WB JEE

Engineering Entrance Exam

Practice Set 3

Physics

Category I (Q. Nos. 1 to 30)

Carry 1 marks 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. The angle of minimum deviation for a glass prism with $\mu = \sqrt{3}$ equals the refracting angle of the prism. What is the angle of the prism?

(a) 60° (b) 30°
(c) 45° (d) 90°

2. In the chemical analysis of a rock, the mass ratio of two radioactive isotopes is found to be 100 : 1. The mean times of the two isotopes are 4×10^9 yr and 2×10^9 yr respectively. If it is assumed that at the time of formation, the atoms of both the isotopes were is equal proportion. Calculate the age of the rock. Ratio of the atomic weight of the two isotopes is 1.02 : 1.

(a) 1.834×10^{10} yr
(b) 1.84×10^{10} yr
(c) 1.81×10^{10} yr
(d) 1.8×10^{10} yr

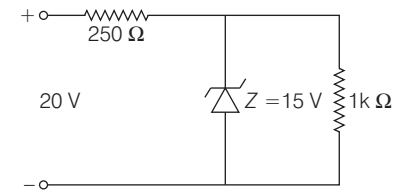
3. The wavelength associated with an electron accelerated through a potential difference of 100 V, is of the order of

(a) 1.2 Å (b) 100 Å
(c) 10.5 Å (d) 1000 Å

4. An electron of a stationary hydrogen atom passes from the fifth energy-level of the ground level. The velocity, that the atom acquired as a result of photon emission will be (m is the mass of the electron, R = Rydberg constant and h = Planck's constant)

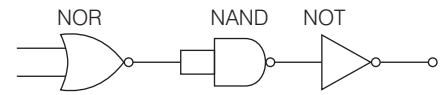
(a) $\frac{25}{24} \cdot \frac{hR}{m}$ (b) $\frac{24}{25} \cdot \frac{m}{hR}$ (c) $\frac{24}{25} \cdot \frac{hR}{m}$ (d) $\frac{25}{24} \cdot \frac{hR}{m}$

5. A Zener diode, having breakdown voltage equal to 15 V is used in a voltage regulator circuit shown in figure. The current through the diode is



(a) 15 mA (b) 10 mA
(c) 5 mA (d) 20 mA

6. The circuit



is equivalent to

(a) AND gate (b) NAND gate
(c) NOR gate (d) OR gate

7. The dimensional formula of torque is

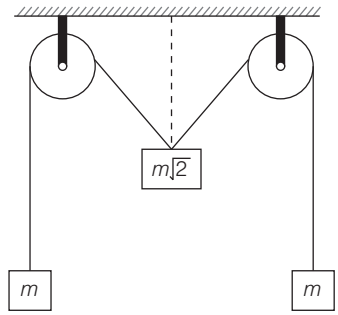
(a) $[ML^{-2}T^{-2}]$ (b) $[ML^{2}T^{-2}]$

(c) $[MLT^{-2}]$ (d) $[ML^{-1}T^{-2}]$

8. The length of a simple pendulum is about 100 cm known to an accuracy of 1 mm. Its period of oscillation is 2 s determined by measuring the time for 100 oscillations using a clock of 0.1 s resolution. What is the accuracy in the determined of g?

(a) 2% (b) 0.5% (c) 0.1% (d) 0.2%

9. The pulleys and strings shown in figure are smooth and of negligible mass. For the system to the under equilibrium, the angle θ should be



(a) 0° (b) 60° (c) 45° (d) 30°

10. A ball is thrown upwards with a speed u from a height h above the ground. The time taken by the ball to hit the ground is

(a) $\sqrt{\frac{2h}{g}}$ (b) $\sqrt{\frac{8h}{g}}$

(c) $\frac{\sqrt{u^2 + 2gh}}{g}$ (d) $\frac{u}{g} + \sqrt{\frac{2h}{g}}$

11. Two stones are projected with the same velocity but making different angles with the horizontal. Their ranges are equal. If angle of projection of one is 30° and its maximum height is Y, then the maximum height of other stone will be

(a) 3Y (b) 2Y (c) Y / 2 (d) Y / 3

12. The time period of moon's revolution is 27.3 days and radius of the earth is 6.37×10^6 m, distance to the moon is 3.84×10^8 m, then the mass of the earth is (approximately)

(a) 10^{24} kg (b) 10^{16} kg (c) 10^{16} kg (d) 10^5 kg

13. A 5 cm length of the cube has its upper face displaced by 0.2 cm by a tangential force of 8 N. The modulus of rigidity of the material of cube is

(a) $5 \times 10^4\ Nm^{-2}$ (b) $6 \times 10^4\ Nm^{-2}$

(c) $7 \times 10^4\ Nm^{-2}$ (d) $8 \times 10^4\ Nm^{-2}$

14. A square plate of 10 cm side moves parallel to another plate with a velocity of 10 cm s^{-1}; both the plates immersed in water. If the viscous force is 200 dyne and viscosity of water is 0.01 poise, what is their separation distance?

(a) 0.05 cm (b) 1 cm (c) 0.07 cm (d) 7 cm

15. In the above problem, if the sun radiates as an ideal black body, what is the temperature of its surface?

(a) 6803 K (b) 5603 K

(c) 5803 K (d) 5503 K

16. At what temperature does the average translation kinetic energy of a molecule in a gas becomes equal to the kinetic energy of a electron accelerated from rest through a potential difference of one volt? ($k = 1.38 \times 10^{-23}\ JK^{-1}$)

(a) 7330 K (b) 7730 K (c) 7530 K (d) 7430 K

17. Two containers of equal volume contained the same gas at the pressures p_1 and p_2 and absolute temperatures T_1 and T_2, respectively. On joining the vessels, the gas reaches a common pressure p and a common temperature T. The ratio p/T is equal to

(a) $\frac{p_1T_1 + p_2T_2}{T_1 \times T_2}$ (b) $\frac{p_1T_2 + p_2T_1}{T_1 + T_2}$

(c) $\frac{1}{2}\left[\frac{p_1T_2 + p_2T_1}{T_1T_2}\right]$ (d) $\frac{p_1T_2 - p_2T_1}{T_1 \times T_2}$

18. A 10 μF capacitor and a 20 μF capacitor are connected in series across 200 V supply line. The charged capacitors are then disconnected from the line and reconnected with their positive plates together and negative plates together and no external voltage is applied. What is the potential difference across each capacitor?

(a) $\frac{800}{9}$ V (b) $\frac{800}{3}$ V (c) 400 V (d) 200 V

19. Equal charges q each are placed at the vertices A and B of an equilateral triangle ABC of side a. The magnitude of the electric field intensity at the point C is

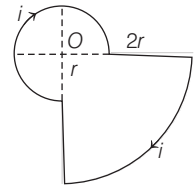
(a) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{q}{a^2}$ (b) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{q\sqrt{2}}{a^2}$

(c) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{q\sqrt{3}}{a^2}$ (d) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{2q}{a^2}$

20. Two point charges exerted on each other a force F when they are placed r distance apart in air. If they are placed R distance apart in a medium of dielectric constant K, they exert the same force. The distance R equals

(a) $\frac{r}{K}$ (b) rK (c) $r\sqrt{K}$ (d) $\frac{r}{\sqrt{K}}$

21. A current i flowing through the loop as shown in figure. The magnetic field at the centre 'O' is



(a) $\frac{7\mu_0 i}{12r}$ acting downwards

(b) $\frac{5\mu_0 i}{12r}$ acting upwards

(c) $\frac{7\mu_0 i}{12r}$ acting upwards

(d) $\frac{5\mu_0 i}{12r}$ acting downwards

22. An electron is revolving around a proton in a circular path of diameter 0.1 nm. It produces a magnetic field 14 T at a proton. Then the angular speed of the electron is

(a) 8.8×10^6 rad s^{-1} (b) 4.4×10^{16} rad s^{-1}

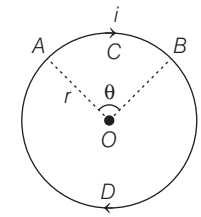
(c) 2.2×10^{16} rad s^{-1} (d) 1.1×10^{16} rad s^{-1}

23. A straight wire of length 30 cm and mass 60 mg lies in a direction 30° East to North. The earth's magnetic field applied in horizontal direction and has a magnitude of 0.8 G. What current must be passed through the wire, so that it may float in air?

(a) 50 A (b) 40 A

(c) 20 A (d) 10 A

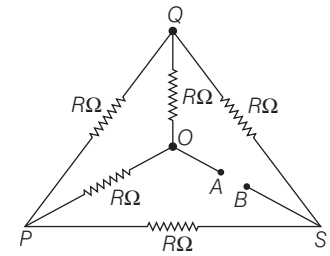
24. Equal current i flows in two segments of a circular loop in the direction shown in figure. The radius of the circular loop is r. The magnitude of magnetic field induction at the centre of the loop is



(a) $\frac{\mu_0}{3\pi}\cdot\frac{i\theta}{r}$ (b) $\frac{\mu_0}{2\pi}\cdot\frac{i}{r}(\pi-\theta)$

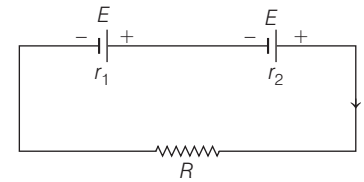
(c) $\frac{\mu_0}{2\pi}\cdot\frac{i}{r}(2\pi-\theta)$ (d) zero

25. If each of the resistances in the network in figure R, the equivalent resistance between terminals A and B (in ohm) is



(a) R (b) $2R$ (c) $3R$ (d) $5R$

26. Two cells with the same emf E and different internal resistances r_1 and r_2 are connected in series to an external resistance R. Can a value for R be selected such that the potential difference (PD) at the first cell should be zero?



(a) $\sqrt{r_1 r_2}$ (b) $\frac{r_1+r_2}{2}$ (c) r_1+r_2 (d) r_1-r_2

27. In a series resonant L-C-R circuit, the voltage across R is 100 V and resistance $R=1\,\text{k}\Omega$ with capacitance $C=2\,\mu\text{F}$. The resonant frequency ω is 200 rad/s. At resonance, the voltage across L is

(a) 2.5×10^{-2} V (b) 40 V
(c) 250 V (d) 4×10^{-3}V

28. The focal length of a lens in air is 20 cm when we put it in a liquid, it becomes disappear. What is the refractive index of the liquid? ($R_1 = R_2 = 10$ cm)

(a) $\frac{4}{3}$ (b) $\frac{4}{5}$ (c) $\frac{5}{4}$ (d) $\frac{3}{4}$

29. Two slits in Young's experiment are 0.003 cm apart. The interference fringes for light of wavelength 7000 Å are formed on a screen 90 cm away. Calculate the distance of the fifth bright fringe.

(a) 12 cm (b) 10.5 cm
(c) 11.5 cm (d) 20 cm

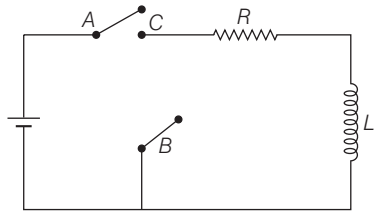
30. Red light of wavelength 5400 Å from a distant source falls on a slit 0.80 mm wide. Calculate the distance between first two dark bands on each side of the central bright band in the diffraction pattern observed on a screen place 1.4 m from the slit.

(a) 1.89 mm (b) 4 mm (c) 1 mm (d) 3 mm

Category II (Q. Nos. 31 to 35)

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.

31. In the circuit shown here, the point C is kept connected to a point A till the current flowing through the circuit becomes constant. Afterward, suddenly point C is disconnected from point A and connected to point B at time $t = 0$. Ratio of the voltage across resistance R and the inductor L at $t = L / R$ will be equal to



(a) $\frac{e}{1-e}$ (b) 1 (c) – 1 (d) $\frac{1-e}{e}$

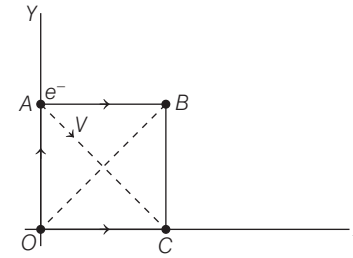
32. The thickness of ice on a lake is 10 cm and the temperature of air is – 10 °C. If rate of cooling of water inside lake is 20000 cal min^{-1} through each square metre surface, then K for ice (in $Wm^{-1}°C^{-1}$) is

(a) 14 (b) 10 (c) 3 (d) 4

33. A lead bullet strikes against a steel armour plate with a velocity of 480 m/s. If the bullet falls dead after impact, find the rise in it's temperature, assuming that the heat produced is equally shared between it and the target. Specific heat of lead is 0.03 cal/g°C.

(a) 457K (b) 400K (c) 500K (d) 600K

34. $OABC$ is a current carrying square loop, an electron is projected from the centre of loop along its diagonal AC as shown in the figure. Unit vector in the direction of initial acceleration will be



(a) $\hat{k}$ (b) $-\left(\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right)$ (c) $-\hat{k}$ (d) $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

35. In a series L-C circuit, $L = 4$ H and $C = 25\,\mu$F. If the frequency is twice of resonant frequency, the net reactance of circuit is

(a) zero (b) 100 Ω (c) 200 Ω (d) 600 Ω

Category III (Q. Nos. 36 to 40)

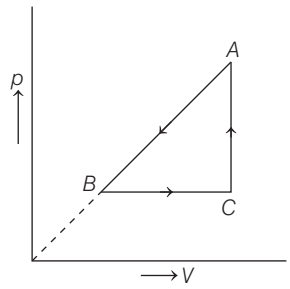
Carry 2 marks each and one or more option(s) is/are correct. If all correct answers are not marked and also no incorrect answer is marked then score = 2 × number of correct answers marked ÷ actual number of correct answers. If any wrong option is marked or if any combination including a wrong option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

36. Relativistic corrections become necessary when the expression for the kinetic energy $\frac{1}{2}mv^2$, becomes comparable with mc^2, where m is the mass of the particle. At what de-Broglie wavelength will relativistic corrections become important for an electron?

(a) $\lambda = 10\,\text{nm}$ (b) $\lambda = 10^{-1}\,\text{nm}$

(c) $\lambda = 10^{-4}\,\text{nm}$ (d) $\lambda = 10^{-6}\,\text{nm}$

37. Figure shows the p-V diagram of an ideal gas undergoing a change of state from A to B. Four different parts I, II, III and IV as shown in the figure may lead to the same change of the state.



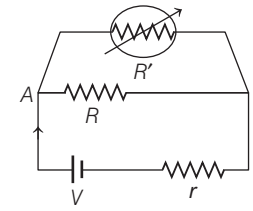
(a) $\Delta Q_{A\to B}$ = negative
(b) $\Delta U_{C\to A}$ = negative
(c) ΔW_{CAB} = negative
(d) $\Delta U_{A\to B}$ = negative

38. Two projectiles A and B are projected with the same speed at angles 15° and 75°, respectively to the maximum and have same horizontal range. If h be the maximum height and T total time of the flight of a projectile, then

(a) $h_A > h_B$ (b) $h_A < h_B$

(c) $T_A < T_B$ (d) $T_A > T_B$

39. Consider a simple circuit shown in figure stands for a variable resistance R'.R' can vary from R_0 to infinity. r is internal resistance of the battery ($r << R << R_0$).



(a) Potential drop across AB is nearly constant as R' is varied.

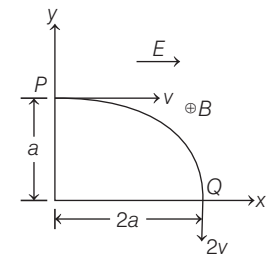
(b) Current through R' is nearly a constant as R' is varied.

(c) Current i depends sensitively on R'.

(d) $I \geq \frac{V}{r+R}$ always

40. A particle of charge $+q$ and mass m moving under the influence of a uniform electric field $E\,\hat{\mathbf{i}}$ and a uniform magnetic field $B\hat{\mathbf{k}}$ follows a trajectory from P to Q as shown in figure.

The velocities at P and Q are $v\,\hat{\mathbf{i}}$ and $-2v\,\hat{\mathbf{i}}$, respectively. Which of the following statement(s) is/are correct?



(a) $E = \frac{3}{4}\left(\frac{\mu v^2}{qa}\right)$

(b) Rate of work done by the electric field at P is $\frac{3}{4}\left(\frac{mv^3}{a}\right)$.

(c) Rate of work done by the electric field at P is zero.

(d) Rate of work done by both the fields at Q is zero.

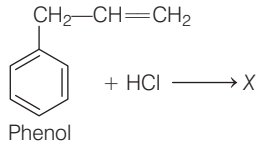
Chemistry

Category I (Q. Nos. 41 to 70)

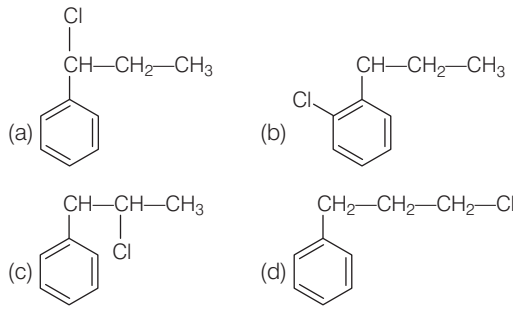
Carry 1 marks each and only one option is correct. In case of incorrect answer or any combination of more than one answer, 1/4 mark will be deducted.

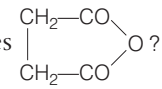
41. Phenol on heating with $CHCl_3$ and NaOH gives salicylaldehyde. The reaction is called
(a) Aldol reaction
(b) Claisen reaction
(c) Reimer-Tiemann reaction
(d) Hell Volhard - Zelinsky reaction

42. One of the product of the following reaction is *X*.



structure of *X* is



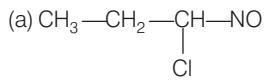
43. The product of which of the following reaction on dehydration gives 

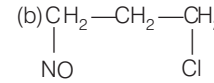
?

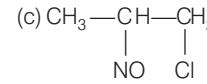
(a) 1, 1-dibromo ethane $\xrightarrow{KCN}$ $\xrightarrow{H_3O^+}$
(b) 1, 1, 1-trichloro ethane $\xrightarrow{\text{Alkaline hydrolysis}}$
(c) 1, 2-dibromo ethane $\xrightarrow{KCN}$ $\xrightarrow{H_3O^+}$
(d) None of the above

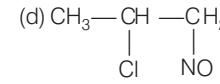
44. $CH_3—C = CH_2 + NOCl \longrightarrow P$.

Identify the product *P*.

(a) 

(b) 

(c) 

(d) 

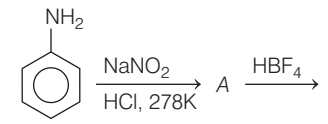
45. Which of the following processes is used in extractive metallurgy of magnesium?
(a) Self reduction
(b) Aqueous solution electrolysis
(c) Thermite reduction
(d) Fused salt electrolysis

46. Which one of the following benefaction processes is used for the mineral $Al_2O_3 \cdot 2H_2O$?
(a) Liquation (b) Magnetic separation
(c) Leaching (d) Froth floatation

47. Amongst the following alcohols which would react fastest with conc. HCl and $ZnCl_2$?
(a) 2-methyl butanol (b) Pentanol
(c) 2-methyl butan-2-ol (d) 2-pentanol

48. Which of the following sets of quantum numbers represents the highest energy of an atom?
(a) $n = 3, l = 1, m = 1, s = +\frac{1}{2}$
(b) $n = 3, l = 0, m = 0, s = +\frac{1}{2}$
(c) $n = 3, l = 2, m = 1, s = +\frac{1}{2}$
(d) $n = 4, l = 0, m = 0, s = +\frac{1}{2}$

49. For the reaction below, the product *A* and *B* respectively are



(a) nitrobenzene and chlorobenzene
(b) phenol and benzene
(c) nitrobenzene and fluorobenzene
(d) benzene diazonium chloride and fluorobenzene

50. The compressibility factor for a real gas at high pressure is

(a) $1+\frac{RT}{pb}$ (b) $1+\frac{pb}{RT}$ (c) $1-\frac{pb}{RT}$ (d) 1

51. 29.5 mg of an organic compound containing nitrogen was digested according to Kjeldahl's method and the evolved ammonia was absorbed in 20 mL of 0.1 M HCl solution. The excess of the acid required 15 mL of 0.1 M NaOH solution for complete neutralisation. The percentage of nitrogen in the compound is

(a) 59.0 (b) 47.4 (c) 23.7 (d) 29.5

52. The correct order of increasing basicity of the given conjugate bases ($R = CH_3$) is

(a) $R\bar{C}OO < HC\equiv\bar{C} < \bar{R} < \bar{N}H_2$

(b) $\bar{R} < HC\equiv\bar{C} < R\bar{C}OO < \bar{N}H_2$

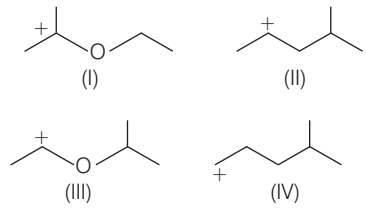
(c) $R\bar{C}OO < \bar{N}H_2 < HC\equiv\bar{C} < \bar{R}$

(d) $R\bar{C}OO < HC\equiv\bar{C} < \bar{N}H_2 < \bar{R}$

53. The two form of d-glucopyranose obtained from the solution of d-glucose are called

(a) epimer (b) anomer
(c) enantiomer (d) isomer

54. The correct stability order for the following species is



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

55. Increasing value of magnetic moment of

I. $[Fe(CN)_6]^{4-}$ II. $[Fe(CN)_6]^{3-}$

III. $[Cr(NH_3)_6]^{3+}$ IV. $[Ni(H_2O)_4]^{2+}$ is

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

56. If pH of acid in hydrogen electrode is 10, its potential will be

(a) 0.59 V (b) 0.059 V
(c) 0.0059 V (d) 0.00059 V

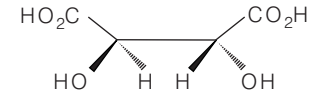
57. 1 L of 1.0 M $CuSO_4$ solution is electrolysed by passing 1.5 F charge. Final molarity of the solution will be [atomic weight of Cu = 63.5]

(a) 0.10 M (b) 0.20 M
(c) 0.25 M (d) 0.30 M

58. Potassium permaganate acts as an oxidant in neutral, alkaline as well as acidic medium. The final products obtained from it in the three conditions are, respectively.

(a) MnO_2^{2-}, Mn^{3+}, Mn^{2+} (b) MnO, MnO_4^{2-}, Mn^{3+}
(c) MnO_2, MnO_2, Mn^{2+} (d) MnO_2, MnO_4^{2-}, Mn^{3+}

59. The absolute configuration of



(a) *S*, *S* (b) *R*, *R*
(c) *R*, *S* (d) *S*, *R*

60. A gaseous hydrocarbon gives 0.72 g of water and 3.08 g of CO_2 upon combustion. The empirical formula of the hydrocarbon is

(a) C_3H_4 (b) C_6H_5
(c) C_7H_8 (d) C_2H_4

61. A blue colouration is not obtained when

(a) ferric chloride reacts with potassium ferrocyanide
(b) anhydrous $CuSO_4$ is dissolved in water
(c) ammonium hydroxide dissolves in copper sulphate
(d) copper sulphate solution reacts with $K_4[Fe(CN)_6]$

62. On heating benzylamine with chloroform and ethanoic KOH, product obtained is

(a) benzyl alcohol (b) benzonitrile
(c) benzyl isocyanide (d) benzaldehyde

63. Which of the following complex species is not expected to exhibit optical isomerism?

(a) $[Co(NH_3)Cl_3]$ (b) $[Co(en)(NH_3)Cl_2]^+$
(c) $[Co(en)_3]^{3+}$ (d) $[Co(en)_2)Cl_2]^+$

64. The treatment of CH_3MgX with $CH_3C\equiv C—H$, produces

(a) $CH_3—C\equiv CH$
(b) $CH_3—C\equiv C—CH_3$
(c) CH_4
(d) $CH_3—\underset{H}{\overset{|}{C}}=\underset{H}{\overset{|}{C}}—CH_3$

65. Rusting follows the following reactions

(i) $2H^+ + \frac{1}{2}O_2 + 2e^- \longrightarrow H_2O$; $E° = 1.23$ V

(ii) $Fe^{2+} + 2e^- \longrightarrow Fe$; $E° = -0.44$ V

The net work done is

(a) 152 kJ (b) 322 kJ
(c) 132 kJ (d) 233 kJ

66. At pH of 0.1 M solution of following increases in the order

(a) $NaCN < NH_4Cl < NaCl < HCl$
(b) $HCl < NaCl < NaCN < NH_4Cl$
(c) $NaCl < NH_4Cl < NaCN < HCl$
(d) $HCl < NH_4Cl < NaCl < NaCN$

67. In which of the following molecules, the van der Waals' forces is likely to be the most important in determining the melting and boiling points?

(a) H_2S (b) Br_2
(c) HCl (d) CO

68. The quantum numbers for the outer electrons of an atom are given by

$$n = 2, l = 0, m = 0, s = +\frac{1}{2}$$

(a) hydrogen (b) lithium (c) beryllium (d) boron

69. X litres of carbon monoxide is present at S.T.P. It is completely oxidised to CO_2. The volume of CO_2 formed is 11.207 L at S.T.P. What is the value of X in litres?

(a) 12.414 L (b) 44.828 L
(c) 11.207 L (d) 8.6035 L

70. Which of the following salts undergoes anionic hydrolysis?

(a) $CuSO_4$ (b) $FeCl_3$
(c) NH_4Cl (d) Na_2CO_3

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.

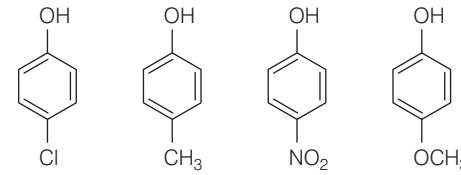
71. An ester (A) with molecular formula, $C_9H_{10}O_2$ was treated with excess of CH_3MgBr and the complex so formed was treated with H_2SO_4 to give an olefin (B). Ozonolysis of (B) gave a ketone with molecular formula C_8H_8O. Which shows positive iodoform test. The structure of (A) is

(a) $C_2H_5COOC_6H_5$ (b) $C_6H_5COOC_2H_5$
(c) $H_3COCH_2COC_6H_5$ (d) $CH_3—COOC_2H_5$

72. The energy required to break one mole of Cl—Cl bonds in Cl_2 is 242 kJ mol^{-1}. The longest wavelength of light capable of breaking a single Cl—Cl bond is

(a) 594 nm (b) 694 nm
(c) 600 nm (d) 494 nm

73. Arrange the following compounds in the order of decreasing acidity.



(I) (II) (III) (IV)

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

74. Which one of the following has an optical isomer?

(a) $[Co(en)_3]^{3+}$ (b) $[Zn(en)_2]^{2+}$
(c) $[Co(H_2O)_4(en)]^{3+}$ (d) $[Zn(en)(NH_3)_2]^{2+}$

75. The oxidation numbers of phosphorus is $Ba(H_2PO_2)_2$ and xenon in Na_4XeO_6 are respectively

(a) + 2 and + 6
(b) + 3 and + 4
(c) + 1 and + 8
(d) – 1 and – 6

Category III (Q. Nos. 76 to 80)

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 × number of correct answers marked ÷ actual number of correct answers. If any wrong option is marked or if any combination including a wrong option is marked, the answer will considered wrong, but there is no negative marking for the same and zero mark will be awarded.

76. Which of the following statements is/are correct about half-life period for a reaction?

(a) For a zero order reaction $t_{1/2} \propto \frac{1}{a}$

(b) For a second order reaction $t_{1/2} \propto \frac{1}{a}$

(c) For third order reaction $t_{1/2} \propto \frac{1}{a}$

(d) Time taken for 75% completion of a first order reaction is twice to $t_{1/2}$

77. Which among the following have regular geometry?

(a) BF_4^- (b) NF_3
(c) BF_3 (d) PF_3

78. Which statement among the following is/are incorrect?

(a) Value of $\Delta G°f$ cannot be determined
(b) Absolute value of heat content of the system can be easily determined by calorimetery
(c) Absolute value of entropy cannot be known
(d) Absolute value of internal energy cannot be known

79. Which of the following, the hybrid orbitals of the central atom have the same *s*-character?

(a) XeO_3 (b) CH_4 (c) $[Ni(CN)_4]^{2-}$ (d) $Ni(CO)_4$

80. $NaNO_3$ is heated in a closed vessel, O_2 is liberated and $NaNO_2$ is left behind. At equilibrium,

(a) increasing pressure favours reverse reaction
(b) addition of $NaNO_2$ favours reverse reaction
(c) increasing temperature favours forward reaction
(d) addition of $NaNO_2$ favours forward reaction

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. Let $L = \lim_{x \to 0} \dfrac{a - \sqrt{a^2 - x^2} - \dfrac{x^2}{4}}{x^4}$, $a > 0$. If L is finite, then

(a) $a = 2$ (b) $a = 1$ (c) $L = \frac{1}{64}$ (d) $L = \frac{1}{32}$

2. If $\int f(x)\,dx = \psi(x)$, then $\int x^5 f(x^3)\,dx$ is equal to

(a) $\frac{1}{3}[x^3 \psi(x^3) - \int x^2 \psi(x^3)\,dx] + C$
(b) $\frac{1}{3}x^3 \psi(x^3) - 3\int x^3 \psi(x^3)dx + C$
(c) $\frac{1}{3}x^3 \psi(x^3) - \int x^2 \psi(x^3)\,dx + C$
(d) $\frac{1}{3}[x^3\psi(x^3) - \int x^3 \psi(x^3)\,dx] + C$

3. The value of $\int (e^{\log x} + \sin x)\cos x\,dx$

(a) $x\sin x + \cos x - \dfrac{\cos 2x}{4} + C$
(b) $x\cos x + \sin x - \dfrac{\sin 2x}{4} + C$
(c) $\sin x + x\cos x - \dfrac{\sin 2x}{2} + C$
(d) $\cos x + x\sin x - \dfrac{\sin 2x}{2} + C$

4. The value of $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \dfrac{x^2 \cos x}{1 + e^x}\,dx$ is equal to

(a) $\frac{\pi^2}{4} - 2$ (b) $\frac{\pi^2}{4} + 2$
(c) $\pi^2 - e^{-\pi/2}$ (d) $\pi^2 + e^{\pi/2}$

5. The value of $\lim_{x \to \infty} \dfrac{(\int_0^{x+y} e^{t^2}\,dt)^2}{\int_0^{x+y} e^{2t^2}\,dt}$ is equal to

(a) 0 (b) 1
(c) $\lim_{x \to 0}\left(\dfrac{\int_0^x \cos t^2}{x}\right) - 1$ (d) – 1

6. If $\int \sqrt{\frac{x^4}{a^6 + x^6}}\, dx = g(x) + c$, then $g(x)$ is equal to

(a) $\frac{1}{3}\log\left|x^3 - \sqrt{a^6 + x^6}\right|$

(b) $\left|x^3 + \sqrt{a^6 + x^6}\right|$

(c) $\frac{1}{3}\log\left|x^3 + \sqrt{a^6 + x^6}\right|$

(d) None of the above

7. $\int_0^2 |x^2 + 2x - 3|\, dx$ is equal to

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

8. $\lim_{x \to \infty} \left\{\frac{1^2}{1 - x^3} + \frac{3}{1 + x^2} + \frac{5^2}{1 - x^3} + \frac{7}{1 + x^2} + \ldots\right\}$ equals

(a) $-\frac{5}{6}$ (b) $-\frac{10}{3}$ (c) $\frac{5}{6}$ (d) $\frac{10}{3}$

9. The solution of the differential equation $(1 + y^2) + (x - e^{\tan^{-1} y})\frac{dy}{dx} = 0$, is

(a) $xe^2 \tan^{-1} y = e^{\tan^{-1} y} + k$

(b) $(x - 2) = ke^{\tan^{-1} y}$

(c) $2xe^{\tan^{-1} y} = e^{2\tan^{-1} y} + k$

(d) $xe^{\tan^{-1} y} = \tan^{-1} y + k$

10. The solution of $x\, dx + ydy = a(x^2 + y^2)dy$, is

(a) $x^2 + y^2 = ce^{ay}$ (b) $x^2 + y^2 = ce^{2ay}$

(c) $x^2 + y^2 = e^{2cay}$ (d) None of these

11. If e and e' be the eccentricities of two conics $s = 0$ and $s' = 0$ and if $e^2 + e'^2 = 3$, then both S and S' can be

(a) hyperbolas (b) ellipses

(c) parabolas (d) None of these

12. A point on the parabola $y^2 = 18x$ at which the ordinate increases at twice the rate of the abscissa is

(a) $\left(\frac{9}{8}, \frac{9}{2}\right)$ (b) (2, – 4) (c) $\left(-\frac{9}{8}, \frac{9}{2}\right)$ (d) (2, 4)

13. Consider a ΔABC and let a, b and c denote the lengths of the sides opposite to vertices A, B and C, respectively. Suppose $a = 6$, $b = 10$ and the area of the triangle is $15\sqrt{3}$. If $\angle ACB$ is abtuse and if r denotes the radius of the incircle of the triangle, then r^2 is equal to

(a) 2 (b) 4

(c) 3 (d) 6

14. If $\log_a x \times \log_5 a = \log_x 5$, $a \neq 1$, $a > 0$, then $x =$

(a) a (b) 5, $\frac{1}{5}$

(c) 1 (d) None of these

15. If z and ω are two non-zero complex numbers such that $|z\omega| = 1$ and $arg(z) - arg(\omega) = \frac{\pi}{2}$, then $\bar{z}\omega$ is equal to

(a) $-i$ (b) 1 (c) – 1 (d) i

16. If $\{x\}$ denotes the fractional part of x, then $\left\{\frac{3^{2n}}{8}\right\}$, $n \in N$ is

(a) $\frac{3}{8}$ (b) $\frac{7}{8}$

(c) $\frac{1}{8}$ (d) None of these

17. If the roots of the equation $x^3 + bx^2 + cx - 1 = 0$ form an increasing GP, then b belongs to the interval.

(a) $(-3, \infty)$ (b) $(-\infty, -3)$

(c) $(-1, \infty)$ (d) $(-\infty, -1)$

18. The letters of the ward COCHIN are permuted and all the permutations are arranged in an alphabetical order as in an English dictionary. The number of words that appear before the word COCH1N, is

(a) 360 (b) 192

(c) 96 (d) 48

19. Suppose that six students, including Madhu and Pooja are having six beds arranged in a row. Further, suppose that Madhu does not want a bed adjacent to Pooja. Then the number of ways, the beds can be alloted to students is

(a) 384 (b) 264

(c) 480 (d) 600

20. For all $n \in N$, $3^{3n} - 26n - 1$ is divisible by

(a) 24 (b) 64

(c) 17 (d) 676

21. The number of rational terms in the expansion of $(1+\sqrt{2}+\sqrt[3]{3})^6$ is

(a) 6 (b) 7 (c) 5 (d) 8

22. If $E(\theta)=\begin{bmatrix}\cos^2\theta & \cos\theta\sin\theta\\ \cos\theta\sin\theta & \sin^2\theta\end{bmatrix}$ and θ and ϕ differ by an odd multiple of $\frac{\pi}{2}$, then $E(\theta)\cdot E(\phi)$ is a

(a) null matrix (b) unit matrix
(c) diagonal matrix (d) None of these

23. Let M be a 3×3 non-singular matrix with $\det(M)=\alpha$. If M^{-1} adj (adj M) $=kI$, then the value of k is

(a) 1 (b) α (c) α^2 (d) α^3

24. If α is a non-real cube of -2, then the value of $\begin{vmatrix}1 & 2\alpha & 1\\ \alpha^2 & 1 & 3\alpha^2\\ 2 & 2\alpha & 1\end{vmatrix}$, is

(a) -11 (b) -12 (c) -13 (d) 0

25. If $A=\begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}$ and $I=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$, then which one of the following holds for all $n\geq 1$, by the principle of mathematical induction

(a) $A^n=2^{n-1}A+(n-1)I$ (b) $A^n=nA+(n-1)I$
(c) $A^n=2^{n-1}A-(n-1)I$ (d) $A^n=nA-(n-1)I$

26. If $A=\{(x,y): y=\frac{4}{x}, x\neq 0\}$ and $B=\{(x,y): x^2+y^2=8, x,y\in R\}$, then

(a) $A\cap B=\phi$
(b) $A\cap B$ contains one point only
(c) $A\cap B$ contains two points only
(d) $A\cap B$ contains 4 points only

27. Let the function $f: R-\{-b\}\to R-\{1\}$ 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

28. Let W denote the words in the English dictionary, define the relation R by $R=\{(x,y)\in N\times W:$ the words x and y have at least one letter is common$\}$. Then R is

(a) not reflexive, symmetric and transitive
(b) reflexive, symmetric and not transitive
(c) reflexive, not symmetric and transitive
(d) reflexive, symmetric and transitive

29. Two numbers are selected randomly from the set $S=\{1,2,3,4,5,6\}$ without replacement one by one. The probability that the minimum of two numbers is less than 4 is

(a) $\frac{1}{15}$ (b) $\frac{14}{15}$
(c) $\frac{1}{5}$ (d) $\frac{4}{5}$

30. A random variable X takes the values 0, 1, 2, 3 and its mean is 1.3. If $P(X=3)=2P(X=1)$ and $P(X=2)=0.3$, then $P(X=0)$ is

(a) 0.1 (b) 0.2
(c) 0.3 (d) 0.4

31. If a and b are distinct positive real numbers such that $a, a_1, a_2, a_3, a_4, a_5, b$ are in AP, $a, b_1, b_2, b_3, b_4, b_5, b$ are in GP and $a, c_1, c_2, c_3, c_4, c_5, b$ are in HP, then the roots of $a_3x^2+b_3x+c_3=0$ are

(a) real and distinct (b) real and equal
(c) imaginary (d) None of these

32. If the angles A, B and C of a triangle are in arithmetic progression and if a, b and c denote the lengths of the sides opposite to A, B and C respectively, then the value of the expression $\frac{a}{c}\sin 2C+\frac{c}{a}\sin 2A$ is

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

33. Let A be the fixed point $(0,4)$ and $B(2t,0)$ be a moving point. Let M be the mid-point of AB and let the perpendicular bisector of AB meet the Y-axis at R. The locus of the mid-point P of MR is

(a) $x^2+y^2=\frac{1}{4}$ (b) $(y-2)^2-x^2=4$
(c) $y+x^2=2$ (d) $3x^2+y^2=8$

34. Let a, b, c and d be non-zero numbers. If the point of intersection of the lines $4ax + 2ay + c = 0$ and $5bx + 2by + d = 0$ lies in the fourth quadrant and is equidistant from the two axes, then

(a) $3bc - 2ad = 0$ (b) $3bc + 2ad = 0$
(c) $2bc - 3ad = 0$ (d) $2bc + 3ad = 0$

35. If a variable line passes through the point of intersection of the lines $x + 2y - 1 = 0$ and $2x - y - 1 = 0$ and meets the coordinate axes in A and B, then the locus of the mid-point of AB is

(a) $x + 3y = 0$ (b) $x + 3y = 10$
(c) $x + 3y = 10xy$ (d) None of these

36. Let the perpendiculars from any point on the line $2x + 11y = 5$ upon the lines $24x + 7y - 20 = 0$ and $4x - 3y - 2 = 0$ have the lengths P_1 and P_2, respectively. Then,

(a) $2P_1 = P_2$ (b) $P_1 = P_2$
(c) $P_1 = 2P_2$ (d) None of these

37. The locus of the centre of the circles which touch both the circles $x^2 + y^2 = a^2$ and $x^2 + y^2 = 4ax$ externally has the equation

(a) $12(x - a)^2 - 4y^2 = 3a^2$ (b) $9(x - a)^2 - 5y^2 = 2a^2$
(c) $8x^2 - 3(y - a)^2 = 9a^2$ (d) None of these

38. The range of values of a for which the point $(a, 4)$ is outside the circles $x^2 + y^2 + 10x = 0$ and $x^2 + y^2 - 12x + 20 = 0$, is

(a) $(-\infty, -8) \cup (-2, 6) \cup (6, \infty)$
(b) $(-\infty, -2)$
(c) $(-\infty, -8) \cup (-2, \infty)$
(d) None of the above

39. A hyperbola, having the transverse axis of length $2\sin\theta$, is confocal with the ellipse $3x^2 + 4y^2 = 12$. Then, its equation is

(a) $x^2\text{cosec}^2\theta - y^2\sec^2\theta = 1$
(b) $x^2\sec^2\theta - y^2\text{cosec}^2\theta = 1$
(c) $x^2\sin^2\theta - y^2\cos^2\theta = 1$
(d) $x^2\cos^2\theta - y^2\sin^2\theta = 1$

40. The number of values of c such that the straight line $y = 4x + c$ touches the curve $\frac{x^2}{4} + y^2 = 1$, is

(a) 0 (b) 1 (c) 2 (d) infinite

41. The equation of a tangent to the hyperbola $16x^2 - 25y^2 - 96x + 100y - 356 = 0$, which makes an angle $\frac{\pi}{4}$ with the transverse axis, is

(a) $y = x + 2$ (b) $y = x - 5$ (c) $y = x + 3$ (d) $x = y + 2$

42. The slope of a common tangent to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ and a concentric circle of radius r is

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

43. The equation of the plane containing the line $\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$ and the point $(0, 7, -7)$, is

(a) $x + y + z = 1$ (b) $x + y + z = 2$
(c) $x + y + z = 0$ (d) None of these

44. Let a, b and c be three real numbers satisfying

$$[a\ b\ c]\begin{bmatrix}1 & 9 & 7\\ 8 & 2 & 7\\ 7 & 3 & 7\end{bmatrix} = [0\ 0\ 0].$$

If the point $P(a, b, c)$ lies on the plane $2x + y + z = 1$, then the value of $7a + b + c$ is

(a) 0 (b) 12 (c) 7 (d) 6

45. If $[\cdot]$ denotes the greatest integer function, then $\lim_{x \to 0} \frac{\tan([-2\pi^2]x^2) - x^2\tan[-2\pi^2]}{\sin^2 x}$ is equal to

(a) $-20 + \tan 20°$ (b) $20 + \tan 20°$
(c) 20 (d) None of these

46. If $f(x) = \frac{1}{1 - x}$, then the derivation of the composite function $f[f\{f(x)\}]$ is equal to

(a) 0 (b) $\frac{1}{2}$ (c) 1 (d) 2

47. If the period of the function $f(x) = \frac{\sin(\sin(nx))}{\tan\left(\frac{x}{n}\right)}$, $n \in N$ is 6π, then n is equal to

(a) 3 (b) 2
(c) 1 (d) None of these

48. Let the sequence $< b_n >$ of real numbers satisfy the recurrence relation $b_{n+1} = \frac{1}{3}\left(2b_n + \frac{125}{b_n^2}\right)$, $b_n \neq 0$, then $\lim_{n \to \infty} b_n$ is equal to

(a) 0 (b) ∞
(c) 5 (d) $\frac{2}{3}$

49. The set of all points where the function $f(x) = \sqrt[3]{x^2 |x|}$ is differentiable is

(a) $[0, \infty)$ (b) $(0, \infty)$
(c) $(-\infty, \infty)$ (d) $(-\infty, 0) \cup (0, \infty)$

50. Let f be twice differentiable function satisfying $f(1) = 1$, $f(2) = 4$, $f(3) = 9$, then

(a) $f'(x) = 2$ for all $x \in R$
(b) $f'(x) = 5 = f''(x)$, for some $x \in [1, 3]$
(c) there exists at least one $x \in (1, 3)$ such that $f''(x) = 2$
(d) None of the above

Category II (Q. No. 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 $C_0, C_1, C_2, \ldots, C_n$ denote the binomial coefficient in the expansion of $(1 + x)^n$, then $\frac{C_1}{2} + \frac{C_3}{4} + \frac{C_5}{6} + \ldots$ is equal to

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

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. Let $\mathbf{a} = \hat{i} + 2\hat{j} + \hat{k}$, $\mathbf{b} = \hat{i} - \hat{j} + \hat{k}$, $\mathbf{c} = \hat{i} + \hat{j} - \hat{k}$. A vector caplanar to $\mathbf{a}$ and $\mathbf{b}$ has a projection along $\mathbf{c}$ of magnitude $\frac{1}{\sqrt{3}}$, then the vector is

(a) $4\hat{i} - \hat{j} + 4\hat{k}$ (b) $4\hat{i} + \hat{j} - 4\hat{k}$
(c) $2\hat{i} + \hat{j} + \hat{k}$ (d) None of these

54. Let $\mathbf{a} = 2\hat{i} + \hat{j} - 2\hat{k}$ and $\mathbf{b} = \hat{i} + \hat{j}$. If $\mathbf{c}$ is a vector such that $\mathbf{a} \cdot \mathbf{c} = |\mathbf{c}|$, $|\mathbf{c} - \mathbf{a}| = 2\sqrt{2}$ and the angle between $\mathbf{a} \times \mathbf{b}$ and $\mathbf{c}$ is 30°. Then, $|(\mathbf{a} \times \mathbf{b}) \times \mathbf{c}|$ is equal to

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

55. Let $S_1, S_2, \ldots$ be squares such that for each $n \geq 1$, the length of a side of S_n equals the length of a diagonal of S_{n+1}. If the length of a side of S_1 is 10 cm, then for which of the following values of n is the area of S_n less than 1 sq cm?

(a) 7 (b) 8 (c) 5 (d) 6

56. The value of k for which the inequality $|\text{Re}(z)| + |\text{Im}(z)| \leq \lambda |z|$ is true for all $z \in C$, is

(a) 2 (b) $\sqrt{2}$
(c) 1 (d) None of these

57. Given, $2x - y + 2z = 2$; $x - 2y + z = -4$; $x + y + \lambda z = 4$, then the value of λ such that the given system of equations has no solution, is

(a) 3 (b) 1 (c) 0 (d) –3

58. Let X and Y be two non-empty sets and $f : X \to Y$ be a function such that $f(C) = \{f(x) : x \in C\}$ for $C \subseteq X$ and $f^{-1}(D) = \{x : f(x) \in D\}$ for $D \subseteq Y$

If $A \subseteq X$ and $B \subseteq Y$, then

(a) $f^{-1}(f(A)) = A$
(b) $f^{-1}(f(A)) = A$ only if $f(X) = Y$
(c) $f(f^{-1}(B)) = B$ only if $B \subseteq f(X)$
(d) $f(f^{-1}(B)) = B$

59. The function $f : (-\infty, -1] \to (0, e^5]$ defined by $f(x) = e^{x^3 - 3x + 2}$ is

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

60. The incentre of the triangle with vertices $(1, \sqrt{3})$, $(0, 0)$ and $(2, 0)$ is

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

61. If radii of director circles of $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ and $\frac{x^2}{a_1^2}-\frac{y^2}{b_1^2}=1$ are $2r$ and r, respectively and e_e and e_h be the eccentricities of the ellipse and hyperbola respectively, then

(a) $2e_h^2-e_e^2=6$ (b) $e_e^2-4e_h^2=6$

(c) $4e_h^2-e_e^2=6$ (d) None of these

62. $\lim\limits_{x\to\infty}\frac{\log[x]}{x}$, where $[x]$ denotes the greatest integer less than or equal to x, is

(a) 0 (b) 1

(c) –1 (d) non-existent

63. If $f(x)=\min\{1, x^2, x^3\}$, then

(a) $f(x)$ is everywhere continuous

(b) $f(x)$ is continuous and differentiable everywhere

(c) $f(x)$ is not differentiable at two points

(d) $f(x)$ is not differentiable at one point

64. Let $f(x)=\sec^{-1}[1+\cos^2 x]$, where $[\cdot]$ denotes the greatest integer function. Then, the range of $f(x)$ is

(a) [1, 2] (b) [0, 2]

(c) $\{\sec^{-1}1, \sec^{-1}2\}$ (d) None of these

65. A spherical iron ball 10 cm in radius is coated with a layer of ice of uniform thickness that melts at a rate of 50 cm^3/min. When the thickness of ice is 5 cm, then the rate at which the thickness of ice decreases, is

(a) $\frac{5}{6\pi}$ cm/min (b) $\frac{1}{54\pi}$ cm/min

(c) $\frac{1}{18\pi}$ cm/min (d) $\frac{1}{36\pi}$ cm/min

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 × number of correct answers marked ÷ actual number of correct answer. If any wrong option is marked or if, any combination including a wrong option is marked, the answer will considered wrong, but there is no negative marking for the same and zero marks will be awarded.

66. Let $f(x)=7\tan^8 x+7\tan^6 x-3\tan^2 x-3\tan^4 x$ for all $x\in\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$. Then the correct expression(s) is/are

(a) $\int_0^{\frac{\pi}{4}} x\, f(x)dx=\frac{1}{12}$

(b) $\int_0^{\frac{\pi}{4}} f(x)dx=0$

(c) $\int_0^{\frac{\pi}{4}} x\, f(x)dx=\frac{1}{6}$

(d) $\int_0^{\frac{\pi}{4}} f(x)dx=1$

67. In a ΔPQR, let $\angle PQR=30°$ and the sides PQ and QR have lengths $10\sqrt{3}$ and 10 respectively, then which of the following statement(s) is/are correct?

(a) $\angle QPR=45°$

(b) The area of the ΔPQR is $25\sqrt{3}$ and $\angle QRP=120°$

(c) The radius of the incircle of the ΔPQR is $10\sqrt{3}-15$

(d) The area of the circumcircle of the ΔPQR is 100π

68. If the line $x=\alpha$ divides the area of region $R=\{(x, y)\in R^2: x^3\le y\le x, 0\le x\le 1\}$ into two equal parts, then

(a) $2\alpha^4-4\alpha^2+1=0$ (b) $\alpha^4+4\alpha^2-1=0$

(c) $\frac{1}{2}<\alpha<1$ (d) $0<\alpha\le\frac{1}{2}$

69. Let S be the set of all non-zero real numbers α such that the quadratic equation $\alpha x^2-x+\alpha=0$ has two distinct real roots x_1 and x_2 satisfying the inequality $|x_1-x_2|<1$. Which of the following interval(s) is/are a subset of S?

(a) $\left(-\frac{1}{2},-\frac{1}{\sqrt{5}}\right)$ (b) $\left(-\frac{1}{\sqrt{5}},0\right)$

(c) $\left(0,\frac{1}{\sqrt{5}}\right)$ (d) $\left(\frac{1}{\sqrt{5}},\frac{1}{2}\right)$

70. Let z_1 and z_2 be two distinct complex numbers and let $z=(1-t)z_1+tz_2$ for some real numbers t with $0<t<1$. If arg(ω) denotes the principal argument of a non-zero complex number ω, then

(a) $|z-z_1|+|z-z_2|=|z_1-z_2|$

(b) $\arg(z-z_1)=\arg(z-z_2)$

(c) $\begin{vmatrix} z-z_1 & \bar{z}-\bar{z}_1 \\ z_2-z_1 & \bar{z}_2-\bar{z}_1 \end{vmatrix}=0$

(d) $\arg(z-z_1)=\arg(z_2-z_1)$

71. If α, β, γ are the roots of $x^3 + ax^2 + b = 0$, then the value of $\begin{vmatrix} \alpha & \beta & \gamma \\ \beta & \gamma & \alpha \\ \gamma & \alpha & \beta \end{vmatrix}$ is

(a) $-a^3$ (b) $a^3 - 3b$

(c) a^3 (d) $a^2 - 3b$

72. If $A(2, 3)$ and $B(-2, 1)$ are two vertices of a triangle and third vertex moves on the line $2x + 3y = 9$, then the locus of the centroid of the triangle, is

(a) $2x + 3y = 1$ (b) $2x + y = 3$

(c) $2x - 3y = 1$ (d) $x - y = 1$

73. The circle $x^2 + y^2 - 8x = 0$ and hyperbola $\frac{x^2}{9} - \frac{y^2}{4} = 1$ intersect at the points A and B. The equation of a common tangent with positive slope to the circle as well as to the hyperbola is

(a) $2x - \sqrt{5}y - 20 = 0$

(b) $2x - \sqrt{5}y + 4 = 0$

(c) $3x - 4y + 8 = 0$

(d) $4x - 3y + 4 = 0$

74. If y is a function of x and $\log(x + y) - 2xy = 0$, then the value of $y'(0)$ is equal to

(a) 1 (b) –1 (c) 2 (d) 0

75. In the interval $\left(0, \frac{\pi}{2}\right)$ the function $f(x) = \tan^n x + \cot^n x$ attains

(a) the minimum value which is independent of n

(b) a minimum value which is a function of n

(c) the minimum value of 1

(d) None of the above

Answers

Physics

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

Chemistry

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

Mathematics

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