SAMPLE PAPER – 03

Physics

Section A

Q. 1. A projectile is fired with a speed u at an angle θ above the horizontal field. The coefficient of restitution between the projectile and field is e. Find the position from the starting point when the projectile will land at its second collision

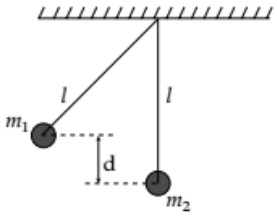
(1) $\frac{e^2u^2\sin 2\theta}{g}$

(2) $\frac{(1-e^2)u^2\sin 2\theta}{g}$

(3) $\frac{(1-e)u^2\sin\theta\cos\theta}{g}$

(4) $\frac{(1+e)u^2\sin 2\theta}{g}$

Q. 2. Two pendulums each of length l are initially situated as shown in figure. The first pendulum is released and strikes the second. Assume that the collision is completely inelastic and neglect the mass of the string and any frictional effects. How high does the centre of mass rise after the collision?



(1) $d\left[\frac{m_1}{(m_1+m_2)}\right]^2$ **(2)** $d\left[\frac{m_1}{(m_1+m_2)}\right]$

(3) $d\left[\frac{(m_1+m_2)^2}{m_2}\right]$ **(4)** $d\left[\frac{m_2}{(m_1+m_2)}\right]^2$

Q. 3. At an instant t, the coordinates of a particle are $x = at^2$, $y = bt^2$ and $z = 0$, then its velocity at the instant t will be :

(1) $t\sqrt{a^2+b^2}$ **(2)** $2t\sqrt{a^2+b^2}$

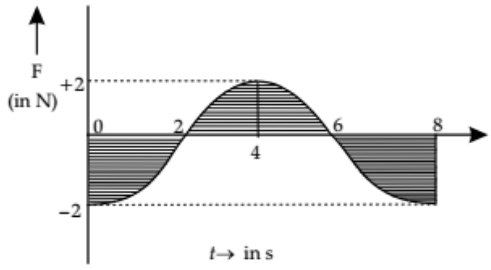
(3) $\sqrt{a^2+b^2}$ **(4)** $2t^2\sqrt{a^2+b^2}$

Q. 4. What is the average velocity of a projectile between the instants it crosses half the maximum height, if it is projected with a speed u at an angle θ with the horizontal :

(1) $u\sin\theta$ **(2)** $u\cos\theta$

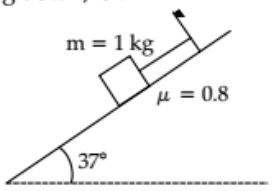
(3) $u\tan\theta$ **(4)** u

Q. 5. A force - time graph for the motion of a body is shown in figure. Change in linear momentum between 0 and 8 s is :



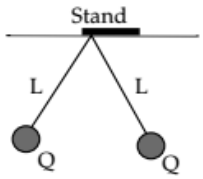
(1) zero (2) 4 N-s
(3) 8 N-s (4) None

Q. 6. For the arrangement shown in figure, the tension in the string to prevent it from sliding down, is :



(1) 6 N (2) 6.4 N
(3) 0.4 N (4) None of these

Q. 7. Two small balls each having equal positive charge Q are suspended by two insulating strings at equal length L metre, from a hook fixed to a stand. The whole set-up is taken in a satellite into space where there is no gravity. Then the angle θ between two strings and tension in each string is :



(1) 0, $\frac{kq^2}{L^2}$ (2) π, $\frac{kq^2}{2L^2}$
(3) π, $\frac{kq^2}{4L^2}$ (4) $\frac{\pi}{2}, \frac{kq^2}{2L^2}$

Q. 8. A charge Q is uniformly distributed over a large plastic plate. The electric field at a point P close to the centre of the plate is 10 V/m. If the plastic plate is replaced by a copper plate of the same geometrical dimensions and carrying the same charge Q, the electric field at the point P will become :

(1) Zero (2) 5 V/m
(3) 10 V/m (4) 20 V/m

Q. 9. In copper, each copper atom releases one electron. If a current of 1.1 A is flowing in the copper wire of uniform cross-sectional area of diameter 1 mm, then drift velocity of electrons will approximately be : (Density of copper = 9×10^3 kg /m^3, Atomic weight of copper = 63)

(1) 10.3 mm/s (2) 0.1 mm/s
(3) 0.2 mm/s (4) 0.2 cm/s

Q. 10. A wire of length L carrying current i is bent into circular loop with (i) one turn (ii) n turns. Find the ratio of magnetic induction at centre in above two cases.

(1) $4 : n^2$ (2) $1 : n^2$
(3) $1 : n^2$ (4) $2 : n^2$

Q. 11. Two plane mirrors are parallel to each other and spaced 20 cm apart. An object is kept in between them at 15 cm from A. Out of the following at which point image is not formed in mirror A (distance measured from mirror A) :

(1) 15 cm (2) 25 cm
(3) 45 cm (4) 55 cm

Q. 12. In a certain double slit experimental arrangement, interference fringes of width 1.0 mm each are observed when light of wavelength 5000 Å is used. Keeping the set-up unaltered if the source is replaced by another of wavelength 6000 Å, the fringe width will be :

(1) 0.5 mm (2) 1.00 mm
(3) 1.2 mm (4) 1.5 mm

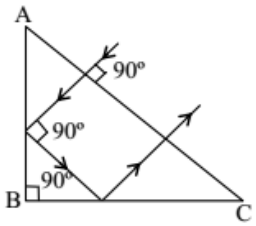
Q. 13. In a vernier callipers, ten smallest divisions of the vernier scale are equal to nine smallest division on the main scale. If the smallest division on the main scale is half millimeter, then the Least Count of Vernier Callipers is :

(1) 0.5 mm (2) 0.1 mm
(3) 0.05 mm (4) 0.005 mm

Q. 14. Two media I and II are separated by a plane surface having speeds of light 2×10^8 m/s and 2.4×10^8 m/s, respectively. What is the critical angle for a ray going from I medium to II ?

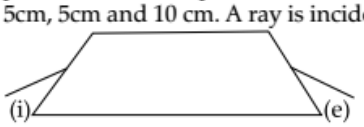
(1) $\sin^{-1}\left(\frac{1}{2}\right)$ (2) $\sin^{-1}\left(\frac{5}{6}\right)$
(3) $\sin^{-1}\left(\frac{5}{12}\right)$ (4) $\sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$

Q. 15. A ray of light is incident on a prism ABC (AB = BC) and travels as shown in figure. The refractive index of the prism material should be at least :



(1) $\frac{4}{3}$ (2) $\sqrt{2}$
(3) 1.5 (4) $\sqrt{3}$

Q. 16. A trapezium is made up of sides of length 5cm, 5cm, 5cm and 10 cm. A ray is incident



On the Slant face of the trapezium such that it emerges through the other slant face. (Given that i=e=45°) what is the angle of deviation of the ray ?

(1) 60° **(2)** 30°

(3) 37° **(4)** 53°

Q. 17. If $n > 1$, then the dependence of frequency of a photon, emitted as a result of transition of electron from n^{th} orbit to $(n-1)^{th}$ orbit, on n will be :

(1) $\upsilon \propto \frac{1}{n}$ **(2)** $\upsilon \propto \frac{1}{n^2}$

(3) $\upsilon \propto \frac{1}{n^3}$ **(4)** $\upsilon \propto \frac{1}{v^3}$

Q. 18. A proton moving with velocity v_0 moves towards a proton initially at rest and free to move. Find the distance of closest approach.

(1) $\frac{e^2}{2\pi\varepsilon_0 m v_0^2}$ **(2)** $\frac{e^2}{4\pi\varepsilon_0 m v_0^2}$

(3) $\frac{e^2}{\pi\varepsilon_0 m v_0^2}$ **(4)** None of these

Q. 19. Photoelectric emission is observed from a metallic surface for frequencies ν_1 and ν_2 of the incident light rays ($\nu_1 > \nu_2$). If the maximum values of kinetic energy of the photoelectrons emitted in the two cases are in the ratio of 1 : k, then the threshold frequency of the metallic surface is :

(1) $\frac{\nu_1 - \nu_2}{k-1}$ **(2)** $\frac{k\nu_1 - \nu_2}{k-1}$

(3) $\frac{k\nu_2 - \nu_1}{k-1}$ **(4)** $\frac{\nu_2 - \nu_1}{k}$

Q. 20. A source of frequency n and an observer are moving on a straight line with velocities a and b, respectively. If the source is ahead of the observer and if the medium is also moving in the direction of their motion with velocity c (the velocity of sound being v) then the apparent frequency of sound heard by the observer would be

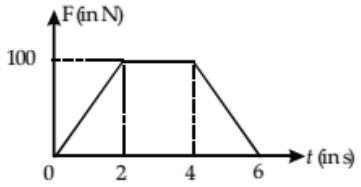
(1) $\left(\frac{v+c+b}{v+c+a}\right)$ **(2)** $\left(\frac{v-c+b}{v-c+a}\right)n$

(3) $\left(\frac{v-c-b}{v-c-a}\right)n$ **(4)** $\left(\frac{v+c-b}{v+c-a}\right)n$

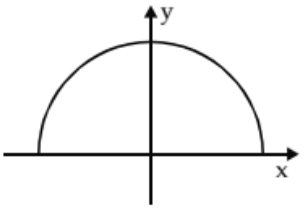
Section B

Q. 21. A motor car is travelling at 60 m/s on a circular road of radius 1200 m. It is increasing its speed at the rate of 4 m/s^2. The acceleration of the car is ..... m/s^2.

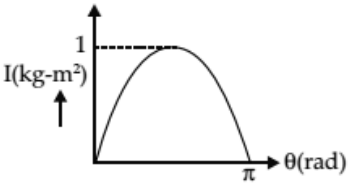
Q. 22. A 10 kg block is initially at rest on a horizontal surface for which the coefficient of friction is 0.5. If a horizontal force F is applied such that it varies with time as shown in figure. The work done (in joule) in first 5 s is 225 α. The value of α is ..... J. (g = 10 ms^{-2})



Q. 23. In the figure below, a uniformly piece of wire is bent in the form of a semicircular arc as shown. Find the distance (in cm) of center of mass of the wire from the origin is ..... cm, if radius of the semicircular ring is $R = 3\pi$ cm.



Q. 24. Figure shows the variation of the moment of inertia of a uniform rod, about an axis passing through its centre and inclined at an angle θ to the length. The moment of inertia (in kg-m^2) of the rod about an axis passing through one of its ends and making an angle $\theta = \frac{\pi}{3}$ rad will be ..... kg-m^2.

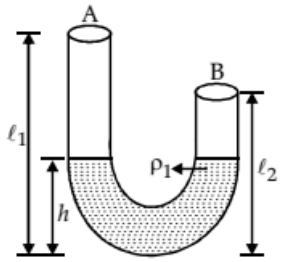


Q.25. Binary stars of comparable masses m_1 and m_2 rotate under the influence of each other's gravity with angular velocity ω. If they are stopped suddenly in their motions, their relative velocity when they collide with each other is $\left[\frac{2G(m_1+m_2)}{(R_1+R_2)} - \left(\frac{\omega^2}{G(m_1+m_2)}\right)^{\alpha}\right]^{\beta}$

where R_1 and R_2 are radii of stars and G is the universal gravitational constant. The value of $\left(\frac{1}{\alpha}+\frac{1}{\beta}\right)^3$ is .....

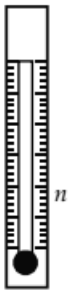
Q.26. A rubber cord has a cross–sectional area 1 mm^2 and total unstretched length 10 cm. It is stretched to 12 cm and then released to project a mass of 5 g. The Young's modulus for rubber is 5×10^8 N–m^2. The velocity of mass is ..... m s^{-1}.

Q. 27. A U-tube having uniform cross-section but unequal arm length l_1 = 100 cm and l_2 = 50 cm has same liquid of density ρ_1 filled in it upto a height h = 30 cm as shown in figure. Another liquid of density $\rho_2 = 2\rho_1$ is poured in arm A. Both liquids are immiscible. The length of the second liquid is ..... (in cm) should be poured in A so that second overtone of A is in unison with fundamental tone of B. (Neglect end correction)



Q. 28. A block is placed on a horizontal platform vibrating up and down, simple harmonically. It is observed that the block loses its contact with the platform when its angular frequency is 5 rad/s. The amplitude of vibration can not be less than 'A' cm, then The value of A is ..... cm.

Q.29. A thermometer has a spherical bulb of volume 1 cm^3 having 1 cm^3 of mercury. A long cylindrical capillary tube is connected to spherical bulb. Volumetric coefficient of expansion of mercury is 1.8×10^{-4} K^{-1}; cross-section area of capillary is 1.8×10^{-4} cm^2. Ignoring expansion of glass, ... cm far apart on the stem are marks indicating 1K temperature change.



Q. 30. A uniform disc of radius R having charge Q distributed uniformly all over its surface is placed on a smooth horizontal surface. A magnetic field $B = Kxt^2$, where K = constant, x is the distance (in metre) from the centre of the disc and t is the time (in second) is switched on perpendicular to the plane of the disc. The torque (in N-m) acting on the disc after 15 sec. (Take 2 KQ = 1 S.I. unit and R = 1 metre) is .....N-m.

Chemistry

Section A

Q. 31. A reaction required three atoms of Mg for two atoms of N. How many g of N are required for 3.6 gm of Mg ?

(1) 2.43 **(2)** 4.86

(3) 1.4 **(4)** 4.25

Q. 32. Which of the following pairs of specis have the same bond order

(1) N_2, NO^+ **(2)** O_2, NO^+

(3) N_2, O_2^- **(4)** CO, NO

Q. 33. Calculate the ground state energies of the electron (in eV) in the case of He^+ and Li^{2+} (R_H = 13.6 eV)

(1) – 13.60 eV and –54.40 eV

(2) –54.40 eV and –13.60 eV

(3) –54.40 eV and –122.40 eV

(4) –13.60 eV and –122.40 eV

Q. 34. The element Z = 107 and Z = 109 have been made recently; element Z = 108 has not yet been made. Indicate the group in which you will place the above elements.

(1) 7, 8, 9 **(2)** 5, 6, 7

(3) 8, 9, 10 **(4)** 4, 5, 6

Q. 35.

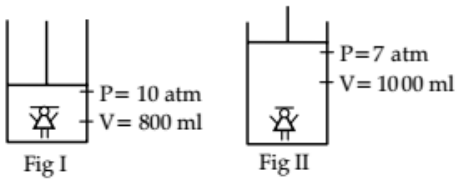


Fig I Fig II

In the above figures a doll is entrapped within a piston and cylinder containing gas. Initial and final conditions are shown Figure I and Figure II respectively. The volume of doll is :

(1) 1000 ml **(2)** $\frac{15000}{17}$ ml

(3) $\frac{1000}{3}$ ml **(4)** $\frac{1000}{15}$ ml

Q. 36. Enthalpy of fusion of a liquid is 1.435 kcal mol^{-1} and molar entropy change is 5.26 cal $mol^{-1}K^{-1}$. Hence melting point of liquid is :

(1) 100°C **(2)** 0°C

(3) 373°C **(4)** –273°C

Q. 37. In $Fe_4\left[Fe(CN)_6\right]_3$ the O.N. of the complexed iron is :

(1) + 3 **(2)** + 2

(3) + 4 **(4)** + 6

Q. 38. For the gas phase reaction

$C_2H_4 + H_2 \rightleftharpoons C_2H_6, \Delta H = -32.7$ kcal carried out in a vessel, the equilibrium concentration of C_2H_4 can be increased by

(1) Increasing the temperature

(2) Increasing concentration of H_2

(3) Decreasing temperature

(4) Increasing pressure

Q. 39. The following equilibrium is established when hydrogen chloride is dissolved in acetic acid $HCl + CH_3COOH \rightleftharpoons Cl^- + CH_3COOH_2^+$. The set that characterises the conjugate acid-base pairs is :

(1) (HCl, CH_3COOH) and $(CH_3COOH_2^+, Cl^-)$

(2) $(HCl, CH_3COOH_2^+)$ and (CH_3COOH, Cl^-)

(3) $(CH_2COOH_2^+, HCl)$ and (Cl^-, CH_3COOH)

(4) (HCl, Cl^-) and $(CH_3COOH_2^+, CH_3COOH)$

Q. 40. Ethyl methyl vinyl amine has the structure :

(1) $CH_3CH_2-\underset{\displaystyle CH_3}{\underset{|}{N}}-CH_2CH=CH_2$

(2) $CH_3CH_2-\underset{\displaystyle CH_3}{\underset{|}{N}}-CH=CH_2$

(3) $CH_2=CH-\underset{\displaystyle CH_3}{\underset{|}{N}}-CH=CH_2$

(4) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{N}}-CH=CH_2$

Q. 41. The correct name of $(CO)_3Fe-CO-Fe(CO)_3$ (CO bridging) is :

(1) Tri-μ-carbonyl bis (tricarbonyl iron (0)

(2) Hexacarbonyl iron (III) μ-tricarbonyl ferrate (0)

(3) Tricarbonyl iron (0) μ-tricarbonyl iron (0) tricarbonyl

(4) Nonacarbonyl iron

Q. 42. The complex that has lowest magnetic moment is:

(1) $[NiCl_4]^{2-}$ **(2)** $[CoF_6]^{3-}$

(3) $[Mn(Cn)_6]^{3-}$ **(4)** $[Ni(CO)_4]$

Q. 43. Concentration of ore of Aluminium is done by

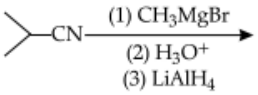
(1) Froth floatation

(2) Gravity separation

(3) Baeyer's process

(4) Magnetic separation

Q. 44. The major product of the following reaction is:



(1) CH_2-NH_2

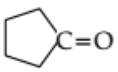
(2) $CH(CH_3)-NH_2$

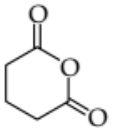
(3) $CH(OH)(CH_3)-NH_2$

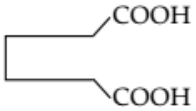
(4) $C(=O)H(CH_3)$

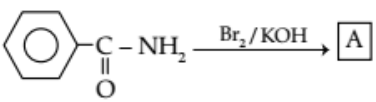
Q. 45. The product formed when adipic acid is heated :

(1) 

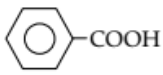
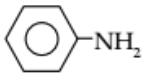
(2) 

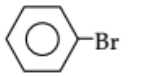
(3) 

(4) 

Q. 46. 

product (A) is

(1)  (2) 

(3)  (4) None of these

Q. 47. $(C_6H_{12}O_5)_n + nH_2O \xrightarrow{(X)}$

$C_{12}H_{22}O_{11} + H_2O \xrightarrow{(Y)} 2C_6H_{12}O_6$

Enzymes X and Y are :

(1) Zymase and Invertase

(2) Diatase and Maltase

(3) Maltase and Diatase

(4) Diatase and Zymase

Q. 48. Pure chlorine is obtained :

(1) by heating $PtCl_4$

(2) by heating MnO_2 with HCl

(3) by heating bleaching powder with HCl

(4) by heating mixture of NaCl, MnO_2 and Conc. H_2SO_4

Q. 49. In the Hunsdiecker reaction :

(1) Number of carbon atoms decrease

(2) Number of carbon atoms increase

(3) Number of carbon atoms remain same

(4) None of the above

Q. 50. In the reaction sequence, $CaC_2 \xrightarrow{H_2O} A \xrightarrow[Hg^{+2}]{dil.H_2SO_4} B \xrightarrow[Ni]{H_2} C$, the product C is :

(1) CH_3OH **(2)** CH_3CHO

(3) C_2H_5OH **(4)** C_2H_4

Section B

Q. 51. Given that the temperature coefficient for the saponification of ethyl acetate by NaOH is 1.75. The activation energy for the saponifiocation of ethyl acetate is ..... K. cal mol^{-1}.

Q. 52. Cyclohexane-1,4-dione is a polar compound, having dipole moment value of 1.2 D. If mol fraction of its chair form is 0.80, the dipole moment of twisted boat form will be .....

Q. 53. For ^{24}Na, $t_{1/2}$ = 14.8 hours. A sample of this substance lose 90% of its radioactive intensity will take ..... hr.

Q. 54. The potential of the standard Iron-Cadmium cell is ..... V, after the reaction has proceeded to 80% completion. Initially 1 M of each taken and E° for cell = 0.04 V.

Q. 55. A mineral of iron contains an oxide containing 72.36% iron by mass and has a density of 5.2 g/cc. Its unit cell is cubic with edge length of 839 pm. The total number of atoms (ions) present in each unit cell is ..... (Fe-56, O-16)

Q. 56. An organic liquid, A, is immiscible with water. When boiled together with water, the boiling point is 90°C at which the partial vapour pressure of water is 526 mm Hg. The atmospheric pressure is 736 mm Hg. The weight ratio of the liquid and water collected is 2.5 : 1. The molecular weight of the liquid is ..... gm.

Q. 57. Graph between log x/m and log p is straight line inclined at an angle of 45°. When pressure is 0.5 atm and $l_n k$ = 0.693, the amount of solute adsorbed per gm of adsorbent will be .....

Q. 58. Fixed amount of an ideal gas contained in a sealed rigid vessel (V = 24.6 litre) at 1.0 bar is heated reversibly from 27°C to 127°C. The change in Gibb's energy is ..... J ($|\Delta G|$ in Joule) if entropy of gas $S = 10 + 10^{-2} T$ (J/K)

Q. 59. The following sequence of reaction occurs in commercial production of aqueous nitric acid.

$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(l)$

$\Delta H = -904$ kJ ... (1)

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

$\Delta H = -1124$ kJ ... (2)

$3NO_2(g) + H_2O(l) \rightarrow 2HNO_3(aq) + NO(g)$

$\Delta H = -140$ kJ ... (3)

The total heat liberated (in kJ) at constant pressure for the production of exactly 1 mole of aqueous nitric acid by this process, is ..... kJ/mol.

Q. 60. The quantity of benzene, when 91.2 gm of Phenylmagnesium iodide is treated with 4.2 gm of Pent-4-yn-1-ol at STP would be produced ..... l.

Section A

Q.61 $\dfrac{\sin 7x+6\sin 5x+17\sin 3x+12\sin x}{\sin 6x+5\sin 4x+12\sin 2x}=$

(1) $\cos x$ **(2)** $2\cos x$

(3) $\sin x$ **(4)** $2\sin x$

Q. 62. The general solution of x when $2\cos x \,.\, \cos 2x = \cos x$ is :

(1) $n\pi+\dfrac{\pi}{2}$ or $k\pi \pm \dfrac{\pi}{6}$, $n, k \in I$

(2) $n\pi \pm \pi$ or $k\pi \pm \dfrac{\pi}{3}$, $n, k \in I$

(3) $(2n+1)\pi$ or $k\pi \pm \dfrac{\pi}{2}$, $n, k \in I$

(4) $n\pi+\dfrac{\pi}{4}$ or $k\pi\pm\dfrac{\pi}{3}$, $n, k \in I$

Q. 63. The value of $\sin\left[\text{arc}\ \cos\left(-\dfrac{1}{2}\right)\right]$ is :

(1) $\dfrac{1}{\sqrt{2}}$ **(2)** 1

(3) $\dfrac{\sqrt{3}}{2}$ **(4)** $\sqrt{3}$

Q. 64. If in a triangle ABC, in usual notation $\dfrac{a^2-b^2}{a^2+b^2} = \dfrac{\sin(A-B)}{\sin(A+B)}$, then the triangle is :

(1) Right angled or isosceles

(2) Right angled and isosceles

(3) Equilateral

(4) Isosceles only

Q. 65. For any $\theta \in \left(\dfrac{\pi}{4}, \dfrac{\pi}{2}\right)$ the expression $3(\sin\theta - \cos\theta)^4 + 6(\sin\theta + \cos\theta)^2 + 4\sin^6\theta$ equals:

(1) $13 - 4\cos^2\theta + 6\sin^2\theta\cos^2\theta$

(2) $13 - 4\cos^6\theta$

(3) $13 - 4\cos^2\theta + 6\cos^4\theta$

(4) $13 - 4\cos^4\theta + 2\sin^2\theta\cos^2\theta$

Q. 66. If $a^2 + 4b^2 = 12ab$, then $\log(a + 2b) =$

(1) $\dfrac{1}{2}(\log a + \log b - \log 2)$

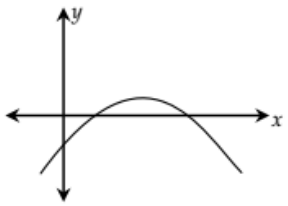
(2) $\log\dfrac{a}{2} + \log\dfrac{b}{2} + \log 2$

(3) $\dfrac{1}{2}(\log a + \log b + 4\log 2)$

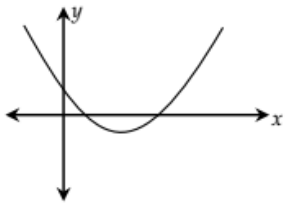
(4) $\dfrac{1}{2}(\log a - \log b + 4\log 2)$

Q. 67 Graph of the function $f(x) = Ax^2 - Bx + C$, where $A = (\sec\theta - \cos\theta)(\text{cosec}\,\theta - \sin\theta)(\tan\theta + \cot\theta)$, $B = (\sin\theta + \text{cosec}\,\theta)^2 + (\cos\theta + \sec\theta)^2 - (\tan^2\theta + \cot^2\theta)$ and $C = 12$, can be represented by :

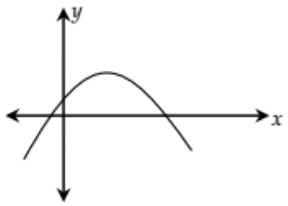
(1)



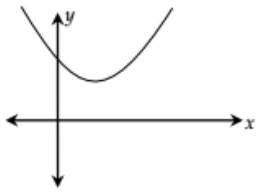
(2)



(3)



(4)



Q. 68. The sum of all even positive integers less than 200 which are not divisible by 6 is :

(1) 6534 **(2)** 6354

(3) 3456 **(4)** 6454

Q. 69. If the angle between the circles $x^2 + y^2 - 2x + 4y - 4 = 0$ and $x^2 + y^2 - 8x - 2y + 8 = 0$ is θ, then the value of $\cos 2\theta$ is :

(1) 1 **(2)** $\dfrac{-1}{2}$

(3) 0 **(4)** $\dfrac{\sqrt{3}}{2}$

Q. 70. The numerically greatest terms in the expansion of $(3-5x)^{15}$ when $x = \frac{1}{5}$ are :

(1) T_4, T_5 **(2)** T_5, T_6

(3) T_6, T_7 **(4)** T_3, T_4

Q. 71. If $A = \left\{x : \frac{\pi}{6} \le x \le \frac{\pi}{3}\right\}$ and $f(x) = \cos x - x(1 + x)$ then $f(A)$ is equal to :

(1) $\left[\frac{\pi}{6}, \frac{\pi}{3}\right]$

(2) $\left[-\frac{\pi}{3}, -\frac{\pi}{6}\right]$

(3) $\left[\frac{1}{2} - \frac{\pi}{3}\left(1+\frac{\pi}{3}\right), \frac{\sqrt{3}}{2} - \frac{\pi}{6}\left(1+\frac{\pi}{6}\right)\right]$

(4) $\left[\frac{1}{2} + \frac{\pi}{3}\left(1-\frac{\pi}{3}\right), \frac{\sqrt{3}}{2} + \frac{\pi}{6}\left(1-\frac{\pi}{6}\right)\right]$

Q. 72. If a function $f(x)$ defined by

$$f(x)\begin{cases} ae^x + be^{-x} & , \ -1 \le x < 1 \\ cx^2 & , \ 1 \le x \le 3 \\ ax^2 + 2cx & , \ 3 > x \le 4 \end{cases}$$

be continuous or some $a, b, c \in R$ and $f'(0) + f'(2) = e$, then the value of a is :

(1) $\frac{1}{e^2 - 3e + 13}$ **(2)** $\frac{e}{e^2 - 3e - 13}$

(3) $\frac{e}{e^2 + 3e + 13}$ **(4)** $\frac{e}{e^2 - 3e + 13}$

Q. 73 $\int \frac{dx}{3 + \sin 2x}$ equals :

(1) $\frac{1}{2\sqrt{3}} \tan^{-1}\left(\frac{2\tan x}{\sqrt{3}}\right) + c$

(2) $\frac{1}{\sqrt{3}} \tan^{-1}\left(\frac{\tan x}{\sqrt{3}}\right) + c$

(3) $\frac{1}{2}\tan^{-1}(2\tan x) + c$

(4) $\frac{1}{2}\tan^{-1}\left(\sqrt{3}\tan x\right) + c$

Q. 74 $\int_0^{400\pi} \sqrt{1 - \cos 2x}\, dx$ is equal to :

(1) $400\sqrt{2}$ **(2)** $800\sqrt{2}$

(3) 0 **(4)** $\frac{400}{\sqrt{2}}$

Q. 75. The area (in sq. units) of the region $A = \{(x, y) : (x-1)[x] \le y \le 2\sqrt{x}, 0 \le x \le 2\}$, where $[t]$ denotes the greatest integer function, is :

(1) $\frac{8}{3}\sqrt{2} - \frac{1}{2}$ **(2)** $\frac{4}{3}\sqrt{2} + 1$

(3) $\frac{8}{3}\sqrt{2} - 1$ **(4)** $\frac{4}{3}\sqrt{2} - \frac{1}{2}$

Q. 76. The differential equation of the family of curves, $x^2 = 4b(y + b)$, $b \in R$, is:

(1) $x(y')^2 = x + 2yy'$ **(2)** $x(y')^2 = 2yy' - x$

(3) $xy'' = y'$ **(4)** $x(y')^2 = x - 2yy'$

Q. 77. The value of $\sum_{n=0}^{100} i^{n!}$ equals (where $i = \sqrt{-1}$)

(1) -1 **(2)** i

(3) $2i + 95$ **(4)** $97 + i$

Q. 78. Let $A = \begin{pmatrix} 0 & 0 & -1 \\ 0 & -1 & 0 \\ -1 & 0 & 0 \end{pmatrix}$. The only correct statement about the matrix A is

(1) $A^2 = I$

(2) $A = (-1)I$, where I is a unit matrix

(3) A^{-1} does not exist

(4) A is a zero matrix

Q. 79. If $A = \begin{bmatrix} 4 & 2 \\ -1 & 1 \end{bmatrix}$ then $(A - 2I)(A - 3I)$ equals :

(1) $A^2 + 6I$ **(2)** I

(3) Zero matrix **(4)** 6I

Q. 80. Points $\vec{a} + \vec{b} + \vec{c}$, $4\vec{a} + 3\vec{b}$, $10\vec{a} + 7\vec{b} - 2\vec{c}$ are :

(1) collinear **(2)** non-coplanar

(3) non-collinear **(4)** form a triangle

Section B

Q. 81. If 'k' is the least distance between the curves $y^2 = 6x$ and $x^2 + y^2 - 16x + 60 = 0$, then the value of $[k]$, is ....., where [.] denotes the greatest integer function.

Q. 82. If the area of the quadrilateral formed by the common tangents of the circle $x^2 + y^2 = 25$ and the ellipse $\frac{x^2}{36}+\frac{y^2}{16}=1$ is A. Then the value of $\left(3\sqrt{11}A-1\right)$ is .....

Q. 83. If area of the triangle formed by latus rectum and tangents at the end points of latus rectum of $\frac{x^2}{16}-\frac{y^2}{9}=1$ is A, then 80 A is .....

Q. 84. Given a regular tetrahdedron OABC with side length 1 unit. Let D and E are mid points of AB and OC respectively. If $\overrightarrow{DE} + \overrightarrow{AC} = \frac{m}{n}\pi$ (where m and n are coprime), then $(m + n)$ is .....

Q. 85. An unbiased coin is tossed indefinitely. Probability that the fourth head is obtained on the sixth toss is $\frac{k}{32}$, then 'k' is equal to .....

Q. 86. Let $f(x) = [[x] + \{x^2\}] + \{[x^2] + \{x\}\}$, then number of points where $|f(x)|$ is non-derivable in [–3, 3] is equal to ..... (where [.] denotes greatest integer function and {.} denotes fractional part function)

Q. 87. Let $f(x) = (lnx)^x + ln(x^x) + x^{lnx}$, then $f'(e)$ is equal to .....

Q. 88. If m is the slope of a line which is tangent to $y^3 = x^4$ and a normal to $x^2 - 2x + y^2 = 0$, then $\left(\frac{3m}{4}\right)^3$ is equal to ..... $(m \neq 0)$

Q. 89. Out of m errors in a computer program Mr. A found 200 errors and Mr. B found 125 errors. 50 errors are common in finding of both A and B, if probability of "neither A nor B" found any error is $\frac{2}{7}$, then value of 'm' is .....

Q. 90. Maximum distance between the plane $2x + y + 2z = 3$ and the circle on the xy-plane $x^2 + y^2 - 2x - 2y + 1 = 0$ is $\frac{\sqrt{a}}{b}$, then the value of $(a + b)$ is ..... (a, b are coprime natural numbers)

ANSWER-KEY

Physics

Q. No.	Answer
1	(4)
2	(1)
3	(2)
4	(2)
5	(1)
6	(4)
7	(3)
8	(2)
9	(2)
10	(3)
11	(3)
12	(3)
13	(3)
14	(2)
15	(2)

Q. No.	Answer
16	(2)
17	(3)
18	(3)
19	(2)
20	(2)
21	5.00
22	1125
23	6.00
24	3.00
25	125
26	20.00
27	6.00
28	40.00
29	1.00
30	3.00

Chemistry

Q. No.	Answer
31	(3)
32	(1)
33	(3)
34	(1)
35	(3)
36	(2)
37	(2)
38	(1)
39	(4)
40	(2)
41	(1)
42	(4)
43	(3)
44	(3)
45	(2)

Q. No.	Answer
46	(2)
47	(2)
48	(1)
49	(1)
50	(3)
51	10.70
52	0.20
53	49.17
54	0.01
55	56.00
56	112.70
57	1.00
58	530
59	493
60	2.24

Mathematics

Q. No.	Answer
61	(2)
62	(1)
63	(3)
64	(1)
65	(1)
66	(3)
67	(2)
68	(1)
69	(1)
70	(1)
71	(3)
72	(2)
73	(1)
74	(2)
75	(2)

Q. No.	Answer
76	(1)
77	(3)
78	(2)
79	(3)
80	(1)
81	4.00
82	999.00
83	324.00
84	4.00
85	5.00
86	1.00
87	5.00
88	4.00
89	385.00
90	8.00