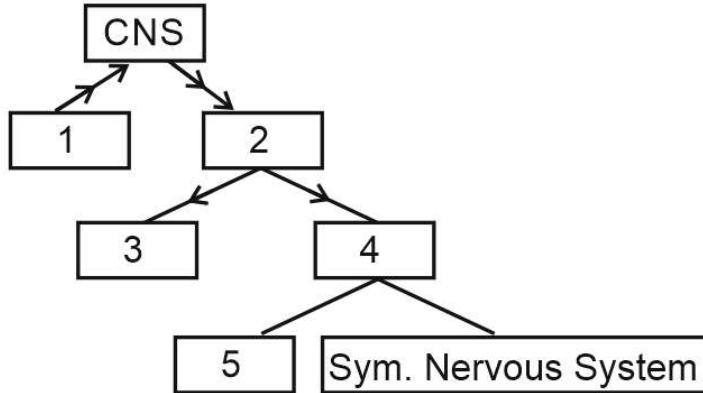




- 
- Q6** Select the correct statement related to mitosis.
- a) Amount of DNA in the parent cell is first doubled and then distributed into two daughter cells
  - b) Amount of DNA in the parent cell is first halved and then distributed into two daughter cells
  - c) Amount of DNA in the parent cell is first halved and then distributed into four daughter cells
  - d) Amount of DNA in the parent cell is first doubled and then distributed into four daughter cells
- Q7** How many in the given examples of animals are Coelentrates?  
*Physalia, Obelia, Plannaria, Pennatula, Gorgonia, Pleurobrachia, Meandrina and Nereis*
- a) Three
  - b) Five
  - c) Four
  - d) Six
- Q8** During DNA replication, Okazaki fragments are used to elongate:
- a) The lagging strand towards replication fork
  - b) The leading strand away from replication fork
  - c) The lagging strand away from the replication fork
  - d) The leading strand towards replication fork
- Q9** Removal of scavengers like vultures primarily affects:
- a) Primary productivity
  - b) Energy flow
  - c) Nutrient cycling
  - d) Population density
- Q10** Insertional inactivation helps in:
- a) Selection of recombinants
  - b) DNA replication
  - c) Protein synthesis
  - d) Transcription regulation

**Q11** Which of the following answer shows the correct arrangement of nerve fibre.



- a) (1) Centrifugal (2) Efferent (3) PNS (4) ANS (5) Parasympathetic
- b) (1) Centripetal (2) Afferent (3) PNS (4) ANS (5) Parasympathetic
- c) (1) Centrifugal (2) Afferent (3) SNS (4) ANS (5) Parasympathetic
- d) (1) Centripetal (2) Efferent (3) SNS (4) ANS (5) Parasympathetic

**Q12** Match column I with column II and select the correct option from the codes given below.

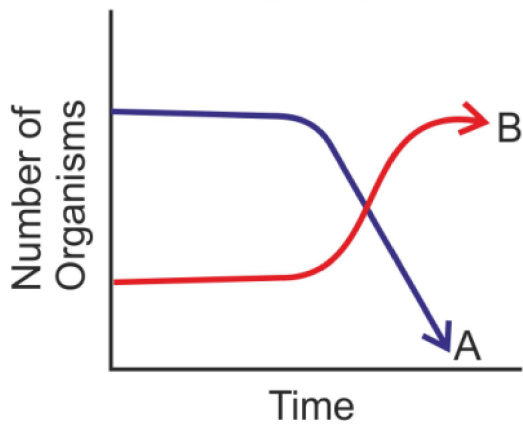
Column I	Column II
(P) RER	(i) Digestion of carbohydrates, proteins, lipids and nucleic acids
(Q) SER	(ii) Lipid synthesis
(R) Golgi complex	(iii) Protein synthesis and secretion
(S) Lysosomes	(iv) Packaging and secretion of proteins

- a) P (iii), Q-(ii), R-(iv), S-(i)
- b) P-(ii), Q-(iii), R-(iv), S-(i)
- c) P-(i), Q-(iii), R-(ii), S-(iv)
- d) P-(iv), Q-(ii), R-(iii), S-(i)

**Q13** Which of the following immunoglobulins does constitute the largest percentage in human milk?

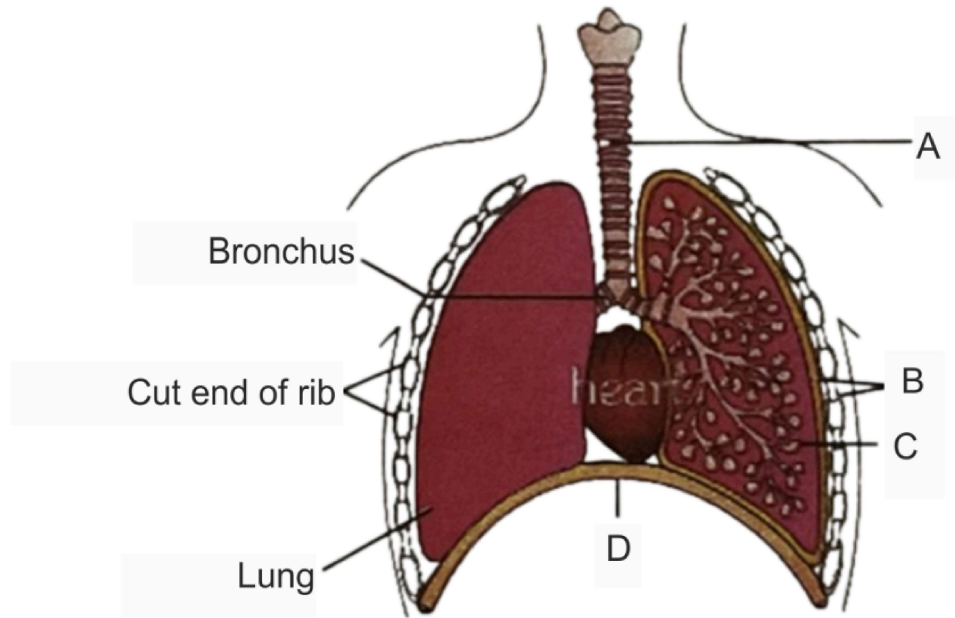
- a) IgG
- b) IgD
- c) IgM
- d) IgA

Q14 The following graph depicts changes in two populations (A and B) of herbivores in a grassy field. A possible reason for these changes is that :



- a) Population B competed more successfully for food than population A
- b) Population A produced more offspring than population B
- c) Population A consumed the members of population B
- d) Both plant populations in this habitat decreased

- Q15** The figure shows a diagrammatic view of human respiratory system with labels A, B, C and (D) Select the option which gives correct identification and main function and/or characteristic :-



- a) D - Lower end of lungs - diaphragm pulls it down during inspiration
- b) A - trachea - long tube supported by complete cartilaginous rings for conducting inspired air
- c) B - pleural membrane - surround ribs on both sides to provide cushion against rubbing
- d) C - Alveoli - thin walled vascular bag like structures for exchange of gases

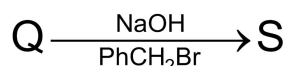
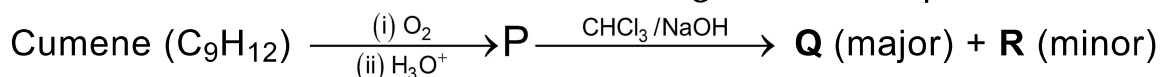
# Chemistry

## Single Choice Question

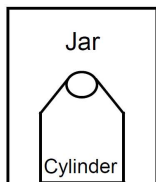
**Q16** For the colourless complex  $[M(H_2O)_6]^{n+}$ , where M is a 3d transition metal, the CORRECT ground state d-electron configuration of M is

- a)  $(t_{2g})^3(e_g)^0$       b)  $(t_{2g})^6(e_g)^4$       c)  $(t_{2g})^6(e_g)^2$       d)  $(t_{2g})^4(e_g)^2$

**Q17** The correct statement about the following reaction sequence is

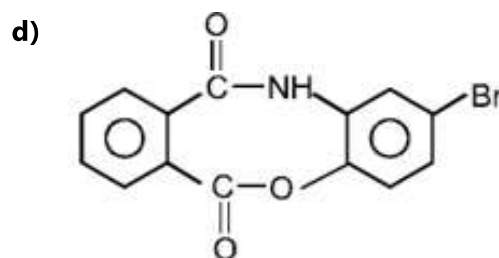
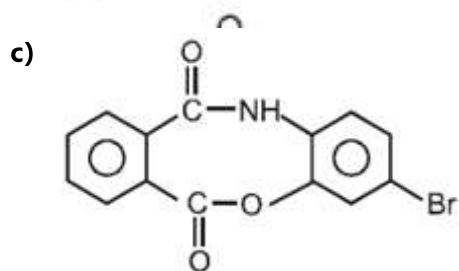
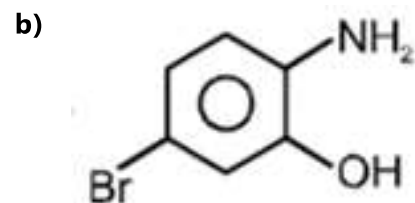
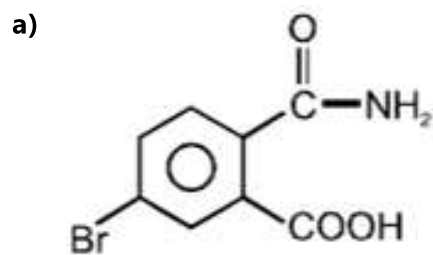
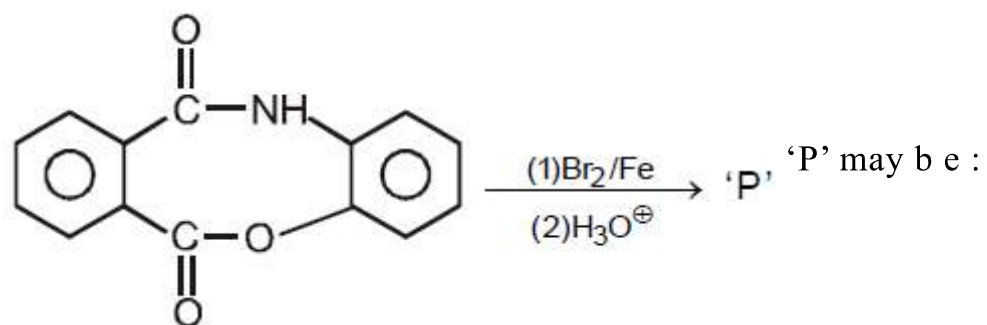


- a) **R** is steam volatile  
b) **Q** gives dark violet coloration with 1% aqueous FeCl<sub>3</sub> solution  
c) **S** does not give yellow precipitate with 2, 4-dinitrophenylhydrazine  
d) **S** gives dark violet coloration with 1% aqueous FeCl<sub>3</sub> solution
- Q18** How many radial nodes does  $\text{Ca}^+$  have in its 4s orbital?  
a) 0      b) 1      c) 2      d) 3
- Q19** A 20 litre rigid cylinder containing  $\text{N}_2$  at 20 atm and 300 K is placed in big jar containing air at 1 atm and 300 K and finally sealed as given below. Now  $\text{N}_2(\text{g})$  was allowed to leak into to jar at constant temperature. Final total pressure in jar is 11 atm. Final volume of jar in litre.

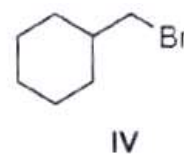
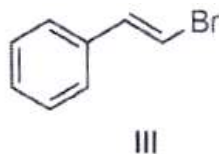
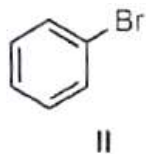
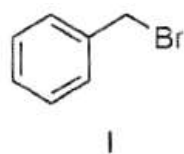


- a) 18 litre      b) 40 litre      c) 58 litre      d) 38 litre
- Q20** Choose the correct statement about the structure of  $\text{C}_{60}$  fullerene  
a) 6 -membered rings are fused with 5 -membered rings ONLY.  
b) 6-membered rings are fused with 6-membered rings ONLY.  
c) 5-membered rings are fused with 6-membered rings ONLY.  
d) 5 -membered rings are fused with both 5 -membered and 6 -membered rings.

Q21



Q22 Which of the following compounds will NOT undergo the Finkelstein reaction with NaI via  $S_N2$  pathway?



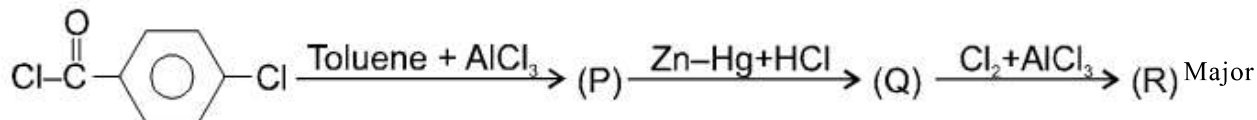
a) I and III

b) II and III

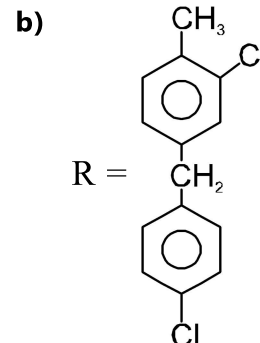
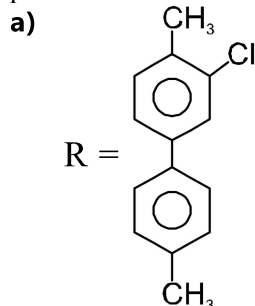
c) II and IV

d) I and IV

**Q23** Identify incorrect statements for given reaction sequence.



product

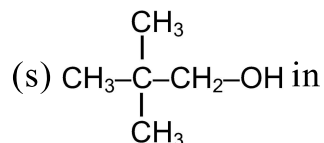
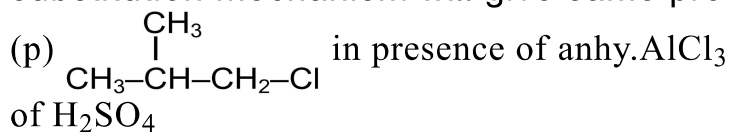


- c) In the given three reaction steps, two are electrophilic substitution steps  
 d) Product(P) gives a racemic mixture with (i) MeMgBr (ii) aq.NH<sub>4</sub>Cl

**Q24** Consider the following reaction:  $\text{CH}_4(\text{g}) \rightarrow \text{C}(\text{g}) + 4\text{H}(\text{g}); \Delta_a H^0 = 1665 \text{kJmol}^{-1}$  Which of the statements is FALSE?

- a)  $\Delta_a H^0$  is the mean bond enthalpy of a C-H bond  
 b) All four C-H bonds in CH<sub>4</sub> are identical in bond length and energy.  
 c) The energy required to break individual C-H bonds in successive steps is different.  
 d) Mean C-H bond enthalpies differ slightly from compound to compound

**Q25** Which of the following reagents used for alkylation of benzene by electrophilic substitution mechanism will give same product ?



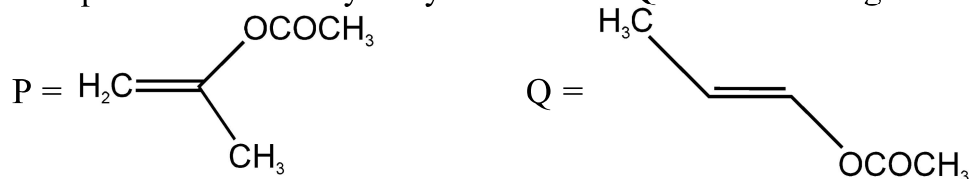
presence of H<sub>2</sub>SO<sub>4</sub>.

- a) p, q, r                      b) q, r, s                      c) p, q, r, s                      d) p, q, s

**Q26** In aqueous solution, the hydronium ion gets further hydrated to give which of the following species?

- a) H<sub>3</sub>O<sub>2</sub><sup>+</sup>                      b) H<sub>5</sub>O<sub>3</sub><sup>+</sup>                      c) H<sub>7</sub>O<sub>4</sub><sup>+</sup>                      d) H<sub>9</sub>O<sub>4</sub><sup>+</sup>

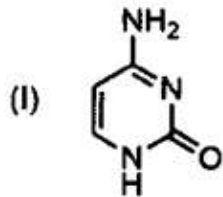
**Q27** The product of acid hydrolysis of P and Q can be distinguished by :



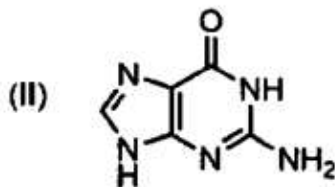
(a) Benedictt solution (b) 2,4-DNP (c) Fehling's solution (d) Tollen reagent

a) (b) & (d)                      b) (a), (b) & (c)                      c) (a) & (c)                      d) (a), (c), (d)

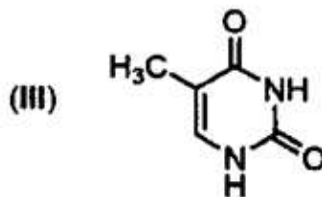
**Q28** Which one amongst the following bases is NOT present in RNA?



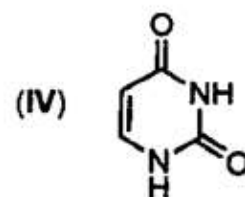
Cytosine



Guanine



Thymine



Uracil

a) I

b) II

c) III

d) IV

**Q29** 2 litres of an acidified solution of  $\text{KMnO}_4$ , containing 1.58 g of  $\text{KMnO}_4$  per litre, is decolorized by passing sufficient amount of  $\text{SO}_2$  gas. If whole of the sulphur from x g of  $\text{FeS}_2$  is converted into  $\text{SO}_2$  to be used in above reaction, calculate the value of x :

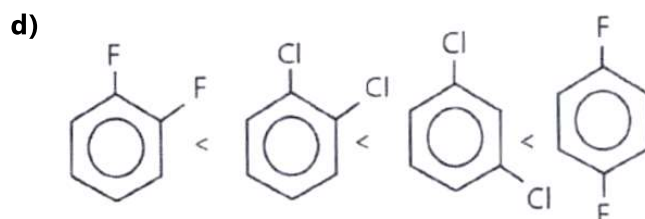
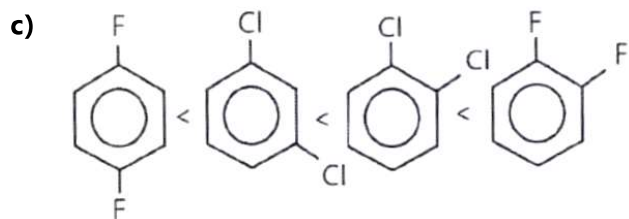
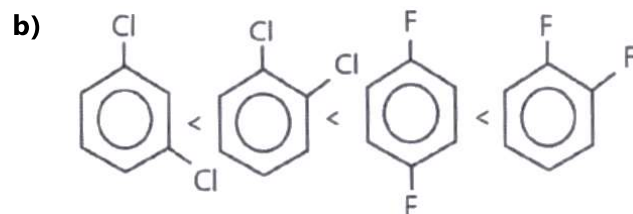
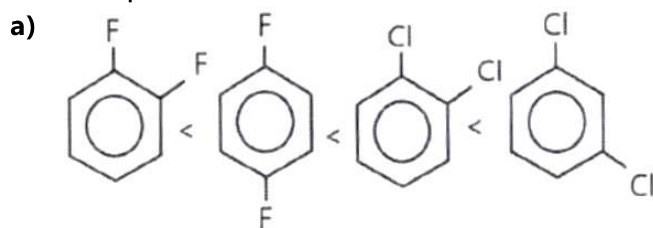
a)  $x = 1.5$

b)  $x = 3$

c)  $x = 4.5$

d)  $x = 6$

**Q30** Identify the correct order of the molecules with respect to the magnitude of their dipole moment :



---

# Mathematics

## Single Choice Question

**Q31** Let  $f : \mathbb{R} \rightarrow \mathbb{R}$  be a differentiable function such that  $f'(0) = 1$  and  $f(x+y) = f(x)f(y)$  for all  $x, y \in \mathbb{R}$ .

Which of the following is true?

- a)  $f$  is a decreasing function but  $f'$  is an increasing function.
- b) Both  $f$  and  $f'$  are increasing functions.
- c)  $f$  is an increasing function but  $f'$  is a decreasing function.
- d) Both  $f$  and  $f'$  are decreasing functions.

**Q32** The roots of the polynomial  $x^3 - 39x^2 + 471x - 1729$  are in an arithmetic progression. Which of the following is a common difference of the progression?

- a) 6
- b) 19
- c) 13
- d) 7

**Q33** Let  $f : \mathbb{R} \rightarrow \mathbb{R}$  be defined as

$$f(x) = \begin{cases} \frac{e^{3x} - e^x - e^{2x} + 1}{x^2} & \text{if } x > 0, \\ a & \text{if } x = 0, \\ \frac{1 - \cos(2x)}{x^2} & \text{if } x < 0. \end{cases}$$

The value of  $a$  for which  $f$  is continuous at 0 is

- a) 1
- b) 2
- c) 0
- d) 3

**Q34** Let  $S$  be a set with 3 elements. What is the probability of choosing an ordered pair  $(A, B)$  of subsets of  $S$  such that  $A$  and  $B$  are disjoint?

- a)  $\frac{1}{2}$
- b)  $\frac{26}{64}$
- c)  $\frac{27}{64}$
- d)  $\frac{1}{8}$

**Q35** Consider the functions  $y_1$  and  $y_2$  satisfying

$$\frac{dy_1}{dx} = -y_2, \frac{dy_2}{dx} = y_1, y_1(0) = 1, y_2(0) = 0.$$

The set  $S = \{(y_1(x), y_2(x)) : x \in \mathbb{R}\}$  lies on a

- a) Hyperbola                      b) Straight line                      c) Circle                      d) Parabola

**Q36** A function  $f$  satisfying  $f \circ f \circ f(x) = x$  for all  $x \in \mathbb{R}$  is

- a) onto but not one-one    b) neither one-one nor onto    c) one-one and onto  
d) one-one but not onto

**Q37** Let  $p$  be a polynomial with real coefficients such that  $\int_0^1 p(t) dt = 0$ . Which of the following statements is always true?

- a)  $p$  has no roots in the interval  $[0, 1]$ .  
b) All roots of  $p$  lie in the interval  $[0, 1]$ .  
c)  $p$  has exactly one root in the interval  $[0, 1]$ .  
d)  $p$  has a root in the interval  $[0, 1]$ .

**Q38** For a complex number  $z$ , let  $(1+z)^{15} = a_0 + a_1z + \dots + a_{15}z^{15}$ . The value of

$$(a_0 - 4a_2 + 16a_4 + \dots - 2^{14}a_{14})^2 + (2a_1 - 8a_3 + 32a_5 \dots - 2^{15}a_{15})^2$$
 is

- a)  $2^{30}$                       b)  $2^{15}$                       c) 1                      d)  $5^{15}$

**Q39** Let  $A$  be a  $3 \times 3$  matrix which has determinant 3 and satisfies the equation

$$A^2 - 7A + 4I = 0. \text{ The value of } |\det(A - 2I)| \text{ is}$$

- a) 5                      b) 1                      c) 3                      d) 9

**Q40** Consider the functions

$$g(x) = \begin{cases} 1 & \text{if } x \in [-1, 1] \\ 0 & \text{otherwise} \end{cases}$$

and

$$f(x) = \lim_{h \rightarrow 0} \frac{1}{2h} \int_{x-h}^{x+h} g(y) dy$$

The value of  $f(1)$  is

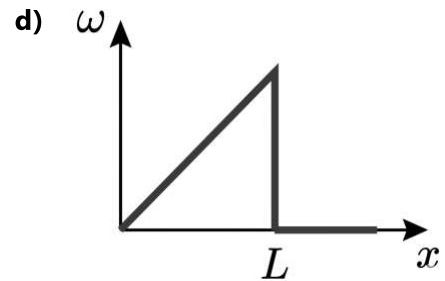
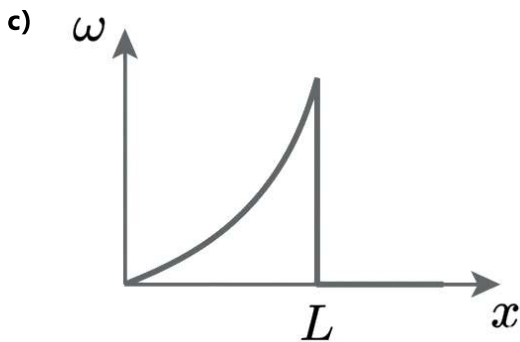
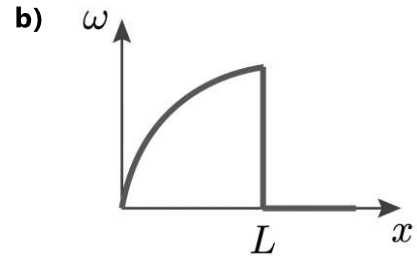
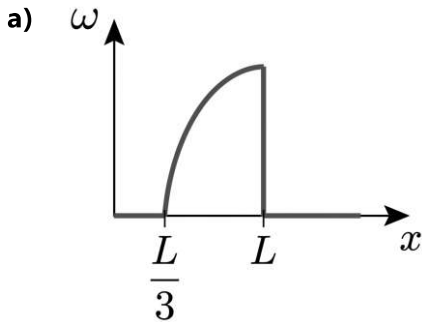
- a)  $1/2$                       b) -1                      c) 1                      d) 0



# Physics

## Single Choice Question

**Q46** A door of mass  $M$  and width  $L$  is hinged at one end and rotates about a vertical axis without friction. A bullet of mass  $m$  ( $m \ll M$ ) fired perpendicularly to the door at a speed  $v$  gets embedded in it at a distance  $x$  from its axis of rotation. Assuming the door was stationary initially, how does the resultant angular speed  $\omega$  of the door vary as a function of  $x$  ?



**Q47** A particle undergoes from position  $O(0, 0, 0)$  to  $A(a, 2a, 0)$  via path  $y = \frac{2x^2}{a}$  in  $x$ - $y$  plane under the action of a force which varies with particle's  $(x, y, z)$  coordinate as  $\vec{F} = x^2y\hat{i} + yz^2e^{2z}\hat{j} - \left(\frac{z}{x+2y}\right)\hat{k}$ . Work done by the force  $\vec{F}$  is: (all symbols have their usual meaning and they are in SI unit.)

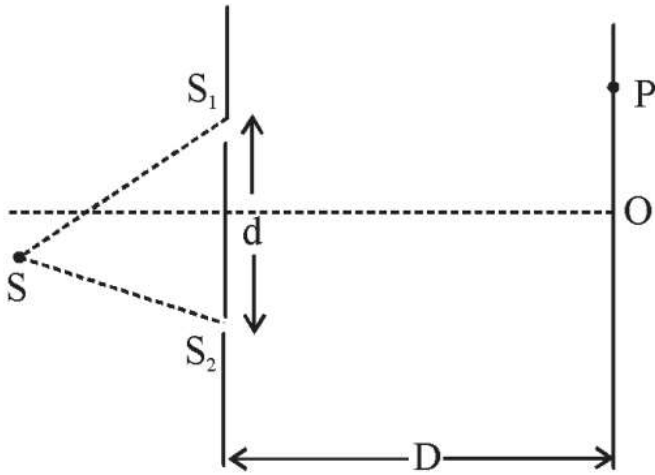
a)  $\frac{4a^4}{5}$

b)  $\frac{a^4}{5}$

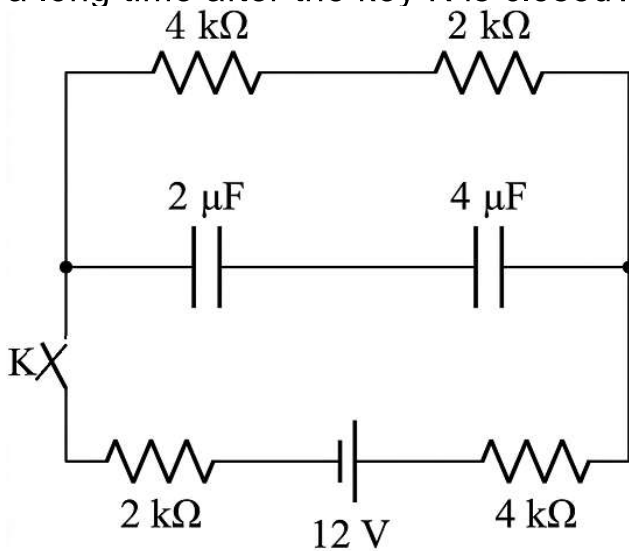
c)  $\frac{a^3}{4}$

d)  $\frac{2a^4}{5}$

- Q48** It is given that  $SS_1 - SS_2 = \frac{\lambda}{2}$  and  $S_2P - S_1P = \frac{\lambda}{2}$  Intensity from slit  $S_2$  is  $I_0$  then which are CORRECT option.



- a) Central maxima will form at point P      b) Central maxima will form at point O.  
 c) Resultant intensity at P is  $4I_0$ .      d) Resultant intensity at P is  $I_0$ .
- Q49** A capacitor of capacitance  $C$  consists of two large parallel metal plates. The coefficient of linear expansion of the metal is  $\alpha$ . What is the change in capacitance if the temperature of the plates rises by  $\Delta T$ , while the gap between the plates is kept fixed?
- a)  $\alpha\Delta TC$       b)  $-\alpha\Delta TC$       c)  $2\alpha\Delta TC$       d)  $-2\alpha\Delta TC$
- Q50** What are the charges stored in the  $2\mu\text{F}$  and  $4\mu\text{F}$  capacitors in the given circuit a long time after the key  $K$  is closed?



- a)  $8\mu\text{C}$  and  $8\mu\text{C}$  respectively      b)  $18\mu\text{C}$  and  $18\mu\text{C}$  respectively  
 c)  $16/3\mu\text{C}$  and  $8/3\mu\text{C}$  respectively      d)  $8/3\mu\text{C}$  and  $16/3\mu\text{C}$  respectively

**Q51** Consider a point charge  $+q$  moving with a constant velocity  $\vec{v} = v\hat{k}$  in vacuum in the presence of an electric field  $\vec{E} = E_x\hat{i} + E_y\hat{j}$  and a magnetic field  $\vec{B} = B_x\hat{i} + B_y\hat{j}$ . Unit vectors  $\hat{i}$ ,  $\hat{j}$ , and  $\hat{k}$  are in the directions of x, y, and z axes, respectively. Which of the following relations is correct?

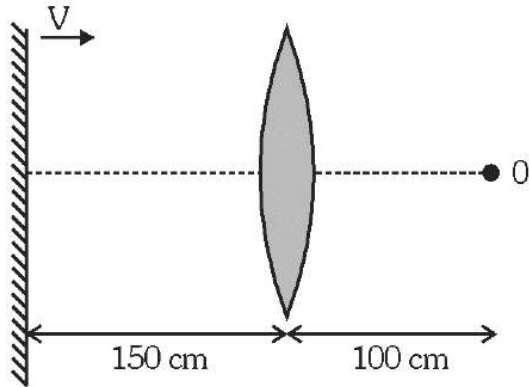
a)  $E_x = vB_x, E_y = vB_y$

b)  $E_x = vB_y, E_y = -vB_x$

c)  $E_x = -vB_y, E_y = vB_x$

d)  $E_x = -vB_x, E_y = -vB_y$

**Q52** An observer is standing at a point O, at a distance of 100 cm from a convex lens of focal length 50 cm. A plane mirror is placed behind the lens at a distance of 150 cm from the lens. The mirror now starts moving towards the right with a velocity of 10 cm/s. What will be the magnitude of velocity (in m/s) of her own image as seen by the observer, at the moment when the mirror just starts moving ?



a)  $\frac{1}{9}$  cm/s

b)  $\frac{10}{9}$  cm/s

c)  $\frac{20}{9}$  cm/s

d)  $\frac{20}{3}$  cm/s

**Q53** The half life of a radioactive element is 2000 hours. Approximately how much time is required for the decay of  $\frac{2}{3}$  of its nuclei? ( $\ln 2 = 0.693$ ,  $\ln 3 = 1.098$ )

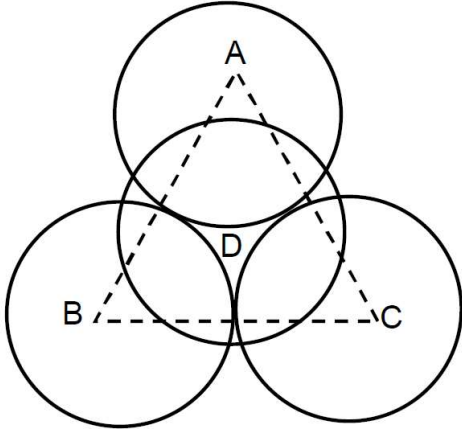
a) 1170 hours

b) 2830 hours

c) 3000 hours

d) 3170 hours

- Q54** Four identical spheres each of mass  $m$  and radius  $R$ , kept such that 3 spheres are lying in horizontal plane, just in contact with each other and the 4th sphere lies above them, touching rest 3 spheres. Coefficient of friction between each contact surface is same and equal to  $\mu$ . Top view of the arrangement is shown. The minimum value of  $\mu$  so that whole system stays in equilibrium will be : (A, B and C are the centers of sphere lying in horizontal plane and D is the centre of 4th sphere which is kept above rest 3 spheres.)

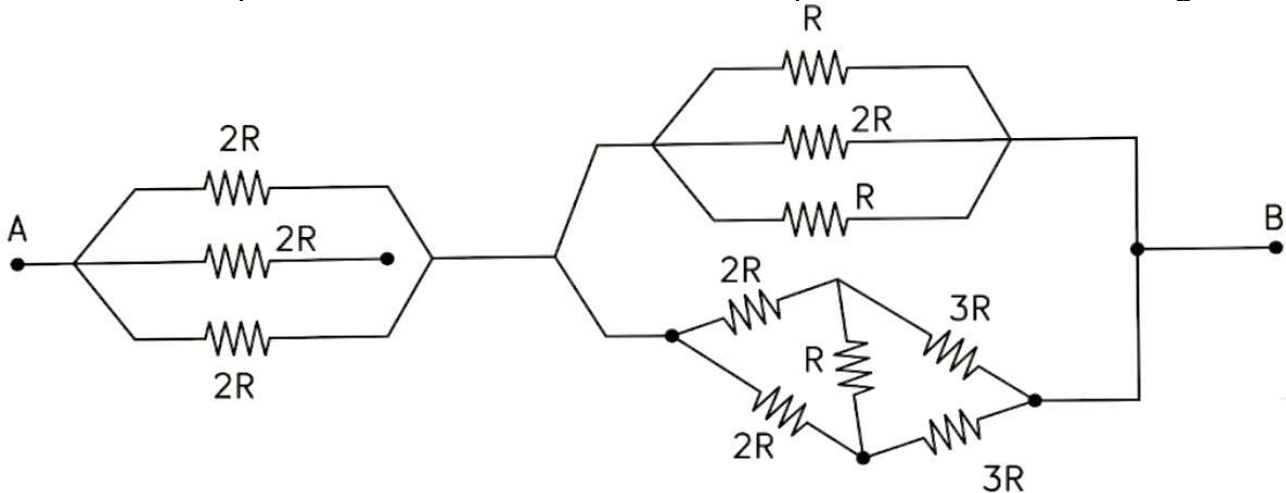


- a)  $\sqrt{3} - \sqrt{2}$                       b)  $\frac{\sqrt{3} - 1}{2}$                       c)  $\sqrt{2} - 1$                       d)  $\frac{\sqrt{2} - 1}{2}$
- Q55** Consider a uniformly charged solid non conducting sphere of radius  $R$  and charge  $Q$ . Consider three spherical regions centered at the centre of the uniformly charged solid non conducting sphere, as given below :
- Region (1)  $R_1 \geq r \geq 0$   
 Region (2)  $R_2 \geq r \geq R_1$   
 Region (3)  $\infty \geq r \geq R_2$
- If electrostatic potential energy stored in each of the three regions is equal then  $\frac{R_2}{R_1}$  is :
- a) 2                                      b) 3                                      c) 1                                      d) 4
- Q56** Consider a mixture of  $O_2$  and  $N_2$  gases at temperature  $27^\circ C$ . Which of the following relations is correct?
- a) RMS speed of  $O_2$  molecules < RMS speed of  $N_2$  molecules  
 b) Average kinetic energy of  $O_2$  molecules < Average kinetic energy of  $N_2$  molecules  
 c) Average kinetic energy of  $O_2$  molecules > Average kinetic energy of  $N_2$  molecules  
 d) RMS speed of  $O_2$  molecules > RMS speed of  $N_2$  molecules

**Q57** A cyclist is riding a bicycle at a speed of 5 m/s on a horizontal road. The distance between the axles is 2 m, and the mass center of the cyclist and the bicycle is located 1 m behind the front axle and 2 m above the ground. If the cyclist applies the brakes only on the front wheel, determine the shortest distance in which he can stop without being thrown over the front wheel. (Take  $g = 10 \text{ m/s}^2$ )

- a) 0.5                                      b) 1.5m                                      c) 2.5 m                                      d) 3.5 m

**Q58** What is the equivalent resistance between the points A and B in the figure?



- a)  $39R/10$                                       b)  $39R/29$                                       c)  $68R/87$                                       d)  $87R/68$

**Q59** There is an isolated planet having mass  $2M$  and radius  $2R$ , where  $M$  and  $R$  are the mass and radius of the earth. A simple pendulum having mass  $m$  and length  $2R$  is made to small oscillations on the planet. the time period of SHM of pendulum is  $3384 \text{ K}$  seconds. Find the value of  $K$ . (take  $\pi = 3.00$ ,  $g = 10 \text{ m/s}^2$ ,  $\sqrt{2} = 1.41$ )

- a) 1    b) 2    c) 3    d) 4

**Q60** In the photoelectric effect experiment, the frequency of the incident light is changed from red to blue while keeping the energy per unit area per unit time of the incident radiation fixed. What will happen to the saturation current?

- a) Saturation current doesn't depend on frequency and therefore will be same for red and blue light  
 b) Saturation current depends on intensity and therefore will be same for red and blue light  
 c) Saturation current for blue colour light is larger than red colour light  
 d) Saturation current for blue colour light is smaller than red colour light

# Answer Key

Que.	1	2	3	4	5	6	7	8	9	10
<b>Ans.</b>	<b>D</b>	<b>B</b>	<b>D</b>	<b>C</b>	<b>B</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>C</b>	<b>A</b>
Que.	11	12	13	14	15	16	17	18	19	20
<b>Ans.</b>	<b>D</b>	<b>A</b>	<b>D</b>	<b>A</b>	<b>D</b>	<b>B</b>	<b>B</b>	<b>D</b>	<b>D</b>	<b>C</b>
Que.	21	22	23	24	25	26	27	28	29	30
<b>Ans.</b>		<b>B</b>	<b>A</b>	<b>A</b>	<b>A</b>	<b>D</b>	<b>D</b>	<b>C</b>	<b>B</b>	<b>C</b>
Que.	31	32	33	34	35	36	37	38	39	40
<b>Ans.</b>	<b>B</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>C</b>	<b>C</b>	<b>D</b>	<b>D</b>	<b>D</b>	<b>A</b>
Que.	41	42	43	44	45	46	47	48	49	50
<b>Ans.</b>	<b>C</b>	<b>D</b>	<b>A</b>	<b>A</b>	<b>B</b>	<b>D</b>	<b>D</b>	<b>A</b>	<b>C</b>	<b>A</b>
Que.	51	52	53	54	55	56	57	58	59	60
<b>Ans.</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>A</b>	<b>A</b>	<b>A</b>	<b>C</b>	<b>B</b>	<b>B</b>	<b>D</b>