

## Question Paper

**Q1.** A student measured the diameter of a wire using a screw gauge with the least count 0.001 cm and listed the measurements. The measured value should be recorded as

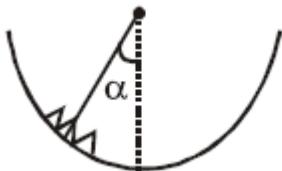
(1) 5.3200 cm (2) 5.3 cm  
(3) 5.32 cm (4) 5.320 cm

**Q2.** The distance travelled by a body moving along a line in time  $t$  is proportional to  $t^3$ . The acceleration-time ( $a, t$ ) graph for the motion of the body will be

The figure consists of four separate graphs, each with the vertical axis labeled  $a$  and the horizontal axis labeled  $t$ .

- (1) A graph showing a curve starting at a positive value on the  $a$ -axis and decreasing as  $t$  increases, approaching the  $t$ -axis asymptotically.
- (2) A graph showing a straight line starting at the origin (0,0) and increasing linearly with a positive slope.
- (3) A graph showing a straight line starting at a positive value on the  $a$ -axis and decreasing linearly towards the  $t$ -axis.
- (4) A graph showing a horizontal line at a constant positive value on the  $a$ -axis.

**Q3.** An insect crawls up a hemispherical surface very slowly. The coefficient of friction between the insect and the surface is  $1/3$ . If the line joining the centre of the hemispherical surface to the insect makes an angle  $\alpha$  with the vertical, the maximum possible value of  $\alpha$  so that the insect does not slip is given by



**Q4.** A projectile moving vertically upwards with a velocity of  $200 \text{ ms}^{-1}$  breaks into two equal parts at a height of  $490 \text{ m}$ . One part starts moving vertically upwards with a velocity of  $400 \text{ ms}^{-1}$ . How much time it will take, after the break up with the other part to hit the ground?

**Q5.** Two bodies  $A$  and  $B$  of mass  $m$  and  $2m$  respectively are placed on a smooth floor. They are connected by a spring of negligible mass. A third body  $C$  of mass  $m$  is placed on the floor. The body  $C$  moves with a velocity  $v_0$  along the line joining  $A$  and  $B$  and collides elastically with  $A$ . At a certain time after the collision it is found

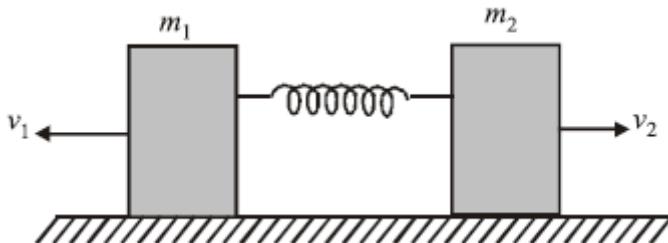
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that the instantaneous velocities of  $A$  and  $B$  are same and the compression of the spring is  $x_0$ . The spring constant  $k$  will be

(1)  $m \frac{v_0^2}{x_0^2}$   
 (3)  $2m \frac{v_0}{x_0}$

(2)  $m \frac{v_0}{2x_0}$   
 (4)  $\frac{2}{3}m \left( \frac{v_0}{x_0} \right)^2$

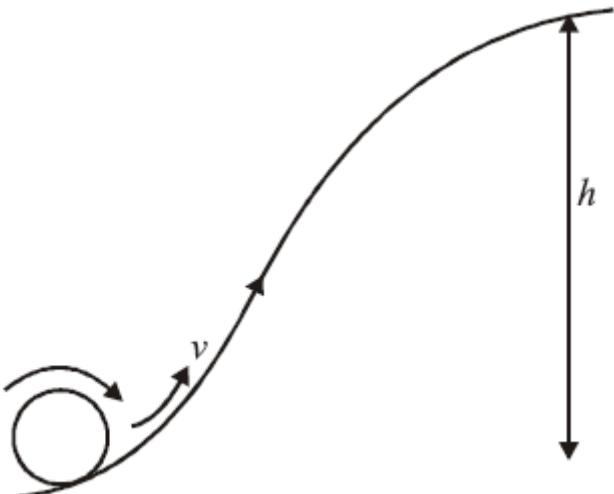
**Q6.** A spring is compressed between two blocks of masses  $m_1$  and  $m_2$  placed on a horizontal frictionless surface as shown in the figure. When the blocks are released, they have initial velocity of  $v_1$  and  $v_2$  as shown. The blocks travel distances  $x_1$  and  $x_2$  respectively before coming to rest. The ratio  $\left( \frac{x_1}{x_2} \right)$  is



(1)  $\frac{m_2}{m_1}$   
 (3)  $\sqrt{\frac{m_2}{m_1}}$

(2)  $\frac{m_1}{m_2}$   
 (4)  $\sqrt{\frac{m_1}{m_2}}$

**Q7.** A solid sphere is rolling on a surface as shown in figure, with a translational velocity  $v$   $\text{m s}^{-1}$ . If it is to climb the inclined surface continuing to roll without slipping, then minimum velocity for this to happen is



(1)  $\sqrt{2gh}$   
 (3)  $\sqrt{\frac{7}{2}gh}$

(2)  $\sqrt{\frac{7}{5}gh}$   
 (4)  $\sqrt{\frac{10}{7}gh}$

**Q8.** This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements. Statement 1: When moment of inertia  $I$  of a body rotating about an axis with angular speed  $\omega$  increases, its angular momentum  $L$  is unchanged but the kinetic energy  $K$  increases if there is no torque applied on it. Statement 2:  $L = I\omega$ , kinetic energy of rotation =  $\frac{1}{2}I\omega^2$

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(1) Statement 1 is true, Statement 2 is true, Statement (2) Statement 1 is false, Statement 2 is true.  
 2 is not the correct explanation of Statement 1.  
 (3) Statement 1 is true, Statement 2 is true, Statement (4) Statement 1 is true, Statement 2 is false.  
 2 is correct explanation of the Statement 1.

**Q9.** Assuming the earth to be a sphere of uniform density, the acceleration due to gravity inside the earth at a distance of  $r$  from the centre is proportional to

(1)  $r$  (2)  $r^{-1}$   
 (3)  $r^2$  (4)  $r^{-2}$

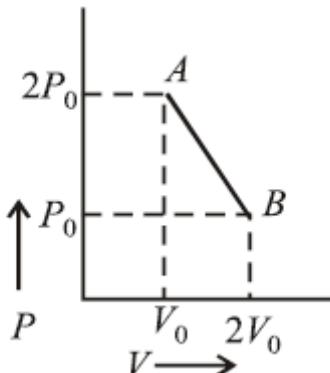
**Q10.** Water is flowing through a horizontal tube having cross-sectional areas of its two ends being  $A$  and  $A'$  such that the ratio  $A/A'$  is 5. If the pressure difference of water between the two ends is  $3 \times 10^5 \text{ N m}^{-2}$ , the velocity of water with which it enters the tube will be (neglect gravity effects)

(1)  $5 \text{ m s}^{-1}$  (2)  $10 \text{ m s}^{-1}$   
 (3)  $25 \text{ m s}^{-1}$  (4)  $50\sqrt{10} \text{ m s}^{-1}$

**Q11.** A given ideal gas with  $\gamma = \frac{C_p}{C_v} = 1.5$  at a temperature  $T$ . If the gas is compressed adiabatically to one-fourth of its initial volume, the final temperature will be

(1)  $2\sqrt{2}T$  (2)  $4T$   
 (3)  $2T$  (4)  $8T$

**Q12.**  $n$  moles of an ideal gas undergo a process  $A \rightarrow B$  as shown in the figure. Maximum temperature of the gas



during the process is

(1)  $\frac{9P_0V_0}{nR}$  (2)  $\frac{3P_0V_0}{2nR}$   
 (3)  $\frac{9P_0V_0}{2nR}$  (4)  $\frac{9P_0V_0}{4nR}$

**Q13.** This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements. Statement 1: Bats emitting ultrasonic waves can detect the location of a prey by hearing the waves reflected from it. Statement 2: When the source and the detector are moving, the frequency of reflected waves is changed.

(1) Statement 1 is false, Statement 2 is true. (2) Statement 1 is true, Statement 2 is false.  
 (3) Statement 1 is true, Statement 2 is true,  
 Statement 2 is not the correct explanation of  
 Statement 1. (4) Statement 1 is true, Statement 2 is true,  
 Statement 2 is the correct explanation of  
 Statement 1.

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**Q14.** A wave represented by the equation  $y_1 = a \cos(kx - \omega t)$  is superimposed with another wave to form a stationary wave such that the point  $x = 0$  is node. The equation for the other wave is

(1) $a \cos(kx - \omega t + \pi)$	(2) $a \cos(kx + \omega t + \pi)$
(3) $a \cos(kx + \omega t + \frac{\pi}{2})$	(4) $a \cos(kx - \omega t + \frac{\pi}{2})$

**Q15.** A series combination of  $n_1$  capacitors, each of capacity  $C_1$  is charged by source of potential difference 4 V. When another parallel combination of  $n_2$  capacitors each of capacity  $C_2$  is charged by a source of potential difference  $V$ , it has the same total energy stored in it as the first combination has. The value of  $C_2$  in terms of  $C_1$  is then

(1) $16 \frac{n_2}{n_1} C_1$	(2) $\frac{2C_1}{n_1 n_2}$
(3) $2 \frac{n_2}{n_1} C_1$	(4) $\frac{16C_1}{n_1 n_2}$

**Q16.** Three resistors of  $4\Omega$ ,  $6\Omega$  and  $12\Omega$  are connected in parallel and the combination is connected in series with a 1.5 V battery of  $1\Omega$  internal resistance. The rate of Joule heating in the  $4\Omega$  resistor is

(1) 0.55 W	(2) 0.33 W
(3) 0.25 W	(4) 0.86 W

**Q17.** It is preferable to measure the e.m.f. of a cell by potentiometer than by a voltmeter because of the following possible reasons. (i) In case of potentiometer, no current flows through the cell. (ii) The length of the potentiometer allows greater precision. (iii) Measurement by the potentiometer is quicker. (iv) The sensitivity of the galvanometer, when using a potentiometer is not relevant. Which of these reasons are correct?

(1) (i),(iii),(iv)	(2) (i),(iii),(iv)
(3) (i),(ii)	(4) (i),(ii),(iii),(iv)

**Q18.** In a sensitive meter bridge apparatus the bridge wire should possess

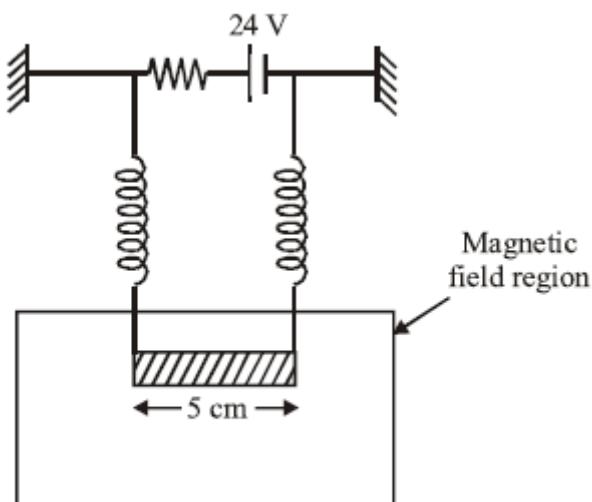
(1) high resistivity and low temperature coefficient.	(2) low resistivity and high temperature coefficient.
(3) low resistivity and low temperature coefficient.	(4) high resistivity and high temperature coefficient.

**Q19.** The magnetic force acting on charged particle of charge  $2\mu\text{C}$  in magnetic field of  $2T$  acting in  $y$ - direction, when the particle velocity is  $(2\hat{i} + 3\hat{j}) \times 10^6 \text{ ms}^{-1}$  is

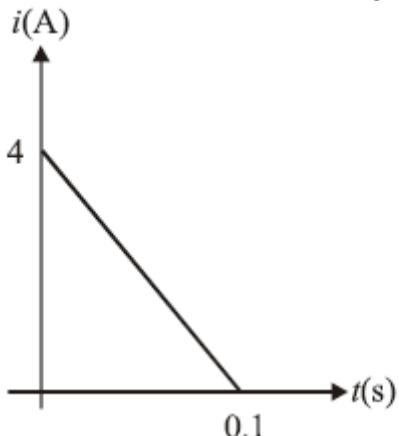
(1) 8 N in z-direction	(2) 8 N in y-direction
(3) 4 N in y-direction	(4) 4 N in z-direction

**Q20.** The circuit in figure consists of wires at the top and bottom and identical springs as the left and right sides. The wire at the bottom has a mass of 10 g and is 5 cm long. The wire is hanging as shown in the figure. The springs stretch 0.5 cm under the weight of the wire and the circuit has a total resistance of  $12\Omega$ . When the lower wire

is subjected to a static magnetic field, the springs stretch an additional 0.3 cm. The magnetic field is



**Q21.** Magnetic flux through a coil of resistance  $10\Omega$  is changed by  $\Delta\phi$  in  $0.1$  s. The resulting current in the coil varies with time as shown in the figure. Then  $|\Delta\phi|$  is equal to (in weber)



**Q22.** A resistance  $R$  and a capacitance  $C$  are connected in series to a battery of negligible internal resistance through a key. The key is closed at  $t = 0$ . If after  $t$  sec the voltage across the capacitance was seven times the voltage across  $R$ , the value of  $t$  is

(1) $3RC\ln 2$	(2) $2RC\ln 2$
(3) $2RC \ln 7$	(4) $3RC\ln 7$

**Q23.** We wish to make a microscope with the help of two positive lenses both with a focal length of 20 mm each and the object is positioned 25 mm from the objective lens. How far apart the lenses should be so that the final image is formed at infinity?

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(1) 20 mm	(2) 100 mm
(3) 120 mm	(4) 80 mm

**Q24.** The first diffraction minimum due to the single slit diffraction is seen at  $\theta = 30^\circ$  for a light of wavelength  $5000\text{\AA}$  falling perpendicularly on the slit. The width of the slit is

(1) $2.5 \times 10^{-5}$ cm	(2) $1.25 \times 10^{-5}$ cm
(3) $10 \times 10^{-5}$ cm	(4) $5 \times 10^{-5}$ cm

**Q25.** The maximum number of possible interference maxima for slit separation equal to  $1.8\lambda$ , where  $\lambda$  is the wavelength of light used, in a Young's double slit experiment is

(1) zero	(2) 3
(3) infinite	(4) 5

**Q26.** A hypothetical atom has only three energy levels. The ground level has energy,  $E_1 = -8\text{eV}$ . The two excited states have energies,  $E_2 = -6\text{eV}$  and  $E_3 = -2\text{eV}$ . Then which of the following wavelengths will not be present in the emission spectrum of this atom?

(1) 207 nm	(2) 465 nm
(3) 310 nm	(4) 620 nm

**Q27.** A doubly ionised Li atom is excited from its ground state ( $n = 1$ ) to  $n = 3$  state. The wavelengths of the spectral lines are given by  $\lambda_{32}$ ,  $\lambda_{31}$  and  $\lambda_{21}$ . The ratio  $\lambda_{32}/\lambda_{31}$  and  $\lambda_{21}/\lambda_{31}$  are, respectively

(1) 8.1, 0.67	(2) 8.1, 1.2
(3) 6.4, 1.2	(4) 6.4, 0.67

**Q28.** Which of the following Statements is correct?

(1) The rate of radioactive decay cannot be controlled but that of nuclear fission can be controlled.	(2) Nuclear forces are short range, attractive and charge dependent.
(3) Nuclei of atoms having same number of neutrons are known as isobars.	(4) Wavelength of matter waves is given by de Broglie formula but that of photons is not given by the same formula

**Q29.** This question has Statement 1 and Statement 2. Of the four choices given after the Statements, choose the one that best describes the two Statements. Statement 1: A pure semiconductor has negative temperature coefficient of resistance. Statement 2: On raising the temperature, more charge carriers are released into the conduction band.

(1) Statement 1 is false, Statement 2 is true.	(2) Statement 1 is true, Statement 2 is false.
(3) Statement 1 is true, Statement 2 is true, Statement 2 is not a correct explanation of Statement 1.	(4) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.

**Q30.** A 10 kW transmitter emits radio waves of wavelength 500 m. The number of photons emitted per second by the transmitter is of the order of

(1) $10^{37}$	(2) $10^{31}$
(3) $10^{25}$	(4) $10^{43}$

**Q31.** An aqueous solution of oxalic acid dihydrate contains its 6.3 g in 250ml. The volume of 0.1 N NaOH required to completely neutralize 10ml of this solution

(1) 4ml	(2) 20ml
(3) 2ml	(4) 40ml

**Q32.** 5 g of benzene on nitration gave 6.6 g of nitrobenzene. The theoretical yield of the nitrobenzene will be

(1) 4.5 g	(2) 5.6 g
(3) 8.09 g	(4) 6.6 g

**Q33.** If the radius of first orbit of H atom is  $a_0$ , the deBroglie wavelength of an electron in the third orbit is

(1) $4\pi a_0$	(2) $8\pi a_0$
(3) $6\pi a_0$	(4) $2\pi a_0$

**Q34.** Which among the following elements has the highest first ionization enthalpy?

(1) Nitrogen	(2) Boron
(3) Carbon	(4) Oxygen

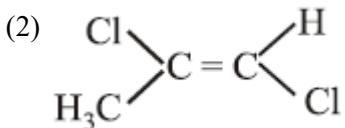
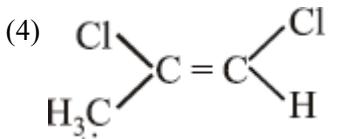
**Q35.** The formation of molecular complex  $\text{BF}_3 - \text{NH}_3$  results in a change in hybridization of boron

(1) from $sp^2$ to $dsp^2$	(2) from $sp^2$ to $sp^3$
(3) from $sp^3$ to $sp^2$	(4) from $sp^3$ to $sp^3d$

**Q36.** Although  $\text{CN}^-$  ion and  $\text{N}_2$  molecule are isoelectronic, yet  $\text{N}_2$  molecule is chemically inert because of

(1) presence of more number of electrons in bonding	(2) lone bond energy
orbitals	
(3) absence of bond polarity	(4) uneven electron distribution.

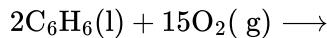
**Q37.** Among the following chloro-compound having the lowest dipole moment is

(1) $\text{CH}_3\text{Cl}$	(2) 
(3) $\text{CH}_2\text{Cl}_2$	(4) 

**Q38.**  $\alpha$ ,  $v$  and  $u$  represent most probable velocity, average velocity and root mean square velocity respectively of a gas at a particular temperature. The correct order among the following is

(1) $u > v > \alpha$	(2) $v > u > \alpha$
(3) $\alpha > u > v$	(4) $u > \alpha > v$

**Q39.** The difference between the reaction enthalpy change ( $\Delta_rH$ ) and reaction internal energy change ( $\Delta_rU$ ) for the reaction:



at 300 K is ( $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ )

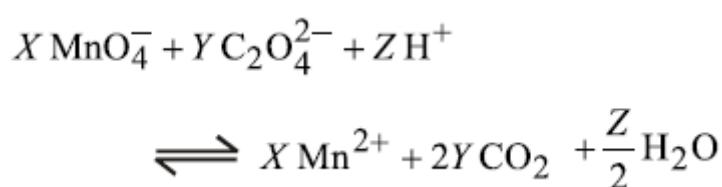
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(1)  $0 \text{ J mol}^{-1}$  (2)  $2490 \text{ J mol}^{-1}$   
 (3)  $-2490 \text{ J mol}^{-1}$  (4)  $-7482 \text{ J mol}^{-1}$

**Q40.** 8 mol of  $AB_3(g)$  are introduced into a  $1.0 \text{ dm}^3$  vessel. If it dissociates as  $2AB_3(g) \rightleftharpoons A_2(g) + 3B_2(g)$ . At equilibrium, 2 mol of  $A_2$  are found to be present. The equilibrium constant of this reaction is

(1) 2 (2) 3  
 (3) 27 (4) 36

**Q41.** Given (i)  $\text{HCN}(aq) + \text{H}_2\text{O}(b) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{CN}^-(aq)$   $K_a = 6.2 \times 10^{-10}$  (ii)  $\text{CN}^-(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{HCN}(aq) + \text{OH}^-(aq)$   $K_b = 1.6 \times 10^{-5}$ . These equilibria show the following order of the relative base strength,  
 (1)  $\text{OH}^- > \text{H}_2\text{O} > \text{CN}^-$  (2)  $\text{OH}^- > \text{CN}^- > \text{H}_2\text{O}$   
 (3)  $\text{H}_2\text{O} > \text{CN}^- > \text{OH}^-$  (4)  $\text{CN}^- > \text{H}_2\text{O} > \text{OH}^-$

**Q42.**

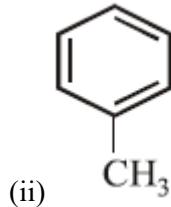
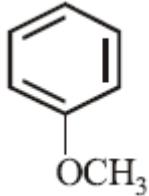
In the following balanced reaction, values of  $X$ ,  $Y$  and  $Z$  respectively are

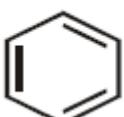
(1) 2, 5, 16 (2) 8, 2, 5  
 (3) 5, 2, 16 (4) 5, 8, 4

**Q43.** A metal  $M$  on heating in nitrogen gas gives  $Y$ .  $Y$  on treatment with  $\text{H}_2\text{O}$  gives a colourless gas which when passed through  $\text{CuSO}_4$  solution gives a blue colour.  $Y$  is

(1)  $\text{NH}_3$  (2)  $\text{Mg}(\text{NO}_3)_2$   
 (3)  $\text{Mg}_3\text{N}_2$  (4)  $\text{MgO}$

**Q44.** In the below mentioned compounds the decreasing order of reactivity towards electrophilic substitution is (i)





(iii)



(iv)

(1) (iv) > (i) > (ii) > (iii)  
 (3) (iii) > (i) > (iv) > (ii)

(2) (ii) > (iii) > (i) > (iv)  
 (4) (i) > (ii) > (iii) > (iv)

**Q45.** The reaction,  $\text{CH}_3\text{CHO} \xrightarrow[\text{Conc. HCl}]{\text{Zn(Hg)}/[\text{H}]} \text{CH}_3\text{CH}_3$

(1) Cannizaro's reaction  
 (2) Rosenmund reduction  
 (3) Wolf-Kishner reduction  
 (4) Clemmenson reduction

**Q46.** Water sample is reported to be highly polluted if BOD (Biological Oxygen Demand) value of sample becomes

(1) more than 17ppm  
 (2) equal to 10ppm  
 (3) equal to 5ppm  
 (4) less than 5ppm

**Q47.** The radius of a calcium ion is 94pm and of the oxide ion is 146pm. The possible crystal structure of calcium oxide will be

(1) tetrahedral  
 (2) trigonal  
 (3) octahedral  
 (4) pyramidal

**Q48.** A solution containing 0.85 g of  $\text{ZnCl}_2$  in 125.0 g of water freezes at  $-0.23^\circ\text{C}$ . The apparent degree of dissociation of the salt is ( $K_f$  for water = 1.86 K kg mol $^{-1}$ , atomic mass: Zn = 65.3 and Cl = 35.5)

(1) 1.36%  
 (2) 73.5%  
 (3) 7.35%  
 (4) 2.47%

**Q49.** The ppm level of  $\text{F}^-$  in a 500 g sample of a tooth paste containing 0.2 g  $\text{F}^-$  is

(1) 400  
 (2) 1000  
 (3) 250  
 (4) 200

**Q50.** In a chemical reaction *A* is converted into *B*. The rates of reaction, starting with initial concentrations of *A* as  $2 \times 10^{-3}\text{M}$  and  $1 \times 10^{-3}\text{M}$ , are equal to  $2.40 \times 10^{-4}\text{Ms}^{-1}$  and  $0.60 \times 10^{-4}\text{Ms}^{-1}$  respectively. The order of reaction with respect to reactant *A* will be

(1) 0  
 (2) 1.5  
 (3) 1  
 (4) 2

**Q51.** The correct statement for both the processes of physisorption and chemisorption is

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(1) both are endothermic  
 (2) chemisorption is endothermic but physisorption is exothermic  
 (3) both are exothermic  
 (4) physisorption is endothermic but chemisorption is exothermic.

**Q52.** In the electrolysis of alumina to obtain aluminium metal, cryolite is added mainly to

(1) lower the melting point of alumina  
 (2) dissolve alumina in molten cryolite  
 (3) remove the impurities of alumina  
 (4) increase the electrical conductivity

**Q53.** Magnetic moment of  $\text{Gd}^{3+}$  ion ( $Z = 64$ ) is

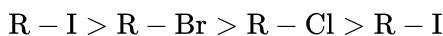
(1) 3.62 BM  
 (2) 9.72BM  
 (3) 7.9 BM  
 (4) 10.60BM

**Q54.** Which of the following complex ions will exhibit optical isomerism? ( $\text{en} = 1, 2$ -diamine ethane).

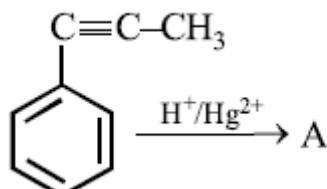
(1)  $[\text{Cr}(\text{NH}_3)_2\text{Cl}_2]^+$   
 (2)  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$   
 (3)  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$   
 (4)  $[\text{Zn}(\text{en})_2]^{2+}$

**Q55.** Which of the following statements is wrong?

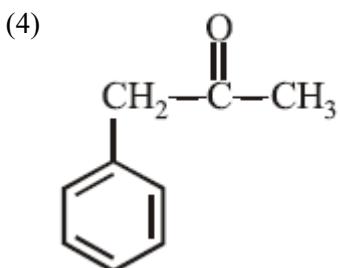
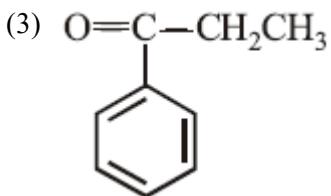
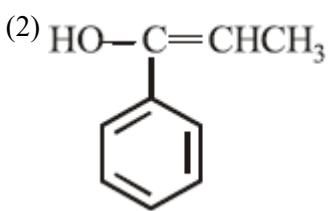
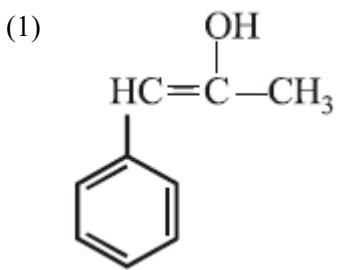
(1) Ethyl chloride on reduction with  $\text{Zn} - \text{Cu}$  couple and alcohol gives ethane.  
 (2) The reaction of methyl magnesium bromide with acetone gives butanol-2.  
 (3) Alkyl halides follow the following reactivity sequence on reaction with alkenes.  
 (4)  $\text{C}_2\text{H}_4\text{Cl}_2$  may exist in two isomeric forms



**Q56.**



In the given reaction,  
 the product 'A' is



**Q57.** The conversion of benzene diazonium chloride to bromobenzene can be accomplished by

**Q58.** Synthetic polymer bakelite can be prepared from following compounds

**Q59.** Chemically heroin is

**Q60.** Amylopectin is a polymer of

(1)  $\alpha-D$ -glucose (2) amino acid  
(3)  $\beta-D$ -glucose (4) amylase.

**Q61.** If  $a, b, c, d$  and  $p$  are distinct real numbers such that  $(a^2 + b^2 + c^2)p^2 - 2p(ab + bc + cd) + (b^2 + c^2 + d^2) \leq 0$ , then

**Q62.** If the sum of the square of the roots of the equation  $x^2 - (\sin \alpha - 2)x - (1 + \sin \alpha) = 0$  is least, then  $\alpha$  is equal to

(1)  $\frac{\pi}{6}$  (2)  $\frac{\pi}{4}$   
 (3)  $\frac{\pi}{3}$  (4)  $\frac{\pi}{2}$

**Q63.** The area of the triangle whose vertices are complex numbers  $z, iz, z + iz$  in the Argand diagram is

(1) $2 z ^2$ (3) $4 z ^2$	(2) $1/2 z ^2$ (4) $ z ^2$
------------------------------	-------------------------------

**Q64.** The sum of the series

$$\frac{1}{1+\sqrt{2}} + \frac{1}{\sqrt{2}+\sqrt{3}} + \frac{1}{\sqrt{3}+\sqrt{4}} + \dots$$

upto 15 terms is

(1) 1	(2) 2
(3) 3	(4) 4

**Q65.** The number of terms in the expansion of  $(y^{1/5} + x^{1/10})^{55}$ , in which powers of  $x$  and  $y$  are free from radical signs are

(1) six	(2) twelve
(3) seven	(4) five

**Q66.** If the point  $(1, a)$  lies between the straight lines  $x + y = 1$  and  $2(x + y) = 3$  then  $a$  lies in interval

(1) $(\frac{3}{2}, \infty)$	(2) $(1, \frac{3}{2})$
(3) $(-\infty, 0)$	(4) $(0, \frac{1}{2})$

**Q67.** If two vertices of a triangle are  $(5, -1)$  and  $(-2, 3)$  and its orthocentre is at  $(0, 0)$ , then the third vertex is

(1) $(4, -7)$	(2) $(-4, -7)$
(3) $(-4, 7)$	(4) $(4, 7)$

**Q68.** The area of triangle formed by the lines joining the vertex of the parabola,  $x^2 = 8y$ , to the extremities of its latus rectum is

(1) 2	(2) 8
(3) 1	(4) 4

**Q69.** If  $P_1$  and  $P_2$  are two points on the ellipse  $\frac{x^2}{4} + y^2 = 1$  at which the tangents are parallel to the chord joining the points  $(0, 1)$  and  $(2, 0)$ , then the distance between  $P_1$  and  $P_2$  is

(1) $2\sqrt{2}$	(2) $\sqrt{5}$
(3) $2\sqrt{3}$	(4) $\sqrt{10}$

**Q70.** The logically equivalent preposition of  $p \Leftrightarrow q$  is

(1) $(p \Rightarrow q \wedge) q \Rightarrow p$	(2) $p \wedge q$
(3) $(p \wedge q \vee) q \neq p$	(4) $(p \wedge q \Rightarrow q \vee (p \quad ))$

**Q71.** If the mean of  $4, 7, 2, 8, 6$  and  $a$  is  $7$ , then the mean deviation from the median of these observations is

(1) 8	(2) 5
(3) 1	(4) 3

**Q72.** If in a triangle  $ABC$ ,  $\frac{b+c}{11} = \frac{c+a}{12} = \frac{a+b}{13}$ , then  $\cos A$  is equal to

(1) $5/7$	(2) $1/5$
(3) $35/19$	(4) $19/35$

**Q73.** If  $A = \{x \in z^+ : x < 10 \text{ and } x \text{ is a multiple of 3 or 4}\}$ , where  $z^+$  is the set of positive integers, then the total number of symmetric relations on  $A$  is

## Question Paper

(1)  $2^5$  (2)  $2^{15}$   
 (3)  $2^{10}$  (4)  $2^{20}$

**Q74.** Let  $A$  and  $B$  be real matrices of the form  $\begin{bmatrix} \alpha & 0 \\ 0 & \beta \end{bmatrix}$  and  $\begin{bmatrix} 0 & \gamma \\ \delta & 0 \end{bmatrix}$ , respectively. Statement 1:  $AB - BA$  is always an invertible matrix. Statement 2:  $AB - BA$  is never an identity matrix.

(1) Statement 1 is true, Statement 2 is false. (2) Statement 1 is false, Statement 2 is true.  
 (3) Statement 1 is true, Statement 2 is true; Statement 2 is a correct explanation of Statement 1.  
 (4) Statement 1 is true, Statement 2 is true, Statement 2 is not a correct explanation of Statement 1.

**Q75.** If  $\begin{vmatrix} -2a & a+b & a+c \\ b+a & -2b & b+c \\ c+a & b+c & -2c \end{vmatrix} = \alpha(a+b)(b+c)(c+a) \neq 0$

then  $\alpha$  is equal to

(1)  $a+b+c$  (2)  $abc$   
 (3) 4 (4) 1

**Q76.** Statement 1: If  $A$  and  $B$  be two sets having  $p$  and  $q$  elements respectively, where  $q > p$ . Then the total number of functions from set  $A$  to set  $B$  is  $q^p$  Statement 2: The total number of selections of  $p$  different objects out of  $q$  objects is  ${}^qC_p$ .

(1) Statement 1 is true, Statement 2 is false. (2) Statement 1 is true, Statement 2 is true, Statement 2 is not a correct explanation of Statement 1.  
 (3) Statement 1 is false, Statement 2 is true (4) Statement 1 is true, Statement 2 is true, Statement 2 is a correct explanation of Statement 1.

**Q77.** Statement 1: A function  $f : R \rightarrow R$  is continuous at  $x_0$  if and only if  $\lim_{x \rightarrow x_0} f(x)$  exists and  $\lim_{x \rightarrow x_0} f(x) = f(x_0)$ . Statement 2: A function  $f : R \rightarrow R$  is discontinuous at  $x_0$  if and only if,  $\lim_{x \rightarrow x_0} f(x)$  exists and  $\lim_{x \rightarrow x_0} f(x) \neq f(x_0)$ .

(1) Statement 1 is true, Statement 2 is true, Statement 2 is not a correct explanation of Statement 1.  
 (2) Statement 1 is false, Statement 2 is true.  
 (3) Statement 1 is true, Statement 2 is true, Statement 2 is a correct explanation of Statement 1.  
 (4) Statement 1 is true, Statement 2 is false.

**Q78.** If  $f'(x) = \sin(\log x)$  and  $y = f\left(\frac{2x+3}{3-2x}\right)$ , then  $\frac{dy}{dx}$  equals

(1)  $\sin\left[\log\left(\frac{2x+3}{3-2x}\right)\right]$  (2)  $\frac{12}{(3-2x^2)}$   
 (3)  $\frac{12}{(3-2x^2)}\sin\left[\log\left(\frac{2x+3}{3-2x}\right)\right]$  (4)  $\frac{12}{(3-2x^2)}\cos\left[\log\left(\frac{2x+3}{3-2x}\right)\right]$

## Question Paper

**Q79.** Consider a rectangle whose length is increasing at the uniform rate of 2 m/sec, breadth is decreasing at the uniform rate of 3 m/sec and the area is decreasing at the uniform rate of 5 m<sup>2</sup>/sec. If after some time the breadth of the rectangle is 2 m then the length of the rectangle is

(1) 2 m	(2) 4 m
(3) 1 m	(4) 3 m

**Q80.** If  $f(x) = xe^{x(1-x)}$ ,  $x \in R$ , then  $f(x)$  is

(1) decreasing on $[-1/2, 1]$	(2) decreasing on $R$
(3) increasing on $[-1/2, 1]$	(4) increasing on $R$

**Q81.** The integral of  $\frac{x^2-x}{x^3-x^2+x-1}$  w.r.t.  $x$  is

(1) $\frac{1}{2}\log(x^2 + 1 + c)$	(2) $\frac{1}{2}\log x^2 - 1  + c$
(3) $\log(x^2 + 1 + c)$	(4) $\log x^2 - 1  + c$

**Q82.** If  $\frac{d}{dx}G(x) = \frac{e^{\tan x}}{x}$ ,  $x \in (0, \pi/2)$ , then  $\int_{1/4}^{1/2} \frac{2}{x} \cdot e^{\tan(\pi x^2)} dx$  is equal to

(1) $G(\pi/4) - G(\pi/16)$	(2) $2[G(\pi/4) - G(\pi/16)]$
(3) $\pi[G(1/2) - G(1/4)]$	(4) $G(1/\sqrt{2}) - G(1/2)$

**Q83.** The area enclosed by the curves  $y = x^2$ ,  $y = x^3$ ,  $x = 0$  and  $x = p$ , where  $p > 1$ , is  $1/6$ . The p equals

(1) $8/3$	(2) $16/3$
(3) 2	(4) $4/3$

**Q84.** If a straight line  $y - x = 2$  divides the region  $x^2 + y^2 \leq 4$  into two parts, then the ratio of the area of the smaller part to the area of the greater part is

(1) $3\pi - 8 : \pi + 8$	(2) $\pi - 3 : 3\pi + 3$
(3) $3\pi - 4 : \pi + 4$	(4) $\pi - 2 : 3\pi + 2$

**Q85.** Statement 1: The degrees of the differential equations  $\frac{dy}{dx} + y^2 = x$  and  $\frac{d^2y}{dx^2} + y = \sin x$  are equal. Statement 2: The degree of a differential equation, when it is a polynomial equation in derivatives, is the highest positive integral power of the highest order derivative involved in the differential equation, otherwise degree is not defined.

(1) Statement 1 is true, Statement 2 is true, Statement 2 is not a correct explanation of Statement 1.	(2) Statement 1 is false, Statement 2 is true.
(3) Statement 1 is true, Statement 2 is false.	(4) Statement 1 is true, Statement 2 is true; Statement 2 is a correct explanation of Statement 1.

**Q86.** If  $\vec{u} = \hat{j} + 4\hat{k}$ ,  $\vec{v} = \hat{i} + 3\hat{k}$  and  $\vec{w} = \cos \theta \hat{i} + \sin \theta \hat{j}$  are vectors in 3-dimensional space, then the maximum possible value of  $|\vec{u} \times \vec{v} \cdot \vec{w}|$  is

(1) $\sqrt{3}$	(2) 5
(3) $\sqrt{14}$	(4) 7

**Q87.** Statement 1: If the points  $(1, 2, 2)$ ,  $(2, 1, 2)$  and  $(2, 2, z)$  and  $(1, 1, 1)$  are coplanar, then  $z = 2$ . Statement 2: If the 4 points  $P, Q, R$  and  $S$  are coplanar, then the volume of the tetrahedron  $PQRS$  is 0.

## Question Paper

(1) Statement 1 is false., Statement 2 is true.  
 (2) Statement 1 is true, Statement 2 is false.  
 (3) Statement 1 is true, Statement 2 is true,  
 Statement 2 is a correct explanation of Statement  
 1.  
 (4) Statement 1 is true, Statement 2 is true,  
 Statement 2 is not a correct explanation of  
 Statement 1.

**Q88.** A unit vector which is perpendicular to the vector  $2\hat{i} - \hat{j} + 2\hat{k}$  and is coplanar with the vectors  $\hat{i} + \hat{j} - \hat{k}$  and  $2\hat{i} + 2\hat{j} - \hat{k}$  is

(1)  $\frac{2\hat{j} + \hat{k}}{\sqrt{5}}$   
 (2)  $\frac{3\hat{i} + 2\hat{j} - 2\hat{k}}{\sqrt{17}}$   
 (3)  $\frac{3\hat{i} + 2\hat{j} + 2\hat{k}}{\sqrt{17}}$   
 (4)  $\frac{2\hat{i} + 2\hat{j} - \hat{k}}{3}$

**Q89.** The coordinates of the foot perpendicular from the point  $(1, 0, 0)$  to the line

$$\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z+10}{8} \text{ are}$$

(1)  $(2, -3, 8)$   
 (2)  $(1, -1, -10)$   
 (3)  $(5, -8, -4)$   
 (4)  $(3, -4, -2)$

**Q90.** A number  $n$  is randomly selected from the set  $\{1, 2, 3, \dots, 1000\}$ . The probability that  $\frac{\sum_{i=1}^n i^2}{\sum_{i=1}^n i}$  is an integer is

(1) 0.331  
 (2) 0.333  
 (3) 0.334  
 (4) 0.332

**ANSWER KEYS**

<b>1.</b> (4)	<b>2.</b> (2)	<b>3.</b> (1)	<b>4.</b> (3)	<b>5.</b> (4)	<b>6.</b> (1)	<b>7.</b> (4)	<b>8.</b> (2)
<b>9.</b> (1)	<b>10.</b> (1)	<b>11.</b> (3)	<b>12.</b> (4)	<b>13.</b> (3)	<b>14.</b> (2)	<b>15.</b> (4)	<b>16.</b> (3)
<b>17.</b> (3)	<b>18.</b> (1)	<b>19.</b> (1)	<b>20.</b> (1)	<b>21.</b> (3)	<b>22.</b> (1)	<b>23.</b> (3)	<b>24.</b> (3)
<b>25.</b> (2)	<b>26.</b> (2)	<b>27.</b> (3)	<b>28.</b> (1)	<b>29.</b> (4)	<b>30.</b> (2)	<b>31.</b> (4)	<b>32.</b> (3)
<b>33.</b> (3)	<b>34.</b> (1)	<b>35.</b> (2)	<b>36.</b> (3)	<b>37.</b> (3)	<b>38.</b> (1)	<b>39.</b> (4)	<b>40.</b> (3)
<b>41.</b> (2)	<b>42.</b> (1)	<b>43.</b> (3)	<b>44.</b> (4)	<b>45.</b> (4)	<b>46.</b> (1)	<b>47.</b> (3)	<b>48.</b> (2)
<b>49.</b> (1)	<b>50.</b> (4)	<b>51.</b> (3)	<b>52.</b> (1)	<b>53.</b> (3)	<b>54.</b> (2)	<b>55.</b> (2)	<b>56.</b> (3)
<b>57.</b> (3)	<b>58.</b> (4)	<b>59.</b> (3)	<b>60.</b> (1)	<b>61.</b> (4)	<b>62.</b> (4)	<b>63.</b> (2)	<b>64.</b> (3)
<b>65.</b> (1)	<b>66.</b> (4)	<b>67.</b> (2)	<b>68.</b> (2)	<b>69.</b> (4)	<b>70.</b> (1)	<b>71.</b> (4)	<b>72.</b> (2)
<b>73.</b> (2)	<b>74.</b> (1)	<b>75.</b> (3)	<b>76.</b> (4)	<b>77.</b> (4)	<b>78.</b> (3)	<b>79.</b> (4)	<b>80.</b> (3)
<b>81.</b> (1)	<b>82.</b> (1)	<b>83.</b> (4)	<b>84.</b> (4)	<b>85.</b> (4)	<b>86.</b> (2)	<b>87.</b> (1)	<b>88.</b> (4)
<b>89.</b> (4)	<b>90.</b> (3)						