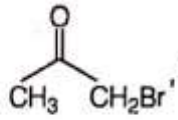
44.

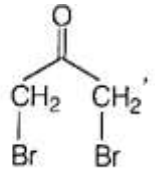


The correct option for the above reaction is.

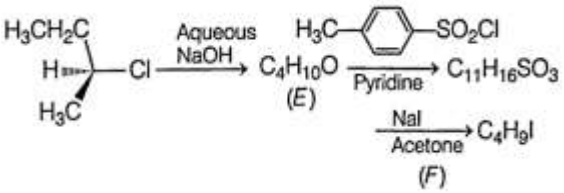
(a) X =  $Y = CHBr_3, Z = CH_3CO_2Na$

(b) X =  $Y = CHBr_3, Z = CH_3CO_2Na$

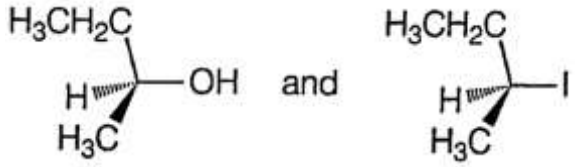
(c) X =  $Y = CHBr_3, Z = CH_2(Br)CO_2Na$

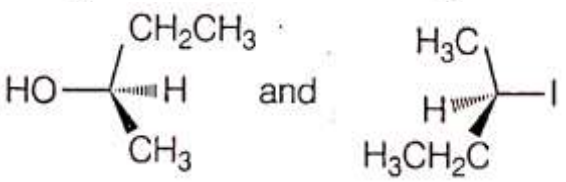
(d) X=  $Y = CHBr_3, Z = CH_2(Br)CO_2Na$

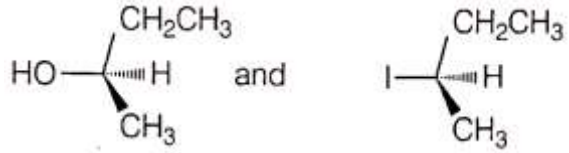
45.

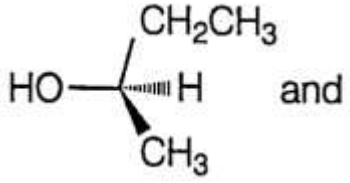
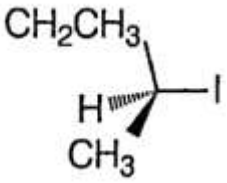


If all the nucleophilic substitution reactions at saturated carbon atoms in the above sequence of reactions follow S_N2 mechanism, then *E* and *F* will be respectively.

(a) 

(b) 

(c)  and

(d)  and 

46.Two base balls (masses: $m_1 = 100$ g and $m_2 = 50$ g) are thrown. Both of them move with uniform velocity, but the velocity of m_2 is 1.5 times that of m_1. The ratio of de-Broglie wavelengths $\lambda(m_1):\lambda(m_2)$ is given by.

(a) 4:3 (b) 3:4
(c) 2:1 (d) 1:2

47. What is the edge length of the unit cell of a body centred cubic crystal of an element whose atomic radius is 75 pm ?

(a) 170 pm (b) 175 pm
(c) 178 pm (d) 173.2 pm

48. The root mean square (rms) speed of X_2 gas is x m/s at a given temperature. When the temperature is doubled, the X_2 molecules dissociated completely into atoms. The root mean square speed of the sample of gas then becomes (in m/s)

(a) $x/2$ (b) x
(c) $2x$ (d) $4x$

49. Arrange the following in order of increasing mass.

I. 1 mole of N_2
II. 0.5 mole of O_3
III. 3.011×10^{23} molecules of O_2
IV. 0.5 gram atom of O_2

(a) IV < III < II < I (b) IV < I < III < II
(c) III < II < IV < I (d) I < III < II < IV

50. Which of the following would give a linear plot?

(a) k vs T (b) k vs $1/T$
(c) ln k vs T (d) ln k vs $1/T$

(k is the rate constant of an elementary reaction and T is temperature in absolute scale)

51. The equivalent conductance of NaCl, HCl and CH_3COONa at infinite dilution are 126.45 , 426.16 and 91 ohm^{-1} cm^2eq^{-1} respectively at 25°C. The equivalent conductance of acetic acid (at infinite dilution) would be.

(a) 461.61 ohm^{-1} cm^2eq^{-1}
(b) 390.71 ohm^{-1} cm^2eq^{-1}
(c) cannot be determined from the given data
(d) 208.71 ohm^{-1} cm^2eq^{-1}

52. For the reaction $A + B \longrightarrow C$, we have the following data

Initial concentration of A (In molarity)	Initlal concentration of B (In molarlty)	Rate (Initial) (Relevant unlt)
1	10	100
1	1	1
10	1	10

The order of the reaction with respect to A and B are

(a) Not possible to tell with the given data.

(b) First order with respect to both A and B.
(c) First order with respect to A and second order with respect to B.
(d) Second order with respect to A and first order with respect to B.

53. The equivalent weight of KIO_3 in the given reaction is (M = molecular mass)

$$2Cr(OH)_3 + 4OH^- + KIO_3 \rightarrow 2CrO_4^{2-} + 5H_2O + KI$$

(a) M (b) $M/2$
(c) $M/6$ (d) $M/8$

54. At STP, the dissociation reaction of water is $H_2O \rightleftharpoons H^+(aq) + OH^-(aq)$, and the pH of water is 7.0 . The change of standard free energy (ΔG°) for the above dissociation process is given by.

(a) 20301cal/mol (b) 19091cal/mol
(c) 20096cal/mol (d) 21301cal/mol

55. Na_2CO_3 is prepared by Solvay process but K_2CO_3 cannot be prepared by the same because

(a) K_2CO_3 is highly soluble in H_2O
(b) $KHCO_3$ is sparingly soluble
(c) $KHCO_3$ is appreciably soluble
(d) $KHCO_3$ decomposes

56. If in case of a radio isotope the value of half-life ($T_{1/2}$) and decay constant (λ) are identical in magnitude, then their value should be.

(a) $0.693/2$ (b) $(0.693)^{1/2}$
(c) $(0.693)^2$ (d) 0.693

57. Suppose a gaseous mixture of He, Ne, Ar and Kr is treated with photons of the frequency appropriate to ionise Ar. What ion(s) will be present in the mixture?

(a) Ar^+
(b) $Ar^+ + Kr^+$.
(c) $Ar^+ + He^+ + Ne^+$
(d) $He^+ + Ar^+ + Kr^+$

58. A solution containing 4 g of polymer in 4.0 litre solution at 27°C shows an osmotic pressure of 3.0×10^{-4} atm. The molar mass of the polymer in g/mol is.

(a) 820000 (b) 82000
(c) 8200 (d) 820

59. The molecular shapes of SF_4, CF_4 and XeF_4 are

(a) the same with 2,0 and 1 lone pairs of electrons on the central atoms, respectively.
(b) the same with 1,1 and 1 lone pairs of electrons on the central atoms, respectively.
(c) different with 0, 1 and 2 lone pairs of electrons on the central atoms, respectively.
(d) different with 1,0 and 2 lone pairs of electrons on the central atoms, respectively.

60. The species in which nitrogen atom is in a state of *sp*-hybridisation is.

(a) NO_3^- (b) NO_2
(c) NO_2^+ (d) NO_2^-

61. The correct statement about the magnetic properties of $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ is.

(a) Both are paramagnetic.
(b) Both are diamagnetic.
(c) $[Fe(CN)_6]^{3-}$ is diamagnetic, $[FeF_6]^{3-}$ is paramagnetic.
(d) $[Fe(CN)_6]^{3-}$ is paramagnetic, $[FeF_6]^{3-}$ is diamagnetic.

62. The calculated spin-only magnetic moment values in BM for $[FeCl_4]^-$ and $[Fe(CN)_6]^{3-}$ are.

(a) 5.9BM, 1.732BM (b) 4.89BM, 1.732BM
(c) 3.87BM, 1.732BM (d) 1.732BM, 2.82BM

63. BrF_3 self-ionises as following.

(a) $2BrF_3 \rightleftharpoons BrF^+ + BrF_5^-$
(b) $2BrF_3 \rightleftharpoons BrF_2^+ + BrF_4^-$
(c) $2BrF_3 \rightleftharpoons BrF_4^+ + BrF_2^-$
(d) $2BrF_3 \rightleftharpoons BrF_3^+ + BrF_3^-$

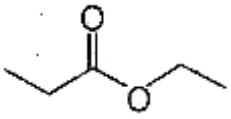
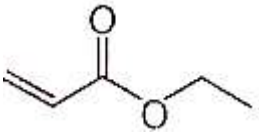
64. $4f^2$ electronic configuration is found in.

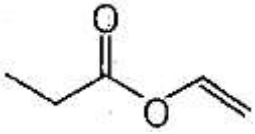
(a) Pr (b) Pr^{3+}
(c) Nd^{3+} (d) Pm^{3+}

65. Which of the following statements is incorrect?

(a) $[VF_6]^{3-}$ is paramagnetic with 2 unpaired electrons.
(b) $[CuCl_4]^{2-}$ is paramagnetic with 1 unpaired electron.
(c) $[Co(NH_3)_6]^{3+}$ is diamagnetic.
(d) $[CoF_6]^{3-}$ is paramagnetic with 2 unpaired electrons.

66. The correct order of C = O bond length in ethyl propanoate (I), ethyl propenoate (II) and ethenyl propanoate (III) is.

(I)  (II) 

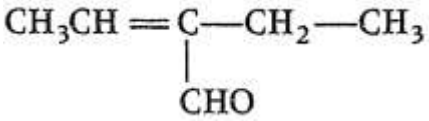

(III)

(a) I > II > III (b) III > II > I
(c) I > III > I (d) II > I > III

67. Select the molecule in which all the atoms may lie on a single plane is.

(a) 4-nitrobenzaldehyde
(b) 4-methoxybenzaldehyde
(c) 4-methylnitrobenzene
(d) 4-nitroacetophenone

68. The IUPAC name of



Is.

(a) 3-formyl-2-pentene
(b) 2-ethylbut-2-enal
(c) 3-ethylbut-3-enal
(d) 2-ethylcrotonaldehyde

69. The correct stability order of the following carbocations is

I. $H_2\overset{\oplus}{C} - CH = CH - CH_3$

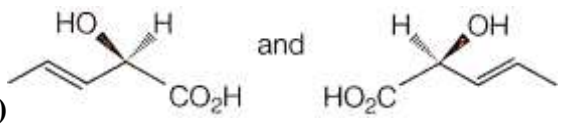
II. $\overset{\oplus}{C}H_2 - CH = CH - BMe_2$

III. $H_2\overset{\oplus}{C} - CH = CH - NMe_2$

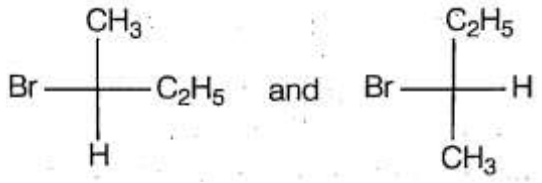
IV. $H_2\overset{\oplus}{C} - CH = CH - OMe$

(a) II > I > III > IV
(b) III > I > II > IV
(c) III > IV > I > II
(d) IV > III > II > I

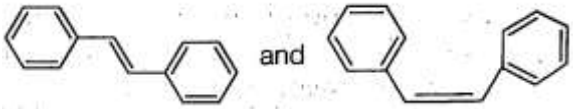
70.

(i) 

(II)



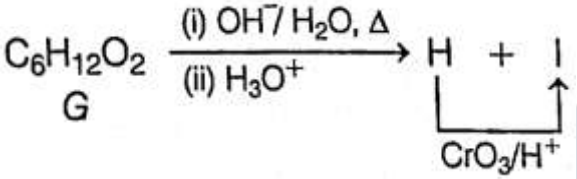
(III)



The relationship between the pair of compounds shown above are respectively,

(a) enantiomer, diastereomer, diastereomer
(b) enantiomer, enantiomer, diastereomer
(c) enantiomer, homomer (identical), diastereomer
(d) homomer (identical), diastereomer, geometrical isomer

71.



' G ' in the above sequence of reaction is.

(a) $(CH_3)_2CHCOOCH_2CH_3$
(b) $CH_3CH_2CH_2COOCH_2CH_3$
(c) $CH_3CH_2COOCH_2CH_2CH_3$
(d) $CH_3CH_2COOCH(CH_3)_2$

72. Case 1 An ideal gas of molecular weight M at temperature T.
Case 2 Another ideal gas of molecular weight $2M$ at temperature $T/2$.
Identify the correct statement in context of above two cases.

(a) Average kinetic energy and average speed will be the same in the two cases.
(b) Both the averages are halved.
(c) Both the averages are doubled.
(d) Only average speed is halved in the second case.

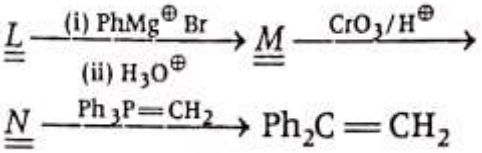
73. 63 g of a compound (Mol. Wt. =126) was dissolved in 500 g distilled water. The density of the resultant solution is 1.126 g/mL. The molarity of the solution is.

(a) 2 M (b) 1.0 M
(c) 0.75 M (d) 1.1 M

74. Nickel combines with a uninegative monodentate ligand (X) to form a paramagnetic complex $[NiX_4]^{2-}$. The hybridisation involved and number of unpaired electrons present in the complex are respectively.

(a) sp^3, two (b) dsp^2, zero
(c) dsp^2, one (d) sp^3, one

75.



' $\underline{\underline{L}}$ ' in the above sequence of reaction is/are (where, $L \neq M \neq N$)

(a) Benzaldehyde (b) Methyl benzoate
(c) Benzoyl chloride (d) Benzonitrile

76. The correct set(s) of reactions to synthesise benzoic acid starting from benzene is/are

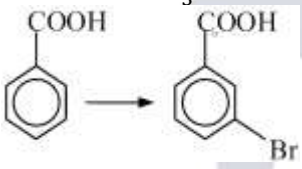
(a) **(i)** Br_2/Fe **(ii)** Mg/dry ether
(iii) CO_2 **(iv)** $H_3O^{\oplus}$

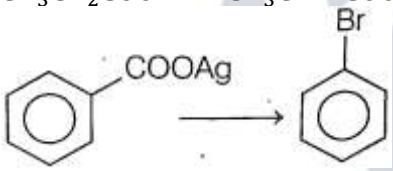
(b) **(i)** Br_2/Fe **(ii)** $NH_3, 25°C$
(iii) $NaNO_2$, dil. $HCl, 0°$ to $5°C$
(iv) $CuCN/KCN$
(v) dil. HCl, Δ
(c) **(i)** CH_3Cl, anhydrous $AlCl_3$
(ii) $KMnO_4 \mid OH, \Delta$ **(iii)** $H_3\overset{\oplus}{O}$
(d) **(i)** CH_3COCl, anhydrous $AlCl_3$
(ii) $Br_2, NaOH$ (iii) $H_3O^{\oplus}$

77. Which statement(s) is/are applicable above critical temperature?
(a) A gas cannot be liquieied.
(b) Surface tension of a liquid is very high.
(c) A liquid phase cannot be distinguished from a gas phase.
(d) Density changes continuously with p or V.

78. Which of the following mixture act(s) as buffer solution?
(a) $NaOH + CH_3COOH$ (1:1 mole ratio)
(b) $NH_4OH + HCl$ (2:1 mole ratio)
(c) $CH_3COOH + NaOH$ (2: 1 mole ratio)
(d) $CH_3COOH + NaOH$ (1:2 mole ratio)

79. An electron in the $5d$ orbital can be represented by the following (n, l, ml) values.
(a) $(5,2,1)$ (b) $(5,1,-1)$
(c) $(5,0,1)$ (d) $(5,2,-1)$

80. The conversion(s) that can be carried out by bromine in carbon tetrachloride solvent is/are.
(a) $PhCH = CHCH_3 \longrightarrow PhCHBrCHBrCH_3$
(b) 

(c) $CH_3CH_2COOH \longrightarrow CH_3CHBrCOOH$
(d) 

Mathematics

81. The straight lines $x + 2y - 9 = 0, 3x + 5y - 5 = 0$ and $ax + by - 1 = 0$ are concurrent if the straight line $35x - 22y + 1 = 0$ passes through the point.
(a) $(-a, -b)$ (b) $(a, -b)$
(c) $(-a, b)$ (d) (a, b)

82. Let A be the point $(0, 4)$ in the XY-plane and let B be the point $(2t, 0)$. Let L be the mid-point of AB and let the perpendicular bisector of AB meet the Y-axis M. Let N be the mid-point of LM. Then, locus of N is.
(a) a circle (b) a parabola
(c) a straight line (d) a hyperbola

83. If $4a^2 + 9b^2 - c^2 + 12ab = 0$, then the family of straight lines $ax + by + c = 0$ is concurrent At.
(a) $(2,3)$ or $(-2,-3)$ (b) $(-2,3)$ or $(2,3)$
(c) $(3,2)$ or $(-3,2)$ (d) $(-3,2)$ or $(2,3)$

84. The tangent at point $(a\cos\theta, b\sin\theta), 0 < \theta < \frac{\pi}{2}$, to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ meets the X-axis at T and Y-axis at T_1. Then, the value of $\min(OT)(OT_1)$ is $0 < \theta < \frac{\pi}{2}$.
(a) ab (b) $2ab$
(c) 0 (d) 1

85. ABC is an isosceles triangle with an inscribed circle with centre O. Let P be the mid-point of

BC. If $AB = AC = 15$ and $BC = 10$, then OP equals.

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

(c) $2\sqrt{5}$ units (d) $5\sqrt{2}$ units

86. Let O be the vertex, Q be any point on the parabola $x^2 = 8y$. If the point P divides the line segment OQ internally in the ratio $1:3$, then the locus of P is.

(a) $x^2 = y$ (b) $y^2 = x$

(c) $y^2 = 2x$ (d) $x^2 = 2y$

87. If the distance between the plane $\alpha x - 2y + z = k$ and the plane containing the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-4}{5}$ is $\sqrt{6}$, then $|k|$ is.

(a) 36 (b) 12

(c) 6 (d) $2\sqrt{3}$

88. Let $A(2\sec\theta, 3\tan\theta)$ and $B(2\sec\phi, 3\tan\phi)$, where $\theta + \phi = \frac{\pi}{2}$ be two points on the hyperbola $\frac{x^2}{4} - \frac{y^2}{9} = 1$. If (α, β) is the point of intersection of normals to the hyperbola at A and B, then β is equal to.

(a) $\frac{12}{3}$ (b) $\frac{13}{3}$

(c) $-\frac{12}{3}$ (d) $-\frac{13}{3}$

89. If the lines joining the focii of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, where $a > b$ and an extremity of its minor axis is inclined at an angle $60°$, then the eccentricity of the ellipse is.

(a) $\frac{\sqrt{3}}{2}$ (b) $\frac{1}{2}$

(c) $\frac{\sqrt{7}}{3}$ (d) $\frac{1}{\sqrt{3}}$

90. If $y = \log^n x$, where $\log^n$ means $\log_e \log_e \log_e \ldots$ (repeated n times), then $x\log x\log^2 x\log^3 x \ldots . \log^{n-1} x\log^n x\frac{dy}{dx}$ is equal to.

(a) $\log x$ (b) x

(c) 1 (d) $\log^n x$

91. The angle between a normal to the plane $2x - y + 2z - 1 = 0$ and the X-axis is.

(a) $\cos^{-1}\frac{2}{3}$ (b) $\cos^{-1}\frac{1}{5}$

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

92. Let $f(x) = [x^2]\sin\pi x, x > 0$. Then,

(a) f is discontinuous everywhere.

(b) f is continuous everywhere.

(c) f is continuous at only those points which are perfect squares.

(d) f is continuous at only those points which are not perfect squares.

93. Suppose, $f: R \to R$ be given by

$$f(x) = \begin{cases} 1, & \text{if } x = 1 \\ e^{(x^{10}-1)} + (x-1)^2 \sin\frac{1}{x-1}, & \text{if } x \neq 1 \end{cases}$$ **then.**

(a) $f'(1)$ does not exist

(b) $f'(1)$ exists and is zero

(c) $f'(1)$ exist and is 9

(d) $f'(1)$ exists and is 10

94. $\lim_{x\to\infty}\left\{x - \sqrt[n]{(x-a_1)(x-a_2)\ldots(x-a_n)}\right\}$, where $a_1, a_2, \ldots a_n$ are positive rational numbers. The limit

(a) does not exist (b) is $\frac{a_1+a_2+\cdots a_n}{n}$

(c) is $\sqrt[n]{a_1 a_2 \ldots a_n}$ (d) is $\frac{n}{a_1+a_2+\cdots+a_n}$

95. Let $\cos^{-1}\left(\frac{y}{b}\right) = \log_e\left(\frac{x}{n}\right)^n$, then $Ay_2 + By_1 + Cy = 0$ is possible for where $y_2 = \frac{d^2y}{dx^2}, y_1 =$

$\frac{dy}{dx}$.

(a) $A = 2, B = x^2, C = n$

(b) $A = x^2, B = x, C = n^2$

(c) $A = x, B = 2x, C = 3n + 1$

(d) $A = x^2, B = 3x, C = 2n$

96. Let $f: [1,3] \to R$ be continuous and be derivable in $(1,3)$ and $f'(x) = [f(x)]^2 + 4 \forall x \in (1,3)$. Then,

(a) $f(3) - f(1) = 5$ holds

(b) $f(3) - f(1) = 5$ does not hold

(c) $f(3) - f(1) = 3$ holds

(d) $f(3) - f(1) = 4$ holds

97. $f(x)$ is a differentiable function and given $f'(2) = 6$ and $f'(1) = 4$, then $L = \lim_{h\to 0} \frac{f(2+2h+h^2)-f(2)}{f(1+h-h^2)-f(1)}$.

(a) does not exist (b) equal to - 3

(c) equal to 3 (d) equal to $3/2$

98. The expression $\frac{\int_0^n [x]dx}{\int_0^n \{x\}dx}$, where $[x]$ and $\{x\}$ are respectively integral and fractional part o x and $n \in N$, is equal to.

(a) $\frac{1}{n-1}$ (b) $\frac{1}{n}$

(c) n (d) $n - 1$

99. If $I = \int \frac{x^2 dy}{(x\sin x+\cos x)^2} = f(x) + \tan x + c$, then $f(x)$ is.

(a) $\frac{\sin x}{x\sin x+\cos x}$ (b) $\frac{1}{(x\sin x+\cos x)^2}$

(c) $\frac{-x}{\cos x(x\sin x+\cos x)}$ (d) $\frac{1}{\sin x(x\cos x+\sin x)}$

100. If $\int \frac{dx}{(x+1)(x-2)(x-3)} = \frac{1}{k}\log_e \left\{\frac{|x-3||^3|x+1|}{(x-2)^4}\right\} + c$, then the value of k is.

(a) 4 (b) 6

(c) 8 (d) 12

101. If $y = \frac{x}{\log_e |cx|}$ is the solution of the differential equation $\frac{dy}{dx} = \frac{y}{x} + \phi\left(\frac{x}{y}\right)$, then $\phi\left(\frac{x}{y}\right)$ is given By.

(a) $\frac{y^2}{x^2}$ (b) $-\frac{y^2}{x^2}$

(c) $\frac{x^2}{y^2}$ (d) $-\frac{x^2}{y^2}$

102. The value of $\int_0^{1/2} \frac{dx}{\sqrt{1-x^{2n}}}$ is $(n \in N)$.

(a) less than or equal to $\frac{\pi}{6}$

(b) greater than or equal to 1

(c) less than $\frac{1}{2}$

(d) greater than $\frac{\pi}{6}$

103. If $I_n = \int_0^{\frac{\pi}{2}} \cos^n x \cos nx dx$, then I_1, I_2, I_3 ... are in.

(a) AP (b) GP

(c) HP (d) No such relation

104. Given, $\frac{d^2y}{dx^2} + \cot x \frac{dy}{dx} + 4y\text{cosec}^2 x = 0$. Changing the independent variable x to z by the substitution $z = \log \tan \frac{x}{2}$, then equation is changed to.

(a) $\frac{d^2y}{dz^2} + \frac{3}{y} = 0$ (b) $2\frac{d^2y}{dz^2} + e^y = 0$

(c) $\frac{d^2y}{dz^2} - 4y = 0$ (d) $\frac{d^2y}{dz^2} + 4y = 0$

105. The function $y = e^{kx}$ satisfies $\left(\frac{d^2y}{dx^2} + \frac{dy}{dx}\right)\left(\frac{dy}{dx} - y\right) = y\frac{dy}{dx}$. It is valid for.

(a) exactly one value of k
(b) two distinct values of k
(c) three distinct values of k
(d) infinitely many values of k

106. If a hyperbola passes through the point $P(\sqrt{2}, \sqrt{3})$ and has foci at $(\pm 2, 0)$, then the tangent to this hyperbola at P is.

(a) $y = x\sqrt{6} - \sqrt{3}$ (b) $y = x\sqrt{3} - \sqrt{6}$
(c) $y = x\sqrt{6} + \sqrt{3}$ (d) $y = x\sqrt{3} + \sqrt{6}$

107. Let $f(x) = \begin{cases} x + 1, & -1 \le x \le 0 \\ -x, & 0 < x \le 1 \end{cases}$

(a) $f(x)$ is discontinuous in $[-1,1]$ and so has no maximum value or minimum value in $[-1,1]$.
(b) $f(x)$ is continuous in $[-1,1]$ and so has maximum value and minimum value.
(c) $f(x)$ is discontinuous in $[-1,1]$ but still has the maximum and minimum value.
(d) $f(x)$ is bounded in $[-1,1]$ and does not attain maximum or minimum value.

108. A missile is fired from the ground level rises x meters vertically upwards in t s, where $x = 100t - \frac{25}{2}t^2$. The maximum height reached is.

(a) 100 m (b) 300 m
(c) 200 m (d) 125 m

109. The value of a for which the scalar triple product formed by the vectors $\alpha = \hat{\imath} + a\hat{\jmath} + \hat{k}$, $\beta = \hat{\jmath} + a\hat{k}$ and $\gamma = a\hat{\imath} + \hat{k}$ is maximum, is.

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

110. A, B are fixed points with coordinates $(0, a)$ and $(0, b)(a > 0, b > 0)$. P is variable point $(x, 0)$ referred to rectangular axis. If the angle $\angle APB$ is maximum, then.

(a) $x^2 = ab$ (b) $x^2 = a + b$
(c) $x = \frac{1}{ab}$ (d) $x = \frac{a+b}{2}$

111. The average length of all vertical chords of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1, a \le x \le 2a$, is.

(a) $b(2\sqrt{3} - \ln|2 + \sqrt{3})$
(b) $b\{3\sqrt{2} + \ln(3 + \sqrt{2})\}$
(c) $a\{2\sqrt{5} - \ln(2 + \sqrt{5})\}$
(d) $a\{5\sqrt{2} + \ln(5 + \sqrt{2})\}$

112. Reflection of the line $\bar{a}z + a\bar{z} = 0$ in the real axis is given by

(a) $az + \bar{a}z = 0$ (b) $\bar{a}z - a\bar{z} = 0$
(c) $az - \overline{az} = 0$ (d) $\frac{a}{z} + \frac{\bar{a}}{\bar{z}} = 0$

113. If the vertices of a square are z_1, z_2, z_3 and z_4 taken in the anti-clockwise order, then z_3 is equal To.

(a) $-1z_1 - (1 + i)z_2$ (b) $z_1 - (1 + i)z_2$
(c) $z_1 + (1 + i)z_2$ (d) $-iz_1 + (1 + i)z_2$

114. If the n terms $a_1, a_2, \ldots a_n$ are in AP with increment r, then the difference between the mean of their squares and the square of their mean of their squares and the square of their mean is.

(a) $\frac{r^2\{(n-1)^2-1\}}{12}$ (b) $\frac{r^2}{12}$
(c) $\frac{r^2(n^2-1)}{12}$ (d) $\frac{n^2-1}{12}$

115. If $1 \cdot \log_9(3^{1-x} + 2), \log_3(4.3^x - 1)$ are in AP, then x equals.

(a) $\log_1 4$ (b) $1 - \log_3 4$
(c) $1 - \log_4 3$ (d) $\log_4 3$

116. n object are distributed at random among n persons. The number of ways in which this can

be done so that at least one of them will not get any object is.

(a) $n! - n$ (b) $n^n - n$

(c) $n^n - n^2$ (d) $n^n - n$!

117. If one root of $x^2 + px - q^2 = 0$. p and q are real, be less than 2 and other be greater than 2, Then.

(a) $4 + 2p + q^2 > 0$ (b) $4 + 2p + q^2 < 0$

(c) $4 + 2p - q^2 > 0$ (d) $4 + 2p - q^2 < 0$

118. The number of ways in which the letters of the word 'VERTICAL' can be arranged without changing the order of the vowels is.

(a) $6! \times 3$! (b) $\frac{8!}{3}$

(c) $6! \times 3$ (d) $\frac{8!}{3!}$

119. Let A and B are orthogonal matrices and $\det A + \det B = 0$. Then,

(a) $A + B$ is singular

(b) $A + B$ is non-singular

(c) $A + B$ is orthogonal

(d) $A + B$ is skew symmetric

120. Let $P(n) = 3^{2n+1} + 2^{n+2}$, where $n \in N$. Then,

(a) $P(n)$ is not divisible by any prime integer.

(b) there exists prime integer which divides $P(n)$.

(c) $P(n)$ is divisible by 5 for all $n \in N$.

(d) $P(n)$ is divisible by 3 for all $n \in N$.

121. Let A be a set containing n elements. A subset P of A is chosen, and the set A is reconstructed by replacing the elements of P. A subset Q of A is chosen again. The number of ways of choosing P and Q such that Q contains just one element more than P is.

(a) ${}^{2n}C_{n-1}$ (b) ${}^{2n}C_n$

(c) ${}^{2n}C_{n+2}$ (d) 2^{2n+1}

122. Let α, β be the roots of the equation $ax^2 + bx + c = 0, a, b, c$ real and $s_n = \alpha^n + \beta^n$ and $\begin{vmatrix} 3 & 1+s_1 & 1+s_2 \\ 1+s_1 & 1+s_2 & 1+s_3 \\ 1+s_2 & 1+s_3 & 1+s_4 \end{vmatrix} = k\frac{(a+b+c)^2}{a^4}$, then k is equal to.

(a) $b^2 - 4ac$ (b) $b^2 + 4ac$

(c) $b^2 + 2ac$ (d) $4ac - b^2$

123. Let $A = \begin{pmatrix} 2 & 0 & 3 \\ 4 & 7 & 11 \\ 5 & 4 & 8 \end{pmatrix}$. Then,

(a) $\det A$ is divisible by 11

(b) $\det A$ is not divisible by 11

(c) $\det A = 0$

(d) A is orthogonal matrix

124. If the matrix M_r is given by $m_r = \begin{pmatrix} r & r-1 \\ r-1 & r \end{pmatrix}$ for $r = 1, 2, 3, \ldots$ then $\det(M_1) + \det(M_2) + \cdots + \det(M_{2008})$ is equal to.

(a) 2007 (b) 2008

(c) $(2008)^2$ (d) $(2007)^2$

125. Let A and B are two independent events. The probability that both A and B happen is $\frac{1}{12}$ and probability that neither A nor B happen is $\frac{1}{2}$. Then,

(a) $P(A) = \frac{1}{3} \cdot P(B) = \frac{1}{4}$

(b) $P(A) = \frac{1}{2} \cdot P(B) = \frac{1}{6}$

(c) $P(A) = \frac{1}{6} \cdot P(B) = \frac{1}{2}$

(d) $P(A) = \frac{2}{2} \cdot P(B) = \frac{1}{8}$

126. Let A, B, C are subsets of set X. Then consider the validity of the following set theoretic

statement :

(a) $A \cup (B \setminus C) = (A \cup B) \setminus (A \cup C)$

(b) $(A \setminus B) \setminus C = A \setminus (B \cup C)$

(c) $(A \cup B) \setminus A = A \setminus B$

(d) $A \setminus C = B \setminus C$

127. Let X be a nonvoid set. If ρ_1 and ρ_2 be the transitive relations on X, then

(a) $\rho_1 \cdot \rho_2$ is transitive relation

(b) $\rho_1 \cdot \rho_2$ is not transitive relation

(c) $\rho_1 \cdot \rho_2$ is equivalence relation

(d) $\rho_1 \cdot \rho_2$ is not any relation on X

128. The equation $r^2\cos^2\left(\theta - \frac{\pi}{3}\right) = 2$ represents.

(a) a parabola

(b) a hyperbola

(c) a circle

(d) a pair of straight lines

129. Let S be the sample space of the random experiment of throwing simultaneously two unbiased dice and $E_k = \{(a, b) \in S : ab = k\}$. If $p_k = P(E_k)$, then the correct among the following is.

(a) $p_1 < p_{10} < p_4$

(b) $p_2 < p_8 < p_{14}$

(c) $p_4 < p_8 < p_{17}$

(d) $p_2 < p_{16} < p_5$

130. If $\frac{1}{6}\sin\theta, \cos\theta, \tan\theta$ are in GP , then the solution set of θ is. (Here, $n \in M$).

(a) $2n\pi \pm \frac{\pi}{6}$ (b) $2n\pi \pm \frac{\pi}{3}$

(c) $n\pi + (-1)^n \frac{\pi}{3}$ (d) $n\pi + \frac{\pi}{3}$

131. The family of curves $y = e^{a\sin x}$, where ' a ' is arbitrary constant, is represented by the differential equation.

(a) $y\log y = \tan x \frac{dy}{dx}$

(b) $y\log x = \cos x \frac{dy}{dx}$

(c) $\log y = \tan x \frac{dy}{dx}$

(d) $\log y = \cot x \frac{dy}{dx}$,

132. The locus of points (x, y) in the plane satisfying $\sin^2 x + \sin^2 y = 1$ consists of

(a) a circle centered at origin

(b) infinitely many circles that are all centered at the origin

(c) infinitely many lines with slope ± 1

(d) finitely many lines with slope ± 1

133. The value of $\lim_{\pi\to\infty}\left[\begin{matrix}\left(\frac{1}{2\cdot 3}+\frac{1}{2^2\cdot 3}\right)+\left(\frac{1}{2^2\cdot 3^2}+\frac{1}{2^3\cdot 3^2}\right)\\ +\cdots+\left(\frac{1}{2^n\cdot 3^n}+\frac{1}{2^{n+1}\cdot 3^n}\right)\end{matrix}\right]$ is.

(a) $\frac{3}{8}$ (b) $\frac{3}{10}$

(c) $\frac{3}{14}$ (d) $\frac{3}{16}$

134. In the interval $(-2\pi, 0)$, the function $f(x) = \sin\left(\frac{1}{x^3}\right)$.

(a) never changes sign

(b) changes sign only once

(c) changes sign more than once but finitely many times

(d) changes sign infinitely many times

135. $\int_0^{2\pi} \theta\sin^6\theta\cos\theta d\theta$ is equal to

(a) $\frac{\pi}{16}$ (b) $\frac{3\pi}{16}$

(c) $\frac{16\pi}{3}$ (d) 0

136. If $x = \sin\theta$ and $y = \sin k\theta$, then $(1-x^2)y_2 - xy_1 - \alpha y = 0$, for α is equal to

(a) k (b) $-k$
(c) $-k^2$ (d) k^2

137. The portion of the tangent to the curve $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}, a > 0$ at any point of it, intercepted between the axes.

(a) varies as abscissa
(b) varies as ordinate
(c) is constant
(d) varies as the product of abscissa and ordinate

138. The average ordinate of $y = \sin x$ over $[0, \pi]$ is.

(a) $\frac{2}{\pi}$ (b) $\frac{3}{\pi}$
(c) $\frac{4}{\pi}$ (d) π

139. Given $f(x) = e^{\sin x} + e^{\cos x}$. The global maximum value of $f(x)$

(a) does not exist.
(b) exists at a point in $\left(0, \frac{\pi}{2}\right)$ and its value is $2e^{\frac{1}{\sqrt{2}}}$.
(c) exists at infinitely many points.
(d) exists at $x = 0$ only.

140. If the volume of the parallelopiped with $\mathbf{a}\times\mathbf{b}, \mathbf{b}\times\mathbf{c}$ and $\mathbf{c}\times\mathbf{a}$ as coterminous edges is 9 cu . units, then the volume of the parallelopiped with $(\mathbf{a}\times\mathbf{b})\times(\mathbf{b}\times\mathbf{c}), (\mathbf{b}\times\mathbf{c})\times(\mathbf{c}\times\mathbf{a})$ and $(\mathbf{c}\times\mathbf{a})\times(\mathbf{a}\times\mathbf{b})$ as coterminous edges is.

(a) 9 cu. Units (b) 729 cu. units
(c) 81 cu. Units (d) 243 cu . units

141. Let $a_1, a_2, a_3, \ldots a_n$ be positive real numbers. Then the minimum value of $\frac{a_1}{a_2} + \frac{a_2}{a_3} + \cdots + \frac{a_n}{a_1}$ ' Is.

(a) 1 (b) n
(c) ${}^{n}C_2$ (d) 2

142. Consider a quadratic equation $ax^2 + 2bx + c = 0$ where a, b, c are positive real numbers. If the equation has no real root, then which of the following is true?

(a) a, b, c cannot be in AP or HP but can be in GP
(b) a, b, c cannot be in G.P. or H.P. but can be in AP
(c) a, b, c cannot be in A.P. or G.P. but can be in HP
(d) a, b, c cannot be in A.P., G.P. or H.P.

143. From the focus of the parabola $y^2 = 12x$, a ray of light is directed in a direction making an angle $\tan^{-1}\frac{3}{4}$ with X-axis. Then, the equation of the line along which the reflected ray leaves the parabola is.

(a) $y = 2$ (b) $y = 18$
(c) $y = 9$ (d) $y = 36$

144. Let $A = \begin{pmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}, B = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$ and $P = \begin{pmatrix} 0 & 1 & 0 \\ x & 0 & 0 \\ 0 & 0 & y \end{pmatrix}$ be an orthogonal matrix such that $B = PAP^{-1}$ holds. Then,

(a) $x = 1 = y$ (b) $x = 1, y = 0$
(c) $x = 0, y = 1$ (d) $x = -1, y = 0$

145. Let ρ be a relation defined on set of natural numbers N, as $\rho = \{(x, y) \in N \times N : 2x + y = 41\}$. Then domain A and range B are.

(a) $A \subset \{x \in N : 1 \le x \le 20\}$ and $B \subset \{y \in N : 1 \le y \le 39\}$
(b) $A = \{x \in N : 1 \le x \le 15\}$ and $B = \{y \in N : 2 \le y \le 30\}$
(c) $A \equiv N, B \equiv Q$
(d) $B = Q, B = Q$

146. Which of the following statements are true?

(a) If $f(x)$ be continuous and periodic with periodicity T, then $U = \int_a^{a+T} f(x)dx$ depend on a.

(b) If $f(x)$ be continuous and periodic with periodicity T, then $l = \int_a^{a+T} f(x)dx$ does not depend on a.

(c) Let $f(x) = \begin{cases} 1, & \text{if } x \text{ is rational} \\ 0, & \text{if } x \text{ is irrational} \end{cases}$ then f is periodic of the periodicity T only if T is rational.

(d) f defined in (C) is periodic for all T.

147. Let $f(x) = x^m$, m being a non-negative integer. The value of m, so that the equality $f'(a+b) = f'(a) + f'(b)$ is valid for all $a, b > 0$ is.

(a) 0 (b) 1

(c) 2 (d) 3

148. If $f(x) = 3\sqrt[3]{x^2} - x^2$, then

(a) f has no extrema

(b) f is maximum at two points $x = 1$ and $x = -1$

(c) f is minimum at $x = 0$

(d) f has maximum at $x = 1$ only

149. Let f be a non-negative function defined on $\left[0, \frac{\pi}{2}\right]$. If $\int_0^x (f'(t) - \sin 2t)dt = \int_x^{\pi} f(t)\tan t dt$, $f(0) = 1$, then $\int_0^{\frac{\pi}{2}} f(x)dx$ is.

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

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

150. A balloon starting from rest is ascending from ground with uniform acceleration of 4ft/sec^2. At the end of 5 sec , a stone is dropped from it. If T be the time to reach the stone in the ground and H be the height of the balloon when the stone reaches the ground, then

(a) $T = 6$ s (b) $H = 112.5$ft

(c) $T = 5/2$ s (d) $H = 225$ft

151. A letter lock consists of three rings with 15 different letters. If N denotes the number of ways in which it is possible to make unsuccessful attempts to open the lock, then.

(a) 482 divides N

(b) N is the product of two distinct prime number.

(c) N is the product of three distinct prime numbers.

(d) 16 divides N.

152. If z_1 and z_2 are two complex numbers satisfying the equation $\left|\frac{z_1+z_2}{z_1-z_2}\right| = 1$, then $\frac{z_1}{z_2}$ may be.

(a) real positive (b) real negative

(c) zero (d) purely imaginary

153. A rectangle $ABCD$ has its side parallel to the line $y = 2x$ and vertices A, B, D are $y = 1, x = 1$ and $x = -1$, respectively. The co-ordinate of C can be.

(a) $(3,8)$ (b) $(-3,8)$

(c) $(-3,-1)$ (d) $(3,-1)$

154. If R and R^1 are equivalence relations on a set A, then so are the relation.

(a) R^{-1} (b) $R \cup R^1$

(c) $R \cap R^1$ (d) All of these

155. Let f be a strictly decreasing function defined on R such that $f(x) > 0, \forall x \in R$. Let $\frac{x^2}{f(a^2+5a+3)} + \frac{y^2}{f(a+15)} = 1$ be an ellipse with major axis along the Y-axis. The value of a can lie in the interval(s).

(a) $(-\infty, -6)$ (b) $(-6,2)$

(c) $(2, \infty)$ (d) $(-\infty, \infty)$