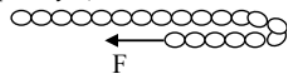


SAMPLE PAPER - 13

Physics

Section A

- Q. 1.** If the units of length and force are increased four times, then the unit of energy will :
- (1) Increase 8 times
 - (2) Increase 16 times
 - (3) Decreases 16 times
 - (4) Increase 4 times
- Q. 2.** If \vec{a} and \vec{b} are two unit vectors and $\vec{R} = \vec{a} + \vec{b}$ and also if $|\vec{R}| = R$, then :
- (1) $R < 0$
 - (2) $R > 2$
 - (3) $0 \leq R \leq 2$
 - (4) R must be 2
- Q. 3.** A body moving with uniform acceleration describes 4 m in third second and 12 m in the fifth second. The distance described in next three second is :
- (1) 100 m
 - (2) 80 m
 - (3) 60 m
 - (4) 20 m
- Q. 4.** For a projectile thrown into space with a speed v , the horizontal range is $\frac{\sqrt{3}v^2}{2g}$. The vertical range is $\frac{v^2}{8g}$. The angle which the projectile makes with the horizontal initially is :
- (1) 15°
 - (2) 30°
 - (3) 45°
 - (4) 60°
- Q. 5.** A chain of mass 'M' and length 'L' is put on a rough horizontal surface and is pulled by constant horizontal force 'F' as shown in figure. Velocity of chain as it turns completely: (Coefficient of friction = μ)
- 
- (1) $\left\{ 2 \left(\frac{F}{M} - \mu g \right) L \right\}^{\frac{1}{2}}$
 - (2) $\left\{ \left(\frac{2F}{M} - \mu g \right) \frac{L}{2} \right\}^{\frac{1}{2}}$
 - (3) $\left\{ 2 \left(\frac{2F}{M} - \mu g \right) L \right\}^{\frac{1}{2}}$
 - (4) $\left\{ \left(\frac{4F}{M} - \mu g \right) \frac{L}{2} \right\}^{\frac{1}{2}}$
- Q. 6.** The earth's radius is R and acceleration due to gravity at its surface is g. If a body of mass m is sent to a height of R/4 from the earth's surface, the potential energy changes by :
- (1) $mg \frac{R}{3}$
 - (2) $mg \frac{R}{4}$
 - (3) $mg \frac{R}{5}$
 - (4) $3 mg \frac{R}{16}$
- Q. 7.** A ball falling in a lake of depth 200 m shows a decrease of 0.1% in its volume. The bulk modulus of elasticity of the material of the ball is : (Take $g = 10 \text{ m/s}^2$)
- (1) 10^9 N/m^2
 - (2) $2 \times 10^9 \text{ N/m}^2$
 - (3) $3 \times 10^9 \text{ N/m}^2$
 - (4) $4 \times 10^9 \text{ N/m}^2$

Q. 8. A particle at the end of a spring executes simple harmonic motion with a period t_1 , while the corresponding period for another spring is t_2 . If the period of oscillation with the two springs in series is T , then :

(1) $T = t_1 + t_2$ (2) $T^2 = t_1^2 + t_2^2$
 (3) $T^{-1} = t_1^{-1} + t_2^{-1}$ (4) $T^{-2} = t_1^{-2} + t_2^{-2}$

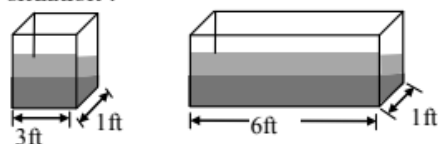
Q. 9. The figure shows two fish tank, each having ends of width 1 foot. Tank A is 3 feet long while tank B is 6 feet long. Both tanks are filled with 1 foot of water.

S_A = the magnitude of the force of the water on the end of tank A

S_B = the magnitude of the force of the water on the end of tank B

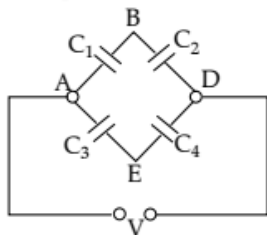
B_A = the magnitude of the force of the water on the bottom of tank A

B_B = the magnitude of the force of the water on the bottom of tank B. Using the notation given above, Which one of the following sets of equations below is correct for this situation ?



- (1) $S_A = S_B$ and $B_A = B_B$
 (2) $S_A = 2S_B$ and $B_A = B_B$
 (3) $2S_A = S_B$ and $2B_A = B_B$
 (4) $S_A = S_B$ and $2B_A = B_B$

Q. 10. Potential difference between the points B and E of the circuits is :

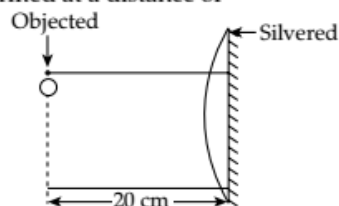


- (1) $\frac{(C_2 - C_1)}{V}$
 (2) $\frac{(C_4 - C_3)}{V}$
 (3) $\left\{ \frac{C_2 C_3 - C_1 C_4}{C_1 + C_2 + C_3 + C_4} \right\} V$
 (4) $\left\{ \frac{C_1 C_4 - C_3 C_2}{(C_1 + C_2)(C_3 + C_4)} \right\} V$

Q. 11. A plane mirror is moving with velocity $4\hat{i} + 5\hat{j} + 8\hat{k}$. A point object in front of the mirror moves with a velocity $3\hat{i} + 4\hat{j} + 5\hat{k}$. Here \hat{k} is along the normal to the plane mirror and facing towards the object. The velocity of the image is :

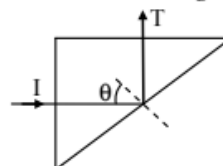
- (1) $-3\hat{i} - 4\hat{j} + 5\hat{k}$ (2) $3\hat{i} + 4\hat{j} + 11\hat{k}$
 (3) $-3\hat{i} - 4\hat{j} + 11\hat{k}$ (4) $7\hat{i} + 9\hat{j} + 11\hat{k}$

Q. 12. An object O is placed at a distance of 20 cm from a thin plano-convex lens of focal length 15 cm. The plane surface of the lens is silvered as shown in fig. The image is formed at a distance of



- (1) 60 cm to the right of the lens
 (2) 30 cm to the left of the lens
 (3) 24 cm to the right of the lens
 (4) 12 cm to the left of the lens

Q. 13. A triangular prism of glass is shown in figure. A ray incident normally to one face is totally internally reflected. If θ is 45° , then index of refraction of the glass is :



- (1) less than 1.41 (2) equal to 1.41
 (3) greater than 1.41 (4) None of these

Q. 14. The central fringe of the interference pattern produced by light of wavelength 6000 \AA is found to shift to the position of fourth bright fringe after a glass plate of refractive index 1.5 is introduced in path of one of beams. The thickness of the glass plate would be :

- (1) 4.8 mm (2) 8.23 mm
 (3) 14.98 mm (4) 3.78 mm

Q. 15. Protons and singly ionized atoms of U^{235} and U^{238} are passed in turn (which means one after the other and not at the same time) through a velocity selector and then enter a uniform magnetic field. The protons

describe semicircles of radius 10 mm. The separation between the ions of U^{235} and U^{238} after describing semicircle is given by :

- (1) 60 mm (2) 30 mm
(3) 2350 mm (4) 2380 mm

Q. 16. In uranium ($Z = 92$) the K absorption edge is 0.107 \AA and the K_{α} line is 0.126 \AA , the wavelength of the L absorption edge is :

- (1) 0.7 \AA (2) 1 \AA
(3) 2 \AA (4) 3.2 \AA

Q. 17. Assuming that about 200 MeV of energy is released per fission of ${}_{92}U^{235}$ nuclei, then the mass of U^{235} consumed per day in fission reactor of power 1 megawatt will be approximately :

- (1) 10^{-2} g (2) 1 g
(3) 100 g (4) $10,000 \text{ g}$

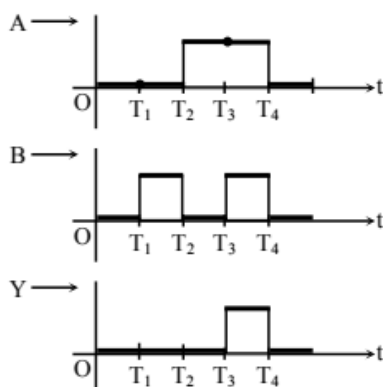
Q. 18. The velocity at which the mass of a particle becomes twice its rest mass will be :

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

Q. 19. If lattice parameter for a crystalline structure is 3.6 \AA , then atomic radius in fcc crystal in \AA is :

- (1) 7.20 \AA (2) 1.80 \AA
(3) 1.27 \AA (4) 2.90 \AA

Q. 20. The given figure shows the waveforms for two inputs A and B and that for the output Y of a logic circuit. The logic circuit is :



- (1) an AND gate (2) an OR gate
(3) a NAND gate (4) a NOT gate

Section B

Q. 21. The maximum kinetic energy of the photoelectrons ejected will be eV, when light of wavelength 350 nm is incident on a cesium surface. Work function of cesium = 1.9 eV.

Q. 22. A man is throwing bricks of mass 2 kg onto a floor from a height of 2 m. Bricks reaches to floor with speed $2\sqrt{10}$ m/s. Man throws 10 bricks in a minute. If power of man is W watt then $\frac{3}{10}W$ is equal to W.

Q. 23. A body starts moving from origin at $t = 0$ with a velocity of $5\hat{i}$ in x - y plane under the action of force producing an acceleration of $(3\hat{i} + 2\hat{j})$ m/s², then y -co-ordinate is m of body when x -co-ordinate is 84 m.

Q. 24. A wheel rotating at same angular speed undergoes constant angular retardation. After revolution angular velocity reduces to half its initial value. It will make revolution before stopping.

Q. 25. Air separated from the atmosphere by a column of mercury of length $h = 15$ cm is present in a narrow cylindrical tube soldered at one end. When the tube is placed horizontally the air occupies a volume $V_1 = 240 \text{ mm}^3$. When it is set vertically with its open end upwards the volume of the air is $V_2 = 200 \text{ mm}^3$. The atmospheric pressure during the experiment is $7n$ cm of Hg where n is single digit number. n will be

Q. 26. An electric heater is used in a room of total wall area 137 m^2 to maintain a temperature of $+20^\circ\text{C}$ inside it, when the outside temperature is -10°C . The walls have three different layers materials. The innermost layer is of wood of thickness 2.5 cm, the middle layer is of cement of thickness 1.0 cm and the outermost layer is brick 25.0 cm. The power of the electric heater will be W. Assume that there is no heat loss through the floor and the ceiling. The thermal conductivities of wood, cement and brick are 0.125, 1.5 and 1.0 watt/m²°C respectively.

Q. 27. Two equal point charges of same sign are fixed on y -axis, on the either sides of the origin equidistant from it, distance between them d . A third charge moves along x axis. The distance of third charge from either of the two fixed charges when force on

third charge is maximum will be cm.
[$d = 10$ cm]

- Q. 28. A capacitor has charge $50 \mu\text{C}$. When the gap between the plates is filled with glass wool, then $120 \mu\text{C}$ charge flows through the battery to capacitor. The dielectric constant of glass wool is
- Q. 29. As a cell ages, its internal resistance increases. A voltmeter of resistance 270Ω connected across an old dry cell reads 1.44 V. However,

a potentiometer at the balance point, gives a voltage measurement of the cell as 1.5 V. Internal resistance of the cell is
+ 5.25Ω .

- Q. 30. The mean lives of a radioactive substance are 1620 and 405 years for β -emission and α -emission respectively. The time after which three fourth of a sample will decay if it is decaying both by β -emission and α -emission simultaneously will be years. (Take $\ln 2 = 0.693$)

Chemistry

Section A

- Q. 31. For the decomposition reaction
 $\text{NH}_2\text{COONH}_4 (\text{s}) \rightleftharpoons 2\text{NH}_3 (\text{g}) + \text{CO}_2 (\text{g})$
the $K_p = 2.9 \times 10^{-5} \text{ atm}^3$. The total pressure of gases at equilibrium when 1 mol of $\text{NH}_2\text{COONH}_4 (\text{s})$ was taken initially could be :

- (1) 0.0194 atm (2) 0.0388 atm
(3) 0.0582 atm (4) 0.0766 atm

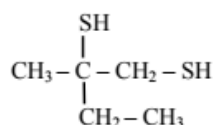
- Q. 32. 400 ml of $\frac{1}{200} \text{ M H}_2\text{SO}_4$, 400 ml of $\frac{1}{100} \text{ M HCl}$ and 200 ml water are mixed together, pH of the resulting solution is :

- (1) 2.1 (2) 2.8
(3) 3 (4) 3.1

- Q. 33. Calculate the work involved when 1 mol of an ideal gas is compressed reversibly from 1.00 bar to 5.00 bar at a constant temperature of 300 K :

- (1) -14.01 kJ (2) $+18.02 \text{ kJ}$
(3) 4.01 kJ (4) -8.02 kJ

- Q. 34. Write the IUPAC name of compound



- (1) 2-methyl butane -1, 2 - di thiol
(2) 3-methyl butane -1, 2 - di thiol
(3) 1-ethyl-2-methyl butane -1, 2 - di thiol
(4) 2-ethyl-1-methyl butane -1, 2 - di thiol

- Q. 35. Alkynes are isomers of :

- (1) Cycloalkane (2) Alkadiene
(3) Alkene (4) All of the above

- Q. 36. Atomic hydrogen is obtained by passing ordinary hydrogen through :

- (1) A suitable catalyst maintained at high temperature under high pressure.
(2) A solution containing zinc and sulphuric acid.
(3) An electric arc.
(4) A silent electric discharge at ordinary temperature.

- Q. 37. When aqueous solution of AlCl_3 is concentrated, it furnishes crystals of :

- (1) $\text{Al}_2\text{Cl}_6 \cdot 2\text{H}_2\text{O}$ (2) $\text{AlCl}_3 \cdot 2\text{H}_2\text{O}$
(3) $\text{Al}_2\text{Cl}_6 \cdot 12\text{H}_2\text{O}$ (4) $\text{Al}_2\text{Cl}_6 \cdot 24\text{H}_2\text{O}$

- Q. 38. $\text{SiCl}_4 \xrightarrow{\text{H}_2\text{O}} (\text{A}) \xrightarrow{\Delta} (\text{B}) \xrightarrow[\text{heat}]{\text{Na}_2\text{CO}_3} (\text{C})$.
The compound C is :

- (1) SiO_2 (2) Si
(3) SiC (4) Na_2SiO_3

- Q. 39. The decreasing order of the second ionization potential of K, Ca and Ba is :

- (1) $\text{K} > \text{Ca} > \text{Ba}$ (2) $\text{Ca} > \text{Ba} > \text{K}$
(3) $\text{Ba} > \text{K} > \text{Ca}$ (4) $\text{K} > \text{Ba} > \text{Ca}$

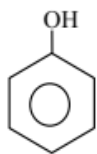
- Q. 40. Which of the following is not paramagnetic :

- (1) Carbon free radical
(2) Singlet carbene
(3) Triplet carbene
(4) All of the above

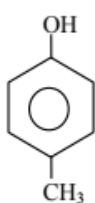
- Q. 41. What would be the main product when propene reacts with HBr in presence of benzoyl peroxide

- (1) $\begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{CH}_3 - \text{C} - \text{C} - \text{H} \\ | \quad | \\ \text{Br} \quad \text{H} \end{array}$ (2) $\begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ \text{CH}_3 - \text{C} - \text{C} - \text{H} \\ | \quad | \\ \text{H} \quad \text{Br} \end{array}$
(3) Both A and B (4) $\text{Br}-\text{CH}_2-\text{CH}=\text{CH}_2$

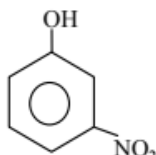
Q. 42. In the following compounds :



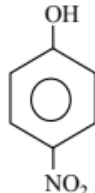
(I)



(II)



(III)



(IV)

The order to acidity is :

- (1) III > IV > I > II
 - (2) I > IV > III > II
 - (3) II > I > III > IV
 - (4) IV > III > I > II
- Q. 43. A gem dichloride is formed in the reaction except :
- (1) CH_3CHO and PCl_5
 - (2) CH_3COCH_3 and PCl_5
 - (3) $\text{CH}_2 = \text{CH}_2$ and Cl_2
 - (4) $\text{CH}_2 = \text{CHCl}$ and HCl
- Q. 44. Which of the following reactions of alkanols does not involve C–O bond breaking :
- (1) $\text{CH}_3\text{CH}_2\text{OH} + \text{SOCl}_2$
 - (2) $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3 + \text{PBr}_3$
 - (3) $\text{CH}_3\text{CH}_2\text{OH} + \text{CH}_3\text{COOH}$
 - (4) $\text{ROH} + \text{HX}$
- Q. 45. Water soluble salt among AgNO_3 , AgF and AgClO_4 are :
- (1) AgF , AgNO_3
 - (2) AgF
 - (3) AgF , AgNO_3 , AgClO_4
 - (4) None of these
- Q. 46. Alkaline hydrolysis of $\text{C}_4\text{H}_8\text{Cl}_2$ gives a compound (A) which on heating with NaOH and I_2 produces a yellow precipitate of CHI_3 . The compound (A) should be.
- (1) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$
 - (2) $\text{CH}_3\text{CH}_2\text{C}(=\text{O})\text{CH}_3$
 - (3) $\text{CH}_3 - \text{CH}_2 - \underset{\text{OH}}{\text{CH}} - \underset{\text{OH}}{\text{CH}_2}$
 - (4) $\text{CH}_3 - \text{CH}_2 - \underset{\text{OH}}{\text{CH}} - \underset{\text{OH}}{\text{CH}_2}$
- Q. 47. The oxidation of toluene with hot KMnO_4 gives :
- (1) Benzoic acid
 - (2) Benzaldehyde
 - (3) Benzene
 - (4) Benzyl alcohol
- Q. 48. Which of the following compound cannot be produced if 1-propane amine is treated with NaNO_2 and HCl :
- (1) Propane -1-ol
 - (2) Propane-2-ol
 - (3) 2-Chloropropane
 - (4) 2-Propaneamine
- Q. 49. The destruction of the biological nature and activity of proteins by heat or chemical agent is called :
- (1) dehydration
 - (2) denaturation
 - (3) denitrogenation
 - (4) deamination.
- Q. 50. A substance was known by its mode of synthesis to contain 10 atoms of carbon per molecule along with unknown number of atoms of chlorine hydrogen and oxygen. Analysis showed 60.5% carbon, 5.55% hydrogen, 16.10% oxygen and 17.9% chlorine. The Empirical formula of the compound is :
- (1) $\text{C}_{10}\text{H}_8\text{OCl}_2$
 - (2) $\text{C}_{10}\text{H}_{11}\text{O}_2\text{Cl}$
 - (3) $\text{C}_{10}\text{H}_{10}\text{OCl}$
 - (4) $\text{C}_{10}\text{H}_{12}\text{O}_2\text{Cl}$

Section B

- Q. 51. The spectral lines of atomic hydrogen wave number is equal to the difference between the wave numbers of the following two lines of the Balmer series : 486.1 and 410.2 nm? The wavelength of that line is $\times 10^{-4}$ cm.
- Q. 52. In a certain region of space there are only 5 molecules per cm^3 on an average. The

temperature is 3 K. The average pressure of this very dilute gas is $\times 10^{-21}$ atoms.

- Q. 53. For a reaction: $A_{(g)} \rightarrow nB_{(g)}$ the rate constant is $6.93 \times 10^{-4} \text{ sec}^{-1}$. The reaction is performed at constant pressure and temperature of 24.63 atm and 300 K, starting with 1 mole of pure 'A'.

If concentration of 'B' after 2000 sec is $\frac{3}{3.25}$ M then the value of 'n' is

- Q. 54. In order to cause coagulation of 100 ml Arsenious sulphide sol 111.7 mg of 2 M NaCl solution is used, the coagulation value of NaCl will be

- Q. 55. The density of solid Argon is 1.6 ml at -233°C . If the Argon atom is assumed to be sphere of radius 1.5×10^{-8} cm, then the % of solid Argon is apparently occupied.

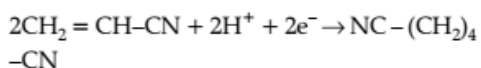
[Take : $N_A = 6 \times 10^{23}$, Atomic mass of Ar = 40]

- Q. 56. Lauryl alcohol is obtained from coconut oil and is used to make detergent. A solution of 5 g of Lauryl alcohol in 200 g of benzene freezes at 4°C . The approximate molar mass of Lauryl alcohol will be

Given, K_f of benzene = 5.1°C/molal , Freezing point of benzene = 5.5°C .

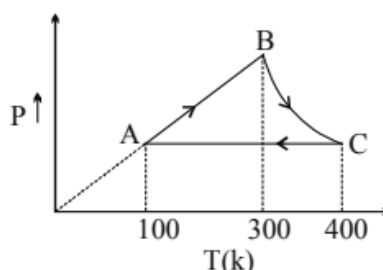
[Give your answer after division by 17]

- Q. 57. To produce 1,4-dicyanobutane following reduction is carried out :



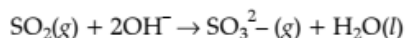
The current (in Ampere) must be used to produce 162 g of 1,4-dicyanobutane per hour.

- Q. 58. The net work done in the following cycle for one mol of an ideal gas will be (in calorie), where in process BC, $PT = \text{constant}$. ($R = 2 \text{ cal/mol}\cdot\text{K}$).

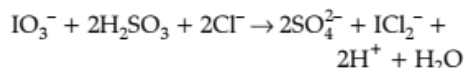


- Q. 59. 2 litre He gas at 2 atm and 300 K is inserted into a 4 litre rigid container containing N_2 at 600K and 4 atm. Finally mixture is maintained at 600K temperature. The final pressure of gaseous mixture would be torr.

- Q. 60. A gaseous mixture was passed at the rate of 2.5 L/min through a solution of NaOH for a total of 1 hour. The SO_2 in the mixture was retained as sulphite ion :



After acidification with HCl the sulphite was titrated with 5 ml of 0.003 M KIO_3



The concentration of SO_2 will be ppm if density of gaseous mixture is 1.6 gm/L.

Mathematics

Section A

Q. 61. If $\log_{\alpha} 8 = \gamma$, $\log_{\beta} \alpha = -1$ and $\log_{1/4} \beta = -1$ then

$\left(\frac{1}{\alpha} + 1\right)^{\log_{\beta}(\beta^2 + 4\gamma^2)}$ is equal to :

- (1) $\sqrt{5}$ (2) 5
(3) 25 (4) 625

Q. 62. If b and c are odd integers, then the equation $x^2 + bx + c = 0$ has :

- (1) two odd roots
(2) two integer roots, one odd and one even
(3) no integer roots
(4) two even roots

Q. 63. The sum of n terms of an AP is $3n^2 + 5n$. The number of term which equals 164 is :

- (1) 13 (2) 21
(3) 27 (4) None of these

Q. 64. Let $(5 + 2\sqrt{6})^n = p + f$ where $n \in \mathbb{N}$ and $p \in \mathbb{N}$ and $0 < f < 1$ then the value of $f^2 - f + pf - p$ is

- (1) a natural number
(2) a negative integer
(3) a prime number
(4) an irrational number

Q. 65. There are $(n + 1)$ white and $(n + 1)$ black balls each set numbered 1 to $(n + 1)$. The number of ways in which the balls can be arranged in row so that the adjacent balls are of different colours is :

- (1) $(2n + 2)!$ (2) $(2n + 2)! \times 2$
(3) $(n + 1)! \times 2$ (4) $2((n + 1)!)^2$

Q. 66. The coordinates of vertices of base BC of an isosceles triangle ABC are given by B (1, 3) and C (-2, 7) which of the following points can be the possible coordinates of the vertex A ?

- (1) (-7, 1/8) (2) (1, 6)
(3) (-1/2, 5) (4) (-5/6, 6)

Q. 67. The value of p so that the straight line $x \cos \alpha + y \sin \alpha - p = 0$ may touch the circle $x^2 + y^2 - 2ax \cos \alpha - 2by \sin \alpha - a^2 \sin^2 \alpha = 0$ is :

- (1) $a \cos^2 \alpha + b \sin^2 \alpha - \sqrt{a^2 + b^2 \sin^2 \alpha}$
(2) $a \cos^2 \alpha - b \sin^2 \alpha - \sqrt{a^2 + b^2 \sin^2 \alpha}$

(3) $a \cos^2 \alpha + b \sin^2 \alpha - \sqrt{a^2 - b^2 \sin^2 \alpha}$

(4) $a \cos^2 \alpha - b \sin^2 \alpha + \sqrt{a^2 - b^2 \sin^2 \alpha}$

Q. 68. The equation of the parabola whose vertex and focus are on the positive side of the x-axis at distances a and b respectively from the origin is

(1) $y^2 = 4(b - a)(x - a)$

(2) $y^2 = 4(a - b)(x - b)$

(3) $x^2 = 4(b - a)(y - a)$

(4) $x^2 = 4(a - b)(y - b)$

Q. 69. The points where the normals to the ellipse $x^2 + 3y^2 = 37$ are parallel to the line $6x - 5y = 2$ are :

(1) (4, 2) (-5, -2) (2) (5, 2) (-5, -3)

(3) (5, 2) (-5, -2) (4) (5, -2) (-5, 2)

Q. 70. The locus of the mid-point of the chords of the hyperbola $\left(\frac{x^2}{a^2}\right) - \left(\frac{y^2}{b^2}\right) = 1$ passing through a fixed point (α, β) is a hyperbola with centre at $\left(\frac{\alpha}{2}, \frac{\beta}{2}\right)$ Its equation is :

(1) $\frac{\left(x - \frac{\alpha}{2}\right)^2}{a^2} - \frac{\left(y - \frac{\beta}{2}\right)^2}{b^2} = \frac{\alpha^2}{4a^2} - \frac{\beta^2}{4b^2}$

(2) $\frac{\left(x + \frac{\alpha}{2}\right)^2}{a^2} - \frac{\left(y - \frac{\beta}{2}\right)^2}{b^2} = \frac{\alpha}{4a^2} + \frac{\beta^2}{4b^2}$

(3) $\frac{\left(x - \frac{\alpha}{2}\right)^2}{a^2} - \frac{\left(y - \frac{\beta}{2}\right)^2}{b^2} = \frac{\alpha}{4a^2} - \frac{\beta^2}{4b^2}$

(4) $\frac{\left(x + \frac{\alpha}{2}\right)^2}{a^2} - \frac{\left(y + \frac{\beta}{2}\right)^2}{b^2} = \frac{\alpha}{4a^2} - \frac{\beta^2}{4b^2}$

Q. 71. The normals to the curve $x = a(\theta + \sin \theta)$, $y = a(1 - \cos \theta)$ at the points $\theta = (2n + 1)\pi$, $n \in \mathbb{I}$ are all :

(1) parallel to x-axis

(2) parallel to y-axis

(3) parallel to the line $y = x$

(4) parallel to the line $y = -x$

Q. 72. Function $f(x) = \log(1+x) - \frac{2x}{2+x}$ is monotonically increasing when :

- (1) $x < 0$ (2) $x > 0$
 (3) $x \in \mathbb{R}$ (4) $x > -1$

Q. 73. A cone of maximum volume is inscribed in a given sphere. Then the ratio of the height of the cone to the diameter of the sphere is

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

Q. 74. In an equilateral triangle, the in-radius, circum-radius and one of the ex-radii are in the ratio :

- (1) 2 : 3 : 5 (2) 1 : 2 : 3
 (3) 1 : 3 : 7 (4) 3 : 7 : 9

Q. 75. $\left(\frac{1 + \cos \theta + i \sin \theta}{1 + \cos \theta - i \sin \theta} \right)^n =$

- (1) $\cos n\theta + i \sin n\theta$
 (2) $\sin n\theta + i \cos n\theta$
 (3) $\cos \frac{n\theta}{2} + i \sin \frac{n\theta}{2}$
 (4) $\cos n\theta$

Q. 76. The points A(5, -1, 1); B(7, -4, 7); C(1, -6, 10) and D(-1, -3, 4) are vertices of a :

- (1) square (2) rhombus
 (3) rectangle (4) trapezium

Q. 77. If the vector \vec{b} is collinear with the vector $\vec{a} = (2\sqrt{2}, -1, 4)$ and $|\vec{b}| = 10$, then

- (1) $\vec{a} \pm \vec{b} = \vec{0}$ (2) $\vec{a} \pm 2\vec{b} = \vec{0}$
 (3) $2\vec{a} \pm \vec{b} = \vec{0}$ (4) $\vec{a} \pm 3\vec{b} = \vec{0}$

Q. 78. If $A = \begin{bmatrix} -2 & 1 \\ 0 & 3 \end{bmatrix}$ Then $2A^2 - 3A :$

- (1) $\begin{bmatrix} 14 & -1 \\ 0 & 9 \end{bmatrix}$ (2) $\begin{bmatrix} -14 & 1 \\ 0 & 9 \end{bmatrix}$
 (3) $\begin{bmatrix} 14 & 1 \\ 0 & -9 \end{bmatrix}$ (4) $\begin{bmatrix} 14 & -1 \\ 0 & -9 \end{bmatrix}$

Q. 79. If A, B and C are the angles of a triangle ABC, then

$$\begin{vmatrix} \sin 2A & \sin C & \sin B \\ \sin C & \sin 2B & \sin A \\ \sin B & \sin A & \sin 2C \end{vmatrix} =$$

- (1) 0 (2) 1
 (3) 2 (4) 3

Q. 80. A bag contains 20 tickets numbered 1 to 20. Two tickets are drawn at random. The probability that both the numbers on the ticket are prime is :

- (1) $\frac{4}{95}$ (2) $\frac{14}{95}$
 (3) $\frac{17}{95}$ (4) $\frac{9}{95}$

Section B

Q. 81. Let $y = f(x)$ be a real-valued differentiable function on \mathbb{R} (the set of all real numbers) such that $f(1) = 1$. If $f(x)$ satisfies $xf'(x) = x^2 + f(x) - 2$, then the area bounded by $f(x)$ with x -axis between ordinates $x = 0$ and $x = 3$ is equal to

Q. 82. If area of the region bounded by $y \geq \cot(\cot^{-1} |\ln |e^{kx}|)$ and $x^2 + y^2 - 6|x| - 6|y| + 9 \leq 0$, is $\lambda\pi$, then λ is

$$\int_0^x ((\cos 2t - 1)(\cos t - e^{-t^2})t^{-n}) dt$$

Q. 83. If $\lim_{x \rightarrow 0} \frac{I t^0}{\cos x - 1}$ is a finite non-zero number, Then the integer value for n is

Q. 84. If $\int \frac{x + (\cos^{-1} 3x)^2}{\sqrt{1-9x^2}} dx$

$$= \frac{1}{\alpha} (\sqrt{1-9x^2} + (\cos^{-1} 3x)^\beta) + C,$$

where C is constant of integration, then $(\alpha + 3\beta)$ is equal to

Q. 85. Let a function $y = f(x)$ is defined by $x = e^\theta \sin \theta$ and $y = \theta e^{\sin \theta}$, where θ is a real parameter, then value of $\lim_{\theta \rightarrow 0} f'(x)$ is

Q. 86. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a polynomial function satisfying $f(x+y) = f(x) + f(y) + 3xy(x+y) - 1 \forall x, y \in \mathbb{R}$ and $f'(0) = 1$, then $\lim_{x \rightarrow \infty} \frac{f(2x)}{f(x)}$ is equal to

Q. 87. If $\lim_{x \rightarrow \infty} \frac{1}{x+1} \tan\left(\frac{\pi x + 1}{2x + 2}\right) = \frac{a}{\pi - b}$

($a, b \in \mathbb{N}$); then the value of $a + b$ is

Q. 88. Let a and b are two positive integers such that $b \neq 1$. Let $g(a, b) =$ Number of lattice points inside the quadrilateral formed by lines $x = 0, y = 0, x = b$ and $y = a$.

$$f(a,b) = \left[\frac{a}{b} \right] + \left[\frac{2a}{b} \right] + \dots + \left[\frac{(b-1)a}{b} \right],$$

then the value of $\left[\frac{g(101,37)}{f(101,37)} \right]$ is

(Note $P(x, y)$ is lattice point if $x, y \in \mathbb{I}$)
(where $[.]$ denotes greatest integer function)

Q. 89. If $\theta \in \left[\frac{5\pi}{2}, 3\pi \right]$ and $2\cos\theta + \sin\theta = 1$, then

the value of $7\cos\theta + 6\sin\theta$ is

Q. 90. In a ΔABC , let $BC = 3$. D is a point on BC such that $BD = 2$, Then the value of $AB^2 + 2AC^2 - 3AD^2$ is

Answers

Physics

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

Q. No.	Answer
16	(1)
17	(4)
18	(3)
19	(3)
20	(1)
21	1.60
22	1.33
23	36.00
24	3.00
25	5.00
26	9000
27	12.20
28	2.40
29	11.25
30	449

Chemistry

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

Q. No.	Answer
46	(2)
47	(1)
48	(4)
49	(2)
50	(2)
51	41.03
52	2.04
53	4.00
54	2.00
55	3.00
56	5.00
57	80.40
58	200
59	4560
60	8.00

Mathematics

Q. No.	Answer
61	(4)
62	(3)
63	(3)
64	(2)
65	(4)
66	(4)
67	(1)
68	(1)
69	(3)
70	(1)
71	(1)
72	(4)
73	(4)
74	(2)
75	(1)

Q. No.	Answer
76	(2)
77	(3)
78	(1)
79	(1)
80	(2)
81	6.00
82	9.00
83	3.00
84	0.00
85	0.00
86	8.00
87	3.00
88	2.00
89	6.00
90	6.00