

WB JEE

Engineering Entrance Exam

Practice Set 4

Physics

Category I (Q. Nos. 1 to 30)

Carry 1 mark each and only one option is correct.
In case of incorrect answer or any combination of more than one answer, 1/4 mark will be deducted.

1. A particle is moving at a constant velocity v from a large distance towards a concave mirror of radius R along the principal axis. The speed of the image as a function of the distance x of the particle from the mirror is

(a) $\frac{R^2 v}{(R - 2x)^2}$	(b) $\frac{R^2}{(R - 2x)}$
(c) $\frac{R^2 v^2}{(R - 2x)^2}$	(d) $\frac{v^2}{(R - 2x)^2}$

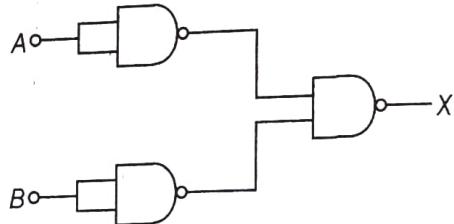
2. The activity of a radioactive substance is R_1 at time t_1 and R_2 at time $t_2 (> t_1)$. Its decay constant is λ_0 . Then,

(a) $R_1 t_1 = R_2 t_2$	(b) $R_2 = R_1 e^{\lambda(t_1 - t_2)}$
(c) $\frac{R_1 - R_2}{t_2 - t_1} = \text{constant}$	(d) $R_2 = R_1 e^{\lambda(t_2 - t_1)}$

3. In a photoemissive cell with exciting wavelength λ , the fastest electron has speed v . If the exciting wavelength is changed to $3\lambda/4$, then the speed of the fastest emitted electron will be

(a) $v \left(\frac{3}{4}\right)^{1/2}$	(b) $v \left(\frac{4}{3}\right)^{1/2}$
(c) less than $v(4/3)^{1/2}$	(d) greater than $v(4/3)^{1/2}$

4. Ionisation potential of hydrogen atom is 13.6 eV. The least energy of photon of Balmer series is
 (a) 3.4 eV (b) 1.89 eV (c) 10.2 eV (d) 8.5 eV
5. The current gain of a transistor in a common configuration is 40. If the emitter current is 82 mA, then base current is
 (a) 0.02 mA (b) 0.20 mA (c) 2.0 mA (d) 0.4 mA
6. The combination of gate shown below yields



- (a) OR gate (b) NOT gate
 (c) XOR gate (d) NAND gate

7. The dimensions of solar constants are
 (a) $[M^0 L^0 T^0]$ (b) $[MLT^{-2}]$ (c) $[ML^2 T^{-2}]$ (d) $[MT^{-3}]$
8. The period of oscillation of a simple pendulum is $T = 2\pi \sqrt{\frac{l}{g}}$. Measured value of l is 20.0 cm known to 1 mm accuracy and time for 100 oscillation of the pendulum is found to be 90 s using a wrist watch of 1 s resolution. The accuracy in the determination of g is
 (a) 2% (b) 3% (c) 1% (d) 5%

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9. A particle of mass m collides with another stationary particle of mass m . If the particle stops just after collision. The coefficient of restitution is equal to
 (a) $\frac{m}{M+m}$ (b) $\frac{m}{M}$ (c) 1 (d) $\frac{M-m}{M+m}$

10. A machine gun fire 360 bullets per minute with a velocity of 600 ms^{-1} . If the power of gun is 5.4 kW . Mass of each bullet is
 (a) 5 kg (b) 0.5 kg (c) 5 g (d) 0.5 g

11. A range of projectile fixed at an angle of 15° is 50 m. If it is fired with the same speed at an angle of 45° . Its range will be
 (a) 25 m (b) 50 m (c) 100 m (d) 77.6 m

12. A geostationary satellite is orbiting. The earth at a height $6R$ above the earth surface, where R is radius of earth. The time period of another satellite at a height $2.5R$ from earth's surface would be
 (a) 24 h (b) $\frac{6}{2.5} \text{ h}$ (c) $\frac{2.5}{6} \text{ h}$ (d) $6\sqrt{2} \text{ h}$

13. A rubber cube of each side 7 cm has one side fixed, while a tangential force equal to the weight of 300 kgf is applied to the opposite face. What is the shearing strain produced and the distance through which the strained side moves? (The modulus of rigidity for rubber is $2 \times 10^7 \text{ dyne cm}^{-2}$, $g = 10 \text{ ms}^{-2}$)
 (a) 0.3 rad, 2.1 cm (b) 0.2 rad, 2.1 cm
 (c) 0.4 rad, 2.1 cm (d) 0.3 rad, 2.5 cm

14. At what speed will the velocity of a stream of water be equal to 20 cm of mercury column? (Take, $g = 10 \text{ ms}^{-2}$)
 (a) 6.4 ms^{-1} (b) 7.3756 ms^{-1}
 (c) 6.4756 ms^{-1} (d) None of these

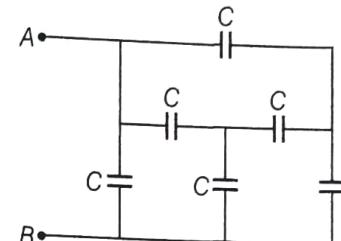
15. Two metallic spheres s_1 and s_2 are made of the same material and have identical surface finish. The mass of s_1 is three times that of s_2 . Both the spheres are heated to the same high temperature and placed in the same room having lower temperature but are thermally insulated from each other. The ratio of initial rates of cooling of s_1 to that of s_2 is
 (a) $\frac{1}{\sqrt{3}}$ (b) $\left(\frac{1}{3}\right)^{1/3}$ (c) $\frac{1}{\sqrt{3}}$ (d) $\frac{\sqrt{3}}{1}$

16. If C_s is the velocity of sound in air and C is the rms velocity, then

- (a) $C_s < C$ (b) $C_s = C$
 (c) $C_s = C \left(\frac{\gamma}{3}\right)^{1/2}$ (d) None of these

17. At constant temperature, the volume of gas is to be decreased by 4%. The pressure must be increased by
 (a) 4% (b) 4.16% (c) 8% (d) 3.86%

18. Find the equivalent capacitance of the system across the terminals A and B . All the capacitors have equal capacitances.



- (a) $2C$ (b) $3C$ (c) $4C$ (d) $5C$

19. Three point charges q , $2q$ and $4q$ are to be placed on a 9 cm long straight line. Find the position of the charge q such that the potential energy of this system is minimum

- (a) 1 cm from $2q$ (b) 2 cm from $2q$
 (c) 3 cm from $2q$ (d) 4 cm from $2q$

20. The electric strength of air is $2 \times 10^7 \text{ NC}^{-1}$. The maximum charge that a metallic sphere of diameter 6 mm can hold is

- (a) 3 nC (b) 20 nC (c) 1.5 nC (d) 2 nC

21. Magnetic field at the centre of a circular loop of area A is B . The magnetic moment of the loop will be

- (a) $\frac{BA^2}{\mu_0 \pi}$ (b) $\frac{BA^{3/2}}{\mu_0 \pi}$ (c) $\frac{BA^{3/2}}{\mu_0 \pi^{1/2}}$ (d) $\frac{2BA^{3/2}}{\mu_0 \pi^{1/2}}$

22. Two circular coil mounted parallel to each other on the same axis carry steady currents. If an observer between the coils reports that one coil is carrying a clockwise current i_1 , while the other is carrying a counter clockwise current i_2 between the coils, then there is

- (a) steady repulsive force (b) zero force
 (c) a repulsive force (d) a steady attractive force

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23. The magnetic susceptibility of a paramagnetic material at -73°C is 0.0075. Its value at -173°C will be
 (a) 0.0045 (b) 0.0030 (c) 0.015 (d) 0.0075
24. The magnetic moment μ of a revolving electron around the nucleus varies with principal quantum numbers n as
 (a) $\mu \propto n$ (b) $\mu \propto \frac{1}{n}$ (c) $\mu \propto n^2$ (d) $\mu \propto \frac{1}{n^2}$
25. The value of i_1 in the circuit diagram will be
-
- (a) 1 A (b) $\frac{1}{2}$ A (c) $\frac{3}{4}$ A (d) $\frac{3}{2}$ A
26. Under what condition will the strength of current in a wire of resistance R be the same for connection in n -series or in parallel of n identical cells each of the internal resistance r_1 when
 (a) $R = nr$ (b) $R = r/n$
 (c) $R = r$ (d) $R \rightarrow \infty, r \rightarrow 0$
27. In an $L-R$ circuit, the value of L is $0.4/\pi$ and the value of R is 30Ω . If in the circuit, an alternating emf of 200 V at 50 cycle per second is connected, the impedance of the circuit and current will be
 (a) $11.4\Omega, 17.5\text{ A}$ (b) $30.7\Omega, 6.5\Omega$
 (c) $40.4\Omega, 5\text{ A}$ (d) $50\Omega, 4\text{ A}$
28. Two identical glass ($\mu_g = 3/2$) equiconvex lenses of focal length f are kept in contact. The space between the two lenses is filled with water ($\mu_w = 4/3$). The focal length of the combination is
 (a) f (b) $\frac{f}{2}$ (c) $\frac{4f}{3}$ (d) $\frac{3f}{4}$
29. A beam of light of wavelength 600 nm from a distance source falls on a single slit 1.0 mm wide and the resulting diffraction pattern is observed on a screen 2 m away. What is the distance between first dark fringe on either side of the central bright fringe.
 (a) 1.5 mm (b) 1 mm (c) 1.2 mm (d) 2.4 mm
30. In young's double slit experiment, the length of band is 1 mm . The ring width is 1.021 mm . The number of fringe is
 (a) 45 (b) 46 (c) 47 (d) 48
- Category II (Q. Nos. 31 to 35)**
 Carry 2 mark each and only one option is correct. In case of incorrect answer or any combination of more than one answer, $1/2$ mark will be deducted.
31. An inductor of inductance $L = 440\text{ mH}$ and resistors of resistances $R_1 = 2\Omega$ and $R_2 = 2\Omega$ are connected to battery of emf 12 V as shown in the figure. The internal resistance of battery is negligible. The switch S is closed at $t = 0$. The potential drop across L as a function of time is
-
- (a) $\frac{12}{t}e^{-3t}\text{ V}$ (b) $6(1 - e^{-t/0.2})\text{ V}$
 (c) $12e^{-5t}\text{ V}$ (d) $6e^{-5t}\text{ V}$
32. Water flows through a horizontal pipe of variable cross-section at rate of 20 L per min . What will be velocity of water at a point where diameter is 4 cm ?
 (a) 0.2651 ms^{-1} (b) 0.5639 ms^{-1}
 (c) 0.4639 ms^{-1} (d) 0.3639 ms^{-1}
33. Water falls from a height of 500 m . What is the rise in temperature of water at the bottom, if whole energy is used up in heating water?
 (a) 0.96°C (b) 1.02°C (c) 1.16°C (d) 0.23°C
34. Instantaneous displacement current of 1.0 A in the space between the parallel plates of $1\mu\text{F}$ capacitor can be established by changing potential difference of
 (a) 10^{-6} Vs^{-1} (b) 10^6 Vs^{-1} (c) 10^{-8} Vs^{-1} (d) 10^8 Vs^{-1}

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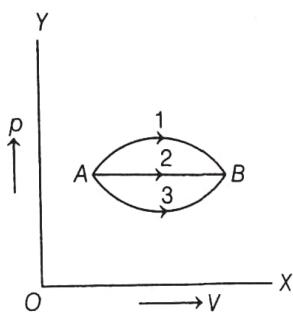
35. The self inductance of the motor of an electric fan is 10 H. In order to impart maximum power at 50 Hz. It should be connected to a capacitor of
 (a) 3×10^{-6} F (b) 2×10^{-6} F
 (c) 10^{-6} F (d) 10^{-6} F

Category III (Q. Nos. 36 to 40)

Carry 2 mark each and only one option is/are correct. If all correct answers are not marked and = 2 × number of correct answers marked then score number of correct answers marked ÷ actual marked or if any combination including a wrong option is marked, the answer will be considered wrong, but there is not negative marking for the same and zero mark will be awarded.

36. When photons of energy 4.25 eV strike the surface of a metal, the ejected photoelectrons have a maximum kinetic energy E_A eV and de-Broglie wavelength λ_A . The maximum kinetic energy of a photoelectrons liberated from another metal B by photons of energy 4.70 eV is $E_B = (E_A - 1.50)$ eV. If the de-Broglie wavelength of the these photoelectron is $\lambda_B = 2\lambda_A$, then
 (a) the work function of A is 2.25 eV
 (b) the work function of B is 4.20 eV
 (c) $E_A = 2.5$ eV (d) $E_B = 2.75$ eV

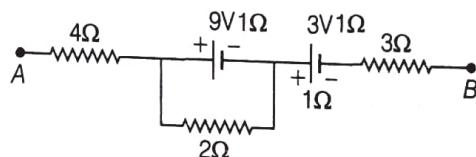
37. A gas undergoes a change in its state from position A to position B via three different paths as shown in the figure. Select the correct statement.



- (a) Heat is absorbed by the gas in all the three paths
- (b) Heat absorbed/released by the gas is maximum in path 2
- (c) Temperature of the gas increases first and then decreased continuously in path 2
- (d) Change in internal energy of the gas is same along all the three paths

38. A particle is projected from a point A with a velocity v at an angle of elevation θ . At a certain point B , the particle moves at right angle to its initial direction. Then,
 (a) velocity of particle at B is $v \sin \theta$
 (b) velocity of particle at B is $v \cot \theta$
 (c) velocity of particle at B is $v \tan \theta$
 (d) velocity of flight from A to B is $\frac{v}{g \sin \theta}$

39. The potential difference between the points A and B in the circuit shown in figure is 16 V. Which is/are the correct statements out of the following?



- (a) The current through the 2Ω resistor is 3.5 A
- (b) The current through the 4Ω resistor is 2.5 A
- (c) The current through the 3Ω resistor is 1.5 A
- (d) The potential difference between the terminals of the 9 V battery is 7 V

40. A charged particle P leaves the origin with speed $v = v_0$, at some inclination with the X -axis. There is uniform magnetic field B along the X -axis. P strikes a fixed target T on the X -axis for a minimum value of $B = B_0$. P will also strikes T , if
 (a) $B = 2B_0, v = 2v_0$
 (b) $B = 2B_0, v = v_0$
 (c) $B = B_0, v = 2v_0$
 (d) $B = B_0/2, v = v_0/2$

Chemistry

Category I (Q. Nos. 41 to 70)

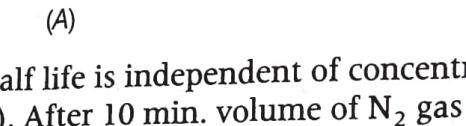
*Carry 1 mark each and only one option is correct.
In case of incorrect answer or any combination of
more than one answer, 1/4 mark will be deducted.*

- 47.** KF combines with HF to form KHF_2 . The compound contains the species.
 (a) K^+ , F^- and H^+ (b) K^+ , F^- and HF
 (c) K^+ and $[\text{HF}_2]^-$ (d) $[\text{KHF}]^+$ and F^-

48. Which of the following factors is most important in making the fluoride as strongest oxidising agent?
 (a) Electron affinity
 (b) Ionisation enthalpy
 (c) Hydration enthalpy
 (d) Bond dissociation energy

49. The electrons can be identified by quantum numbers n and l , the correct order of increasing energy for the following orbitals is
 1. $n = 4, l = 1$ 2. $n = 4, l = 0$
 2. $n = 3, l = 2$ 4. $n = 3, l = 1$
 (a) (3) < (4) < (2) < (1) (b) (4) < (2) < (3) < (1)
 (c) (2) < (4) < (1) < (3) (d) (1) < (3) < (2) < (4)

50. Hydrolysis of trichloromethane with aqueous KOH gives
 (a) methanol (b) acetic acid
 (c) ethanol (d) formic acid

1. For the reaction,

 (A)

the half life is independent of concentration of (A). After 10 min. volume of N_2 gas is 10 L and after complete reaction is 50 L. Hence, rate constant is
 (a) $\frac{2.303}{10} \log 5 \text{ min}^{-1}$ (b) $\frac{2.303}{10} \log 125 \text{ min}^{-1}$
 (c) $\frac{2.303}{10} \log 2 \text{ min}^{-1}$ (d) $\frac{2.303}{10} \log 4 \text{ min}^{-1}$

• Which of the following pair of compounds cannot exist together in a solution?
 (a) NaHCO_3 and NaOH (b) NaHCO_3 and H_2O
 (c) NaHCO_3 and NaCl (d) Na_2CO_3 and NaOH

An acid, that cannot suitable for preparation of H_2 by the action of metals is
 (a) HCl (b) CH_3COOH
 (c) HNO_3 (d) H_2SO_4

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54. During electrolysis of fused calcium hydride, hydrogen is produced at
 (a) cathode
 (b) anode
 (c) hydrogen will not liberate
 (d) H_2 produced will react with oxygen and give H_2O

55. Assuming that each salt is 90% dissociated. Which of the following will have highest osmotic pressure?
 (a) Decinormal $Al_2(SO_4)_3$ (b) Decinormal $BaCl_2$
 (c) Decinormal Na_2SO_4 (d) Decinormal Urea.

56. For a reaction,



If, $K_c = 10^{12}$, then $E_{(cell)}^\circ$ is

- (a) 0.354 V (b) 0.708 V (c) 0.0098 V (d) 1.36 V

57. Radon is produced by radioactive decay of
 (a) Ra (b) U
 (c) Th (d) None of these

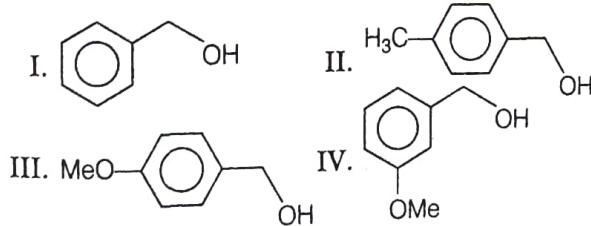
58. The equivalent weight of $MnSO_4$ is half of its molecular weight, when it is converted to
 (a) Mn_2O_3 (b) MnO_2
 (c) MnO_4^- (d) MnO_4^{2-}

59. Geometry of $Ni(CO)_4$ and $Ni(PPh_3)_2Cl_2$ are
 (a) both are square planar
 (b) square planar and tetrahedral respectively
 (c) both are tetrahedral
 (d) tetrahedral and square planar respectively

60. Arsenic (III) sulphide forms with negative charge over it. Which of the following ionic substance should be most effective in coagulation of solution?

- (a) KCl (b) $MgCl_2$
 (c) $Al_2(SO_4)_3$ (d) Na_3PO_4

61. The decreasing order of reactivity of the following compounds with HBr is



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

62. The decreasing order of rate of bromination of the following compounds is

- (I) $ph-NMe_3$ (II) $ph-\overset{\oplus}{CH_2}NMe_3$
 (III) $ph-Me$ (IV) $ph-\overset{\oplus}{N}Me_2$
 (a) (I) > (II) > (III) > (IV)
 (b) (IV) > (III) > (II) > (I)
 (c) (III) > (IV) > (I) > (II)
 (d) (III) > (IV) > (II) > (I)

63. Which one of the following arrangement represents the correct order of electron gain enthalpy (with negative sign) of the given atomic species?

- (a) $Cl < F < S < O$ (b) $O < S < F < Cl$
 (c) $S < O < Cl < F$ (d) $F < Cl < O < S$

64. Which of the following is correct option for free expansion of an ideal gas under adiabatic condition?

- (a) $q \neq 0, \Delta T = 0, W = 0$ (b) $q = 0, \Delta T = 0, W = 0$
 (c) $q = 0, \Delta T < 0, W \neq 0$ (d) $q = 0, \Delta T \neq 0, W = 0$

65. A reaction is $A + B \longrightarrow C + D$, initially start with equal concentrations of (A) and (B), we find the moles of C is two times of (A). What is the equilibrium constant of the reaction?

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

66. A solid compound 'X' on heating gives CO_2 gas and a residue. The residue mixed with water forms 'Y'. On passing an excess of CO_2 through 'Y' in water, a clear solution of 'Z' is obtained. On boiling the 'Z', 'X' is reformed. The compound 'X' is

- (a) $Ca(HCO_3)_2$ (b) $CaCO_3$
 (c) Na_2CO_3 (d) K_2CO_3

67. Which of the following undergoes nucleophilic substitution exclusively by S_N1 mechanism?

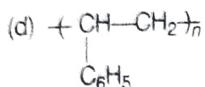
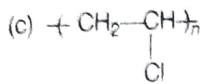
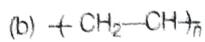
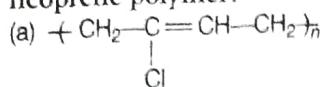
- (a) Benzyl chloride (b) Ethylchloride
 (c) Chloro propane (d) Isopropyl chloride

68. Hydrolysis of sucrose is called

- (a) inversion (b) esterification
 (c) hydration (d) saponification

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69. Which of the following structure represent neoprene polymer?



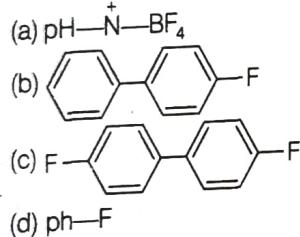
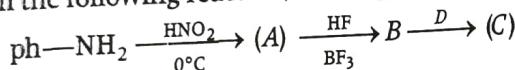
70. Which one of the following is employed as a tranquilizer drug?

- (a) Promethazine (b) Valium
 (c) Naproxen (d) Mifepristone

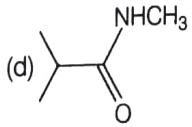
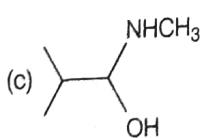
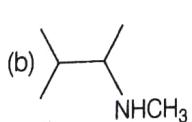
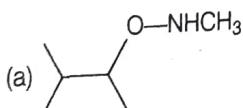
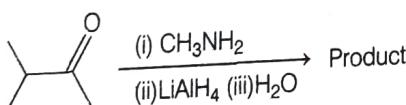
Category II (Q Nos. 71 to 75)

Carry 2 marks each and only one option is correct.
In case of incorrect answer or any combination of
more than one answer, 1/2 mark will be deducted.

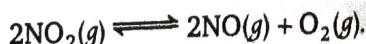
71 In the following reaction, identify product (C)



72. The major organic compound formed from the following reaction



73. For the reaction,



$(K_c = 1.8 \times 10^{-6}$ at 184°C and $R = 0.000831$ kJ/mol K) when K_p and K_c are compared at 184°C , it is found that
 (a) $K_p \leq K_c$ (b) $K_p = K_c$ (c) $K_p < K_c$ (d) $K_p > K_c$

74. Which of the following is a polar molecule
 (a) SF_4 (b) SiF_4 (c) BaCl_2 (d) BF_3

75. Among the given compounds, which one can be distinguished by AgNO_3 ,

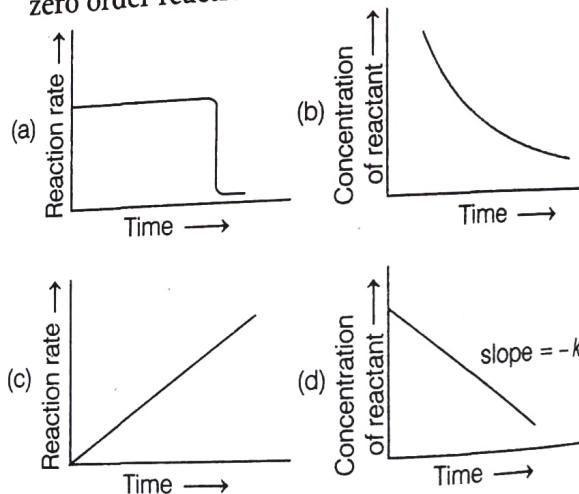
- (a) ethene
- (b) ethylene
- (c) acetylene
- (d) diethyl ether

Category III (Q Nos. 76 to 80)

Category -

Carry 2 marks each and one or more options(s) is/are correct. If all correct answers are not marked and also no incorrect answer is marked then score = $2 \times$ number of correct answers marked \div actual number of correct answers. If any wrong option is marked or if any combination including a wrong option is marked, the answer will be considered wrong, but there is no negative marking for the same and zero mark will be awarded.

76. Which of the following graphs is correct for a zero order reaction?



77 Which of the following are cyclic compounds?

- (a) Borazole
 - (b) Pyrrole
 - (c) Anthracene
 - (d) Isobutylene

78. Which of the following species are isoelectronic as well as isostructural?

- (a) CH_4 (b) NH_4^+ (c) HF (d) NO_3^-

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- 79.** Which of the following options are not in accordance with the property mentioned against them?
- $F_2 > Cl_2 > Br_2 > I_2$ Oxidising power
 - $Mi > MBr > MCl > MF$ Ionic character of metal halide
 - $F_2 > Cl_2 > Br_2 > I_2$ Bond dissociation enthalpy
 - $Hl < HBr < HCl < HF$ Hydrogen-halogen bond strength

- 80.** Which of the following reactions would give propanal?

- Ethyl propanoate + DBAH (diisobutyl aluminium hydride) $[(i - C_4H_9)_2AlH]$ at $-70^\circ C$ followed by hydrolysis
- Propyl propanoate + DIBAL-H/H₂O
- Ethyl cyanide + DBAH
- Propanoyl chloride + LBAH

Mathematics

Category I (Q. Nos. 1 to 50)

Only one answer is correct. Correct answer will fetch full marks 1. Incorrect answer or any combination of more than one answer will fetch $-1/4$ marks.

- 1.** $\lim_{x \rightarrow \infty} \frac{\log[x]}{x}$, where $[x]$ denotes the greatest integer less than or equal to x , is
- 0
 - 1
 - 1
 - Non-existent

- 2.** If $u = \int e^{ax} \sin bx dx$ and $v = \int e^{ax} \cos bx dx$, then $(u^2 + v^2)(a^2 + b^2)$ is equal to
- $2e^{2ax}$
 - e^{2ax}
 - $2e^{2ax}$
 - bxe^{ax}

- 3.** The equation of a curve passing through the point $(0, 1)$ be given by $y = \int x^2 \cdot e^{x^3} dx$. If the equation of the curve be written in the form $x = f(y)$, then $f(y)$ is equal to

- $\sqrt{\log_e(3y - 2)}$
- $\sqrt[3]{\log_e(3y - 2)}$
- $\sqrt[3]{\log_e(2 - 3y)}$
- None of these

- 4.** If $\int_{\sin x}^1 t^2 f(t) dt = 1 - \sin x$ for all $x \in \left[0, \frac{\pi}{2}\right]$, then $f\left(\frac{1}{\sqrt{3}}\right)$ is equal to
- 3
 - $\sqrt{3}$
 - $\frac{1}{3}$
 - None of these

- 5.** The value of $\int_0^2 x d([x] - x)$ is
- $\frac{1}{2}$
 - 1
 - 1
 - 0

- 6.** If $\int f(x) dx = 2\{f(x)\}^3 + c$, then $f(x)$ is

- $\frac{x}{2}$
- x^3
- $\frac{1}{\sqrt{x}}$
- $\sqrt{\frac{x}{3}}$

- 7.** The value of the integral $\int_0^{400\pi} \sqrt{1 - \cos 2x} dx$ is
- $200\sqrt{2}$
 - $400\sqrt{2}$
 - $800\sqrt{2}$
 - None of these

- 8.** $\lim_{n \rightarrow \infty} \left\{ \frac{1}{n^2} \sec^2 \frac{1}{n^2} + \frac{2}{n^2} \sec^2 \frac{4}{n^2} + \dots + \frac{1}{n} \sec^2 1^\circ \right\}$ equals

- $\frac{1}{2} \tan 1^\circ$
- $\tan 1^\circ$
- $\frac{1}{2} \operatorname{cosec} 1^\circ$
- $\frac{1}{2} \sec 1^\circ$

- 9.** The general solution of the differential equation $(x + y)(dx - dy) = dx + dy$ is

- $(x - y) = ke^{x-y}$
- $x + y = ke^{x+y}$
- $(x + y) = k(x - y)$
- $x + y = ke^{x-y}$

- 10.** Solution of the differential equation

- $\cos x dy = y(\sin x - y)dx$, $0 < x < \frac{\pi}{2}$ is

- $y \tan x = \sec x + c$
- $\tan x = (\sec x + c)y$
- $\sec x = (\tan x + c)y$
- $y \sec x = \tan x + c$

- 11.** If the chords of tangents from two points (x_1, y_1) and (x_2, y_2) to the hyperbola

- $$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$
- are at right angles, then
- $\frac{x_1 x_2}{y_1 y_2}$
- equal to

- $-\frac{a^2}{b^2}$
- $-\frac{b^2}{a^2}$
- $-\frac{b^4}{a^4}$
- $-\frac{a^4}{b^4}$

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43. If $\tan \theta_1 \tan \theta_2 = -\frac{a^2}{b^2}$, then the chord joining

two points θ_1 and θ_2 on the ellipse

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ will subtend a right angle at

- (a) focus (b) centre
- (c) end of the major axis (d) end of minor axis

44. The equation of the plane through the line $x + y + z - 3 = 0 = 2x - y + 3z + 1$ and parallel to the line $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$, is

- (a) $x - 5y + 3z = 7$ (b) $x - 5y + 3z = -7$
- (c) $x + 5y + 3z = 7$ (d) $x + 5y + 3z = -7$

45. If α and β are the roots of the equation $ax^2 + bx + c = 0$, then

$\lim_{x \rightarrow \alpha} \frac{1}{(1 + ax^2 + bx + c)^{x - \alpha}}$ is

- (a) $e^{a(\alpha - \beta)}$ (b) $e^{a(\beta - \alpha)}$
- (c) 1 (d) None of these

46. Let f and g be differentiable functions satisfying $g'(a) = 2$, $g(a) = b$ and $f \circ g = 1$ (identity function). Then, $f'(b)$ is equal to

- (a) 2 (b) $\frac{2}{3}$
- (c) $\frac{1}{2}$ (d) None of these

47. A line makes the same angle θ , with each of the X and Z -axes. If the angle β , which it makes with Y -axis, is such that $\sin^2 \beta = 3 \sin^2 \theta$, then $\cos^2 \theta$ equals

- (a) $\frac{2}{5}$ (b) $\frac{1}{5}$ (c) $\frac{3}{5}$ (d) $\frac{2}{3}$

48. $\lim_{x \rightarrow \frac{\pi}{2}} \frac{\left[\frac{x}{2} \right]}{\log_e(\sin x)}$ where $[.]$ denotes the greatest integer function

- (a) does not exist (b) equals 1
- (c) equals 0 (d) equals -1

49. Let f be a function satisfying $f'(x) = f(x)$. Then, $(f^{-1})''(x)$ is equal to

- (a) $-\frac{1}{x^3}$ (b) $-\frac{1}{x^2}$ (c) $f(x)$ (d) $f^{-1}(x)$

50. If $f(x)$ is continuous and differentiable function such that $f\left(\frac{1}{n}\right) = 0$ for all $n \in N$, then

- (a) $f(x) = 0$ for all $x \in N \cup (0, 1]$
- (b) $f(0) = 0, f'(0) = 0$
- (c) $f'(0) = (0), f''(0) = 0$
- (d) $f(0)$ and $f'(0)$ may or may not be zero

Category II (Q. Nos. 51 to 65)

Carry 2 marks each and only one option is correct. In case of incorrect answer or any combination of more than one answer, 1/2 mark will be deducted.

51. If $\sum_{r=1}^{\infty} \frac{1}{(2r-1)^2} = \frac{\pi^2}{8}$, then $\sum_{r=1}^{\infty} \frac{1}{r^2}$ is equal to

- (a) $\frac{\pi^2}{24}$ (b) $\frac{\pi^2}{3}$
- (c) $\frac{\pi^2}{6}$ (d) None of these

52. If $I_n = \int (\log x)^n dx$, then $I_n + n \cdot I_{n-1}$ is equal to

- (a) $(x \log x)^n$ (b) $x (\log x)^n$ (c) $n (\log x)^n$ (d) $(\log x)^{n-1}$

53. Given, $|\mathbf{a}| = |\mathbf{b}| = 1$ and $|\mathbf{a} + \mathbf{b}| = \sqrt{3}$. If \mathbf{c} be vector such that $\mathbf{c} - \mathbf{a} - 2\mathbf{b} = 3(\mathbf{a} \times \mathbf{b})$, then $\mathbf{c} \cdot \mathbf{b}$ is equal to

- (a) $-\frac{1}{2}$ (b) $\frac{1}{2}$ (c) $\frac{3}{2}$ (d) $\frac{5}{2}$

54. Let $\alpha = a\hat{i} + b\hat{j} + c\hat{k}$, $\beta = b\hat{i} + c\hat{j} + a\hat{k}$ and $\gamma = c\hat{i} + a\hat{j} + b\hat{k}$ be three coplanar vectors with $a \neq b$, and $\mathbf{v} = \hat{i} + \hat{j} + \hat{k}$. Then \mathbf{v} is perpendicular to

- (a) α (b) β
- (c) γ (d) All of these

55. A particle P starts from the point $Z_0 = 1 + 2i$, where $i = \sqrt{-1}$. It moves first horizontally away from origin by 5 units and then vertically away from origin by 3 units to reach a point Z_1 . From Z_1 , the particle moves $\sqrt{2}$ units in the direction of the vector $\hat{i} + \hat{j}$ and then it moves through an angle $\frac{\pi}{2}$ in anticlockwise direction on a circle with

centre at origin, to reach a point Z_2 . The point Z_2 is given by :

- (a) $6 + 7i$ (b) $-7 + 6i$ (c) $7 + 6i$ (d) $-6 + 7i$

56. The set of points Z in the complex plane satisfying $|Z - i| |Z| = |Z + i| |Z|$ is contained or equal to the set of points Z satisfying

- (a) $\operatorname{Im}(Z) = 0$ (b) $\operatorname{Im}(Z) \leq 1$
 (c) $|\operatorname{Re}(Z)| \leq 2$ (d) $|Z| \leq 3$

57. If the system of lines equations

$$x + 4ay + az = 0; x + 3b + bz = 0; x + 2cy + cz = 0$$

have a non-trivial solution, then a, b, c are in

- (a) HP (b) GP
 (c) AP (d) None of these

58. Let the function $f : R - \{-b\} \rightarrow R - \{1\}$ be defined by $f(x) = \frac{x+a}{x+b}$, $a \neq b$, then

- (a) f is one-one but not onto
 (b) f is onto but not one-one
 (c) f is both one-one and onto
 (d) None of the above

59. Let $f : R \rightarrow R$ be given by

$$f(x) = [x^2] + [x+1] - 3$$

Where $[x]$ denotes the greatest integer less than or equal to x . Then, $f(x)$ is

- (a) many-one and onto (b) many-one and into
 (c) one-one and onto (d) one-one and onto

60. The area of the triangle formed by the origin, the point $P(x, y)$ and its reflection in X -axis is

- (a) xy (b) $2|x \cdot y|$ (c) $\frac{1}{2}|xy|$ (d) $|xy|$

61. The foci of a hyperbola are $(-5, 18)$ and $(10, 20)$ and it touches the Y -axis. The length of its transverse axis is

- (a) 100 (b) $\frac{\sqrt{89}}{2}$ (c) $\sqrt{89}$ (d) $\sqrt{50}$

62. The value of $\lim_{x \rightarrow a} \left(2 - \frac{a}{x}\right)^{\tan \frac{\pi x}{2a}}$ is

- (a) $e^{-\frac{1}{\pi}}$ (b) $e^{2/\pi}$ (c) $e^{-2/\pi}$ (d) $e^{1/\pi}$

63. Let $P(x)$ be a real polynomial of least degree which has a local maximum at $x = 1$ and a

local minimum at $x = 3$. If $P(1) = 6$ and $P(3) = 2$, then $P'(0)$ is

- (a) 8 (b) 9 (c) 3 (d) 6

64. If the graph of the function $y = f(x)$ is symmetrical about the line $x = 2$, then

- (a) $f(x) = -f(-x)$ (b) $f(2+x) = f(2-x)$
 (c) $f(x) = f(-x)$ (d) $f(x+2) = f(x-2)$

65. The altitude of a cone is 20 cm and its semi-vertical angle is 30° . If the semi-vertical angle is increasing at the rate of 2° per second, then the radius of the base is increasing at the rate of

- (a) 30 cm/sec (b) $\frac{160}{3}$ cm/sec
 (c) 10 cm/sec (d) 160 cm/sec

Category III (Q. Nos. 66 to 75)

Carry 2 marks each and one or more option(s) is/are correct. If all correct answers are not marked and also no incorrect answer is marked then score = $2 \times$ number of correct answers marked \div actual number of correct answer. If any wrong option is marked or if, any combination including a wrong option is marked, the answer will be considered wrong, but there is no negative marking for the same and zero marks will be awarded.

66. If $\sum_{k=1}^{98} \int_k^{k+1} \frac{k+1}{x(x+1)} dx$, then

- (a) $I > \log_e 99$ (b) $I < \log_e 99$
 (c) $I < \frac{49}{50}$ (d) $I > \frac{49}{50}$

67. Let $f : R \rightarrow R$, $g : R \rightarrow R$ and $h : R \rightarrow R$ be

differentiable functions such that

$f(x) = x^3 + 3x + 2$, $g(f(x)) = x$ and $h(g(g(x))) = x$ for all $x \in R$. Then,

- (a) $g'(2) = \frac{1}{15}$ (b) $h'(1) = 666$
 (c) $h(0) = 16$ (d) $h(g(3)) = 36$

68. Area of the region bounded by the curve $y = e^x$ and lines $x = 0$ and $y = e$ is

- (a) $e - 1$ (b) $\int_1^e \ln(e+1-y) dy$
 (c) $e - \int_0^1 e^x dy$ (d) $\int_1^e \ln y dy$

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and $(a^2 + 1)x - 6by + 2(a^3 + a) = 0$,
then P is equal to
(a) $3a$ (b) $-2a$ (c) $-3a$ (d) $2a$

73. If a hyperbola passing through the origin has $3x - 4y - 1 = 0$ and $4x - 3y - 6 = 0$ as its asymptotes, then the equations of its transverse and conjugate axes are
(a) $x - y - 5 = 0$ and $x + y + 1 = 0$
(b) $x - y = 0$ and $x + y + 5 = 0$
(c) $x + y - 5 = 0$ and $x - y - 1 = 0$
(d) $x + y - 1 = 0$ and $x - y - 5 = 0$

74. Let f be a differentiable function satisfying $f(x) + f(y) + f(z) + f(x)f(y)f(z) = 14$ for all $x, y, z \in R$, then
(a) $f'(x) < 0$ for all $x \in R$ (b) $f'(x) = 0$ for all $x \in R$
(c) $f'(x) > 0$ for all $x \in R$ (d) None of these

75. Let $f : R \rightarrow R$ be defined as $f(x) = |x| + |x^2 - 1|$. The total number of points at which f attains either a local maximum or a local minimum is
(a) 2 (b) 4 (c) 5 (d) 6

Answers

Physics

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|------------|------------|------------|------------|------------|
| 1. (a) | 2. (b) | 3. (d) | 4. (b) | 5. (b) | 6. (a) | 7. (d) | 8. (b) | 9. (b) | 10. (c) |
| 11. (c) | 12. (d) | 13. (a) | 14. (b) | 15. (b) | 16. (c) | 17. (b) | 18. (a) | 19. (c) | 20. (d) |
| 21. (d) | 22. (d) | 23. (c) | 24. (a) | 25. (a) | 26. (c) | 27. (d) | 28. (d) | 29. (c) | 30. (c) |
| 31. (c) | 32. (a) | 33. (c) | 34. (b) | 35. (c) | 36. (a, b) | 37. (a, d) | 38. (b, d) | 39. (a, d) | 40. (a, d) |

Chemistry

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|------------|---------------|------------|------------|------------------|
| 41. (b) | 42. (d) | 43. (c) | 44. (b) | 45. (a) | 46. (b) | 47. (c) | 48. (c) | 49. (b) | 50. (d) |
| 51. (b) | 52. (a) | 53. (c) | 54. (b) | 55. (a) | 56. (a) | 57. (a) | 58. (b) | 59. (c) | 60. (c) |
| 61. (c) | 62. (b) | 63. (b) | 64. (b) | 65. (b) | 66. (b) | 67. (a) | 68. (a) | 69. (a) | 70. (b) |
| 71. (d) | 72. (b) | 73. (d) | 74. (a) | 75. (c) | 76. (a, d) | 77. (a, b, c) | 78. (a, b) | 79. (b, c) | 80. (a, b, c, d) |

Mathematics

- | | | | | | | | | | |
|---------|---------|---------|---------|---------|-----------|-----------|-------------|-----------|-------------|
| 1. (a) | 2. (b) | 3. (b) | 4. (a) | 5. (b) | 6. (d) | 7. (c) | 8. (a) | 9. (d) | 10. (c) |
| 11. (d) | 12. (c) | 13. (d) | 14. (d) | 15. (a) | 16. (d) | 17. (b) | 18. (d) | 19. (c) | 20. (c) |
| 21. (c) | 22. (d) | 23. (c) | 24. (b) | 25. (d) | 26. (c) | 27. (b) | 28. (a) | 29. (c) | 30. (d) |
| 31. (b) | 32. (d) | 33. (c) | 34. (c) | 35. (d) | 36. (b) | 37. (b) | 38. (c) | 39. (b) | 40. (a) |
| 41. (c) | 42. (a) | 43. (b) | 44. (a) | 45. (a) | 46. (c) | 47. (c) | 48. (c) | 49. (b) | 50. (b) |
| 51. (c) | 52. (b) | 53. (d) | 54. (d) | 55. (d) | 56. (a) | 57. (a) | 58. (c) | 59. (b) | 60. (d) |
| 61. (c) | 62. (c) | 63. (b) | 64. (b) | 65. (b) | 66. (b,d) | 67. (b,c) | 68. (b,c,d) | 69. (b,c) | 70. (a,b,c) |
| 71. (d) | 72. (b) | 73. (c) | 74. (b) | 75. (c) | | | | | |