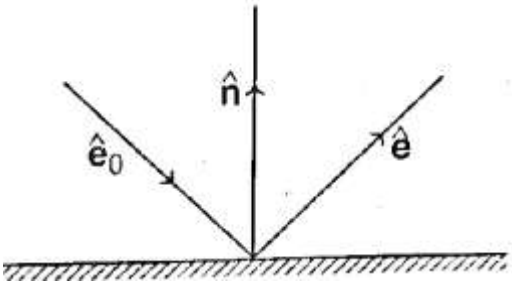
Physics

1. A ray of light is reflected by a plane mirror. $\hat{e}_0$, $\hat{e}$ and $\hat{n}$ be the unit vectors along the incident ray, reflected ray and the normal to the reflecting surface respectively. Which of the following gives an expression for $\hat{e}$?



(a) $\hat{e}_0 + 2(\hat{e}_0 \cdot \hat{n})\hat{n}$
(b) $\hat{e}_0 - 2(\hat{e}_0 \cdot \hat{n})\hat{n}$
(c) $\hat{e}_0 - (\hat{e}_0 \cdot \hat{n})\hat{n}$
(d) $\hat{e}_0 + (\hat{e}_0 \cdot \hat{n})\hat{n}$

2. A parent nucleus X undergoes α-decay with a half-life of 75000 yrs. . The daughter nucleus Y undergoes β-decay with a half-life of 9 months. In a particular sample, it is found that the rate of emission of β-particles is nearly constant (over several months) at 10^7/h. What will be the number of α-particles emitted in an hour?.

(a) 10^2 (b) 10^7
(c) 10^{12} (d) 10^{14}

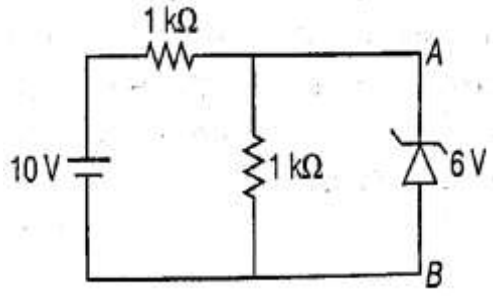
3. A proton and an electron initially at rest are accelerated by the same potential difference. Assuming that a proton is 2000 times heavier than an electron, what will be the relation between the de Broglie wavelength of the proton (λ_p) and that of electron (λ_e)?

(a) $\lambda_p = 2000\lambda_e$
(b) $\lambda_p = \frac{\lambda_e}{2000}$
(c) $\lambda_\rho = 20\sqrt{5}\lambda_e$
(d) $\lambda_\rho = \frac{\lambda_e}{20\sqrt{5}}$

4. To which of the following the angular velocity of the electron in the n-th Bohr orbit is proportional?

(a) n^2 (b) $\frac{1}{n^2}$
(c) $\frac{1}{n^{3/2}}$ (d) $\frac{1}{n^3}$

5. In the circuit shown, what will be the current through the 6 V zener?



(a) 6 mA , from A to B
(b) 2 mA , from A to B
(c) 2 mA , from B to A
(d) Zero

6. Each of the two inputs A and B can assume values either 0 or 1 . Then which of the following will be equal to $\bar{A} \cdot \bar{B}$?.

(a) $A + B$ (b) $\overline{A + B}$
(c) $\overline{A \cdot B}$ (d) $\bar{A} + \bar{B}$

7. The correct dimensional formula for impulse is given by.

(a) $ML^2\ T^{-2}$, (b) MLT^{-1}
(c) ML^2T^{-1} (d) MLT^{-2}

8. The density of the material of a cube can be estimated by measuring its mass and the length of one of its sides. If the maximum error in the measurement of mass and length are 0.3% and 0.2% respectively, the maximum error in the estimation of the density of the cube is approximately.

(a) 1.1% (b) 0.5%
(c) 0.9% (d) 0.7%

9. Two weights of the mass m_1 and $m_2 (> m_1)$ are joined by an inextensible string of negligible mass passing over a fixed frictionless pulley. The magnitude of the acceleration of the loads is.

(a) g (b) $\frac{m_2-m_1}{m_2}g$
(c) $\frac{m_1}{m_2+m_1}g$ (d) $\frac{m_2-m_1}{m_2+m_1}g$

10. A body starts from rest, under the action of an engine working at a constant power and moves along a straight line. The displacement s is given as a function of time (t) as.

(a) $s = at + bt^2, a$ and b are constants
(b) $s = bt^2, b$ is a constant
(c) $s = at^{3/2}, a$ is a constant
(d) $s = at, a$ is a constant

11. Two particles are simultaneously projected in the horizontal direction from a point P at a certain height. The initial velocities of the particles are oppositely directed to each other and have magnitude v each. The separation between the particles at a time when their position vectors (drawn from the point P) are mutually perpendicular, is.

(a) $\frac{v^2}{2g}$ (b) $\frac{v^2}{g}$
(c) $\frac{4v^2}{g}$ (d) $\frac{2v^2}{g}$

12. Assume that the earth moves around the sun in a circular orbit of radius R and there exists a planet which also move around the sun in a circular orbit with an angular speed twice as large as that of the earth. The radius of the orbit of the planet is.

(a) $2^{-2/3}R$ (b) $2^{2/3}R$
(c) $2^{-1/3}R$ (d) $\frac{R}{\sqrt{2}}$

13. A compressive force is applied to a uniform? rod of rectangular cross-section so that its length decreases by 1%. If the Poisson's ratio for the material of the rod be 0.2 , which of the following statements is correct? "The volume approximately "

(a) decreases by 1%
(b) decreases by 0.8%
(c) decreases by 0.6%
(d) increases by 0.2%

14. A small spherical body of radius r and density ρ moves with the terminal velocity v in a fluid of coefficient of viscosity η and density σ. What will be the net force on the body?

(a) $\frac{4\pi}{3}r^3(\rho-\sigma)g$ (b) $6\pi\eta rv$
(c) Zero (d) Infinity

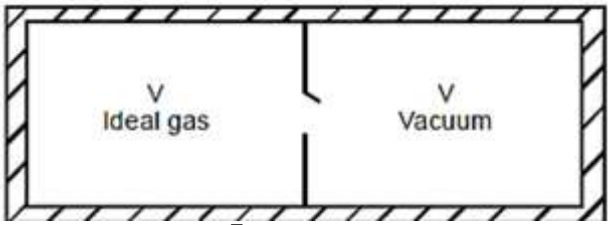
15. Two black bodies A and B have equal surface areas and are maintained at temperatures 27°C and 177°C respectively. What will be the ratio of the thermal energy radiated per second by A to that by B ?

(a) $4:9$ (b) $2:3$
(c) $16:81$ (d) $27:177$

16. What will be the molar specific heat at constant volume of an ideal gas consisting of rigid diatomic molecules?

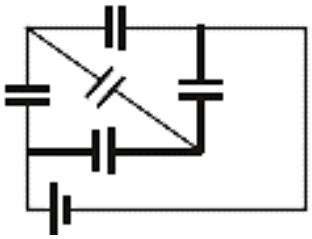
(a) $\frac{3}{2}R$ (b) $\frac{5}{2}R$
(c) R (d) $3R$

17. Consider the given diagram. An ideal gas is contained in a chamber (left) of volume V and is at an absolute temperature T. It is allowed to rush freely into the right chamber of volume V which is initially vacuum. The whole system is thermally isolated. What will be the final temperature of the equilibrium has been attained?



(a) T (b) $\frac{T}{2}$
(c) $2T$ (d) $\frac{T}{4}$

18. Five identical capacitors, of capacitance 20μ F each, are connected to a battery of 150 V , in a combination as shown in the diagram. What is the total amount of charge stored?



(a) 15×10^{-3}C (b) 12×10^{-3}C
(c) 10×10^{-3}C (d) 3×10^{-3}C

19. Eleven equal point charges, all of them having a charge $+Q$, are placed at all the hour positions of a circular clock of radius r, except at the 10 h position. What is the electric field strength at the center of the clock?

(a) $\frac{Q}{4\pi\varepsilon_0 r^2}$ from the centre towards the mark 10
(b) $\frac{Q}{4\pi\varepsilon_0 r^2}$ from the mark 10 towards the centre
(c) $\frac{Q}{4\pi\varepsilon_0 r^2}$ from the centre towards the mark 6
(d) Zero.

20. A negative charge is placed at the midpoint between two fixed equal positive charges, separated by a distance $2d$. If the negative charge is given a small displacement $x(x \ll d)$ perpendicular to the line joining the positive charges, how the force (F) developed on it will approximately depend on x ?

(a) $F \propto x$ (b) $F \propto \frac{1}{x}$
(c) $F \propto x^2$ (d) $F \propto \frac{1}{x^2}$

21. To which of the following quantities, the radius of the circular path of a charged particle moving at right angles to a uniform magnetic field is directly proportional?.

(a) energy of the particle
(b) magnetic field
(c) charge of the particle
(d) momentum of the particle

22. An electric current ' I ' enters and leaves a uniform circular wire of radius r through diametrically opposite points. A particle carrying a charge q moves along the axis of the circular wire with speed v. What is the magnetic force experienced by the particle when it passes through the centre of the circle?.

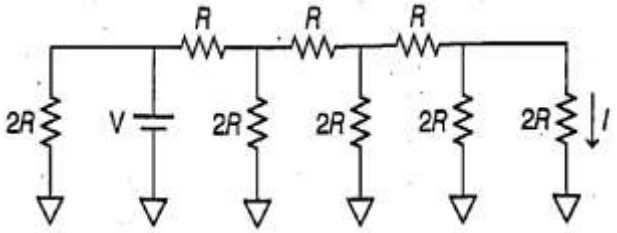
(a) $qv\frac{\mu_0 i}{a}$ (b) $qv\frac{\mu_0 i}{2a}$
(c) $qv\frac{\mu_0 i}{2\pi a}$ (d) Zero

23. A current ' I ' is flowing along an infinite, straight wire, in the positive Z-direction and the same current is flowing along a similar parallel wire 5 m apart, in the negative Z-direction. A point P is at a perpendicular distance 3 m from the first wire and 4 m from the second. What will be magnitude of the magnetic field P of P ?

(a) $\frac{5}{12}(\mu_0 I)$ (b) $\frac{7}{24}(\mu_0)$
(c) $\frac{5}{24}(\mu_0 l)$ (d) $\frac{25}{288}(\mu_0)$

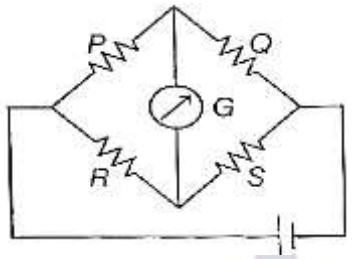
24. A square conducting loop is placed near an infinitely long current carrying wire with one edge parallel to the wire as shown in the figure. If the current in the straight wire is suddenly halved, which of the following statements will be true?
"The loop will ".
(a) stay stationary
(b) move towards the wire
(c) move away from the wire
(d) move parallel to the wire

25. What is the current I shown in the given circuit?



(a) $\frac{V}{2R}$ (b) $\frac{V}{R}$
(c) $\frac{V}{16R}$ (d) $\frac{V}{BR}$

26. When the value of R in the balanced Wheatstone bridge, shown in the figure, is increased from 5Ω to 7Ω, the value of S has to be increased by 3Ω in order to maintain the balance. What is the initial values of S ?



(a) 2.5Ω (b) 3Ω
(c) 5Ω (d) 7.5Ω

27. When a 60 mH inductor and a resistor are connected in series with an AC voltage source, the voltage leads the current by $60°$. If the inductor is replaced by a 0.5μ F capacitor, the voltage lags behind the current by $30°$. What is the frequency of the AC supply?
(a) $\frac{1}{2\pi} \times 10^4$ Hz (b) $\frac{1}{\pi} \times 10^4$ Hz
(c) $\frac{3}{2\pi} \times 10^4$ Hz (d) $\frac{1}{2\pi} \times 10^8$ Hz

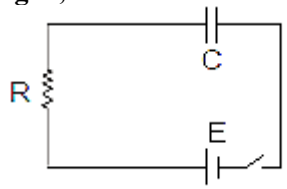
28. A point object is placed on the axis of a thin convex lens of focal length 0.05 m at a distance of 0.2 m from the lens and its image is formed on the axis. If the object is now made to oscillate along the axis with a small amplitude of A cm, then what is the amplitude of oscillation of the image?
[. you may assume, $\frac{1}{1+x} \approx 1 - x$, where $x \ll 1$]
(a) $\frac{4\,A}{9} \times 10^{-2}$ m
(b) $\frac{5A}{9} \times 10^{-2}$ m
(c) $\frac{A}{3} \times 10^{-2}$ m
(d) $\frac{A}{9} \times 10^{-2}$ m

29. In Young's experiment for the interference of light, the separation between the slits is d and the distance of the screen from the slits is D. If D is increased by 0.5% and d is decreased by 0.3% then for the light of a given wavelength, which one of the following is true?
"The fringe width
(a) increases by 0.8%
(b) decreases by 0.8%
(c) increases by 0.2%
(d) decreases by 0.2%

30. When the frequency of the light used is changed from 4×10^{14} s^{-1} to 5×10^{14} s^{-1}, the angular width of the principal (central) maximum in a single slit Fraunhoffer diffraction pattern changes by 0.6 radian. What is the width of the slit (assume that the experiment is performed in vacuum)?

(a) 1.5×10^{-7} m
(b) 3×10^{-7} m
(c) 5×10^{-7} m
(d) 6×10^{-7} m

31. A capacitor of capacitance C is connected in series with a resistance R and DC source of emf E through a key. The capacitor starts charging when the key is closed. By the time the capacitor has been fully charged, what amount of energy is dissipated in the resistance R ?



(a) $\frac{1}{2}CE^2$ (b) 0
(c) CE^2 (d) $\frac{E^2}{R}$

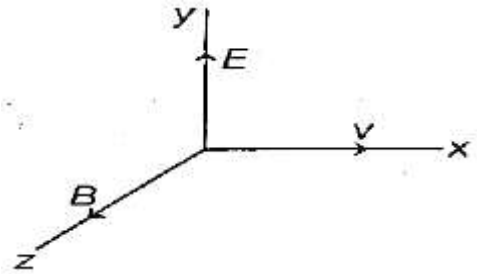
32. A horizontal fire hose with a nozzle of cross-sectional area $\frac{5}{\sqrt{21}} \times 10^{-3}$ m^2 delivers a cubic metre of water in 10s. What will be the maximum possible increase in the temperature of water while it hits a rigid wall (neglecting the effect of gravity)?

(a) 1°C (b) 0.1°C
(c) 10°C (d) 0.01°C

33. Two identical blocks of ice move in opposite directions with equal speed and collide with each other. What will be the minimum speed required to make both the blocks melt completely, if the initial temperatures of the blocks were $-8°C$ each?
(Specific heat of ice is $2100 Jkg^{-1} K^{-1}$ and latent heat of fusion of ice is $3.36 \times 10^5 Jkg^{-1}$)

(a) 840 ms^{-1} (b) 420 ms^{-1}
(c) 8.4 ms^{-1} (d) 84 ms^{-1}

34. A particle with charge q moves with a velocity v in a direction perpendicular to the directions of uniform electric and magnetic fields, E and B respectively, which are mutually perpendicular to each other. Which one of the following gives the condition for which the particle moves undeflected in its original trajectory?



(a) $v = \frac{E}{B}$ (b) $v = \frac{B}{E}$
(c) $V = \sqrt{\frac{E}{B}}$ (d) $v = q\frac{B}{E}$

35. A parallel plate capacitor in series with a resistance of 100Ω, an inductor of 20 mH and an AC voltage source of variable frequency shows resonance at a frequency of $\frac{1250}{\pi}$ Hz. If this capacitor is charged by a DC voltage source to a voltage 25 V , what amount of charge will be stored in each plate of the capacitor?

(a) 0.2μC (b) 2 mC
(c) 0.2 mC (d) 0.2 C

36. Electrons are emitted with kinetic energy T from a metal plate by an irradiation of light of intensity J and frequency v. Then, which of the following will be true?

(a) $T \propto J$

(b) T linearly increasing with v
(c) $T \propto$ time of irradiation
(d) Number of electrons emitted $\propto J$

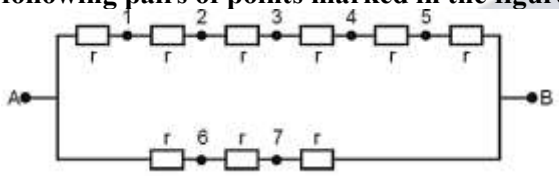
37. The initial pressure and volume of a given mass of an ideal gas (with $\frac{C_p}{C_v} = \gamma$), taken in a cylinder fitted with a piston, are p_0 and V_0 respectively. At this stage the gas has the same temperature as that of the surrounding medium which is T_0. It is adiabatically. compressed to a volume equal to $\frac{V_0}{2}$. Subsequently the gas is allowed to come to thermal equilibrium with the surroundings. What is the heat released to the surrounding?

(a) 0 (b) $(2^{\gamma-1} - 1)\frac{p_0V_0}{\gamma-1}$
(c) $\gamma p_0 V_0 \ln 2$ (d) $\frac{p_0V_0}{2(\gamma-1)}$

38. A projectile thrown with an initial velocity of $10\ ms^{-1}$ at an angle α with the horizontal, has a range of 5 m . Taking $g = 10\ ms^{-2}$ and neglecting air resistance, what will be the estimated value of α ?

(a) 15° (b) 30°
(c) 45° (d) 75°

39. In the circuit shown in the figure all the resistance are identical and each has the value $r\Omega$. The equivalent resistance of the combination between the points *A* and *B* will remain unchanged even when the following pairs of points marked in the figure are connected through a resistance *R*.



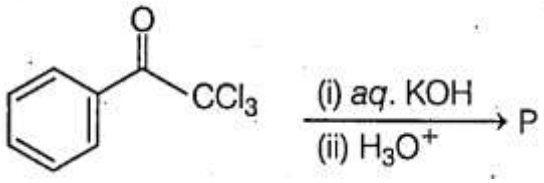
(a) 2 and 6 (b) 3 and 6
(c) 4 and 7 (d) 4 and 6

40. A metallic loop is placed in a uniform magnetic field B with the plane of the loop perpendicular to B. Under which condition(s) given an emf will be induced in the loop? "If the loop is ."

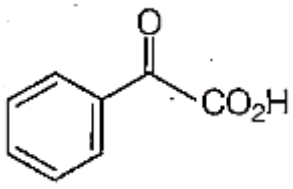
(a) moved along the direction of B
(b) squeezed to a smaller area
(c) rotated about its axis
(d) rotated about one of its diameters

Chemistry

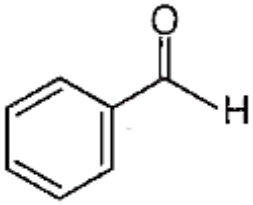
41. One of the products of the following reaction is *P*. Structure of *P* is.

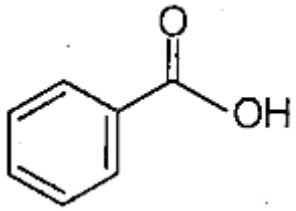


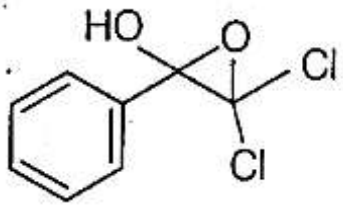
(a)



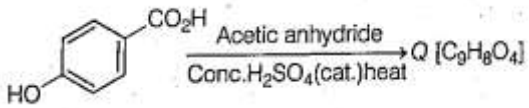
(b)



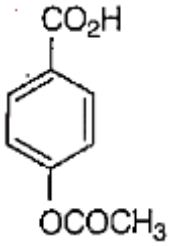
(c) 

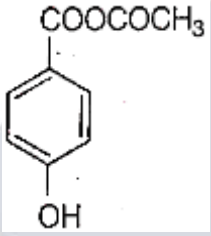
(d) 

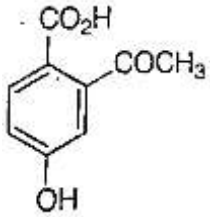
42.For the reaction below, the product is Q.

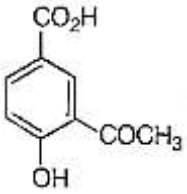


The compound Q is.

(a) 

(b) 

(c) 

(iv) 

43.Cyclopentanol on reaction with NaH followed by CS_2 and CH_3I produces a/an

(a) ketone (b) alkene
(c) ether (d) xanthate

44.The compound, which evolves carbon dioxide on treatment with aqueous solution of sodium bicarbonate at 25°C, is

(a) C_6H_5OH (b) CH_3COCl
(c) CH_3CONH_2 (d) $CH_3COOC_2H_5$

45.The indicated atom is not a nucleophilic site in.

(a) BH_4^- (b) CH_3MgI
(c) CH_3OH (d) CH_3NH_2

46.The charge carried by 1 millimole of M^{n+} ions is 193 coulombs. The value of n is

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

47.Which of the following mixtures will have the lowest pH at 298 K ?

(a) 10 mL0.05 NCH_3COOH + 5 mL0.1 NNH_4OH
(b) 5 mL0.2 NNH_4Cl + 5 mL0.2 NNH_4OH
(c) 5 mL0.1 NCH_3COOH + 10 $mL^2$0.05 NCH_3COONa
(d) 5 mL0.1 NCH_3COOH + 5 mL0.1 NNaOH

48. Consider the following two first order reactions occurring at 298 K with same initial concentration of A :

(1) $A \rightarrow B$; rate constant, $k = 0.693\ min^{-1}$
(2) $A \rightarrow C$; half-life, $t_{1/2} = 0.693$ min

Choose the correct option.
(a) Reaction (1) is faster than reaction (2).
(b) Reaction (1) is slower than reaction (2).
(c) Both reactions proceed at the same rate.
(d) Since two different products are formed, rates cannot be compared.

49. For the equilibrium, $H_2O(l) \rightleftharpoons H_2O(v)$, which of the following is correct?
(a) $\Delta G = 0, \Delta H < 0, \Delta S < 0$
(b) $\Delta G < 0, \Delta H > 0, \Delta S > 0$
(c) $\Delta G > 0, \Delta H = 0, \Delta S > 0$
(d) $\Delta G = 0, \Delta H > 0, \Delta S > 0$

50. For a van der Waals' gas, the term $\left(\frac{ab}{V^2}\right)$ represents some represents some.
(a) pressure
(b) energy
(c) critical density
(d) molar mass

51. In the equilibrium, $H_2 + I_2 \rightleftharpoons 2HI$, if at a given temperature the concentrations of the reactants are increased, the value of the equilibrium constant, K_C, will.
(a) increase
(b) decrease
(c) remain the same
(d) cannot be predicted with certainty

52. If electrolysis of aqueous $CuSO_4$ solution is carried out using Cu-electrodes, the reaction taking place at the anode is.
(a) $H^+ + e^- \rightarrow H$
(b) $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$
(c) $SO_4^{2-}(aq) - 2e^- \rightarrow SO_4$
(d) $Cu(s) - 2e^- \rightarrow Cu^{2+}(aq)$

53. Which one of the following electronic arrangements is absurd?
(a) $n = 3, l = 1, m = -1$
(b) $n = 3, l = 0, m = 0$
(c) $n = 2, l = 0, m = -1$
(d) $n = 2, l = 1, m = 0$

54. The quantity hv/K_B corresponds to.
(a) wavelength
(b) velocity
(c) temperature
(d) angular momentum

55. In the crystalline solid $MSO_4 \cdot nH_2O$ of molar mass 250 g mol^{-1}, the percentage of anhydrous salt is 64 by weight.
The value of n is
(a) 2 (b) 3
(c) 5 (d) 7

56. At S.T.P. the volume of 7.5 g of a gas is 5.6 L . The gas is
(a) NO (b) N_2O
(c) CO (d) CO_2

57. The half-life period of $_{53}I^{125}$ is 60 days. The radioactivity after 180 days will be.
(a) 25% (b) 12.5%
(c) 33.3% (d) 3.0%

58. Consider, the radioactive disintegration
$_{82}A^{210} \rightarrow B \rightarrow C \rightarrow {}_{82}D^{206}$
The sequence of emission can be.
(a) β, β, β (b) α, α, β
(c) β, β, γ (d) β, β, α

59. The second ionisation energy of the following elements follows the order

(a) $Zn > Cd < Hg$
(b) $Zn > Cd > Hg$
(c) $Cd > Hg < Zn$
(d) $Zn < Cd < Hg$

60. The melting points of (i) $BeCl_2$ (ii) $CaCl_2$ and (iii) $HgCl_2$ follows the order.

(a) i < ii < iii (b) ii < i < ii
(c) i < iii < ii (d) ii < i < iii

61. Which of these species will have non-zero magnetic moment?

(a) Na^+ (b) Mg
(c) F^- (d) Ar^+

62. The first electron affinity of C, N and O will be of the order.

(a) C < N < O
(b) N < C < O
(c) C < O < N
(d) O < N < C

63. The H-N-H angle in ammonia is $107.6°$, while the $H-P-H$ angle in phosphine is $93.5°$. Relative to phosphine, the *p*-character of the lone-pair on ammonia is expected to be.

(a) Less (b) More
(c) Same (d) Cannot be predicted

64. The reactive species in chlorine bleach is.

(a) Cl_2O (b) OCl^-
(c) ClO_2 (d) HCl

65. The conductivity measurement of a coordination compound of cobalt (III) shows that it dissociates into 3 ions in solution. The compound is.

(a) hexaamminecobalt(III) chloride
(b) pentaamminesulphatocobalt(III) chloride
(c) pentaamminechloridocobalt(III) sulphate
(d) pentaamminechloridocobalt(III) chloride

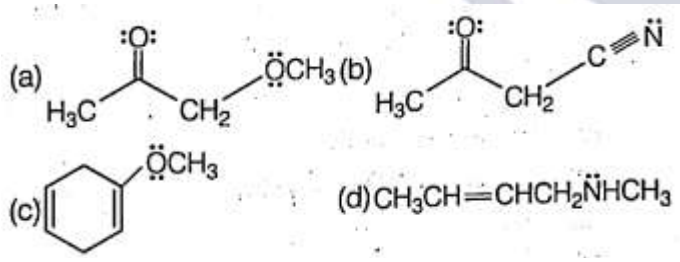
66. In the Bayer's process, the leaching of alumina is done by using

(a) Na_2CO_3 (b) NaOH
(c) SiO_2 (d) CaO

67. Which atomic species cannot be used as a nuclear fuel?

(a) $^{233}_{92}U$ (b) $^{235}_{92}U$
(c) $^{239}_{94}Pu$ (d) $^{238}_{92}U$

68. The molecule/molecules that has/have delocalised lone pair(s) of electrons is/are.



(a) I, II and III (b) I, II and IV
(c) I and III (d) only III

69. The conformations of *n*-butane, commonly known as eclipsed, gauche and anti-conformations can be interconverted by.

(a) rotation around C − H bond of a methyl group
(b) rotation around C − H bond of a methylene group
(c) rotation around C1-C2 linkage
(d) rotation around C2-C3 linkage

70. The correct order of the addition reaction rates of halogen acids with ethylene is.

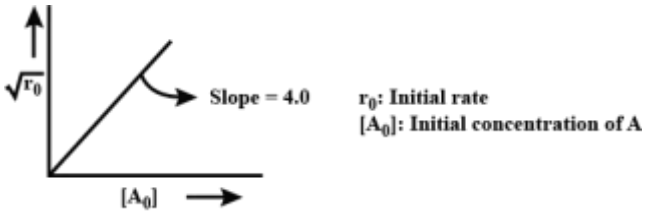
(a) hydrogen chloride > hydrogen bromide > hydrogen iodide
(b) h ydrogen iodide > hydrogen bromide > hydrogen chloride

(c) hydrogen bromide > hydrogen chloride > hydrogen iodide
(d) hydrogen iodide > hydrogen chloride> hydrogen bromide

71. The total number of isomeric linear dipeptides which can be synthesised from racemic alanine is.

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

72. The kinetic study of a reaction like $vA \rightarrow P$ at 300 K provides the following curve, where concentration is taken in $\mathbf{mol dm^{-3}}$ and time in min .



Identify the correct order (n) and rate constant (k)
(a) $n = 0, k = 4.0$ mol dm^{-3} min^{-1}
(b) $n = 1/2, k = 2.0$ mol$^{1/2}$dm$^{-3/2}$ min^{-1}
(c) $n = 1, k = 8.0$ min^{-1}
(d) $n = 2, k = 16.0$dm^3 mol^{-1} min^{-1}

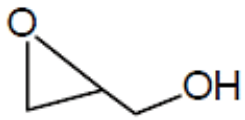
73. At constant pressure, the heat of formation of a compound is not dependent on temperature, when

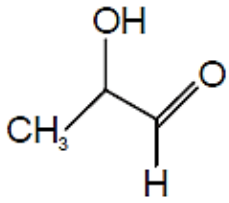
(a) $\Delta C_p = 0$ (b) $\Delta C_v = 0$
(c) $\Delta C_p > 0$ (d) $\Delta C_p < 0$

74. A copper coin was electroplated with Zn and then heated at high temperature until there is a change in colour. What will be the resulting colour?

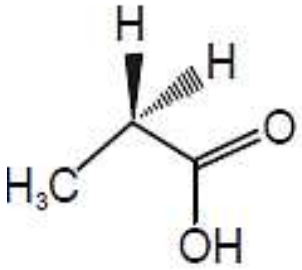
(a) white (b) black
(c) silver (d) golden

75. Oxidation of allyl alcohol with a peracid gives a compound of molecular formula $\mathbf{C_3H_6O_2}$, which contains an asymmetric carbon atom. The structure of the compound is.

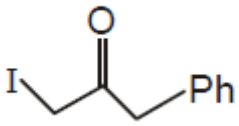
(a) 

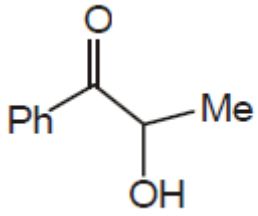
(b) 

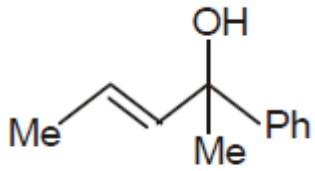
(c) 

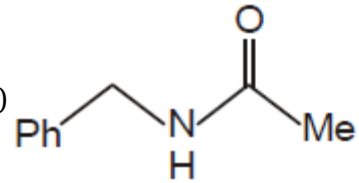
(d) 

76. Haloform reaction with I_2 and KOH will be responded by.

(a) 

(b) 

(c) 

(d) 

77. Identify the correct statement(s):

(a) The oxidation number of Cr in CrO_5 is +6 .

(b) $\Delta H > \Delta U$ for the reaction $N_2O_4(g) \rightarrow 2NO_2(g)$, provided both gases behave ideally.

(c) pH of 0.1 NH_2SO_4 is less than that of 0.1 N HCl at 25°C.

(d) $\left(\frac{RT}{F}\right) = 0.0591$ volt at 25°C.

78. Compounds with spin-only magnetic moment equivalent to five unpaired electrons are.

(a) $K_4[Mn(CN)_6]$ (b) $[Fe(H_2O)_6]Cl_3$

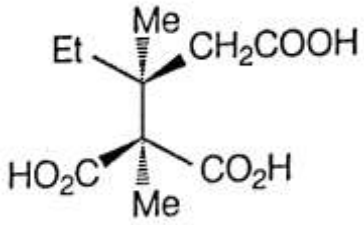
(c) $K_3[FeF_6]$ (d) $K_4[MnF_6]$

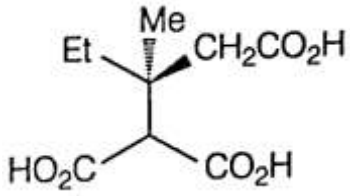
79. Which of the following chemicals may be used to identify three unlabelled beakers containing conc. NaOH , conc. H_2SO_4 and water?

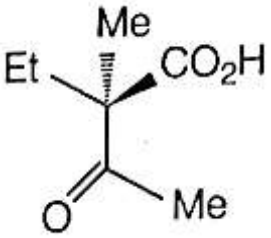
(a) NH_4NO_3 (b) NaCl

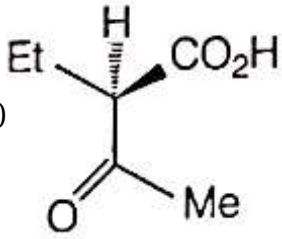
(c) $(NH_4)_2CO_3$ (d) HCOONa

80. The compound(s), capable of producing achiral compound on heating at 100°C is/are.

(a) 

(b) 

(c) 

(d) 

Mathematics

81. $\lim_{x\to 0^+}(x^n \ln x), n > 0$
(a) dres not exist
(b) exists and is zero
(c) exists and is 1
(d) exists and is e^{-1}

82. If $\int \cos x \log\left(\tan\frac{x}{2}\right) dx$ $= \sin x \log\left(\tan\frac{x}{2}\right) + f(x)$, then $f(x)$ is equal to (assuming c is a arbitrary real constant)
(a) c (b) $c - x$
(c) $c + x$ (d) $2x + c$

83. $y = \int \cos\left\{2\tan^{-1}\sqrt{\frac{1-x}{1+x}}\right\} dx$ is an equation of a family of
(a) straight lines (b) circles
(c) ellipses (d) parabolas

84. The value of the integration
$$\int_{-\pi/4}^{\pi/4}\left(\lambda|\sin x| + \frac{\mu \sin x}{1+\cos x} + \gamma\right) dx$$
(a) is independent of λ only
(b) is independent of μ only
(c) is independent of γ only
(d) depends on λ, μ and γ

85. The value of $\lim_{x\to 0}\frac{1}{x}\left[\int_y^a e^{\sin^2 t} dt - \int_{x+y}^a e^{\sin^2 t} dt\right]$ is equal to.
(a) $e^{\sin^2 y}$ (b) $e^{2\sin y}$
(c) $e^{|\sin y|}$ (d) $e^{\operatorname{cosec}^2 y}$

86. If $\int 2^{2^x} \cdot 2^x dx = A \cdot 2^{2^x} + C$, then A is equal to.

(a) $\frac{1}{\log 2}$ (b) $\log 2$

(c) $(\log 2)^2$ (d) $\frac{1}{(\log 2)^2}$

87. The value of the integral $\int_{-1}^{1} \left\{\frac{x^{2015}}{e^{|x|}(x^2+\cos x)} + \frac{1}{e^{|x|}}\right\} dx$ is equal to.

(a) 0 (b) $1 - e^{-1}$

(c) $2e^{-1}$ (d) $2(1 - e^{-1})$

88. $\lim_{n\to\infty} \frac{3}{n}\left\{1 + \sqrt{\frac{n}{n+3}} + \sqrt{\frac{n}{n+6}} + \sqrt{\frac{n}{n+9}} + \cdots + \sqrt{\frac{n}{n+3(n-1)}}\right\}$

(a) does not exist (b) is 1

(c) is 2 (d) is 3

89. The general solution of the differential equation $\left(1 + e^{\frac{x}{y}}\right) dx + \left(1 - \frac{x}{y}\right) e^{x/y} dy = 0$ is (C is an arbitrary constant).

(a) $x - ye^{\frac{x}{y}} = C$

(b) $y - xe^{\frac{x}{y}} = C$

(c) $x + ye^{\frac{x}{y}} = c$

(d) $y + xe^{\frac{x}{y}} = C$

90. General solution of $(x + y)^2 \frac{dy}{dx} = a^2, a \neq 0$ is (C is an arbitrary constant).

(a) $\frac{x}{a} = \tan\frac{y}{a} + C$

(b) $\tan xy = C$

(c) $\tan(x + y) = C$

(d) $\tan\frac{y+C}{a} = \frac{x+y}{a}$

91. Let $P(4, 3)$ be a point on the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$. If the normal at P intersects the X-axis at $(16, 0)$, then the eccentricity of the hyperbola is.

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

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

92. If the radius of a spherical balloon increases by 0.1%, then its volume increases approximately by.

(a) 0.2% (b) 0.3%

(c) 0.4% (d) 0.05%

93. The three sides of a right angled triangle are in GP (geometric progression). If the two acute angles be α and β, then $\tan\alpha$ and $\tan\beta$ are.

(a) $\frac{\sqrt{5}+1}{2}$ and $\frac{\sqrt{5}-1}{2}$ (b) $\sqrt{\frac{\sqrt{5}+1}{2}}$ and $\sqrt{\frac{\sqrt{5}-1}{2}}$

(c) $\sqrt{5}$ and $\frac{1}{\sqrt{5}}$ (d) $\frac{\sqrt{5}}{2}$ and $\frac{2}{\sqrt{5}}$

94. If $\log_2^6 + \frac{1}{2x} = \log_2\left(2^{\frac{1}{x}} + 8\right)$ then the values of x are.

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

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

95. Let z be a complex number such that the principal value of argument, $\arg z > 0$. Then, $\arg z - \arg(-z)$ is

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

(c) π (d) $-\pi$

96. The general value of the real angle θ, which satisfies the equation, $(\cos\theta + i\sin n\theta)(\cos 2\theta + i\sin 2\theta) \ldots (\cos n\theta + i\sin n\theta) = 1$ is given by, (assuming k is an integer).

(a) $\frac{2k\pi}{n+2}$ (b) $\frac{4k\pi}{n(n+1)}$
(c) $\frac{4k\pi}{n+1}$ (d) $\frac{6k\pi}{n(n+1)}$

97. Let a, b, c be real numbers such that $a+b+c<0$ and the quadratic equation $ax^2+bx+c=0$ has imaginary roots. Then,
(a) $a>0, c>0$
(b) $a>0, c<0$
(c) $a<0, c>0$
(d) $a<0, c<0$

98. A candidate is required to answer 6 out of 12 questions which are divided into two parts A and B, each containing 6 questions and he/she is not permitted to attempt rnore than 4 questions from any part. In how many different ways can he/she make up his/her. choice of 6 questions?
(a) 850 (b) 800
(c) 750 (d) 700

99. There are 7 greeting cards, each of a different colour and 7 envelopes of same 7 colours as that of the cards. The number of ways in which the cards can be put in envelopes, so that exactly 4 of the cards go into envelopes of respective colour is,
(a) ${}^7C_3$ (b) 2. ${}^7C_3$
(c) $31\,{}^4C_4$ (d) $31{}^7C_3\,{}^4C_3$

100. $7^{2n}+16n-1\cdot(n\in N)$ is divisible by.
(a) 65 (b) 63
(c) 61 (d) 64

101. The number of irrational terms in the expansion of $\left(3^{\frac{1}{8}}+5^{\frac{1}{4}}\right)^{84}$ is.
(a) 73 (b) 74
(c) 75 (d) 76

102. Let A be a square matrix of order 3 whose all entries are 1 and let I_3 be the identity matrix of order 3. Then, the matrix $A-3I_3$ is.
(a) invertible
(b) orthogonal
(c) non-invertible
(d) real Skew Symmetric matrix

103. If M is any square matrix of order 3 over $\mathbb{R}$ and if M' be the transpose of M, then $\text{adj}(M')-(\text{adj}M)'$ is equal to.
(a) M (b) M'
(c) null matrix (d) identity matrix

104. If $A=\begin{pmatrix}5 & 5x & x\\ 0 & x & 5x\\ 0 & 0 & 5\end{pmatrix}$ and $|A^2|=25$, then $|x|$ is equal to.
(a) $\frac{1}{5}$ (b) 5
(c) 5^2 (d) 1

105. Let A and B be two square matrices of order 3 and $AB=O_3$, where O_3 denotes the null matrix of order 3. Then,
(a) must be $A=O_3, B=O_3$
(b) if $A\neq O_3$, must be $B\neq O_3$.
(c) if $A=O_3$, must be $B\neq O_3$
(d) may be $A\neq O_3, B\neq O_3$

106. Let P and T be the subsets of k, y-plane defined by
$P=\{(x,y): x>0, y>0 \text{ and } x^2+y^2=1\}$
$T=\{(x,y): x>0, y>0 \text{ and } x^8+y^8<1\}$
Then, $P\cap T$ is.
(a) the void set ϕ (b) P
(c) T (d) $P-T^C$

107. Let $f: R\to R$ be defined by $f(x)=x^2-\frac{x^2}{1+x^2}$ for all $x\in R$. Then,

(a) f is one-one but not onto mapping
(b) f is onto but not one-one mapping
(c) f is both one-one and onto
(d) f is neither one-one nor onto

108. Let the relation ρ be defined on R as $a\rho b$ if $1 + ab > 0$. Then,
(a) ρ is reflexive only.
(b) ρ is equivalence relation.
(c) ρ is reflexive and transitive but not symmetric
(d) ρ is reflexive and symmetric but not transitive.

109. A problem in mathematics is given to 4 students whose chances of solving individually are $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}$ and $\frac{1}{5}$. The probability that the problem will be solved at least by one student is.
(a) $\frac{2}{3}$ (b) $\frac{3}{5}$
(c) $\frac{4}{5}$ (d) $\frac{3}{4}$

110. If X is a random variable such that $\sigma(X) = 2.6$, then $\sigma(1 - 4X)$ is equal to.
(a) 7.8 (b) -10.4
(c) 13 (d) 10.4

111. If $e^{\sin x} - e^{-\sin x} - 4 = 0$, then the number of real values of x is.
(a) 0 (b) 1
(c) 2 (d) 3

112. The angles of a triangle are in the ratio $2:3:7$ and the radius of the circumscribed circle is 10 cm . The length of the smallest side is.
(a) 2 cm (b) 5 cm
(c) 7 cm (d) 10 cm

113. A variable line passes through a fixed point (x_1, y_1) and meets the axes at A and B. If the rectangle $OAPB$ be completed, the locus of P is, (O being the origin of the system of axes).
(a) $(y - y_1)^2 = 4(x - x_1)$
(b) $\frac{x_1}{x} + \frac{y_1}{y} = 1$
(c) $x^2 + y^2 = x_1^2 + y_1^2$
(d) $\frac{x^2}{2x_1^2} + \frac{y^2}{y_1^2} = 1$

114. A straight line through the point $(3, -2)$ is inclined at an angle $60°$ to the line $\sqrt{3}x + y = 1$. it intersects the X-axis, then its equation will be.
(a) $y + x\sqrt{3} + 2 + 3\sqrt{3} = 0$
(b) $y - x\sqrt{3} + 2 + 3\sqrt{3} = 0$
(c) $y - x\sqrt{3} - 2 - 2\sqrt{3} = 0$
(d) $x - x\sqrt{3} + 2 - 3\sqrt{3} = 0$

115. A variable line passes through the fixed point (α, β). The locus of the foot of the perpendicular from the origin on the line is.
(a) $x^2 + y^2 - \alpha x - \beta y = 0$
(b) $x^2 - y^2 + 2\alpha x + 2\beta y = 0$
(c) $\alpha x + \beta y \pm \sqrt{(\alpha^2 + \beta^2)} = 0$
(d) $\frac{x^2}{\alpha^2} + \frac{y^2}{\beta^2} = 1$

116. If the point of intersection of the lines $2ax + 4ay + c = 0$ and $7bx + 3by - d = 0$ lies in the 4th quadrant and is equidistant from the two axes, where a, b, c and d are non-zero numbers, then $ad:bc$ equals to
(a) 2:3 (b) 2:1
(c) 1:1 (d) 3:2

117. A variable circle passes through the fixed point $A(p, q)$ and touches X-axis. The locus of the other end of the diameter through A is.
(a) $(x - p)^2 = 4qy$
(b) $(x - q)^2 = 4py$

(c) $(y-p)^2 = 4qx$
(d) $(y-q)^2 = 4px$

118. If $P(0,0), Q(1,0)$ and $R\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$ are three given points, then the centre of the circle for which the lines PQ, QR and RP are the tangents is.

(a) $\left(\frac{1}{2}, \frac{1}{4}\right)$ (b) $\left(\frac{1}{2}, \frac{\sqrt{3}}{4}\right)$
(c) $\left(\frac{1}{2}, \frac{1}{2\sqrt{3}}\right)$ (d) $\left(\frac{1}{2}, \frac{-1}{\sqrt{3}}\right)$

119. For the hyperbola $\frac{x^2}{\cos^2\alpha} - \frac{y^2}{\sin^2\alpha} = 1$, which of the following remains fixed when α varies?

(a) directrix (b) vertices
(c) foci (d) eccentricity

120. S and T are the foci of an ellipse and B is the end point of the minor axis. If STB is equilateral triangle, the eccentricity of the ellipse is.

(a) $\frac{1}{4}$ (b) $\frac{1}{3}$
(c) $\frac{1}{2}$ (d) $\frac{2}{3}$

121. The equation of the directrices of the hyperbola $3x^2 - 3y^2 - 18x + 12y + 2 = 0$ is

(a) $x = 3 \pm \sqrt{\frac{13}{6}}$ (b) $x = 3 \pm \sqrt{\frac{6}{13}}$
(c) $x = 6 \pm \sqrt{\frac{13}{3}}$ (d) $x = 6 \pm \sqrt{\frac{3}{13}}$.

122. P is the extremity of the latusrectum of ellipse $3x^2 + 4y^2 = 48$ in the first quadrant. The eccentric angle of P is.

(a) $\frac{\pi}{8}$ (b) $\frac{3\pi}{4}$
(c) $\frac{\pi}{3}$ (d) $\frac{2\pi}{3}$

123. The direction ratios of the normal to the plane passing through the points $(1,2,-3)$, $(-1,-2,1)$ and parallel to $\frac{x-2}{2} = \frac{y+1}{3} = \frac{z}{4}$ is.

(a) (2,3,4) (b) $(14,-8,-1)$
(c) $(-2,0,-3)$ (d) $(1,-2,-3)$

124. The equation of the plane, which bisects the line joining the points $(1,2,3)$ and $(3,4,5)$ at right angles is.

(a) $x+y+z=0$
(b) $x+y-z=9$
(c) $x+y+z=9$
(d) $x+y-z+9=0$

125. The limit of the interior angle of a regular polygon of n sides as $n \to \infty$ is.

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

126. Let $f(x) > 0$ for all x and $f'(x)$ exists for all x. If f is the inverse function of h and $h'(x) = \frac{1}{1+\log x}$. Then, $f'(x)$ will be.

(a) $1 + \log(f(x))$
(b) $1 + f(x)$
(c) $1 - \log(f(x))$
(d) $\log f(x)$

127. Consider the function $f(x) = \cos x^2$. Then,

(a) f is of period 2π
(b) f is of period $\sqrt{2\pi}$
(c) f is not periodic
(d) f is of period π

128. $\lim_{x\to 0^+} (e^x + x)^{1/x}$

(a) Does not exist finitely
(b) is 1

(c) is e^2
(d) is 2

129. **Let $f(x)$ be a derivable function, $f'(x) > f(x)$ and $f(0) = 0$. Then,**
(a) $f(x) > 0$ for all $x > 0$
(b) $f(x) < 0$ for all $x > 0$
(c) no sign of $f(x)$ can be ascertained
(d) $f(x)$ is a constant function

130. **Let $f: [1,3] \to R$ be a continuous function that is differentiable in $(1,3)$ an $f'(x) = |f(x)|^2 + 4$ for all $x \in (1,3)$. Then,**
(a) $f(3) - f(1) = 5$ is true
(b) $f(3) - f(1) = 5$ is false
(c) $f(3) - f(1) = 7$ is false
(d) $f(3) - f(1) < 0$ only at one point of (1,3)

131. **Let $a = \min\{x^2 + 2x + 3 : x \in R\}$ and $b = \lim_{\theta \to 0} \frac{1-\cos\theta}{\theta^2}$. Then $\sum_{r=0}^{n} a^r b^{n-r}$ is.**
(a) $\frac{2^{n+1}-1}{3 \cdot 2^n}$ (b) $\frac{2^{n+1}+1}{3 \cdot 2^n}$
(c) $\frac{4^{n+1}-1}{3 \cdot 2^n}$ (d) $\frac{1}{2}(2^n - 1)$

132. **Let $a > b > 0$ and $I(n) = a^{1/n} - b^{1/n}$, $J(n) = (a-b)^{1/n}$ for all $n \geq 2$, Then.**
(a) $I(n) < J(n)$
(b) $I(n) > J(n)$
(c) $I(n) = J(n)$
(d) $I(n) + J(n) = 0$

133. **Let $\hat{\alpha}, \hat{\beta}, \hat{\gamma}$ be three unit vectors such that $\hat{\alpha} \times (\hat{\beta} \times \hat{\gamma}) = \frac{1}{2}(\hat{\beta} + \hat{\gamma})$ where $\hat{\alpha} \times (\hat{\beta} \times \hat{\gamma}) = (\hat{\alpha} \cdot \hat{\gamma})\hat{\beta} - (\hat{\alpha} \cdot \hat{\beta})\hat{\gamma}$. If $\hat{\beta}$ is not parallel to $\hat{\gamma}$, then the angle between $\hat{\alpha}$ and $\hat{\beta}$ is.**
(a) $\frac{5\pi}{6}$ (b) $\frac{\pi}{6}$
(c) $\frac{\pi}{3}$ (d) $\frac{2\pi}{3}$

134. **The position vectors of the points A, B, C and D are $3\hat{i} - 2\hat{j} - \hat{k}, 2\hat{i} - 3\hat{j} + 2\hat{k}, 5\hat{i} - \hat{j} + 2\hat{k}$ and $4\hat{i} - \hat{j} - \lambda\hat{k}$, respectively. If the points A, B, C and D lie on a plane, the value of λ is.**
(a) 0 (b) 1
(c) 2 (d) -4

135. **A particle starts at the origin and moves 1 unit horizontally to the right and reaches P_1, then it moves $\frac{1}{2}$ unit vertically up and reaches P_2, then it moves $\frac{1}{4}$ unit horizontally to right and reaches P_3, then it moves $\frac{1}{8}$ unit vertically down and reaches P_4, then it moves $\frac{1}{16}$ unit horizontally to right and reaches P_5 and so on. Let $P_n = (x_n, y_n)$ and $\lim_{n\to\infty} x_n = \alpha$ and $\lim_{n\to\infty} y_n = \beta$. Then, (α, β) is**
(a) (2,3) (b) $\left(\frac{4}{3}, \frac{2}{5}\right)$
(c) $\left(\frac{2}{5}, 1\right)$ (d) $\left(\frac{4}{3}, 3\right)$

136. **For any non-zero complex number z, the minimum value of $|z| + |z-1|$ is.**
(a) 1 (b) $\frac{1}{2}$
(c) 0 (d) $\frac{3}{2}$

137. **The system of equations**
$$\lambda x + y + 3z = 0$$
$$2x + \mu y - z = 0$$
$$5x + 7y + z = 0$$
has infinitely many solutions in R. Then,
(a) $\lambda = 2, \mu = 3$
(b) $\lambda = 1, \mu = 2$
(c) $\lambda = 1, \mu = 3$
(d) $\lambda = 3, \mu = 1$

138. **Let $f: X \to Y$ and A, B are non-void subsets of Y, then (where the symbols have their usual**

interpretation)
(a) $f^{-1}(A) - f^{-1}(B) \supset f^{-1}(A - B)$ but the opposite does not hold.
(b) $f^{-1}(A) - f^{-1}(B) \subset f^{-1}(A - B)$ but the opposite does not hold.
(c) $f^{-1}(A - B) = f^{-1}(A) - f^{-1}(B)$
(d) $f^{-1}(A - B) = f^{-1}(A) \cup f^{-1}(B)$

139. Let S, T, U be three non-void sets and $f: S \to T, g: T \to U$ be so that $g \circ f: s \to U$ is surjective. Then,
(a) g and f are both surjective
(b) g is surjective, f may not be so
(c) f is surjective, g may not be so
(d) f and g both may not be surjective

140. The polar coordinate of a point P is $\left(2, -\frac{\pi}{4}\right)$ The polar coordinate of the point Q which is such that line joining PQ is bisected perpendicularly by the initial line, is.
(a) $\left(2, \frac{\pi}{4}\right)$ (b) $\left(2, \frac{\pi}{6}\right)$
(c) $\left(-2, \frac{\pi}{4}\right)$ (d) $\left(-2, \frac{\pi}{6}\right)$

141. The length of conjugate axis of a hyperbola is greater than the length of transverse axis. Then, the eccentricity e is.
(a) $= \sqrt{2}$ (b) $> \sqrt{2}$
(c) $< \sqrt{2}$ (d) $< \frac{1}{\sqrt{2}}$

142. The value of $\lim_{x \to 0^+} \frac{x}{p}\left[\frac{q}{x}\right]$ is
(a) $\frac{[q]}{p}$ (b) 0
(c) 1 . (d) ∞

143. Let $f(x) = x^4 - 4x^3 + 4x^2 + c, c \in R$. Then,
(a) $f(x)$ has infinitely many zeros in $(1,2)$ for all c
(b) $f(x)$ has exactly one zero in $(1,2)$ if $-1 < c < 0$
(c) $f(x)$ has double zeros in $(1,2)$ if $-1 < c < 0$
(d) whatever be the value of c, $f(x)$ has no zero in $(1,2)$

144. The graphs of the polynomial $x^2 - 1$ and $\cos x$ intersect.
(a) at exactly two points
(b) at exactly 3 points
(c) at least 4 but at finitely many points.
(d) at infinitely many points.

145. A point is in motion along a hyperbola $y = \frac{10}{x}$ so that its abscissa x increases uniformly at a rate of 1 unit per second. Then, the rate of change of its ordinate when the point passes through $(5, 2)$.
(a) increases at the rate of $\frac{1}{2}$ unit per second
(b) decreases at the rate of $\frac{1}{2}$ unit per second
(c) decreases at the rate of $\frac{2}{5}$ unit per second
(d) increases at the rate of $\frac{2}{5}$ unit per second

146. Let $I_n = \int_0^1 x^n \tan^{-1} x dx$. If $a_n I_{n+2} + b_n I_n = c_n$ for all $n \geq 1$, then.
(a) a_1, a_2, a_3 are in GP
(b) b_1, b_2, b_3 are in AP
(c) c_1, c_2, c_3 are in HP
(d) a_1, a_2, a_3 are in AP

147. Two particles A and B move from rest along a straight line with constant accelerations f and h, respectively. If A takes m seconds more than B and describes n units more than that of B acquiring the same speed, then.
(a) $(f + h)m^2 = fhn$
(b) $(f - fh)m^2 = fhn$

(c) $(h-f)n=\frac{1}{2}fhm^2$

(d) $\frac{1}{2}(f+h)n=fhm^2$

148. The area bounded by $y=x+1$ and $y=\cos x$ and the X-axis, is.

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

(c) $\frac{1}{4}$ sq unit (d) $\frac{1}{8}$ sq unit

149. Let x_1, x_2 be the roots of $x^2-3x+a=0$ and x_3, x_4 be the roots of $x^2-12x+b=0$. If $x_1<x_2<x_3<x_4$ and x_1, x_2, x_3, x_4 are in GP, then ab equals.

(a) $\frac{24}{5}$ (b) 64

(c) 16 (d) 8

150. If $\theta \in \mathbb{R}$ and $\frac{1-i\cos\theta}{1+2i\cos\theta}$ is real number, then θ will be (when I : Set of integers).

(a) $(2n+1)\frac{\pi}{2}, n\in I$

(b) $\frac{3n\pi}{2}, n\in I$

(c) $n\pi, n\in I$

(d) $2n\pi, n\in I$

151. Let $A=\begin{pmatrix}3&0&3\\0&3&0\\3&0&3\end{pmatrix}$. Then, the roots of the equation $\det(A-\lambda I_3)=0$ (where I_3 is the identity matrix of order 3) are.

(a) 3,0,3 (b) 0,3,6

(c) $1,0,-6$ (d) 3,3,6

152. Straight lines $x-y=7$ and $x+4y=2$ intersect at B. Points A and C are so chosen on these two lines such that $AB=AC$. The equation of line AC passing through $(2,-7)$ is

(a) $x-y-9=0$

(b) $23x+7y+3=0$

(c) $2x-y-11=0$

(d) $7x-6y-56=0$

153. Equation of a tangent to the hyperbola $5x^2-y^2=5$ and which passes through an external point $(2,8)$ is.

(a) $3x-y+2=0$

(b) $3x+y-14=0$

(c) $23x-3y-22=0$

(d) $3x-23y+178=0$

154. Let f and g be differentiable on the interval I and let $a, b\in I, a<b$. Then,

(a) If $f(a)=0=f(b)$, the equation $f'(x)+f(x)g'(x)=0$ is solvable in (a,b)

(b). If $f(a)=0=f(b)$, the equation $f'(x)+f(x)g'(x)=0$ may not be solvable in (a,b).

(c) If $g(a)=0=g(b)$, the equation $g'(x)+kg(x)=0$ is solvable in (a,b), $k\in\mathbb{R}$

(d) If $g(a)=0=g(b)$, the equation $g'(x)+kg(x)=0$ may not be solvable in $(a,b), k\in\mathbb{R}$.

155. Consider the function $f(x)=\frac{x^3}{4}-\sin\pi x+3$

(a) $f(x)$ does not attain value within the interval $[-2,2]$

(b) $f(x)$ takes on the value $2\frac{1}{3}$ in the interval $[-2,2]$

(c) $f(x)$ takes on the value $3\frac{1}{4}$ in the interval $[-2,2]$

(d) $f(x)$ takes no value $p, 1<p<5$ in the interval $[-2,2]$.