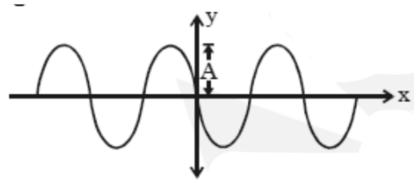
JEE-Main Exam April, 2019 / 12-4-19 / Morning session

Physics

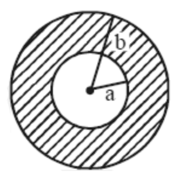
1. The value of numerical aperature of the objective lens of a microscope is 1.25. If light of wavelength 5000 Å is used, the minimum separation between two points, to be seen as distinct, will be :
(a) 0.24 μm (b) 0.48 μm (c) 0.12 μm (d) 0.38 μm

2. A progressive wave travelling along the positive x-direction is represented by $y(x, t) = A \sin(kx - \omega t + \phi)$. Its snapshot at t = 0 is given in the figure:



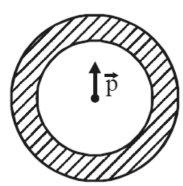
For this wave, the phase ϕ is:
(a) 0 (b) $-\frac{\pi}{2}$ (c) π (d) $\frac{\pi}{2}$

3. A circular disc of radius b has a hole of radius a at its centre (see figure). If the mass per unit area of the disc varies as $\left(\frac{\sigma_0}{r}\right)$, then the radius of gyration of the disc about its axis passing through the centre is :



(a) $\frac{a+b}{2}$ (b) $\frac{a+b}{3}$ (c) $\sqrt{\frac{a^2+b^2+ab}{2}}$ (d) $\sqrt{\frac{a^2+b^2+ab}{3}}$

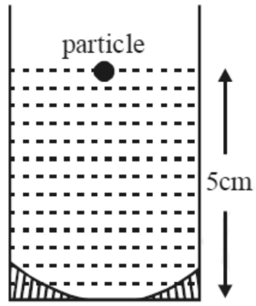
4. Shown in the figure is a shell made of a conductor. It has inner radius a and outer radius b, and carries charge Q. At its centre is a dipole $\vec{p}$ as shown. In this case :



(a) Electric field outside the shell is the same as that of a point charge at the centre of the shell.
(b) Surface charge density on the inner surface of the shell is zero everywhere.
(c) Surface charge density on the inner surface is uniform and equal to $\frac{(Q/2)}{4\pi a^2}$.
(d) Surface charge density on the outer surface depends on $|\vec{p}|$

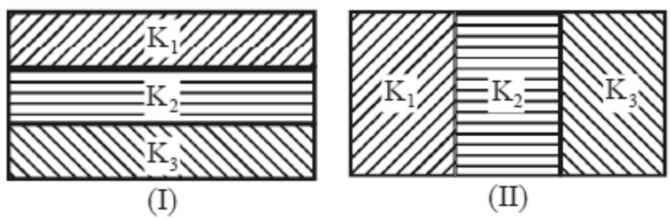
5. A person of mass M is, sitting on a swing of length L and swinging with an angular amplitude θ_0. If the person stands up when the swing passes through its lowest point, the work done by him, assuming that his centre of mass moves by a distance ℓ ($\ell << L$), is close to :
(a) $Mg\ell$ (b) $Mg\ell(1+\theta_0^2)$ (c) $Mg\ell(1-\theta_0^2)$ (d) $Mg\ell\left(1+\frac{\theta_0^2}{2}\right)$

6. A concave mirror has radius of curvature of 40 cm. It is at the bottom of a glass that has water filled up to 5 cm (see figure). If a small particle is floating on the surface of water, its image as seen, from directly above the glass, is at a distance d from the surface of water. The value of d is close to :
(Refractive index of water = 1.33)



(a) 8.8 cm (b) 11.7 cm (c) 6.7 cm (d) 13.4 cm

7. Two identical parallel plate capacitors, of capacitance C each, have plates of area A, separated by a distance d. The space between the plates of the two capacitors, is filled with three dielectrics, of equal thickness and dielectric constants K_1, K_2 and K_3. The first capacitor is filled as shown in fig. I, and the second one is filled as shown in fig. II. If these two modified capacitors are charged by the same potential V, the ratio of the energy stored in the two, would be (E_1 refers to capacitor (I) and E_2 to capacitor (II)):



(a) $\frac{E_1}{E_2}=\frac{9K_1K_2K_3}{(K_1+K_2+K_3)(K_2K_3+K_3K_1+K_1K_2)}$
(b) $\frac{E_1}{E_2}=\frac{K_1K_2K_3}{(K_1+K_2+K_3)(K_2K_3+K_3K_1+K_1K_2)}$
(c) $\frac{E_1}{E_2}=\frac{(K_1+K_2+K_3)(K_2K_3+K_3K_1+K_1K_2)}{K_1K_2K_3}$
(d) $\frac{E_1}{E_2}=\frac{(K_1+K_2+K_3)(K_2K_3+K_3K_1+K_1K_2)}{9K_1K_2K_3}$

8. A point dipole $\vec{p}=-p_0\hat{x}$ is kept at the origin. The potential and electric field due to this dipole on the y-axis at a distance d are, respectively: (Take V = 0 at infinity) :

(a) $\frac{|\vec{p}|}{4\pi\varepsilon_0 d^2},\frac{-\vec{p}}{4\pi\varepsilon_0 d^3}$ (b) $0,\frac{-\vec{p}}{4\pi\varepsilon_0 d^3}$ (c) $\frac{|\vec{p}|}{4\pi\varepsilon_0 d^2},\frac{\vec{p}}{4\pi\varepsilon_0 d^3}$ (d) $0,\frac{-\vec{p}}{4\pi\varepsilon_0 d^3}$

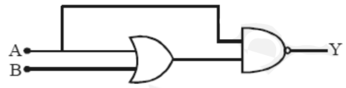
9. When M_1 gram of ice at –10°C (specific heat = 0.5 cal g^{-1} °C^{-1}) is added to M_2 gram of water at 50°C, finally no ice is left and the water is at 0°C. The value of latent heat of ice, in cal g^{-1} is:

(a) $\frac{5M_1}{M_2}-50$ (b) $\frac{50M_2}{M_1}$ (c) $\frac{50M_2}{M_1}-5$ (d) $\frac{5M_2}{M_1}-5$

10. The trajectory of a projectile near the surface of the earth is given as $y = 2x - 9x^2$. If it were launched at an angle θ_0 with speed v_0 then ($g = 10\ ms^{-2}$) :

(a) $\theta_0=\cos^{-1}\left(\frac{1}{\sqrt{5}}\right)$ and $v_0=\frac{5}{3}\ ms^{-1}$
(b) $\theta_0=\sin^{-1}\left(\frac{1}{\sqrt{5}}\right)$ and $v_0=\frac{5}{3}\ ms^{-1}$
(c) $\theta_0=\sin^{-1}\left(\frac{2}{\sqrt{5}}\right)$ and $v_0=\frac{3}{5}\ ms^{-1}$
(d) $\theta_0=\cos^{-1}\left(\frac{2}{\sqrt{5}}\right)$ and $v_0=\frac{3}{5}\ ms^{-1}$

11. The truth table for the circuit given in the fig. is:



(a)

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

(b)

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

(c)

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

(d)

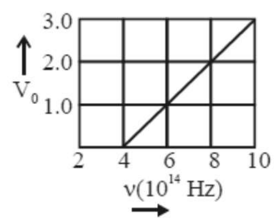
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	1

12. A shell is fired from a fixed artillery gun with an initial speed u such that it hits the target on the ground at a distance R from it. If t_1 and t_2 are the values of the time taken by it to hit the target in two possible ways, the product t_1t_2 is:
(a) R/g (b) R/4g (c) 2R/g (d) R/2g

13. A submarine (A) travelling at 18 km/hr is being chased along the line of its velocity by another submarine (B) travelling at 27 km/hr. B sends a sonar signal of 500 Hz to detect A and receives a reflected sound of frequency ν. The value of ν is close to : (Speed of sound in water = 1500 ms^{-1})
(a) 499 Hz (b) 502 Hz (c) 507 Hz (d) 504 Hz

14. Two moles of helium gas is mixed with three moles of hydrogen molecules (taken to be rigid). What is the molar specific heat of mixture at constant volume? (R = 8.3 J/mol K)
(a) 21.6 J/mol K (b) 19.7 J/mol K (c) 17.4 J/mol K (d) 15.7 J/mol K

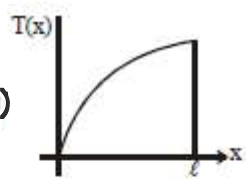
15. The stopping potential V_0 (in volt) as a function of frequency (ν) for a sodium emitter, is shown in the figure. The work function of sodium, from the data plotted in the figure, will be :
(Given : Planck's constant
(h) = 6.63×10^{-34} Js, electron
charge e = 1.6×10^{-19} C)

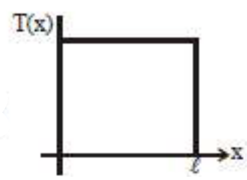


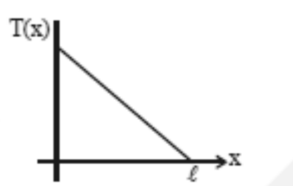
(a) 1.95 eV (b) 1.82 eV (c) 1.66 eV (d) 2.12 eV

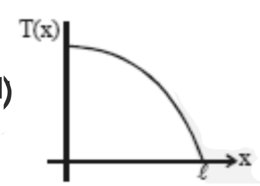
16. At 40°C, a brass wire of 1 mm radius is hung from the ceiling. A small mass, M is hung from the free end of the wire. When the wire is cooled down from 40°C to 20°C it regains its original length of 0.2 m. The value of M is close to : (Coefficient of linear expansion and Young's modulus of brass are 10^{-5}/°C and 10^{11} N/m², respectively; g = 10 ms^{-2})
(a) 1.5 kg (b) 9 kg (c) 0.9 kg (d) 0.5 kg

17. A uniform rod of length ℓ is being rotated in a horizontal plane with a constant angular speed about an axis passing through one of its ends. If the tension generated in the rod due to rotation is T(x) at a distance x from the axis, then which of the following graphs depicts it most closely?

(a)


(b)


(c)


(d)


18. Which of the following combinations has the dimension of electrical resistance (ε_0 is the permittivity of vacuum and μ_0 is the permeability of vacuum)?

(a) $\sqrt{\frac{\varepsilon_0}{\mu_0}}$ (b) $\frac{\mu_0}{\varepsilon_0}$ (c) $\sqrt{\frac{\mu_0}{\varepsilon_0}}$ (d) $\frac{\varepsilon_0}{\mu_0}$

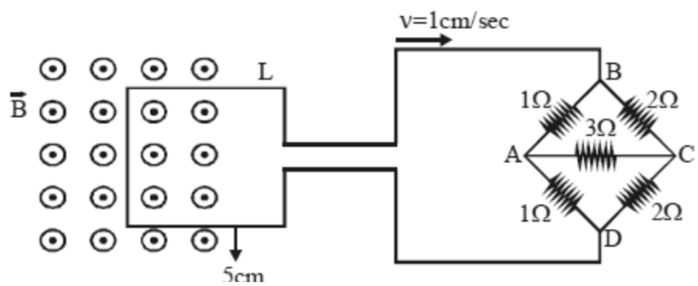
19. In a double slit experiment, when a thin film of thickness t having refractive index μ is introduced in front of one of the slits, the maximum at the centre of the fringe pattern shifts by one fringe width. The value of t is (λ is the wavelength of the light used) :

(a) $\frac{\lambda}{2(\mu-1)}$ (b) $\frac{\lambda}{(2\mu-1)}$ (c) $\frac{2\lambda}{(\mu-1)}$ (d) $\frac{\lambda}{(\mu-1)}$

20. An electromagnetic wave is represented by the electric field $\vec{E} = E_0\hat{n}\sin[\omega t + (6y - 8z)]$. Taking unit vectors in x, y and z directions to be $\hat{i}, \hat{j}, \hat{k}$, the direction of propogation $\hat{s}$, is :

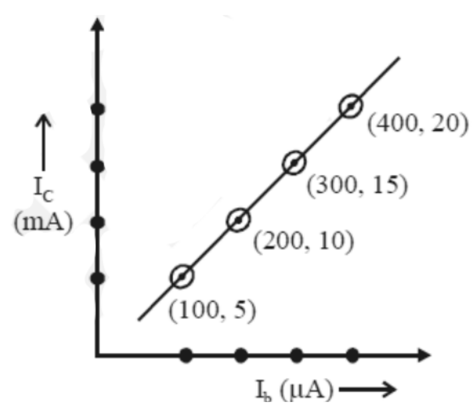
(a) $\hat{s} = \frac{4\hat{j} - 3\hat{k}}{5}$ (b) $\hat{s} = \frac{3\hat{i} - 4\hat{j}}{5}$ (c) $\hat{s} = \left(\frac{-3\hat{j} + 4\hat{k}}{5}\right)$ (d) $\hat{s} = \frac{-4\hat{k} + 3\hat{j}}{5}$

21. The figure shows a square loop L of side 5 cm which is connected to a network of resistances. The whole setup is moving towards right with a constant speed of 1 cms^{-1}. At some instant, a part of L is in a uniform magnetic field of 1T, perpendicular to the plane of the loop. If the resistance of L is 1.7 Ω, the current in the loop at that instant will be close to :



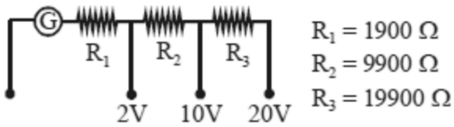
(a) 115 μA (b) 170 μA (c) 60 μA (d) 150 μA

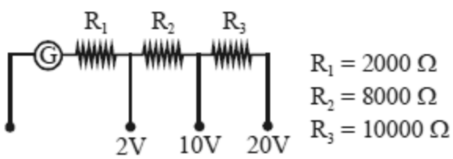
22. The transfer characteristic curve of a transistor, having input and output resistance 100 Ω and 100 kΩ respectively, is shown in the figure. The Voltage and Power gain, are respectively :

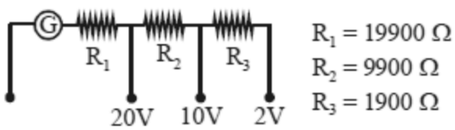


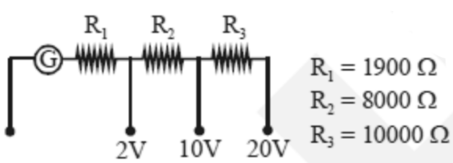
(a) 5×10^4, 5×10^5 (b) 5×10^4, 5×10^6
(c) 5×10^4, 2.5×10^6 (d) 2.5×10^4, 2.5×10^6

23. A galvanometer of resistance $100\,\Omega$ has 50 divisions on its scale and has sensitivity of 20 μA/division. It is to be converted to a voltmeter with three ranges, of 0–2 V, 0–10 V and 0–20 V. The appropriate circuit to do so is :

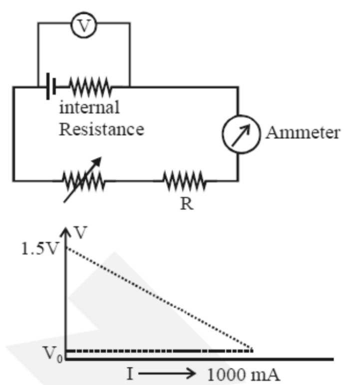
(a) 

(b) 

(c) 

(d) 

24. To verify Ohm's law, a student connects the voltmeter across the battery as, shown in the figure. The measured voltage is plotted as a function of the current, and the following graph is obtained:



If V_0 is almost zero, identify the correct statement:

(a) The value of the resistance R is 1.5 Ω

(b) The emf of the battery is 1.5 V and the value of R is 1.5 Ω

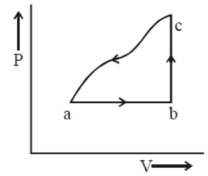
(c) The emf of the battery is 1.5 V and its internal resistance is 1.5 Ω

(d) The potential difference across the battery is 1.5 V when it sends a current of 1000 mA.

25. An excited He^{+} ion emits two photons in succession, with wavelengths 108.5 nm and 30.4 nm, in making a transition to ground state. The quantum number n, corresponding to its initial excited state is (for photon of wavelength λ, energy $E = \dfrac{1240\text{eV}}{\lambda(\text{in nm})}$

(a) n = 5 (b) n = 4 (c) n = 6 (d) n = 7

26. A sample of an ideal gas is taken through the cyclic process abca as shown in the figure. The change in the internal energy of the gas along the path ca is –180J. The gas absorbs 250 J of heat along the path ab and 60 J along the path bc. The work done by the gas along the path abc is:



(a) 100 J (b) 120 J (c) 140 J (d) 130 J

27. A thin ring of 10 cm radius carries a uniformly distributed charge. The ring rotates at a constant angular speed of 40π rad s^{-1} about its axis, perpendicular to its plane. If the magnetic field at its centre is 3.8×10^{-9} T, then the charge carried by the ring is close to ($\mu_0 = 4\pi \times 10^{-7}$ N/A^2) :

(a) 2×10^{-6} C (b) 3×10^{-5} C (c) 4×10^{-5} C (d) 7×10^{-6} C

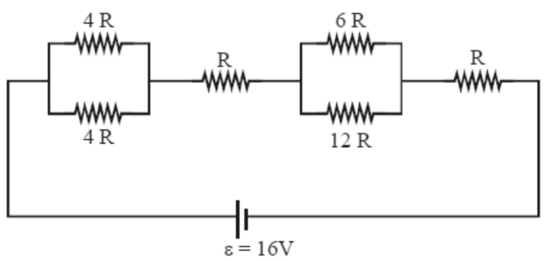
28. A magnetic compass needle oscillates 30 times per minute at a place where the dip is 45°, and 40 times per minute where the dip is 30°. If B_1 and B_2 are respectively the total magnetic field due to the earth at the two places, then the ratio B_1/B_2 is best given by :

(a) 2.2 (b) 1.8 (c) 0.7 (d) 3.6

29. A man (mass = 50 kg) and his son (mass = 20 kg) are standing on a frictionless surface facing each other. The man pushes his son so that he starts moving at a speed of 0.70 ms^{-1} with respect to the man. The speed of the man with respect to the surface is :

(a) 0.20 ms^{-1} (b) 0.14 ms^{-1} (c) 0.47 ms^{-1} (d) 0.28 ms^{-1}

30. The resistive network shown below is connected to a D.C. source of 16V. The power consumed by the network is 4 Watt. The value of R is :



(a) 8 Ω (b) 6 Ω (c) 1 Ω (d) 16 Ω

Chemistry

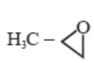
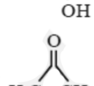
31. 5 moles of AB_2 weigh 125×10^{-3} kg and 10 moles of A_2B_2 weigh 300×10^{-3} kg. The molar mass of A(MA) and molar mass of B(MB) in kg mol^{-1} are :

(a) $M_A = 50 \times 10^{-3}$ and $M_B = 25 \times 10^{-3}$ (b) $M_A = 25 \times 10^{-3}$ and $M_B = 50 \times 10^{-3}$
(c) $M_A = 5 \times 10^{-3}$ and $M_B = 10 \times 10^{-3}$ (d) $M_A = 10 \times 10^{-3}$ and $M_B = 5 \times 10^{-3}$

32. The major product of the following addition reaction is :

$H_3C-CH=CH_2 \xrightarrow{Cl_2/H_2O}$

(a) $CH_3-CH(Cl)-CH_2(OH)$ (b) $H_3C-CH(OH)-CH_2(Cl)$

(c)  (d) 

33. What is the molar solubility of $Al(OH)_3$ in 0.2 M NaOH solution? Given that, solubility product of $Al(OH)_3$ = 2.4×10^{-24} :

(a) 12×10^{-23} (b) 12×10^{-21} (c) 3×10^{-19} (d) 3×10^{-22}

34. But-2-ene on reaction with alkaline $KMnO_4$ at elevated temperature followed by acidification will give :
   (a) one molecule of CH_3CHO and one molecule of CH_3COOH
   (b) $CH_3-\underset{OH}{\underset{|}{CH}}-\underset{OH}{\underset{|}{CH}}-CH_3$
   (c) 2 molecules of CH_3COOH
   (d) 2 molecules of CH_3CHO

35. The correct sequence of thermal stability of the following carbonates is
   (a) $BaCO_3 < CaCO_3 < SrCO_3 < MgCO_3$
   (b) $MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$
   (c) $BaCO_3 < SrCO_3 < CaCO_3 < MgCO_3$
   (d) $MgCO_3 < SrCO_3 < CaCO_3 < BaCO_3$

36. The correct statement among the following is
   (a) $(SiH_3)_3N$ is pyramidal and more basic than $(CH_3)_3N$
   (b) $(SiH_3)_3N$ is planar and more basic than $(CH_3)_3N$
   (c) $(SiH_3)_3N$ is pyramidal and less basic than $(CH_3)_3N$
   (d) $(SiH_3)_3N$ is planar and less basic than $(CH_3)_3N$

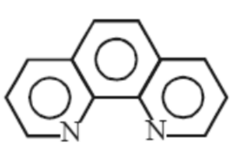
37. Peptization is a :
   (a) process of converting a colloidal solution into precipitate
   (b) process of converting precipitate into colloidal solution
   (c) process of converting soluble particles to form colloidal solution
   (d) process of bringing colloidal molecule into solution

38. Given :
   $Co^{3+} + e^- \rightarrow Co^{2+}$; $E^o = + 1.81$ V
   $Pb^{4+} + 2e^- \rightarrow Pb^{2+}$; $E^o = + 1.67$ V
   $Ce^{4+} + e^- \rightarrow Ce^{3+}$; $E^o = + 1.61$ V
   $Bi^{3+} + 3e^- \rightarrow Bi$; $E^o = + 0.20$ V
   Oxidizing power of the species will increase in the order :
   (a) $Ce^{4+} < Pb^{4+} < Bi^{3+} < Co^{3+}$
   (b) $Co^{3+} < Pb^{4+} < Ce^{4+} < Bi^{3+}$
   (c) $Co^{3+} < Ce^{4+} < Bi^{3+} < Pb^{4+}$
   (d) $Bi^{3+} < Ce^{4+} < Pb^{4+} < Co^{3+}$

39. The metal that gives hydrogen gas upon treatment with both acid as well as base is :
   (a) zinc (b) iron (c) magnesium (d) mercury

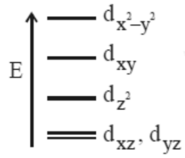
40. The group number, number of valence electrons, and valency of an element with atomic number 15, respectively, are
   (a) 16, 5 and 2 (b) 16, 6 and 3 (c) 15, 5 and 3 (d) 15, 6 and 2

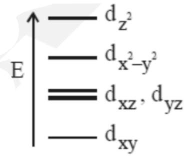
41. The complex ion that will lose its crystal field stabilization energy upon oxidation of its metal to +3 state is

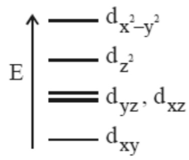
   (Phen = 

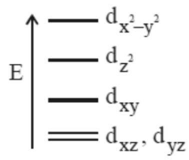
   and ignore pairing energy)
   (a) $[Fe(phen)_3]^{2+}$
   (b) $[Zn(phen)_3]^{2+}$
   (c) $[Ni(phen)_3]^{2+}$
   (d) $[Co(phen)_3]^{2+}$

42. Complete removal of both the axial ligands (along the z-axis) from an octahedral complex leads to which of the following splitting patterns? (relative orbital energies not on scale).

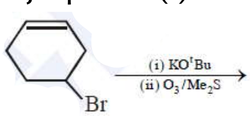
(a) 

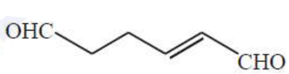
(b) 

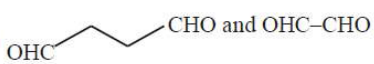
(c) 

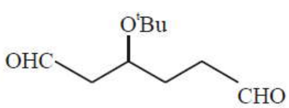
(d) 

43. The major product(s) obtained in the following reaction is/are :



(a) 

(b) 

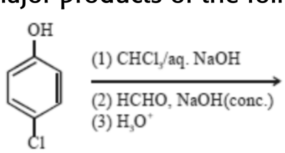
(c) 

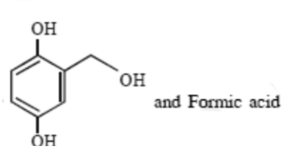
(d) 

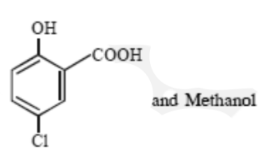
44. An element has a face-centred cubic (fcc) structure with a cell edge of a. The distance between the centres of two nearest tetrahedral voids in the lattice is :

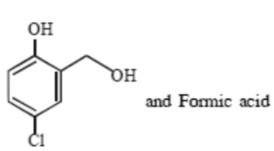
(a) $\frac{a}{2}$ (b) a (c) $\frac{3}{2}a$ (d) $\sqrt{2}a$

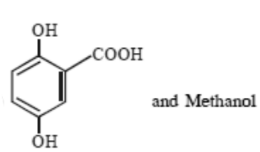
45. The major products of the following reaction are :



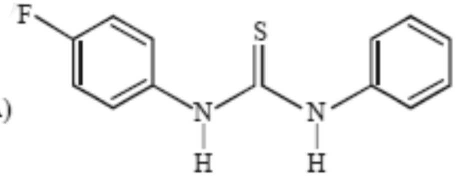
(a) 

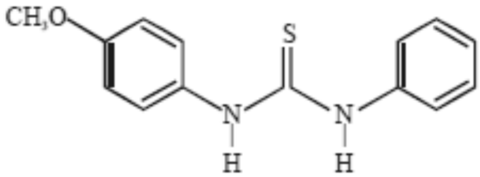
(b) 

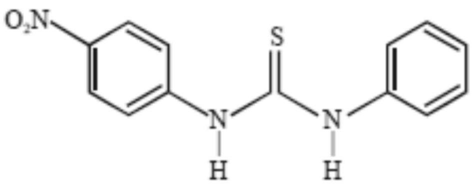
(c) 

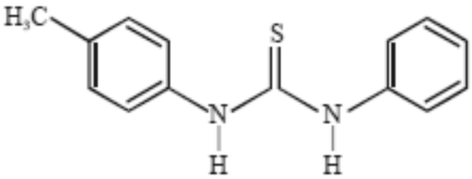
(d) 

46. The increasing order of the pK_b of the following compound is :

(A)


(B)


(C)


(D)


(a) (A) < (C) < (D) < (B)
(b) (B) < (D) < (A) < (C)
(c) (C) < (A) < (D) < (B)
(d) (B) < (D) < (C) < (A)

47. Which of the following statements is not true about RNA ?
(a) It has always double stranded α-helix structure
(b) It usually does not replicate
(c) It is present in the nucleus of the cell
(d) It controls the synthesis of protein

48. In the following reaction; $xA \rightarrow yB$ $\log_{10}\left[-\frac{d[A]}{dt}\right] = \log_{10}\left[\frac{d[B]}{dt}\right] + 0.3010$ 'A' and 'B' respectively can be :
(a) n-Butane and Iso-butane
(b) C_2H_4 and C_4H_8
(c) N_2O_4 and NO_2
(d) C_2H_2 and C_6H_6

49. Glucose and Galactose are having identical configuration in all the positions except position.
(a) C–3
(b) C–2
(c) C–4
(d) C–5

50. An ideal gas is allowed to expand from 1 L to 10 L against a constant external pressure of 1bar. The work done in kJ is :
(a) –9.0
(b) +10.0
(c) –0.9
(d) –2.0

51. Which of the following is a thermosetting polymer?
(a) Buna–N
(b) PVC
(c) Bakelite
(d) Nylon 6

52. The idea of froth floatation method came from a person X and this method is related to the process Y of ores. X and Y, respectively, are:
(a) fisher woman and concentration
(b) washer man and reduction
(c) washer woman and concentration
(d) fisher man and reduction

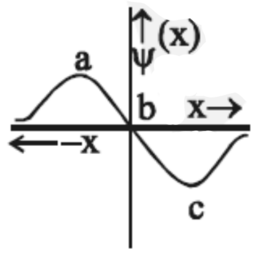
53. An example of a disproportionation reaction is :

(a) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$
(b) $2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$
(c) $2CuBr \rightarrow CuBr_2 + Cu$
(d) $2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$

54. The correct set of species responsible for the photochemical smog is :

(a) NO, NO_2, O_3 and hydrocarbons
(b) N_2, O_2, O_3 and hydrocarbons
(c) N_2, NO_2 and hydrocarbons
(d) CO_2, NO_2, SO_2 and hydrocarbons

55. The electrons are more likely to be found :



(a) in the region a and b
(b) in the region a and c
(c) only in the region c
(d) only in the region a

56. The basic structural unit of feldspar, zeolites, mica, and asbestos is :

(a) $(SiO_3)^{2-}$
(b) SiO_2
(c) $(SiO_4)^{4-}$
(d) $-(SiR_2-O)_n-$ (R=Me)

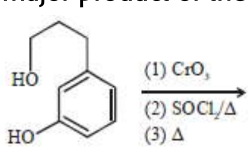
57. An organic compound 'A' is oxidized with Na_2O_2 followed by boiling with HNO_3.The resultant solution is then treated with ammonium molybdate to yield a yellow precipitate. Based on above observation, the element present in the given compound is :

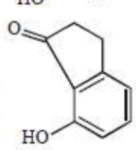
(a) Sulphur
(b) Nitrogen
(c) Fluorine
(d) Phosphorus

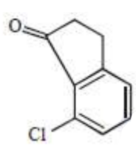
58. Enthalpy of sublimation of iodine is 24 cal g^{-1} at 200°C. If specific heat of $I_2(s)$ and $I_2(vap)$ are 0.055 and 0.031 cal $g^{-1}K^{-1}$ respectively, then enthalpy of sublimation of iodine at 250°C in cal g^{-1} is :

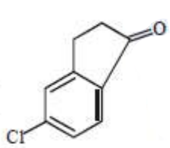
(a) 2.85
(b) 11.4
(c) 5.7
(d) 22.8

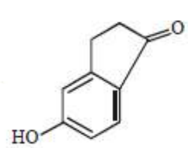
59. The major product of the following reaction



(a)


(b)


(c)


(d)


60. The mole fraction of a solvent in aqueous solution of a solute is 0.8. The molality (in mol kg^{-1}) of the aqueous solution is

(a) 13.88×10^{-1}
(b) 13.88×10^{-2}
(c) 13.88
(d) 13.88×10^{-3}

Mathematics

61. If m is the minimum value of k for which the function $= f(x) = x\sqrt{kx - x^2}$ is increasing in the interval [0, 3] and M is the maximum value of f in [0, 3] when k = m, then the ordered pair (m, M) is equal to :
(a) $(4, 3\sqrt{2})$ (b) $(4, 3\sqrt{3})$ (c) $(3, 3\sqrt{3})$ (d) $(5, 3\sqrt{6})$

62. The equation $|z - i| = |z - 1|$, $i = \sqrt{-1}$, represents:
(a) the line through the origin with slope −1.
(b) a circle of radius 1.
(c) a circle of radius $\frac{1}{2}$
(d) the line through the origin with slope 1

63. For $x \in \left(0, \frac{3}{2}\right)$, let $f(x) = \sqrt{x}$, $g(x) = \tan x$ and $h(x) = \frac{1-x^2}{1+x^2}$. If $\phi(x) = ((hof)og)(x)$, then $\phi = \left(\frac{\pi}{3}\right)$ is equal to:
(a) $\tan\frac{\pi}{12}$ (b) $\tan\frac{7\pi}{12}$ (c) $\tan\frac{11\pi}{12}$ (d) $\tan\frac{5\pi}{12}$

64. If three of the six vertices of a regular hexagon are chosen at random, then the probability that the triangle formed with these chosen vertices is equilateral is :
(a) $\frac{3}{10}$ (b) $\frac{1}{10}$ (c) $\frac{3}{20}$ (d) $\frac{1}{5}$

65. If the normal to the ellipse $3x^2 + 4y^2 = 12$ at a point P on it is parallel to the line, $2x + y = 4$ and the tangent to the ellipse at P passes through Q(4, 4) then PQ is equal to :
(a) $\frac{\sqrt{221}}{2}$ (b) $\frac{\sqrt{157}}{2}$ (c) $\frac{\sqrt{61}}{2}$ (d) $\frac{5\sqrt{5}}{2}$

66. If $e^y + xy = e$, the ordered pair $\left(\frac{dy}{dx}, \frac{d^2y}{dx^2}\right)$ at x = 0 is equal to:
(a) $\left(-\frac{1}{e}, \frac{1}{e^2}\right)$ (b) $\left(\frac{1}{e}, \frac{1}{e^2}\right)$ (c) $\left(\frac{1}{e}, -\frac{1}{e^2}\right)$ (d) $\left(-\frac{1}{e}, -\frac{1}{e^2}\right)$

67. If the line $\frac{x-2}{3} = \frac{y+1}{2} = \frac{z-1}{-1}$ intersects the plane $2x + 3y - z + 13 = 0$ at a point P and the plane $3x + y + 4z = 16$ at a point Q, then PQ is equal to :
(a) $2\sqrt{14}$ (b) $\sqrt{14}$ (c) $2\sqrt{7}$ (d) 14

68. The value of $\sin^{-1}\left(\frac{12}{13}\right) - \sin^{-1}\left(\frac{3}{5}\right)$ is equal to:
(a) $\pi - \sin^{-1}\left(\frac{63}{65}\right)$ (b) $\pi - \cos^{-1}\left(\frac{33}{65}\right)$ (c) $\frac{\pi}{2} - \sin^{-1}\left(\frac{56}{65}\right)$ (d) $\frac{\pi}{2} - \cos^{-1}\left(\frac{9}{65}\right)$

69. If α and β are the roots of the equation $375x^2 - 25x - 2 = 0$, then $\lim_{n\to\infty}\sum_{r=1}^{n}\alpha^r + \lim_{n\to\infty}\sum_{r=1}^{n}\beta^r$ is equal to:
(a) $\frac{21}{346}$ (b) $\frac{29}{358}$ (c) $\frac{1}{12}$ (d) $\frac{7}{116}$

70. If $\int_0^{\frac{\pi}{2}} \frac{\cot x}{\cot x + \operatorname{cosec} x}\, dx = m(\pi + n)$, then m.n is equal to :
(a) −1 (b) 1 (c) $\frac{1}{2}$ (d) $-\frac{1}{2}$

71. The number of ways of choosing 10 objects out of 31 objects of which 10 are identical and the remaining 21 are distinct, is :
(a) 2^{20} (b) $2^{20} - 1$ (c) $2^{20} + 1$ (d) 2^{21}

72. If the data $x_1, x_2, ..., x_{10}$ is such that the mean of first four of these is 11, the mean of the remaining six is 16 and the sum of squares of all of these is 2,000; then the standard deviation of this data is :
(a) 4 (b) 2 (c) $\sqrt{2}$ (d) $2\sqrt{2}$

73. The number of solutions of the equation $1 + \sin^4 x = \cos^2 3x$, $x \in \left[-\frac{5\pi}{2}, \frac{5\pi}{2}\right]$ is:
(a) 5 (b) 4 (c) 7 (d) 3

74. Let S_n denote the sum of the first n terms of an A.P. If $S_4 = 16$ and $S_6 = -48$, then S_{10} is equal to:
(a) −320 (b) −260 (c) −380 (d) −410

75. If $B = \begin{bmatrix} 5 & 2\alpha & 1 \\ 0 & 2 & 1 \\ \alpha & 3 & -1 \end{bmatrix}$ is the inverse of a 3 × 3 matrix A, then the sum of all values of α for which det (A) + 1 = 0 , is:
(a) 0 (b) 2 (c) 1 (d) −1

76. Let a random variable X have a binomial distribution with mean 8 and variance 4. If $P(x \le 2) = \frac{k}{2^{16}}$, then k is equal to :
(a) 17 (b) 1 (c) 121 (d) 137

77. If the truth value of the statement $P \to (\sim p \vee r)$ is false (F), then the truth values of the statements p, q, r are respectively :
(a) F, T, T (b) T, F, F (c) T, T, F (d) T, F, T

78. Consider the differential equation, $y^2 dx + \left(x - \frac{1}{y}\right) dy = 0$. If value of y is 1 when x = 1, the value of x for which y = 2, is:
(a) $\frac{1}{2} + \frac{1}{\sqrt{e}}$ (b) $\frac{3}{2} - \sqrt{e}$ (c) $\frac{5}{2} + \frac{1}{\sqrt{e}}$ (d) $\frac{3}{2} - \frac{1}{\sqrt{e}}$

79. Let f : R → R be a continuously differentiable function which that f(2) = 6 and f(2) = $\frac{1}{48}$. If $\int_6^{f(x)} 4t^3 dt = (x-2) g(x)$, then $\lim_{x \to 2} g(x)$ is equal to :
(a) 24 (b) 36 (c) 12 (d) 18

80. The coefficient of x^{18} in the product $(1 + x)(1 - x)^{10}(1 + x + x^2)^9$ is :
(a) −84 (b) 84 (c) 126 (d) −126

81. For $x \in R$, let [x] denote the greatest integer $\le$ x, then the sum of the series $\left[-\frac{1}{3}\right] + \left[-\frac{1}{3} - \frac{1}{100}\right] + \left[-\frac{1}{3} - \frac{2}{100}\right] + ... + \left[-\frac{1}{3} - \frac{99}{100}\right]$ is
(a) −153 (b) −133 (c) −131 (d) −135

82. The equation $y = \sin x \sin(x + 2) - \sin^2(x + 1)$ represents a straight line lying in:
(a) second and third quadrants only (b) third and fourth quadrants only
(c) first, third and fourth quadrants (d) first, second and fourth quadrants

83. Let P be the point of intersection of the common tangents to the parabola $y^2 = 12x$ and the hyperbola $8x^2 - y^2 = 8$. If S and S' denote the foci of the hyperbola where S lies on the positive x-axis then P divides SS' in a ratio:
(a) 5:4 (b) 14:13 (c) 2:1 (d) 13:11

84. If the volume of parallelopiped formed by the vectors $\hat{i}+\lambda\hat{j}+\hat{k}, \hat{j}+\lambda\hat{k}$ and $\lambda\hat{i}+\hat{k}$ is minimum, then λ is equal to :

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

85. A 2 m ladder leans against a vertical wall. If the top of the ladder begins to slide down the wall at the rate 25 cm/sec., then the rate (in cm/sec.) at which the bottom of the ladder slides away from the wall on the horizontal ground when the top of the ladder is 1 m above the ground is:

(a) $25\sqrt{3}$ (b) 25 (c) $\frac{25}{\sqrt{3}}$ (d) $\frac{25}{3}$

86. If a is A symmetric matrix and B is a skew-symmetrix matrix such that $A + B = \begin{bmatrix} 2 & 3 \\ 5 & -1 \end{bmatrix}$, then AB is equal to :

(a) $\begin{bmatrix} -4 & 2 \\ 1 & 4 \end{bmatrix}$ (b) $\begin{bmatrix} -4 & -2 \\ -1 & 4 \end{bmatrix}$ (c) $\begin{bmatrix} 4 & -2 \\ -1 & -4 \end{bmatrix}$ (d) $\begin{bmatrix} 4 & -2 \\ 1 & -4 \end{bmatrix}$

87. Let $\vec{a}=3\hat{i}+2\hat{j}+2\hat{k}$ and $\vec{b}=\hat{i}+2\hat{j}-2\hat{k}$ be two vectors. If a vector perpendicular to both the vectors $\vec{a}+\vec{b}$ and $\vec{a}-\vec{b}$ has the magnitude 12 then one such vector is

(a) $4(2\hat{i}+2\hat{j}-\hat{k})$ (b) $4(-2\hat{i}-2\hat{j}+\hat{k})$ (c) $4(2\hat{i}-2\hat{j}-\hat{k})$ (d) $4(2\hat{i}+2\hat{j}+\hat{k})$

88. The integral $\int \frac{2x^3-1}{x^4+x}$ is equal to: (Here C is a constant of integration)

(a) $\log_e\left|\frac{x^3+1}{x}\right|+C$ (b) $\frac{1}{2}\log_e\frac{(x^3+1)^2}{|x^3|}+C$ (c) $\frac{1}{2}\log_e\frac{|x^3+1|}{x^2}+C$ (d) $\log_e\frac{|x^3+1|}{x^2}+C$

89. If the angle of intersection at a point where the two circles with radii 5 cm and 12 cm intersect is 90°, then the length (in cm) of their common chord is :

(a) $\frac{60}{3}$ (b) $\frac{120}{13}$ (c) $\frac{13}{2}$ (d) $\frac{13}{5}$

90. If the area (in sq. units) of the region $\{(x, y) : y^2 \le 4x, x + y \le 1, x \ge 0, y \ge 0\}$ is $a\sqrt{2}+b$, then a – b is equal to :

(a) $\frac{8}{3}$ (b) $\frac{10}{3}$ (c) 6 (d) $-\frac{2}{3}$

PCM Answers

1	a	11	a	21	b	31	c	41	a	51	c	61	b	71	a	81	b
2	c	12	c	22	c	32	b	42	a	52	c	62	d	72	b	82	b
3	d	13	b	23	d	33	d	43	b	53	c	63	c	73	a	83	a
4	a	14	c	24	c	34	c	44	a	54	a	64	b	74	a	84	c
5	b	15	c	25	a	35	b	45	c	55	b	65	d	75	c	85	c
6	a	16	b	26	d	36	d	46	b	56	c	66	a	76	d	86	c
7	a	17	d	27	b	37	b	47	a	57	d	67	a	77	c	87	c
8	d	18	c	28	c	38	d	48	b	58	d	68	c	78	d	88	a
9	c	19	d	29	a	39	a	49	c	59	d	69	c	79	d	89	b
10	a	20	c	30	a	40	c	50	c	60	c	70	a	80	b	90	c