FIITJEE

ALL INDIA TEST SERIES

FULL TEST – VIII

JEE (Main)-2019

TEST DATE: 31-03-2019

Time Allotted: 3 Hours **Maximum Marks: 360**

General Instructions:

- The test consists of total 90 questions.
- Each subject (PCM) has 30 questions.
- This question paper contains **Three Parts.**
- **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
- Each part has only one section: **Section-A**.

  Section-A (01 – 30, 31 – 60, 61 – 90) *contains 90 multiple choice questions which have* ***only one correct answer****. Each question carries* ***+4 marks*** *for correct answer and* ***–1 mark*** *for wrong answer.*

Physics

PART – I

SECTION – A
(One Options Correct Type)

This section contains **30 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

1. A radioactive isotope is produced at a constant rate R in a nuclear reactor, by exposing a precursor sample to the neutrons produced in the reactor. The radioactive isotope has a disintegration constant, λ
   (A) If precursor sample is placed in the reactor for a very long time, the maximum no. of isotope atoms produced will be $\frac{R}{2\lambda}$.
   (B) If precursor sample is placed in the reactor for a very short time t, the approximate no. of isotope atoms produced will be Rt^2.
   (C) If precursor sample is placed in the reactor for N half-lives, then the activity of isotope atoms when it is taken out will be $R\left(\frac{1}{2^N}\right)$.
   (D) If precursor sample is (i) introduced for 1-half-life into the reactor (ii) then removed for 1-half-life; and this process is repeated many times – the activity of the sample will become $\frac{R}{3}$ after a very long time, just after steps (i) and (ii) are completed.

2. A particle of mass m moves along x-axis under a force which is given by:
   $F(x) = -Ax\left[1 - e^{-kx^2}\right]$
   Where x is the position; while A, k are constants. If the amplitude of oscillation be a, and the time period be T then
   (A) T is nearly independent of amplitude a for small values of a
   (B) T is nearly independent of amplitude a
   (C) $T \propto \frac{1}{a}\sqrt{\frac{m}{Ak}}$ for small values of amplitude a
   (D) $T \propto \frac{1}{a}\sqrt{\frac{m}{Ak}}$ for large values of amplitude a

3. Sound waves are incident normally onto a wall and are completely reflected off the wall. The waves have constant amplitude and have a fixed wavelength. It is observed that there is no sound at a point P, which is initially at a distance L_0 from the wall. The wall is slowly moved forward with uniform acceleration, and at a time t_0 after it starts: it is observed that the speed of the wall is v_0 and there is maximum sound at P. Which, of the following, is/are possible?
   (A) The wavelength of sound can have the value $\frac{v_0 t_0}{3}$.
   (B) The wavelength of sound can be $\frac{2v_0 t_0}{3}$.
   (C) $L_0 = \frac{5v_0 t_0}{3}$
   (D) $L_0 = v_0 t_0$

4. A metallic sphere having density ρ_s falls in glycerin of density ρ_g, which is kept in a cylindrical container of radius R and a very large height h. Assume that the acceleration due to gravity is g, that the radius of the sphere is a and that the viscosity of glycerin is very large (η).

(P) The terminal speed of the sphere is $v_T = \frac{2}{9}(\rho_s - \rho_g)\frac{a^2 g}{\eta}$.

(Q) The terminal speed of the sphere $v_T < \frac{2}{9}(\rho_s - \rho_g)\frac{a^2 g}{\eta}$.

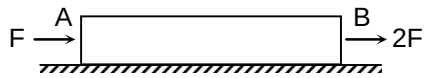
(R) The viscous force acting on the sphere is $6\pi\eta av$.

(S) The viscous force acting on the sphere is greater than $6\pi\eta av$.

Consider the statements ABOVE and select the correct option BELOW

(A) P & R are correct
(B) Q & S are correct
(C) P & S are correct
(D) Q & R are correct

5. A uniform metallic bar of mass m, length L and cross-sectional area 'A' is acted upon by force 2F, F as shown in the figure – acting along its length. There is no friction between the bar and the ground. Young's modulus of elasticity of the material of the bar is Y.



(A) The longitudinal stress within the bar is uniform and has the value $\frac{3F}{A}$.

(B) The longitudinal stress within the bar is uniform and has the value $\frac{F}{A}$.

(C) The longitudinal stress within the bar becomes zero, at the ends A & B.

(D) The average longitudinal strain in the bar is less than $\frac{F}{AY}$.

6. In a Young's double slit experiment, the fringe pattern is observed on a screen placed at a distance D from the slits. The slits are separated by a distance d, and are illuminated by monochromatic light of wavelength λ. The length of the slits is ℓ, ℓ is usually much greater than d. The slit width w is extremely small, and the slits are otherwise identical.

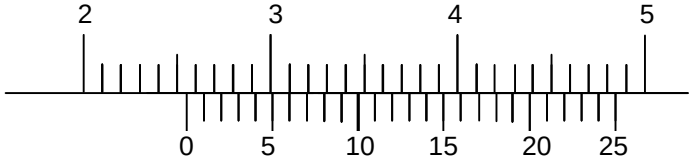
(A) The intensity falls to $\frac{1}{3}$ its maximum value at a distance of $\frac{\lambda D}{6d}$ from the central point.

(B) If the width of one of the slits is doubled (compared to the other), the intensity of the maxima decreases, and that of the minima also increases.

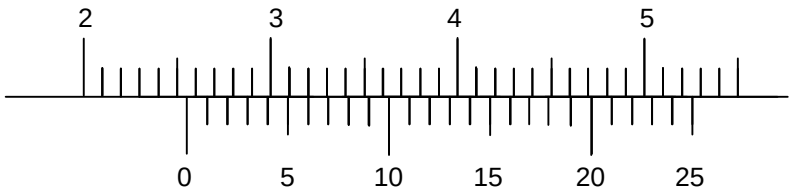
(C) If the length of the slits is decreased so that it is almost equal to w, the intensity of the maxima remains unchanged.

(D) If the length of the slits is decreased so that it is almost equal to w, the fringes become curved.

7. There are two Vernier Calipers both of which have 1 cm divided into 10 equal divisions on the main scale. The Vernier scale of one of the calipers has 25 equal divisions coinciding with 27 divisions on the main scale; while the Vernier scale of the other has 25 divisions coinciding with 23 divisions on the main scale. You have to decide which pair of data correspond to which calipers by referring to the figures below:



Vernier calipers C_1



Vernier calipers C_2

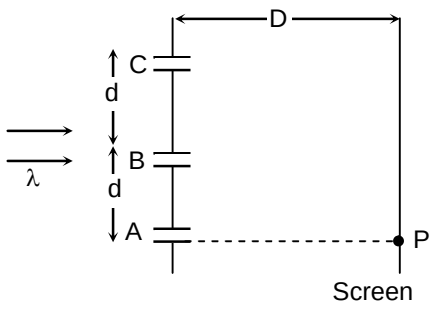
(A) The smallest reading that can be taken on C_1 is 0.004 cm.
(B) The smallest reading that can be taken on C_2 is 0.008 cm.
(C) The reading indicated by C_1 is 2.552.
(D) The reading indicated by C_2 is 2.548.

8. A cubical block is suspended by a uniform light wire. The wire vibrates in its 8^{th} harmonic in unison with a tuning fork. When the block is completely immersed in water, it is found to vibrate in its 10^{th} harmonic with the same turning fork. Find the specific gravity of the block.
(A) 0.7
(B) 1.4
(C) 2.8
(D) 5.6

9. A satellite orbits a spherical planet close to its surface, in a circular path, with an orbital speed v_0. Calculate (approximately) the impulse per unit mass to be delivered to the satellite in the direction of its velocity, so that it reaches a maximum altitude (above the planet's surface) equal to its radius.
(A) $0.3v_0$
(B) $0.15\ v_0$
(C) $0.6\ v_0$
(D) $0.075\ v_0$

10. Two equi-convex lenses of focal lengths 20 cm and 30 cm respectively are placed at a separation 'd' with their principal axes coinciding. An object placed at a distance 'u' from the first lens, forms an image at a distance 'v' from the second lens. Find the ratio $\frac{v}{u}$, if it is observed that u and v have the same set of values for d = 30 cm, 60 cm, 120 cm and 150 cm.
(A) 1/2
(B) 2/3
(C) 2
(D) 3/2

11. Three equidistant slits are illuminated by a monochromatic parallel beam of light falling normally onto them. The screen is parallel to the plane of the slits and the slit separation d << D, the slit-screen separation. The observation point P is directly opposite A. It is given that BP – AP = $\frac{\lambda}{4}$, λ being the wavelength of light. Find the ratio of the intensity at P when all slits are open to the intensity at P when only one slit is open.

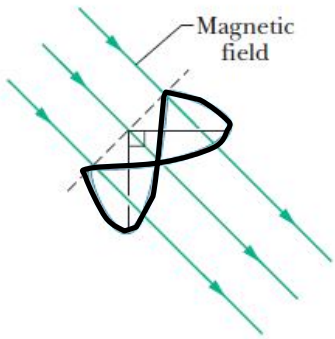


(A) 3
(B) 4
(C) 5
(D) 6

12. An electron moves in a circular orbit in a region containing a uniform magnetic field, B. Assume that Bohr's rule for quantization of angular momentum is valid. The flux of the magnetic field through the electron's orbit varies in integral multiples of $\frac{h}{\lambda e}$, where h is Planck's constant, e is the electronic charge and λ is a constant. Find λ.
(A) 0.5
(B) 2
(C) π
(D) 2π

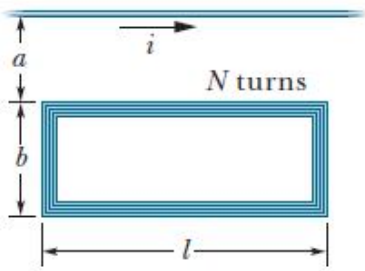
13. The electric field at a point associated with a light wave is given by
$$E = \left(200\frac{V}{m}\right)\sin\left(2\times10^{15}s^{-1}\right)t \ . \ \cos\left(7\times10^{15}s^{-1}\right)t + \left(100\frac{V}{m}\right)\sin\left(3\times10^{15}s^{-1}\right)t.\sin\left(6\times10^{15}s^{-1}\right)t.$$
If this light falls on a metal surface having work function 1.9 eV, then find the maximum KE of the emitted photoelectrons. Take h = 4.14×10^{-15} eV-s.
(A) 2 eV
(B) 2.5 eV
(C) 4 eV
(D) 6 eV

14. Figure shows a closed loop of wire that consists of a pair of equal semicircles, of radius R, lying in mutually perpendicular planes. The loop was formed by folding a flat circular loop along a diameter until the two halves became perpendicular to each other. A uniform magnetic field of magnitude B is directed perpendicular to the fold diameter and makes equal angles (of 45°) with the planes of the semicircles, initially (t = 0). The loop is rotated at a constant angular velocity ω about the fold diameter. This induces an emf, which causes a current to flow in the wire. The resistance per unit length of the wire is λ. The magnetic moment of the loop is



(A) $\left(\frac{B\pi R^3\omega}{2\sqrt{2}\lambda}\sin\omega t\right)$
(B) $\left(\frac{B\pi R^3\omega}{2\lambda}\cos\omega t\right)$
(C) $\left(\frac{B\pi R^3\omega}{4\lambda}\cos\omega t\right)$
(D) $\left(\frac{B\pi R^3\omega}{4\lambda}\sin\omega t\right)$

15. A rectangular loop of N closely packed turns is positioned near a long straight wire as shown in figure. The rectangular loop performs linear SHM with its distance 'a' varying as : a = a_0 + Asinωt, where A << a or b. The induced emf in the loop has the peak value.

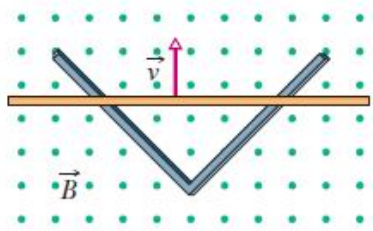


(A) $\frac{\mu_0 Ni}{2\pi}\left(\frac{\ell}{a_0}\right)A\omega$
(B) $\frac{\mu_0 Ni}{2\pi}\left(\frac{\ell b}{a_0(a_0+b)}\right)A\omega$

(C) $\frac{\mu_0 Ni}{2\pi}\left(\frac{b}{(a_0+b)}\right)A\omega$

(D) $\frac{\mu_0 Ni}{2\pi}\left(\frac{\ell b}{a_0}\right)\omega$

16. In the figure, two straight conducting rails form a right angle. A conducting bar in contact with the rails starts at the vertex at time t = 0 and moves with a constant velocity of v along them. A magnetic field B is directed out of the page. The current in the loop is (λ = resistance per unit length of the rails and bar).



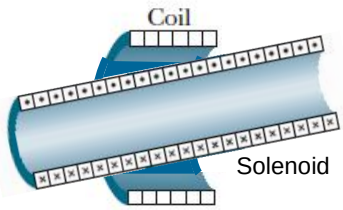
(A) $\frac{2Bv}{\lambda}$

(B) $\frac{Bv}{\lambda\left(1+\sqrt{2}\right)}$

(C) $\frac{\sqrt{2}Bv}{\lambda}$

(D) $\frac{2Bv}{\lambda\left(1+\sqrt{2}\right)}$

17. In the figure, a 120-turn coil of radius 5 cm and resistance 3.6 Ω is wrapped around a long solenoid of 250 turns/cm and diameter 4 cm. The axis of the coil and the axis of the solenoid make angle of 30° with each other. The solenoid current drops from 1.5 A to zero in time interval t = 25 ms. Find the total charge that flows through the coil. Take $\pi^2 \approx 10$.



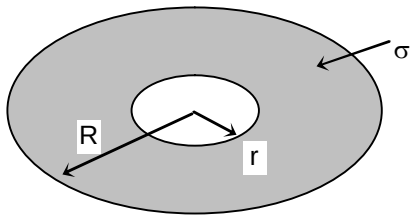
(A) 2×10^{-3}C

(B) 4×10^{-3}C

(C) $2\sqrt{3}\times10^{-3}$C

(D) $\sqrt{3}\times10^{-3}$C

18. Figure shows a annular disc of outer radius R inner radius r, and uniform surface charge density. Total charge is q. The potential at the centre is $\frac{kq}{r'}\left(k=\frac{1}{4\pi\varepsilon_0}\right)$ where r′ is



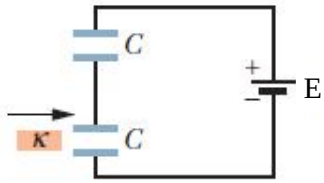
(A) $\frac{R+r}{2}$

(B) $\frac{R-r}{2}$

(C) $R+r$

(D) $R-r$

19. The initial charge on each 2μF capacitor is 6 μC, in the steady state. A dielectric slab of dielectric constant K = 4 is inserted slowly between the plates of the lower capacitor at a constant velocity so that its capacitance changes at a constant rate of 2μF/s. The current through the circuit, when the ratio of the voltages on the capacitors is 1 : 2, is



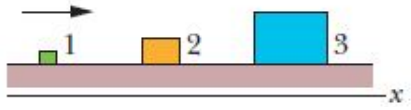
(A) $1.5\,\mu A$

(B) $3\,\mu A$

(C) $\frac{2}{3}\mu A$

(D) $\frac{4}{3}\mu A$

20. In figure, block 1 of mass m_1 slides along an *x* axis on a frictionless floor at speed 9 m/s. Then it undergoes a one-dimensional elastic collision with stationary block 2 of mass $m_2 = 2m_1$. Next, block 2 undergoes a one-dimensional elastic collision with stationary block 3 of mass $m_3 = 2\,m_2$.



Read the following four statement(s) which refer to the situation when the collisions are over.

(P) Block 3 has a speed of 4 m/s

(Q) The speed of Block 3 is less than the initial speed of block 1

(R) The momentum of block 3 is greater than the initial momentum of block 1

(S) The KE (kinetic energy) of block 3 is less than the initial KE of block 1

Select the correct option BELOW after considering the statements above.

(A) Only P, Q are correct

(B) P, Q, S are correct

(C) Q, R, S are correct

(D) All the statements are correct

21. Three flexible chains A, B & C, hanging from the ceiling by means of hooks are joined at their lowest points: all the three of them are horizontal at the common joint & make 120° with each other, in the horizontal plane. The chains A, B make 30° with the vertical at the ceiling, while chain C makes 60° with the vertical at the ceiling. The masses of the chains are m_A, m_B, m_C. The ratio $m_A : m_B : m_C$ equals

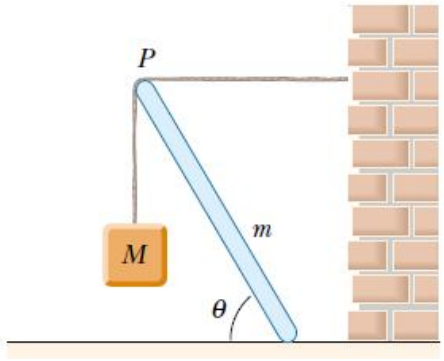
(A) $1:1:\sqrt{3}$

(B) 1 : 1 : 3

(C) $\sqrt{3}:\sqrt{3}:1$

(D) 3 : 3 : 1

22. A uniform beam of mass *m* is inclined at an angle θ to the horizontal. Its upper end produces a 90° bend in a very rough rope tied to a wall, and its lower end rests on a rough floor (see figure). If the coefficient of static friction between the beam and the floor is μ then the maximum value of M is given by the expression



(A) $M \le \frac{m(2\mu - \cot\theta)}{2(\cot\theta - \mu)}$

(B) $M \le \frac{\mu m}{(1-3\mu)}$

(C) $M \le \frac{m(2\mu - \tan\theta)}{2(\tan\theta - \mu)}$

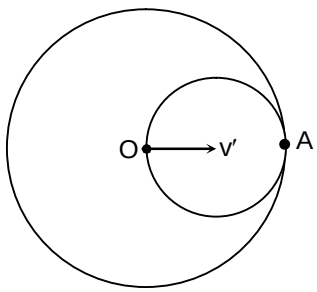
(D) $M \le \frac{m}{(1-3\mu)}$

23. The output current of a 60% modulated AM generator is 1.5 A. If the generator is additionally modulated by another radio wave of modulation index 0.7, the new modulation index is (in percentage)
(A) 20%
(B) 92%
(C) 80%
(D) 55%

24. N moles of an ideal diatomic gas is in an enclosed rigid volume at temperature T. Some heat is supplied to the gas, and it is observed that $\frac{N}{3}$ moles dissociate into atoms while the temperature remains constant. If heat supplied to the gas is Q then
(A) $Q = \frac{NRT}{6}$
(B) $Q = \frac{8}{3}NRT$
(C) $Q > \frac{NRT}{6}$
(D) $Q > \frac{8}{3}NRT$

25. A uniform solid cone of height H is cut at a distance x below its vertex, parallel to its base and the upper part is discarded. The C.M. of the remaining part is found to be 50% lower, w.r.t. to the base. The ratio, $r = \frac{x}{H}$ satisfies.
(A) $7r^3 - 8r^4 = 1$
(B) $r = \frac{1}{2^{1/3}}$
(C) $r = \frac{1}{2}$
(D) $7r^3 - 6r^4 = 1$

26. From a solid sphere of mass M and radius R, a spherical portion of radius $\frac{R}{2}$ is removed. The diameter of the cavity so formed coincides with a radius of the sphere. v_0 was the escape speed of a particle projected from the surface of this sphere without cavity. Then the velocity v′ that must be given to a particle along OA so that it can just reach A, starting from O within the cavity, is:



(A) v_0
(B) $\frac{v_0}{2}$

(C) $\frac{v_0}{\sqrt{2}}$

(D) $\frac{v_0}{4}$

27. A mixture of n_1 moles of a mono atomic gas and n_2 moles of a diatomic gas has $\frac{C_p}{C_v} = \gamma = 1.5$. Then, $\frac{n_1}{n_2}$ equals

(A) 2 : 1
(B) 1 : 2
(C) 1 : 1
(D) 1 : 3

28. The angular width of the central maximum of a diffraction pattern of a single slit pattern is 60°, the slit width being 1 μm. A double slit experiment is now performed with the same wavelength of light and the same slit widths and it is found that the 10^{th} interference maximum is not formed, but all lower maxima are visible. The separation between the double slits is

(A) 9 μm
(B) 10 μm
(C) 20 μm
(D) $10\sqrt{3}\mu$m

29. A Carnot engine converts $\frac{1}{5}$ of the available heat into work. Keeping the temperature of the reservoirs the same, two Carnot engines are used to replace the single Carnot engine: the heat rejected by the first is equal to the heat input to the second and the heat rejected by the second is to the lower reservoir. The efficiency of the second engine is 9.09% (i.e. $\frac{1}{11}$). The efficiency of the first engine is

(A) 11%
(B) 29%
(C) 12%
(D) 31%

30. An AC source producing emf $e = e_0\cos\left(100\pi s^{-1}\right)t + e_0\cos\left(500\pi s^{-1}\right)t$ is connected in series with a capacitor and resistor. The steady state current in the circuit is found to be $i = i_1\cos\left[\left(100\pi s^{-1}\right)t + \phi_1\right] + i_2\cos\left[\left(500\pi s^{-1}\right)t + \phi_2\right]$.

(A) $i_1 > i_2$
(B) $i_1 = i_2$
(C) $i_1 < i_2$
(D) The information is insufficient to find the relation between i_1 and i_2.

Chemistry

PART – II

SECTION – A
(One Options Correct Type)

This section contains **30 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

31. What is difference in the density (gm/litre) of dry air at 1 atm and 27°C and moist air with relative humidity 40% under same condition. Given that the vapour pressure of water is 19 torr at 27°C and dry air has 80% N_2 and 20% by volume.

(Take $R = \frac{1}{12}\ell$, atm $mol^{-1}K$)

(A) 2.32×10^{-3} g/L
(B) 6.24×10^{-3} g/L
(C) 1.64×10^{-3} g/L
(D) 4.38×10^{-3} g/L

32. Which of the following is not an example of disproportionation:

(A) HCHO + 50% conc. NaOH $\rightarrow$
(B) $P_4 + OH^- \rightarrow$
(C) $Br^- + BrO_3^- + H^+ \longrightarrow$
(D) $H_2O_2 \xrightarrow{h\nu}$

33. 2 moles of an ideal gas is slowly compressed from 1.2 L to 0.6 L at a constant temperature of 300 K. Calculate the work done by the gas in this process.

(A) 4.59 kJ
(B) 3.48 kJ
(C) 5.35 kJ
(D) 0

34. Which one of the following statements is **incorrect**?

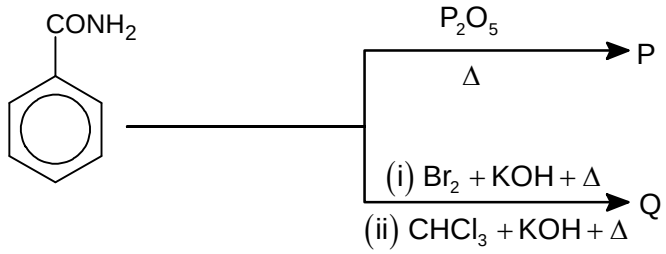
(A) For CH_3COCH_3 and $CHCl_3$ solution, $\Delta H_{solution} < 0$ and $\Delta V_{solution} < 0$
(B) When mercuric iodide is added to an aqueous solution of KI then freezing point of KI solution is raised and its boiling point is lowered.
(C) NaCl is less soluble in acetone than H_2O.
(D) For H_2O and $(CH_3)_3COH$ solution, $\Delta H_{solution} < 0$ and $\Delta V_{solution} < 0$.

35. (i) S_8 + NaOH (aq) $\longrightarrow$
(ii) $SF_4 + H_2O$ (liq.) $\longrightarrow$
(iii) $Na_2S_2O_3$ + HCl (aq) $\longrightarrow$
(iv) H_2S(aq) + SO_2(g) $\longrightarrow$

Which of the above reaction give one of the product as precipitate?

(A) (i) only
(B) (i) and (iii)
(C) (iii) and (IV)
(D) (ii) and (iv)

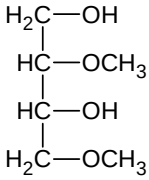
36.



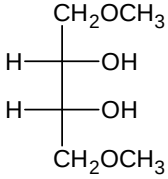
Which statement is **incorrect:**

(A) Reduced product of P and Q will be metamers to each other.
(B) By dry distillation of hydrolysed products of P with $Ca(OH)_2$, gives benzophenone.
(C) Hydrolysed product of Q, reacts with $NaNO_2$ + HCl followed by reaction with phenol, give orange red dye.
(D) Electrophile involved in the formation of Q is dichlorocarbene.

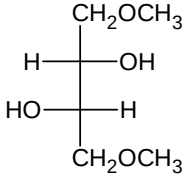
37. Match each of the following four structures with one of compounds A – D, on the basis of the following experimental facts. Compounds A, B and C are optically active but compound D is not compound C gives the same products as compound D on treatment with periodic acid, but compound B gives a different product. Compound A does not react with periodic acid.



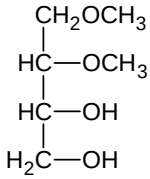
(I)



(II)



(III)



(IV)

(A) A – (III), B – (II), C – (I), D – (IV)
(B) A – (III), B – (I), C – (IV), D – (II)
(C) A – (I), B – (IV), C – (III), D – (II)
(D) A – (I), B – (IV), C – (II), D – (III)

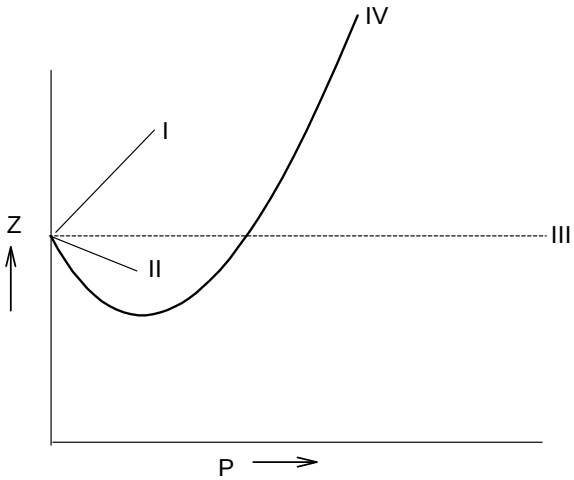
38. How many of the following give colourless gas/gases with conc. H_2SO_4?
$H_2C_2O_4$, NaCl, KI, HCOOH, $KClO_3$, Na_2CO_3, KBr, Na_3PO_4, $K_4[Fe(CN)_6]$

(A) 3
(B) 4
(C) 5
(D) 8

39. Which type of crystal systems (of the following) have all their interfacial angles right angle?

(A) Triclinic
(B) Monclinic
(C) Orthorhombic
(D) Hexagonal

40.



For the above plot of the compressibility factor Z versus P for few gases, which of the following statement is **incorrect** for a van der Waal's gas?

(A) The plot I is applicable provided the van der Waal's constant a is negligible.
(B) The plot II is applicable provided the van der Waal's constant b is negligible.
(C) The plot III is applicable provided the van der Waal's constant a and b are negligible.
(D) The plot IV is applicable provided the temperature of the gas is much higher than its critical temperature.

41. Solid BaF_2 is added to a solution containing 0.1 mole of sodium oxalate solution of 1 litre until equilibrium is reached. If the K_{sp} of BaF_2 and $BaC_2O_4(s)$ is 10^{-6} and 10^{-7} respectively. Assume addition of BaF_2 does not cause any change in volume and no hydrolysis of any of the catons or anions. If conc. of Ba^{+2} ions in resulting solution at equilibrium is represented as 2.7×10^{-x}, then x is…… (Given: $\sqrt{116} = 10.77$)

(A) 3
(B) 3.5
(C) 5
(D) 5.4

42. Which of the following involves carbon reduction during extraction of metal from ore?

(i)	Bauxite – Al	(ii)	Copper pyrites – Cu
(iii)	Haematite – Fe	(iv)	Galena – Pb
(v)	Carnelite – Mg	(vi)	Sylvine – K
(vii)	Cassiterite – Sn	(viii)	Zinc blende – Zn

(A) (iii), (iv), (vii), (viii)
(B) (iii), (iv), (vi)
(C) (i), (ii), (iii), (iv), (viii)
(D) (i), (ii), (iii), (viii)

43. Select correct orders of the properties given below:

(A) $CH_2F_2 > CH_3F > CHF_3 > CF_4$, decreasing C – F bond length.
(B) $CCl_4 < CH_3Cl < CH_2Cl_2 < CHCl_3$, increasing dipole moment.
(C) LiCl < NaCl < KCl < RbCl, increasing melting point.
(D) $COF_2 < COCl_2 < COBr_2$, increasing XOX bond angle.

44. Which of the following can give two gases on heating?

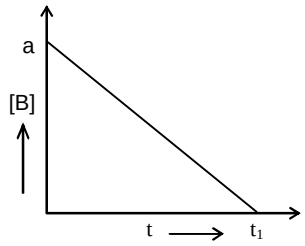
(A) $Zn(ClO_3)_2$
(B) NH_4ClO_4
(C) $K_2Cr_2O_7$
(D) $KMnO_4$

45. In the reaction: $A + 2B \longrightarrow$ Product

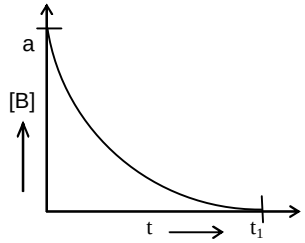
$\text{Rate} = K[A][B]^{o}$

The initial conc. of both A and B are 'a' molar. The graph of conc. of B vs. time is $(t_1 = t_{1/2}$ for $A)$

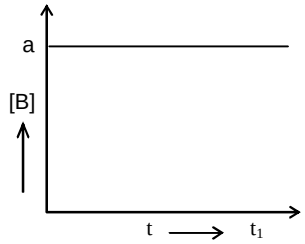
(A)



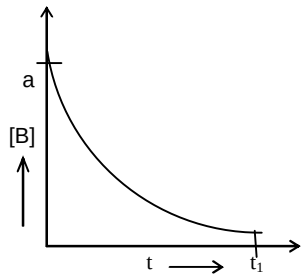
(B)



(C)



(D)



46. Which of the following statement is correct?
- (A) Brownian movement is more pronounced for smaller particles than for bigger ones.
- (B) Sols of metal sulphides are lyophilic.
- (C) Schulze-Hardy law states, the bigger the size of the ion, the greater is its coagulation power.
- (D) Charcoal absorb chlorine more strongly than hydrogen suphide.

47. Ammonia gas is prepared by:
- (A) Reduction of sodium nitrite or sodium nitrate by the reaction of zinc dust and NaOH.
- (B) Hydrolysis of calcium cyanamide.
- (C) Heating ammonium chloride with slaked lime.
- (D) All of the above.

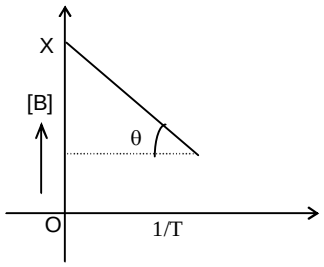
48. Which one of the following statements is **incorrect?**
(A) In the aluminothermite process aluminium acts as reducing agent.
(B) Lead is extracted from its ore by both carbon reduction and self reduction.
(C) Extraction of gold involves the leaching of ore with cyanide solution followed by reduction with zinc.
(D) In Hall-Heroult process, the electrolyte used is a molten mixture of alumina, NaOH and cryolite.

49. $FeCr_2O_4 + Na_2CO_3 + O_2 \xrightarrow{\text{Fusion}} [X] \xrightarrow[H_2O]{H^+} [Y] \xrightarrow[H_2O_2]{H^+} [Z]$

Which of the following statement is true for the compounds [X], [Y] and [Z]?
(A) In all three compounds, the chromium is in +6 oxidation state.
(B) [Z] is a deep blue-violet coloured compound which decomposes rapidly in aq. solution into Cr^{+3} and dioxygen.
(C) Saturated solution of [Y] gives bright orange compounds chromic anhydride with conc. H_2SO_4.
(D) All of these

50. Co-ordination number of Cr in $CrCl_3.6H_2O$ is 6. The volume of 0.1 N $AgNO_3$ needed to precipitate the chorine in ionization sphere in 200 ml of 0.01 M solution of the complex can not be:
(A) 60 ml
(B) 40 ml
(C) 80 ml
(D) 20 ml

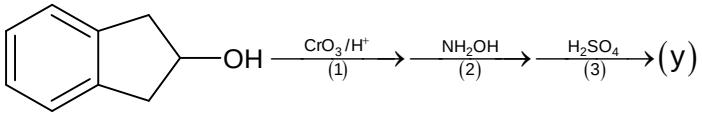
51. Graph between $\log K$ and $\frac{1}{T}$ [where K is rate constant (s^{-1}) and T is temperature in (K)] is a straight line with OX = 5, $\theta = \tan^{-1}\left[-\frac{1}{2.303}\right]$. Hence Ea and logA respectively will be:

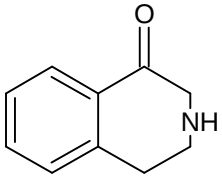


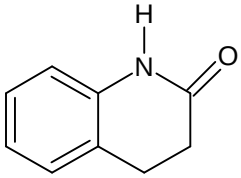
(A) 2.303 × 2 cal, 5
(B) $\frac{2}{2.303}$ cal, e^5
(C) 2 cal, 5
(D) None of these

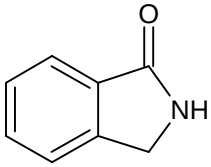
52. Total number of stereoisomers for the complex $[Pt(NH_3)_2(NO_3)_2\ ClBr]$ is:
(A) 2
(B) 4
(C) 6
(D) 8

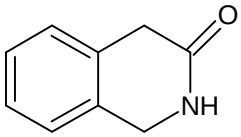
53. Major product of the following sequence of reactions could be:



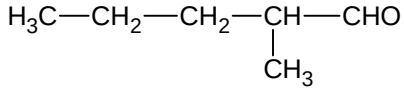
(A) 

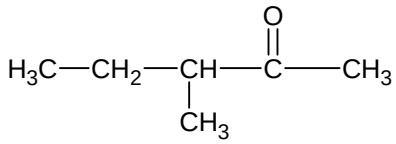
(B) 

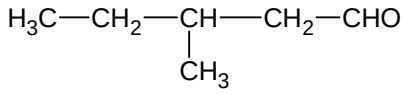
(C) 

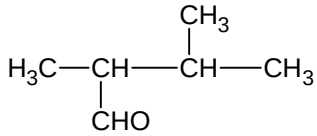
(D) 

54. Choose the correct optically active isomer of $C_6H_{12}O$ that gives a positive Tollen's test and does not racemise in base.

(A) 

(B) 

(C) 

(D) 

55. Which of the following statements are correct?
(i) Sucrose is dextrorotatory but after hydrolysis the mixture aquires a levorotatory nature.
(ii) In amylopectin branching occurs by $C_1 – C_6$ glycosidic linkage.
(iii) Glycine is a optically inactive amino acids.
(iv) Pernicious anemia is caused by deficiency of Vitamin B_{12}.
(A) (i), (ii), (iii), (iv)
(B) (i), (iii), (iv) only
(C) (ii), (iii), (iv) only
(D) (i), (ii) only

56. Which of the following reacting substances will not liberate ethyne gas?
(A) CH_3Cl and Ag
(B) CaC_2 and H_2O
(C) CHI_3 and Ag
(D) Vinylic chloride heated with sodamide followed by reaction with water.

57. $BrF_5 + H_2O \longrightarrow X + Y$
X and Y are respectively:
(A) HBr, HOF
(B) HBrO, HF
(C) $HBrO_2$, HF
(D) $HBrO_3$, HF

58. Number of orbital(s) in zinc having at least one angular node:
(A) 11
(B) 7
(C) 6
(D) 5

59. Which one of the following statements is correct?
(A) Potassium iodide solution reacts with $FeCl_3$ (aq) to form precipitate of FeI_3.
(B) XeF_6 reacts with silica to form a compound in which the oxidation state of Xe is 8.
(C) Anhydrous ferric chloride is prepared by heating hydrated ferric chloride with thionyl chloride.
(D) Iron reacts with Cl_2 to form $FeCl_2$.

60. Which is the correct statement for positive deviation of solution from Raoult's law?
(A) The energy released in solvation exceeds the energy used in breaking up interaction /intermolecular forces.
(B) Solute – solvent interaction is weaker than their own interactions (like particle interactions).
(C) Volume would contract during formation of solution.
(D) Boiling point of solution will be higher than expected.

Mathematics

PART – III

SECTION – A
(One Options Correct Type)

This section contains **30 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

61. A value of θ for which $\frac{(2\cos\theta + i)}{(\sin\theta - 1 - i\cos\theta)}$ is purely real, is

(A) $\frac{\pi}{4}$

(B) $\frac{\pi}{3}$

(C) $-\frac{\pi}{6}$

(D) $-\frac{\pi}{2}$

62. If $n \in N$ and $\int_0^1 e^x \cdot x^n dx = 120 - 44e$, then n is

(A) 3
(B) 4
(C) 5
(D) 6

63. If function $g(x) = x^3 + e^{4x}$ and $f(x) = g^{-1}(x)$, then the value of $f'(1)$ is

(A) $\frac{1}{4}$

(B) 4

(C) $\frac{1}{3 + 4e^4}$

(D) $3 + 4e^4$

64. If $x, y, z \in R^+$ and $16(16x^2 + y^2 - 4xy) = z(16x + 4y - z)$, then

(A) y, z, x are in A.P.
(B) y, z, x are in G.P.
(C) x, y, z are in A.P.
(D) x, y, z are in G.P.

65. The value of the expression $\frac{1}{\sqrt{3}\sin(250^o)} + \frac{1}{\cos(290^o)}$ is

(A) $\frac{\sqrt{3}}{4}$

(B) $\frac{4}{\sqrt{3}}$

(C) $\sqrt{3}$

(D) $\frac{1}{\sqrt{3}}$

66. The coefficient of x^5 in $(1 + x + x^2 + x^3)^{11}$ is
(A) 2,620
(B) 2,682
(C) 2,820
(D) 2,882

67. The number of irrational roots of the equation
$(x^2 – 3x + 1)(x^2 + 3x + 2)(x^2 – 9x + 20) = –30$ is
(A) 6
(B) 4
(C) 2
(D) 0

68. If $\tan(\pi \cos\theta) = \cot(\pi \sin\theta)$, then $\cos^2\left(\theta - \frac{\pi}{4}\right)$ is
(A) $\frac{1}{16}$
(B) $\frac{1}{8}$
(C) $\frac{1}{4}$
(D) $\frac{1}{2}$

69. Let $\vec{a} = \alpha\hat{i} + 2\hat{j} - 3\hat{k}$, $\vec{b} = \hat{i} + 2\alpha\hat{j} - 2\hat{k}$ and $\vec{c} = 2\hat{i} - \alpha\hat{j} + \hat{k}$ where $\alpha \in R$.
If $\{(\vec{a}\times\vec{b})\times(\vec{b}\times\vec{c})\}\times(\vec{c}\times\vec{a}) = 0$, then the value of α is
(A) $\frac{2}{3}$
(B) $\frac{3}{2}$
(C) $\frac{3}{4}$
(D) $\frac{4}{3}$

70. If $ax^2 + 2hxy – ay^2 = 0$, $a > 0$, represents a pair of straight lines forming with $2x + 3y = –8$ an isosceles triangle which is right angled at origin, then $(a + h)$ is
(A) 7
(B) 17
(C) –7
(D) –17

71. If real numbers x and y satisfy $x^2 + y^2 – 16x + 30y + 280 = 0$, then maximum value of $(x^2 + y^2)^{1/2}$ is
(A) 15
(B) 20
(C) 25
(D) 30

72. The value of $\tan^{-1}\left(\frac{9}{19}\right)+\tan^{-1}\left(\frac{9}{49}\right)+\tan^{-1}\left(\frac{9}{97}\right)+\tan^{-1}\left(\frac{9}{163}\right)+.....\infty$ equals

(A) $\tan^{-1}(3)$

(B) $\tan^{-1}\left(\frac{1}{3}\right)$

(C) $\tan^{-1}\left(\frac{2}{3}\right)$

(D) $\tan^{-1}\left(\frac{3}{2}\right)$

73. In a ΔABC, b = 10 units, c = 24 units and area of triangle is 120 square units (where b is side AC and c is side AB). If 'd' is the distance between vertex A and incentre of the triangle, then the value of d^2 is?

(A) 32
(B) 36
(C) 40
(D) 44

74. The number of positive integral solutions of the equation $\begin{vmatrix} x^3+1 & xy^2 & xz^2 \\ x^2y & y^3+1 & yz^2 \\ x^2z & y^2z & z^3+1 \end{vmatrix} = 37$ is

(A) 1
(B) 3
(C) 6
(D) 12

75. Radius of largest circle which passes through the focus of the parabola $y^2 = 5x$, and is contained in the parabola, is

(A) 4

(B) $\frac{21}{5}$

(C) 5

(D) $\frac{26}{5}$

76. The digits 1, 2, 3, 4, 5, 6, 7 and 8 are written in random order to form an eight digit number with distinct digits. Then the probability that this number is divisible by 36 is

(A) $\frac{11}{56}$

(B) $\frac{3}{14}$

(C) $\frac{13}{56}$

(D) $\frac{1}{4}$

77. A straight line PQ touches ellipse $\frac{x^2}{(3)^2}+\frac{y^2}{(1)^2}=1$ and circle $x^2 + y^2 = 4$. RS is a focal chord of ellipse. If RS is parallel to PQ and RS meets the circle at points R′ and S′, then the length of R′S′ is
(A) 1 unit
(B) 2 units
(C) 3 units
(D) 4 units

78. Let x, y, z and w be whole numbers. Then the number of 4 digit numbers 'xyzw' that can be formed such that x < y and z > w is
(A) 1,008
(B) 1,296
(C) 1,620
(D) 2,025

79. Let P(3 sec α, 2 tan α) and Q(3 sec β, 2 tan β) be two points on hyperbola $H_1 : \frac{x^2}{9}-\frac{y^2}{4}=1$ such that $\alpha-\beta=\frac{2\pi}{3}$. If PQ is tangent to hyperbola $H_2 : \frac{x^2}{a^2}-\frac{y^2}{b^2}=1$, then eccentricity of hyperbola H_2 is
(A) $\frac{\sqrt{10}}{3}$
(B) $\frac{2}{\sqrt{3}}$
(C) $\frac{\sqrt{13}}{3}$
(D) $\frac{\sqrt{5}}{\sqrt{3}}$

80. If matrix $A = [a_{ij}]_{4\times 4}$ such that $a_{ij}=\begin{cases}3 & ; \ i=j\\ 0 & ; \ i\neq j\end{cases}$ and $\det(\text{adj}(\text{adj } A)) = 3^k$, then k is
(A) 12
(B) 20
(C) 28
(D) 36

81. The equation of the image of the plane x – 2y + 2z – 3 = 0 in the plane x + y + z + 1 = 0 is
(A) x – 8y + 4z – 7 = 0
(B) x – 8y + 4z – 11 = 0
(C) x + 8y – 4z – 7 = 0
(D) x + 8y – 4z – 11 = 0

82. The proposition $\sim(p \vee q) \vee (\sim p \wedge q)$ is logically equivalent to
(A) ~p
(B) p
(C) ~q
(D) q

83. The mean of 5 observations is 4 and their variance is 5.2. If three of these observations are 1, 2 and 6, then the other two are
(A) 2, 9
(B) 3, 8
(C) 4, 7
(D) 5, 6

84. A balloon is observed simultaneously from three points A, B and C on a straight road directly under it. The angular elevation at B is twice that of A and at C is thrice that of A. If distance between A and B is 200 metres and distance between B and C is 100 metres, then the height of balloon is given by
(A) 50 m
(B) $50\sqrt{3}$ m
(C) 100 m
(D) $100\sqrt{3}$ m

85. The value of $\lim\limits_{x\to 0} \dfrac{(1+4x+x^2)^{\frac{1}{x}} - (1+4x-5x^2)^{\frac{1}{x}}}{x}$ is
(A) $5e^4$
(B) $6e^4$
(C) $7e^4$
(D) $8e^4$

86. If the number of points of discontinuity and number of points of non-differentiability of $f(x) = \text{minimum}\{\sin x, \sin^{-1}(\cos x)\}$ in $(0, 2\pi)$ are p and q respectively, then ordered pair (p, q) is
(A) (1, 2)
(B) (1, 3)
(C) (0, 2)
(D) (0, 3)

87. Let f: R $\to$ R be a function defined by $f(x) = -x^3 - 3x^2 - 6x + 1$. Number of integers in the solution set of x satisfying the inequality $f(f(x^3 + f(x))) \geq f(f(-f(x) - x^3))$ is
(A) 3
(B) 4
(C) 5
(D) 6

88. $\int \cos(9x) \cdot \cos^7 x\,dx$ equals
(A) $\dfrac{\sin(8x) \cdot \sin^8 x}{8} + c$
(B) $\dfrac{\sin(8x) \cdot \cos^8 x}{8} + c$
(C) $\dfrac{\cos(8x) \cdot \sin^8 x}{8} + c$
(D) $\dfrac{\cos(8x) \cdot \cos^8 x}{8} + c$

89. A continuous function f : R $\to$ R satisfies the differential equation $f(x) = (1+x^2)\left[1+\int_0^x \frac{(f(t))^2}{1+t^2}dt\right]$, then f(–3) is

(A) $\frac{13}{10}$

(B) $\frac{8}{5}$

(C) $\frac{10}{13}$

(D) $\frac{5}{8}$

90. Consider two curves $C_1 : y = e^x$ and $C_2 : y = e^{t-x}$, where $t \in R^+$. Let S be the area bounded by C_1, C_2 and y-axis. Then $\lim_{t\to 0}\left(\frac{S}{t^2}\right)$ is

(A) $\frac{1}{4}$

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

(C) 0

(D) 4