

# CEE Assam 2018

## PART-A MATHEMATICS

- The normal to the curve  $x = a(\cos \theta + \theta \sin \theta)$ ,  $y = a(\sin \theta - \theta \cos \theta)$  at any point  $\theta$  is such that
  - It makes a constant angle with X - axis
  - It passes through the origin
  - It is parallel to Y - axis
  - It is at a constant distance from the origin
- Let  $S = \{1, 2, 3, \dots, 24\}$ . Define a relation ' $\sim$ ' on S as  $x \sim y$  if the product of the digits in x is same as that of the digits of y (Note that if x is a single digit number then the product of the digits in x will be considered to be x). Then the number of equivalence classes for this equivalence relation is
  - 9
  - 10
  - 20
  - 24
- If  $\alpha, \beta, \gamma$  are the roots of the equation  $x^3 + ax^2 + b = 0$ , then 
$$\begin{vmatrix} \alpha & \beta & \gamma \\ \beta & \gamma & \alpha \\ \gamma & \alpha & \beta \end{vmatrix} =$$
  - $a^3 - 3b$
  - $-a^3$
  - $a^3$
  - $a^3 + 3b$
- If  $x = \frac{1 + \sqrt{3}i}{2}$  then the value of the expression  $y = x^4 - x^2 + 6x - 4$ , equals
  - $-1 + 2\sqrt{3}i$
  - $2 - 2\sqrt{3}i$
  - $2 + 2\sqrt{3}i$
  - none of these
- The line  $(K + 1)^2x + Ky - 2K^2 - 2 = 0$  passes through a point regardless of the value of K. Which of the following is the equation of the line with slope 2 and passing through that point?
  - $y = 2x + 8$
  - $y = 2x - 4$
  - $y = 2x - 5$
  - $y = 2x - 8$
- If  $[ \cdot ]$  denotes the greatest integer function then  $\lim_{n \rightarrow \infty} \frac{[x] + [2x] + \dots + [nx]}{n^2}$  is
  - 0
  - x
  - $\frac{x}{2}$
  - $\frac{x^2}{2}$
- If  $\binom{20}{1}, \binom{20}{2}, \dots, \binom{20}{20}$  denote binomial coefficients, then  $\binom{20}{1} - 2\binom{20}{2} + 3\binom{20}{3} - 4\binom{20}{4} + \dots - n\binom{20}{20}$  is equal to
  - 0
  - 20
  - $2^{20}$
  - $\frac{1}{21}$

8. Consider the circle with centre at the point (1, 2) and having the line  $x = y$  as a tangent. The area of the circle is
- (a)  $\frac{\pi}{4}$  (b)  $\pi$  (c)  $2\pi$  (d)  $\frac{\pi}{2}$
9. For each  $t \in \mathbb{R}$  let  $[t]$  denote the greatest integer less than or equal to  $t$ . Then  $\lim_{x \rightarrow 3} ([x] - [2x - 1])$
- (a) is equal to  $-1$  (b) is equal to  $-2$   
 (c) is equal to  $-3$  (d) does not exist
10. An equation of the common tangent to the parabola  $y = x^2$  and  $y = -(x - 2)^2$  is
- (a)  $y = 4(x + 1)$  (b)  $y = 0$   
 (c)  $y = -4(x - 1)$  (d)  $y = -30x - 50$
11. If  $A = \{(a_1, a_2, \dots, a_{10}) : a_i \in \{1, 2, 3\}, a_i + a_{i+1} \text{ is even}, 1 \leq i \leq 9\}$ , then the number of elements in the set  $A$  is
- (a)  $2^{11} + 1$  (b)  $2^{10} + 1$  (c)  $3^{10} + 1$  (d)  $3^{33} + 1$
12. If  $iz^3 + z^2 - z + i = 0$ , then  $|z| =$
- (a) 1 (b) 0 (c) 2 (d) 3
13. The common chord of the circles  $x^2 + y^2 - 4x - 4y = 0$  and  $x^2 + y^2 = 16$  subtends at the origin an angle equal to
- (a)  $\frac{\pi}{6}$  (b)  $\frac{\pi}{4}$  (c)  $\frac{\pi}{3}$  (d)  $\frac{\pi}{2}$
14. If  $f$  is a continuous function on the real line, and  $x^2 + (f(x) - 2)x - \sqrt{3}f(x) + 2\sqrt{3} - 3 = 0$ . Then the value of  $f(\sqrt{3})$
- (a) cannot be determined (b) is zero  
 (c)  $2(1 - \sqrt{3})$  (d)  $\frac{2(\sqrt{3} - 2)}{\sqrt{3}}$
15. Given that  $x \in [0, 1]$  and  $y \in [0, 1]$ . Let  $A$  be the event of  $(x, y)$  satisfying  $y^2 \leq x$  and  $B$  be the event of  $(x, y)$  satisfying  $x^2 \leq y$ . Then
- (a)  $P(A \cap B) = \frac{1}{3}$  (b)  $A, B$  are exhaustive  
 (c)  $A, B$  are mutually exclusive (d)  $A, B$  are independent
16. If  $A$  and  $B$  are two non-empty sets, then  $(B - A) \cap (A \cap B)'$  is equal to
- (a)  $A$  (b)  $A'$  (c)  $B$  (d) None of these
17. Which of the following values of  $x$  does not satisfy the equation  $\sin(2 \cos^{-1}(\cot(2 \tan^{-1} x))) = 0$ ?
- (a)  $1 + \sqrt{2}$  (b)  $-1 - \sqrt{2}$  (c)  $-1 + \sqrt{2}$  (d)  $-1$
18. The total number of points on the curve  $x^2 - 4y^2 = 1$  at which the tangents to the curve are parallel to the line  $x = 2y$  is
- (a) 0 (b) 1 (c) 2 (d) 4

19. The equation of the plane passing through the point  $(-10, 5, 4)$  and perpendicular to the line joining the points  $(4, -1, 2)$  ; and  $(-3, 2, 3)$  is
- (a)  $7x - 3y - z + 89 = 0$  (b)  $7x - 3y - z - 89 = 0$   
 (c)  $7x + 3y - z + 89 = 0$  (d)  $7x - 3y + z - 89 = 0$
20. The total number of subsets of the set  $\{1, 2, \dots, 10\}$  which do not contain the element 6 is
- (a) 512 (b) 812 (c) 1023 (d) 1024
21. Let  $A = \begin{bmatrix} 1 & 7\alpha & \alpha^2 \\ 0 & \alpha & 7\alpha^2 \\ 0 & 0 & 2 \end{bmatrix}$ . If  $|A^2| = 36$ , then  $|\alpha|$  equals
- (a) 3 (b)  $\frac{1}{3}$  (c) 7 (d)  $\frac{1}{7}$
22. The sum of first 8 terms of the series  $\frac{1^3}{1} + \frac{1^3 + 2^3}{1+3} + \frac{1^3 + 2^3 + 3^3}{1+3+5} \dots$  is
- (a) 96 (b) 192 (c) 71 (d) 132
23. If the lines  $3x - 4y - 7 = 0$  and  $2x - 3y - 5 = 0$  are two diameters of a circle of area  $49\pi$ , square units, the equation of the circle is
- (a)  $x^2 + y^2 + 2x - 2y - 47 = 0$  (b)  $x^2 + y^2 - 2x + 2y - 62 = 0$   
 (c)  $x^2 + y^2 + 2x - 2y - 62 = 0$  (d)  $x^2 + y^2 - 2x + 2y - 47 = 0$
24. If  $y = f(x)$ , passes through the point  $(1, -1)$  and satisfies the equation  $y(1 + xy) dx = x dy$ , then  $f\left(\frac{1}{2}\right)$  is equal to
- (a)  $-\frac{4}{5}$  (b)  $\frac{2}{5}$  (c)  $\frac{4}{5}$  (d)  $-\frac{2}{5}$
25. A dice is tossed once and even number has come up. The probability that it is either 2 or 4 is
- (a)  $\frac{1}{3}$  (b)  $\frac{2}{3}$  (c)  $\frac{1}{2}$  (d)  $\frac{3}{4}$
26. The value of  $\cot \left\{ \sum_{n=1}^{100} \cot^{-1} \left( 1 + \sum_{K=1}^n 2K \right) \right\}$  is
- (a)  $\frac{51}{50}$  (b)  $\frac{50}{51}$  (c)  $\frac{100}{101}$  (d)  $\frac{101}{100}$
27. Let A and B be two  $3 \times 3$  non-singular skew-symmetric matrices and are such that  $AB = BA$ . If  $M^T$  denotes the transpose of M, then  $A^2 B^2 (A^T B)^{-1} (A B^{-1})^T$  is equal to
- (a)  $A^2$  (b)  $-A^2$  (c)  $B^2$  (d)  $-B^2$

28. Let  $\frac{d}{dx}(F(x)) = \frac{e^{\sin x}}{x}$ ,  $x > 0$ . If  $\int_1^4 \frac{3e^{\sin x^3}}{x} dx = F(k) - F(1)$ , then one possible value of  $k$  is
- (a) 15                      (b) 64                      (c) 63                      (d) 16
29. Given that  $\lim_{x \rightarrow 0} x^m (\log x)^n = 0$  if  $m \geq n$ . Let  $I_n = \int_0^1 x^n (\log x)^n dx$ , then  $I_n$  is equal to
- (a)  $\frac{(-1)^n n!}{(n+1)^n}$                       (b)  $\frac{(-1)^n n!}{n^n}$                       (c)  $\frac{(-1)^{n+1}}{n^n}$                       (d)  $\frac{(-1)^n n!}{(n+1)^{n+1}}$
30. The shortest distance between  $A(1, 0, 2)$  and the line  $\frac{x+1}{3} = \frac{y-2}{-2} = \frac{z+1}{-1}$  is given by line joining  $A$  and  $B$ , then  $B$  in the line is
- (a)  $\left(\frac{1}{2}, 1, -\frac{3}{2}\right)$                       (b)  $\left(\frac{2}{3}, 1, -1\right)$                       (c)  $\left(\frac{2}{3}, \frac{-1}{2}, -2\right)$                       (d)  $(1, -2, -1)$
31. The value of  $\int_0^1 \frac{\log(1+x)}{1+x^2} dx$  is
- (a)  $\frac{\pi}{2} \log 2$                       (b)  $\pi \log 2$                       (c)  $\log 2$                       (d)  $\frac{\pi}{8} \log 2$
32. If  $\frac{dy}{dx} = 1 - y$  and  $y(0) = 3$ , then  $y(\log_e 8)$  is equal to
- (a) 5                      (b)  $5/4$                       (c) 0                      (d) -5
33. Let for all  $x > 0$ ,  $f(x) = \lim_{n \rightarrow \infty} n(x^{1/n} - 1)$ , then
- (a)  $f(x) + f(y) = 1$                       (b)  $f(xy) = f(x) + f(y)$   
(c)  $f(xy) = xf(x) + yf(y)$                       (d)  $f(xy) = xf(y) + yf(x)$
34. Let  $P$  and  $Q$  be  $3 \times 3$  matrices with  $p \neq Q$ . If  $P^3 = Q^3$  and  $P^2Q = Q^2P$ , then determinant of  $(P^2 + Q^2)$  is equal to
- (a) -2                      (b) -1                      (c) 0                      (d) 1
35.  $y = \{x(x-3)\}^2$  increases for all values of  $x$  lying in the interval
- (a)  $0 < x < \frac{3}{2}$                       (b)  $0 < x < \infty$                       (c)  $-\infty < x < 0$                       (d)  $1 < x < 3$
36. If  $\vec{a}$  and  $\vec{b}$  are any two vectors, then  $(\vec{a} \times \vec{b})^2 + (\vec{a} \cdot \vec{b})^2 =$
- (a)  $|\vec{a}| |\vec{b}|$                       (b)  $\lambda |\vec{a}|^2 |\vec{b}|^2$ , where  $|\lambda| < 1$   
(c)  $|\vec{a}|^2 |\vec{b}|^2$                       (d)  $|\vec{a}|^2 + |\vec{b}|^2$

37. Solution of the LPP

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$$\text{Min. } Z = 5x + 10y$$

subject to :

$$x + 2y \leq 120$$

$$x + y \geq 60$$

$$x - 2y \geq 0$$

$$x, y \geq 0$$

is

(a)  $x = 60, y = 0$

(b)  $x = 0, y = 60$

(c)  $x = 60, y = 30$

(d)  $x = 60, y = 20$

38. If  $(p \wedge \sim r) \rightarrow (\sim p \vee q)$  is false, then the truth values of p, q and r are respectively

(a) T, F and F

(b) F, F and T

(c) F, T and T

(d) T, F and T

39. From  $3n$  consecutive natural numbers, 3 natural numbers are chosen at random without replacement. The probability that the sum of the chosen numbers is divisible by 3 is

(a)  $\frac{n(3n^2 - 3n + 2)}{2}$

(b)  $\frac{(3n^2 - 3n + 2)}{2(3n - 1)(3n - 2)}$

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

(d)  $\frac{n(3n - 1)(3n - 2)}{3(n - 1)}$

40. If  $D_r = \begin{vmatrix} 2 \times 3^{r-1} & 4 \times 5^{r-1} & 6 \times 7^{r-1} \\ 1 & 2 & 3 \\ 3^{2018} - 1 & 5^{2018} - 1 & 7^{2018} - 1 \end{vmatrix}$  then  $\sum_{r=1}^{2018} D_r$  is equal to

(a)  $(2018)^2$

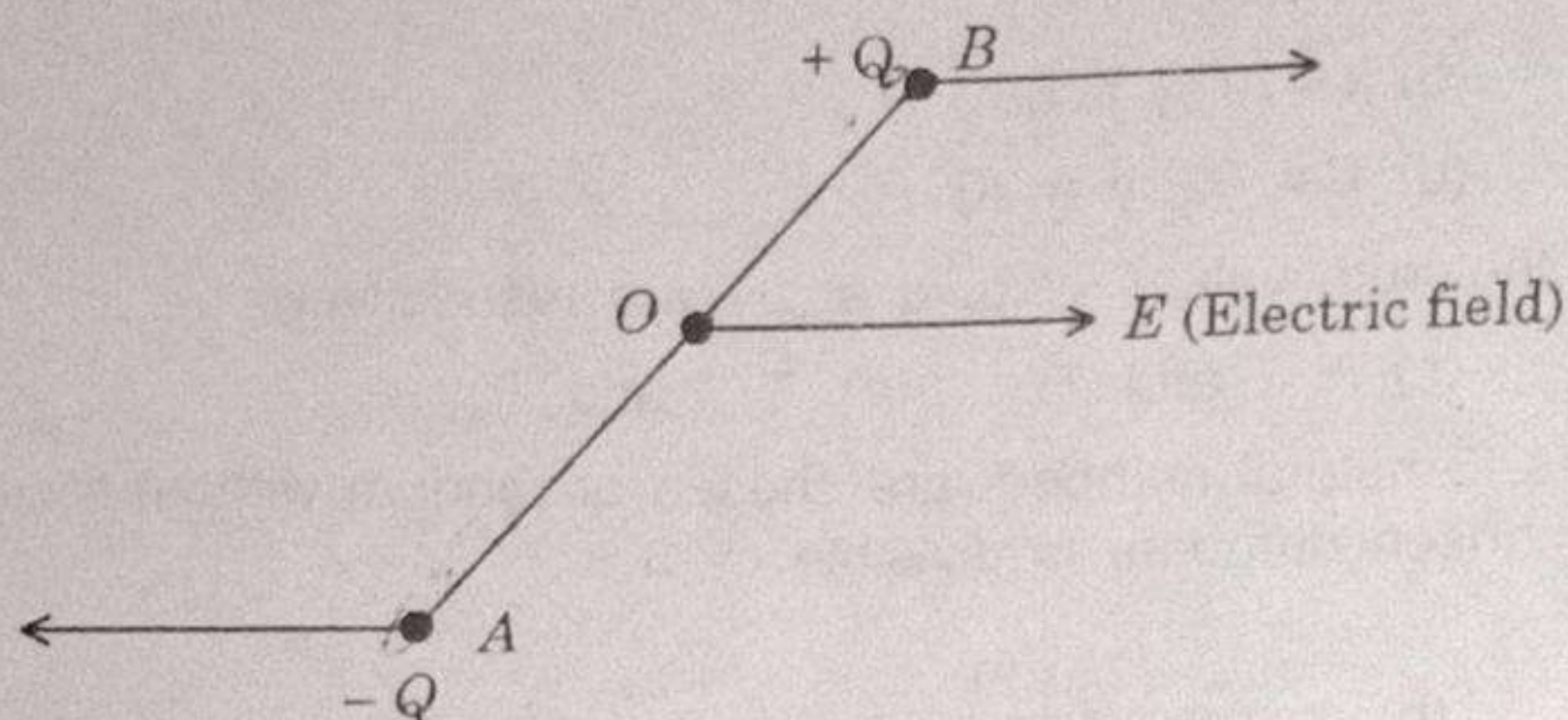
(b)  $\left(\frac{1}{2}\right)^{2018}$

(c) 2018

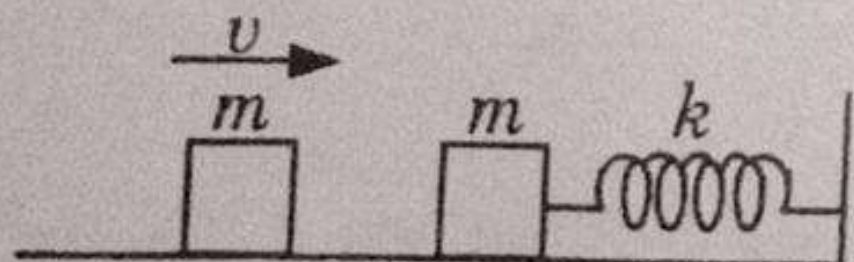
(d) 0

PART - B  
PHYSICS

41. In the figure the net torque acting on the dipole is

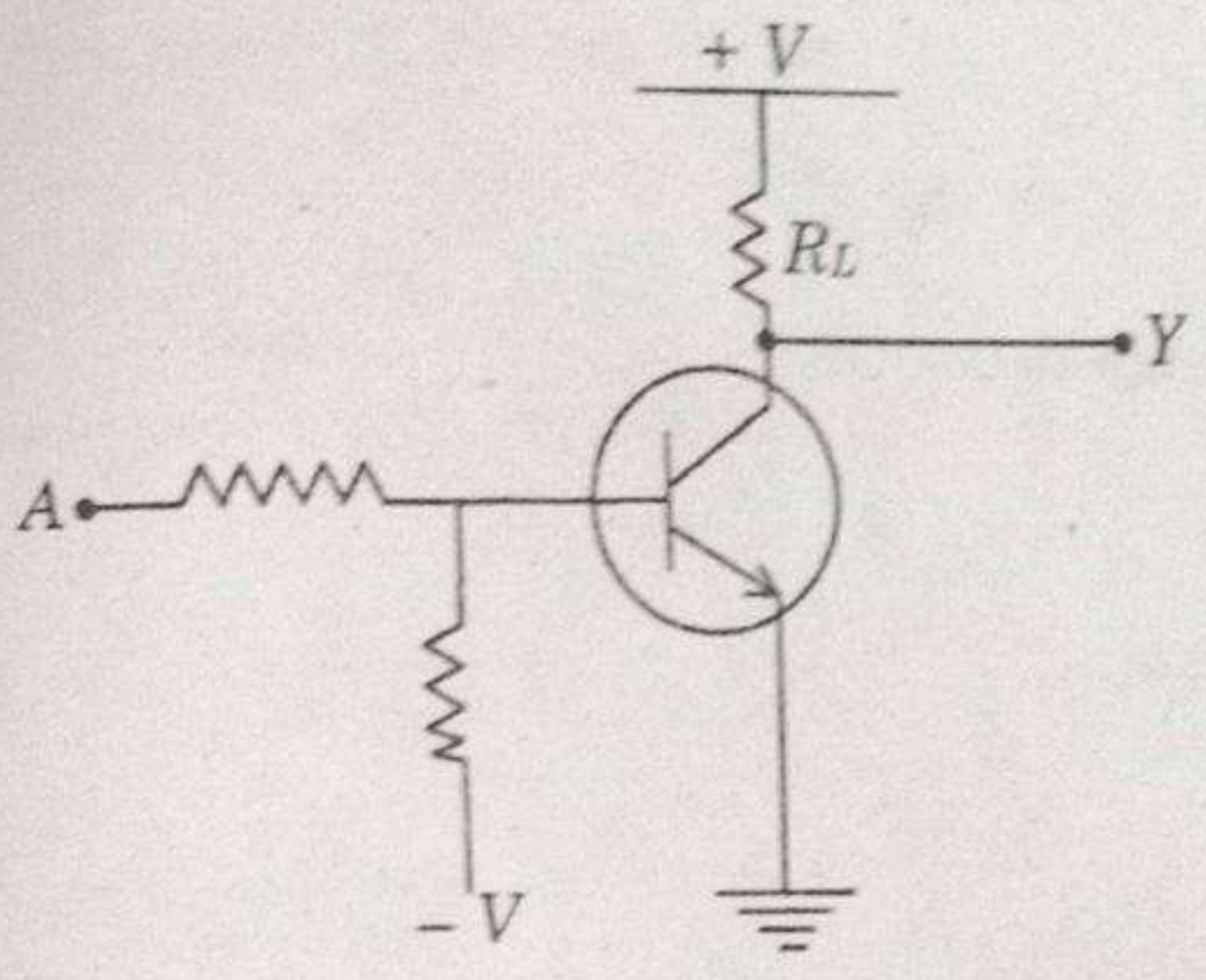


- (a)  $Q(\vec{OB} \times \vec{E})$       (b)  $-Q(\vec{OA} \times \vec{E})$       (c) Zero      (d)  $-Q(\vec{AB} \times \vec{E})$
42. A resistor develops 800 J of thermal energy in 20 s when a current of 4 A is passed through it. If the current is increased to 8 A, the energy developed in 20 s is  
 (a) 800 J      (b) 1600 J      (c) 3200 J      (d) 400 J
43. A beam of protons with velocity 600 km/s enters a uniform magnetic field of 0.2 T. The velocity makes an angle of  $30^\circ$  with the magnetic field. The radius of the helical path will be  
 (a) 1.56 cm      (b) 2.56 cm      (c) 3.56 cm      (d) 4.56 cm
44. An LCR series circuit has an inductance of 100 mH, connected to a  $100 \mu\text{F}$  capacitor and the resistive load is  $120 \Omega$ , which is connected to an a.c. source of 60 Hz. The resonant frequency of the circuit is  
 (a) 80 Hz      (b) 70 Hz      (c) 60 Hz      (d) 50 Hz
45. An elevator is descending (see the figure below) with a uniform acceleration. If the force exerted by the block A on block B is 4 N, what is the acceleration of the lift, if the mass of the block A is  $\frac{1}{2}$  kg?  
 (a)  $0.5 \text{ m/s}^2$       (b)  $1 \text{ m/s}^2$       (c)  $2 \text{ m/s}^2$       (d)  $4 \text{ m/s}^2$
46. In the figure given below, the mass on the left is moving to the right with a constant velocity  $v$  and after colliding elastically with the mass on the right, sticks to it. If the spring of constant  $k$  was initially at its equilibrium position, what is the amplitude of the resultant oscillation?



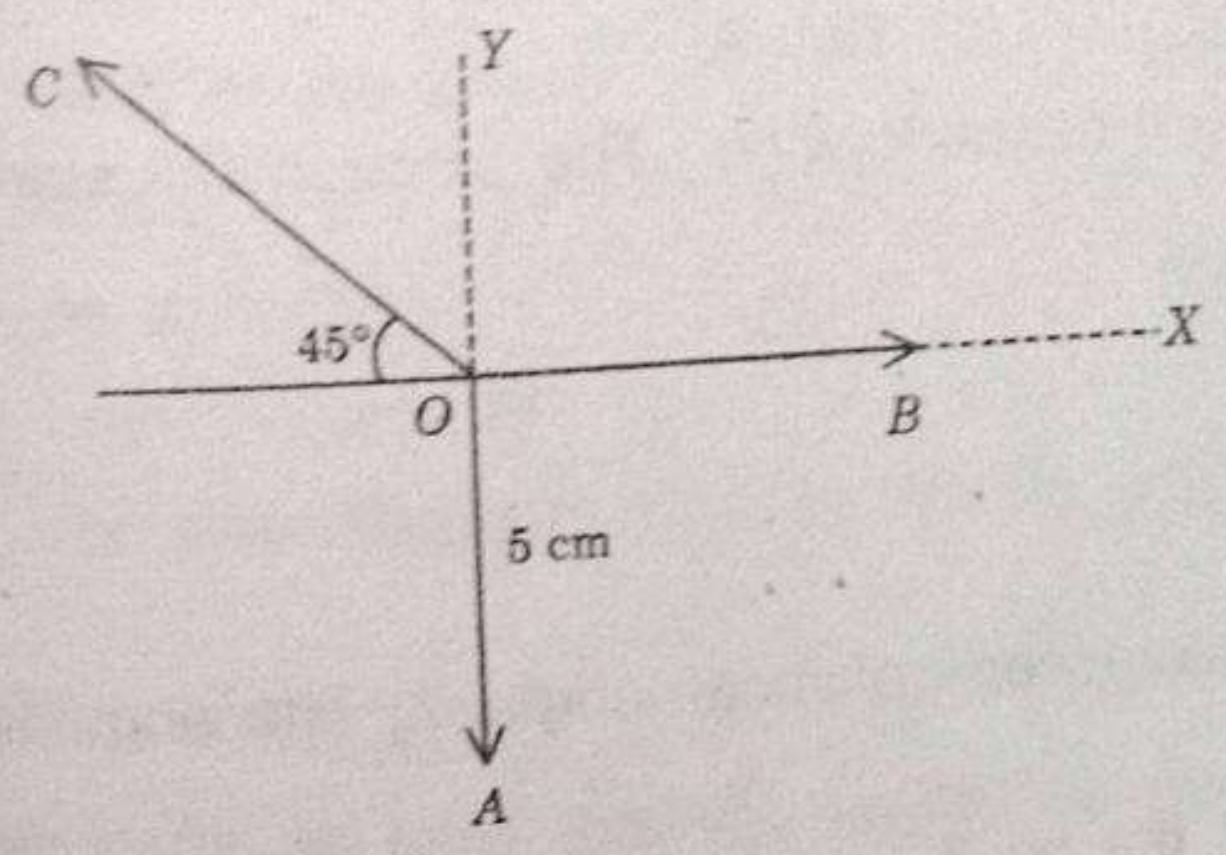
- (a)  $v\left(\frac{m}{2k}\right)^{1/2}$       (b)  $\left(\frac{m}{2k}\right)^{1/2}$       (c)  $\left(\frac{m}{k}\right)^{1/2}$       (d)  $v\left(\frac{2m}{k}\right)^{1/2}$

47. Light quanta with an energy 4.9 eV eject photoelectron from metal with work function 4.5 eV. The maximum momentum of the ejected electron is  
 (a)  $3.41 \times 10^{-25} \text{ kgms}^{-1}$  (b)  $5.0 \times 10^{-12} \text{ kgms}^{-1}$   
 (c)  $2.8 \times 10^{-20} \text{ kgms}^{-1}$  (d)  $1.5 \times 10^{-15} \text{ kgms}^{-1}$
48. The binding energy per nucleon of  ${}^6_3\text{C}^{12}$ , if mass of  ${}^6_3\text{C}^{12} = 12.0038 \text{ a.m.u.}$ , mass of neutron = 1.00898 a.m.u. and mass of proton = 1.007599 a.m.u. is  
 (a) 9.5 MeV (b) 8.0 MeV (c) 6.8 MeV (d) 7.2 MeV
49. The truth table for the following circuit is



- (a)  $\begin{vmatrix} 0 & 1 \\ 1 & 0 \end{vmatrix}$  (b)  $\begin{vmatrix} 0 & 0 \\ 1 & 1 \end{vmatrix}$  (c)  $\begin{vmatrix} 1 & 0 \\ 0 & 0 \end{vmatrix}$  (d)  $\begin{vmatrix} 0 & 1 \\ 1 & 1 \end{vmatrix}$

50. The sum of three vectors in the figure below is zero. The magnitude of  $\vec{OC}$  and  $\vec{OB}$  is

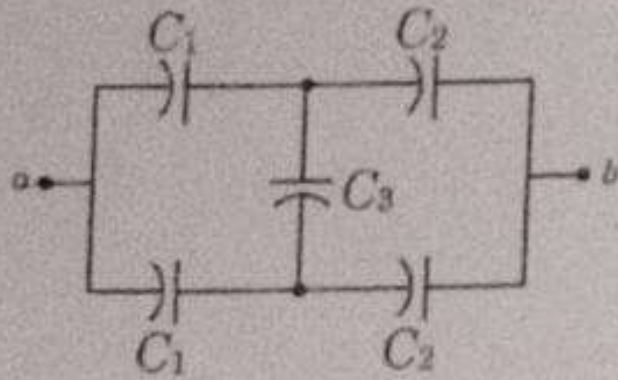


- (a) 5 m,  $5\sqrt{2}$  m (b) 5 m, 5 m  
 (c)  $5\sqrt{2}$  m, 5 m (d)  $5\sqrt{2}$  m,  $5\sqrt{2}$  m

51. The driver of a bus moving at an speed of 60 km/hr saw a man at a distance of 52 m from the bus. The driver stopped the car at a distance of 2 m from the man using brake. The time required to stop the bus is

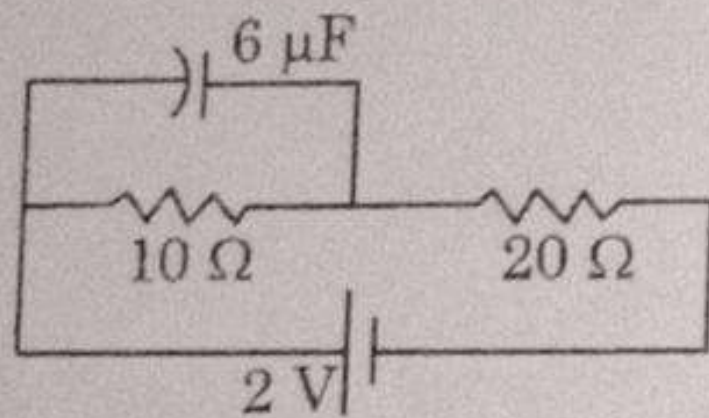
- (a) 18s (b) 12s (c) 6s (d) 2s

52. The equivalent capacitance of the following combination between a and b is



- (a)  $\frac{2C_1C_2C_3}{C_1+C_2+C_3}$  (b)  $\frac{2C_1C_2}{C_1+C_2} + C_3$  (c)  $\frac{C_1C_2}{C_1+C_2}$  (d)  $\frac{2C_1C_2}{C_1+C_2}$

53. What is the charge on the capacitor in the circuit shown below?



- (a) 4  $\mu$ C (b) 4  $\mu$ F (c) 4 mC (d) 4 C

54. An electric dipole is formed with two point charges  $+3.2 \times 10^{-19}$  C and  $-3.2 \times 10^{-19}$  C and separated by a distance of  $2.4 \times 10^{-10}$  m. The work done in rotating the dipole through  $180^\circ$  from the position of equilibrium in a uniform electric field of  $4 \times 10^5$  Vm $^{-1}$  is

- (a)  $6.14 \times 10^{-23}$  J (b)  $5.25 \times 10^{-25}$  J (c)  $4.95 \times 10^{-15}$  J (d)  $6.35 \times 10^{-22}$  J

55. A transformer has efficiency 80%. It works at 5 kW and 150 V. If the secondary voltage is 240 V, the secondary current is

- (a) 13.3 A (b) 16.6 A (c) 15.5 A (d) 18.8 A

56. A free electron is placed on the path of a plane electromagnetic wave. The electron will start moving

- (a) along the electric field  
(b) along the magnetic field  
(c) along the direction of propagation of the wave  
(d) none of the above

57. An object is placed at a distance 'u' from a simple microscope of focal length 'f'. The angular magnification depends on

- (a) on 'f' but not on 'u' (b) on 'u' but not on 'f'  
(c) on 'f' as well as 'u' (d) neither on 'f' nor on 'u'

58. An audio signal of 1 kHz is used to modulate a carrier of 500 kHz. The bandwidth required is

- (a) 499 kHz (b) 501 kHz (c)  $(500 \pm 1)$  kHz (d) 2 kHz

59. The dimensions in M, L and T of the term  $a/V^2$  in Vander Waals equation are

- (a) 1, -1, -2 (b) 1, 1, -2 (c) 2, 1, -1 (d) 1, 1, 1

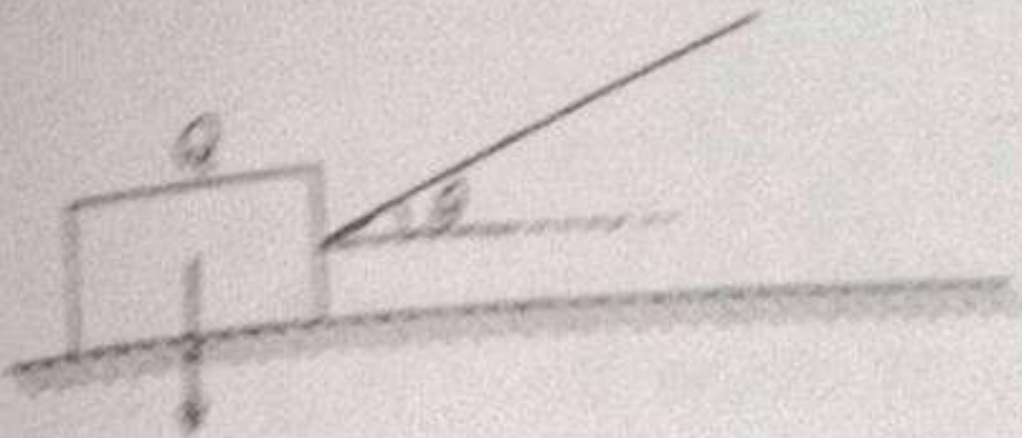
The displacement of a particle moving along a straight line is related to time as  $\sqrt{x} = t - 3$ . The displacement of the particle when its velocity is zero is

- (a) 6m (b) 3m (c) 9m (d) 0

A bullet of mass 50 g is fired from a rifle of mass 2 kg and the total kinetic energy produced by the explosion is 2050 J. Then the kinetic energy of the bullet and the rifle are

- (a) 2000 J and 50 J (b) 1500 J and 50 J  
(c) 2500 J and 25 J (d) 1000 J and 75 J

62. The block 'Q' is pulled on a straight horizontal surface making an angle  $\theta$  with the horizontal. If 'a' is the acceleration of the block, 'N' the contact force by the surface, 'T' the pull of the string along it and 'M' the mass of the block, then



- (a)  $N = \frac{M}{g - a \tan \theta}$  (b)  $N = \frac{M}{g + a \tan \theta}$   
(c)  $M = \frac{N}{g - a \tan \theta}$  (d)  $M = \frac{N}{g + a \tan \theta}$

63. Two equal masses are attached to two ends of a spring of spring constant k. The masses are pulled out symmetrically to stretch the spring by a length 'x' over its natural length. The work done by the spring on each mass is

- (a)  $\frac{1}{2} kx^2$  (b)  $-\frac{1}{2} kx^2$  (c)  $\frac{1}{4} kx^2$  (d)  $-\frac{1}{4} kx^2$

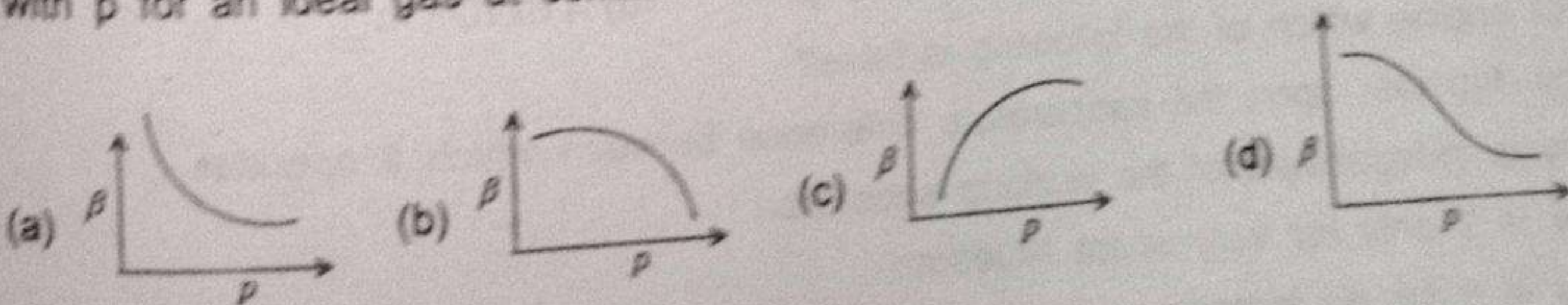
64. The time period of an earth satellite in circular orbit is independent of

- (a) Mass of satellite (b) Radius of the orbit  
(c) Both of the above (d) None of the above

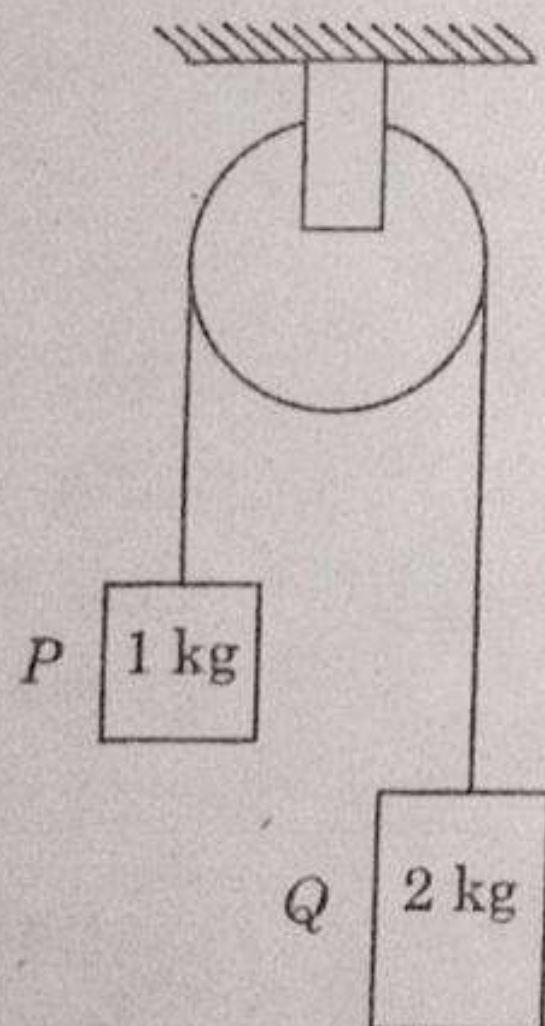
65. A transistor can be used as a

- (a) as a rectifier (b) as an amplifier  
(c) both (A) and (B)  
(d) for alternating current as rectifier and for direct current as amplifier

66. Which of the graphs shown in the following figures correctly represents the variation of  $\beta = -\left(\frac{dV}{dp}\right) \frac{1}{V}$  with p for an ideal gas at constant temperature?

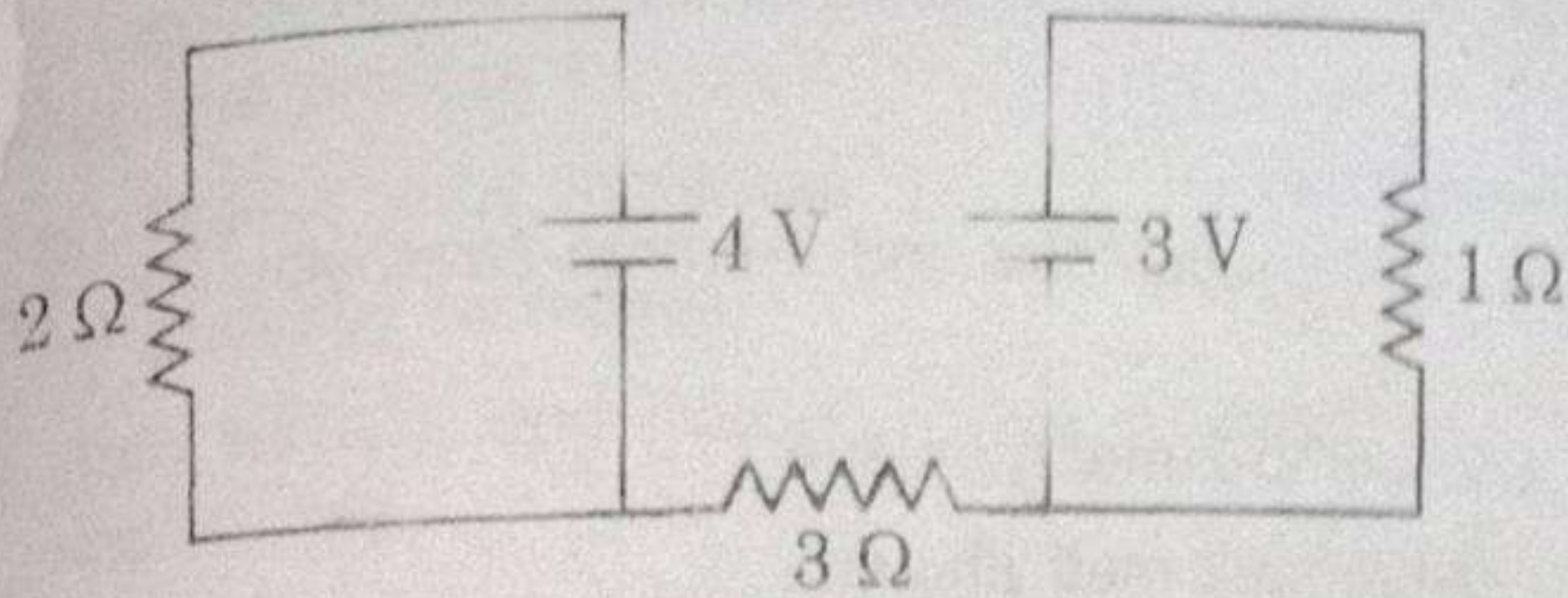


67. Solar energy of  $200 \text{ Wm}^{-2}$  is incident on a horizontal surface. If 20% of this energy can be into useful electrical energy, the area needed to supply 8 kW energy is  
 (a)  $150 \text{ m}^2$  (b)  $200 \text{ m}^2$  (c)  $250 \text{ m}^2$  (d)  $100 \text{ m}^2$
68. The mass of a solid circular disc is 500 g, the circumference is 3.14 m and thickness is 5 mm. The moment of inertia of the disc about an axis tangential to the rim and perpendicular to the plane of rotation is  
 (a)  $100 \text{ kgm}^2$  (b)  $0.188 \text{ kgm}^2$  (c)  $10 \text{ kgm}^2$  (d)  $18.8 \text{ kgm}^2$
69. A body is projected upwards with a velocity of  $4 \times 11.2 \text{ kms}^{-1}$  from the surface of earth. The velocity of the body when it escapes the gravitational pull of earth is  
 (a)  $11.2 \text{ kms}^{-1}$  (b)  $2 \times 11.2 \text{ kms}^{-1}$  (c)  $3 \times 11.2 \text{ kms}^{-1}$  (d)  $\sqrt{15} \times 11.2 \text{ kms}^{-1}$
70. A potential difference of 5 V is applied across a conductor of length 0.1 m. If the electron mobility is  $5 \times 10^{-6} \text{ m}^2\text{v}^{-1}\text{s}^{-1}$  then the drift velocity of electron is  
 (a)  $2.5 \times 10^{-4} \text{ ms}^{-1}$  (b)  $3.0 \times 10^{-5} \text{ ms}^{-1}$  (c)  $3.5 \times 10^{-4} \text{ ms}^{-1}$  (d)  $2.5 \times 10^{-5} \text{ ms}^{-1}$
71. A galvanometer has a coil of resistance  $5 \Omega$  and requires 15 mA for full scale deflection. The shunt resistance needed to convert the galvanometer into an ammeter of range 0 - 1 A is  
 (a)  $0.076 \Omega$  (b)  $35 \Omega$  (c)  $0.050 \Omega$  (d)  $0.025 \Omega$
72. A resistance of  $10 \Omega$  is joined to an inductance of 0.5 H and a capacitance of  $20.24 \times 10^{-6} \text{ F}$ . When the circuit is connected to mains of 200 V and 50 cycle per second, maximum current flows in the circuit. The value of current is  
 (a) 10 A (b) 20 A (c) 50 A (d) 0.5 A
73. The two blocks P and Q are connected by a metal wire with breaking stress  $10^9 \text{ N/m}^2$  through a frictionless pulley. The minimum radius of the wire for it not to break is (consider  $g = 10 \text{ m / s}^2$ )



- (a)  $2.6 \times 10^{-4} \text{ m}$  (b)  $4.6 \times 10^{-4} \text{ m}$  (c)  $2.6 \times 10^{-5} \text{ m}$  (d)  $4.6 \times 10^{-5} \text{ m}$
74. For a carnot engine which of the following is false?  
 (a) Efficiency depends upon the temperature difference between which it operates  
 (b) Efficiency is independent of the working substance  
 (c) Efficiency is 1 only for very spent situations  
 (d) Efficiency is 0 for no temperature differences between which it operates

The potential difference through the  $3\ \Omega$  resistor shown in figure is



- (a) 0                      (b) 1 V                      (c) 3.5 V                      (d) 7 V

76. The frequency of  $K_\alpha$  line of a source of atomic number  $z$  is proportional to

- (a)  $z^2$                       (b)  $(z - 1)^2$                       (c)  $1/z$                       (d)  $z$

77. A gas with the ratio of specific heat  $\gamma$  expands from an initial pressure of  $p_1$  and volume  $V_1$  to pressure  $p_2$  and volume  $V_2$ , adiabatically. The work done is given by

- (a)  $\frac{p_1 V_1 - p_2 V_2}{\gamma - 1}$                       (b)  $\frac{p_1 V_1 + p_2 V_2}{\gamma - 1}$   
 (c)  $\frac{p_1 V_1 \times p_2 V_2}{\gamma - 1}$                       (d) None of the above

78. In case of charging of a capacitor if  $I_c$  and  $I_D$  be the conduction current and displacement current then at any instant

- (a)  $I_c = I_D$                       (b)  $I_c \approx I_D$                       (c)  $I_c > I_D$                       (d)  $I_c < I_D$

79. The radii of curvature of the spherical surfaces of a biconvex lens are 20 cm and 30 cm. The refractive index of the material of the lens is 1.65. If the lens is submerged in a liquid of refractive index 1.1, its effective focal length will be

- (a) 25 cm                      (b) 30 cm                      (c) 20 cm                      (d) 24 cm

80. The ratio of momenta of an electron and an alpha particle which are accelerated from rest by a potential difference of  $V$  is

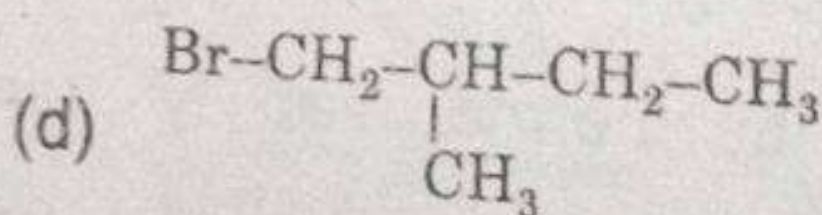
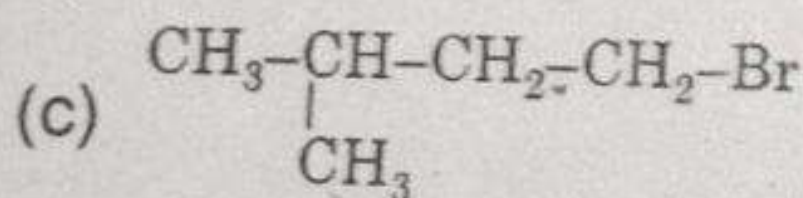
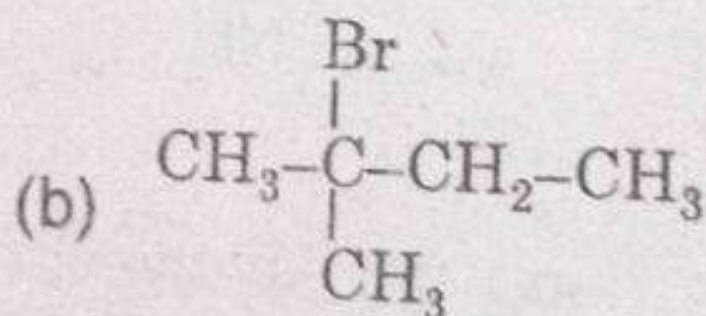
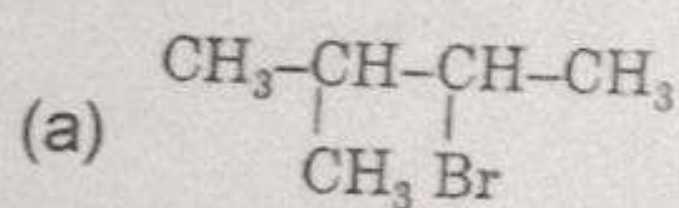
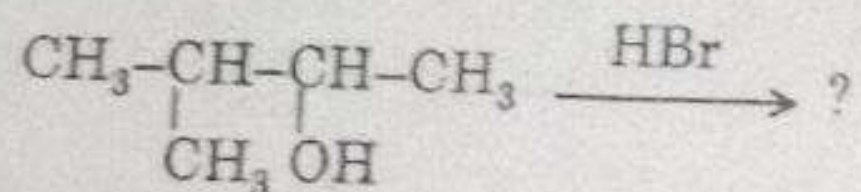
- (a)  $\sqrt{\frac{m_\alpha}{m_e}}$                       (b)  $\sqrt{\frac{m_e}{2m_\alpha}}$                       (c)  $\sqrt{\frac{m_e}{m_\alpha}}$                       (d)  $\frac{2m_e}{m_\alpha}$

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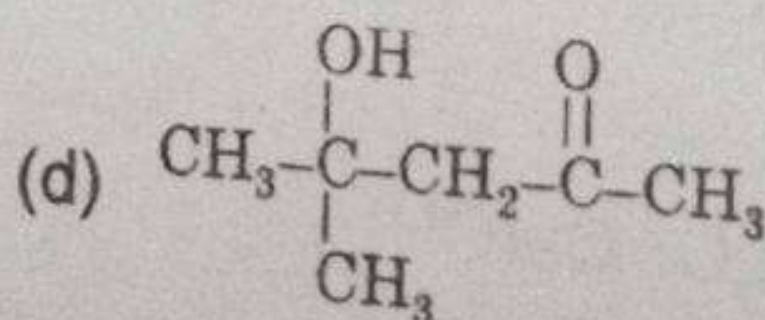
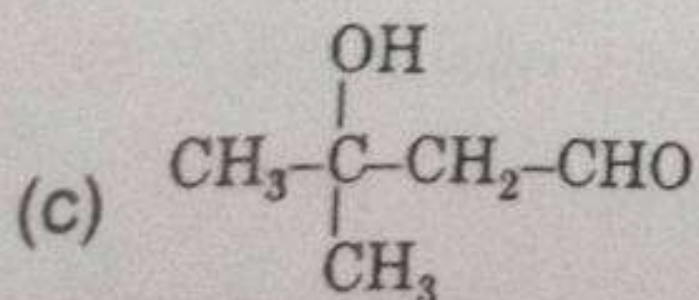
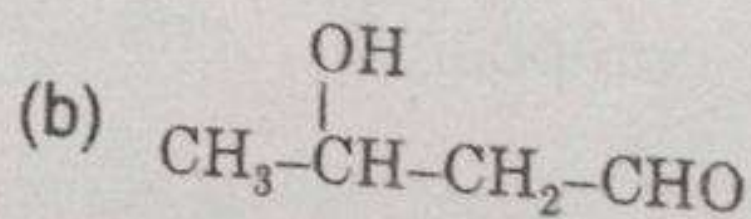
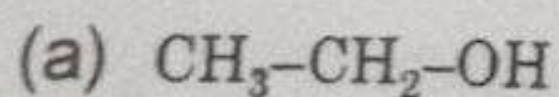
81. The order of reactivity of 1-bromopentane, 2-bromopentane and 2-bromo-2methylbutane, towards displacement, is
- (a) 1-bromopentane > 2-bromopentane > 2-bromo-2-methylbutane  
(b) 2-bromopentane > 1-bromopentane > 2-bromo-2-methylbutane  
(c) 2-bromo-2-methylbutane > 2-bromopentane > 1-bromopentane  
(d) 2-bromo-2-methylbutane > 1-bromopentane > 2-bromopentane
82. The alcohol prepared from But-1-ene ( $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH}_2$ ) by hydroborationoxidation reaction is
- (a) Butan-1-ol (b) Butan-2-ol (c) Butan-1,2-diol (d) Propan-1-ol
83. Passing  $\text{H}_2\text{S}$  gas into a mixture of  $\text{Mn}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Cu}^{2+}$  and  $\text{Hg}^{2+}$  ions in an acidified aqueous solution precipitate
- (a)  $\text{CuS}$  and  $\text{HgS}$  (b)  $\text{MnS}$  and  $\text{CuS}$   
(c)  $\text{MnS}$  and  $\text{NiS}$  (d)  $\text{NiS}$  and  $\text{HgS}$
84. On heating ammonium dichromate and barium azide separately, we get
- (a)  $\text{N}_2$  in both cases  
(b)  $\text{N}_2$  from ammonium dichromate and  $\text{NO}$  from barium azide  
(c)  $\text{N}_2\text{O}$  from ammonium dichromate and  $\text{N}_2$  from barium azide  
(d)  $\text{N}_2\text{O}$  from ammonium dichromate and  $\text{NO}_2$  from barium azide
85.  $\text{KMnO}_4$  acts as an oxidizing agent in alkaline medium. When alkaline  $\text{KMnO}_4$  is treated with  $\text{KI}$ , then iodide ion is oxidized to
- (a)  $\text{I}_2$  (b)  $\text{IO}^-$  (c)  $\text{IO}_3^-$  (d)  $\text{IO}_4^-$
86. An acid solution of  $\text{pH} = 6$  is diluted 1000 times. The  $\text{pH}$  of the final solution becomes
- (a) 6.99 (b) 6 (c) 3 (d) 9
87. The correct order of reactivity in electrophilic substitution reactions of benzene (I), toluene (II), chlorobenzene (III) and nitrobenzene (IV) is
- (a)  $\text{I} > \text{II} > \text{III} > \text{IV}$  (b)  $\text{IV} > \text{III} > \text{II} > \text{I}$   
(c)  $\text{II} > \text{I} > \text{III} > \text{IV}$  (d)  $\text{II} > \text{III} > \text{I} > \text{IV}$
88. The compound having the lowest boiling point is
- (a) n-butane (b) isobutane (c) 1-butene (d) 1-butyne
89. Carbon monoxide is a pollutant as it
- (a) inactivates nerves (b) inhibits glycolysis  
(c) combines with oxygen (d) combines with haemoglobin
90. The number of molecules of 8 g of oxygen gas at NTP is
- (a)  $6.022 \times 10^{23}$  (b)  $8 \times 6.022 \times 10^{23}$   
(c)  $\frac{1}{4} \times 6.022 \times 10^{23}$  (d)  $\frac{1}{2} \times 6.022 \times 10^{23}$

- The dipole moment of which of the following molecule is greater than zero?  
 a)  $\text{CCl}_4$  (b)  $\text{BF}_3$  (c)  $\text{CO}_2$  (d)  $\text{NH}_3$
- In equilibrium mixture of ice and water is under constant pressure, where ice melts if heat is supplied. For this process  
 (a) Free energy increases (b) Entropy increases  
 (c) Enthalpy increases (d) Entropy decreases
93. Both  $\text{Ni}(\text{CO})_4$  and  $[\text{Ni}(\text{CN})_4]^{2-}$  are diamagnetic. The hybridization of Nickel in these complexes are respectively  
 (a)  $\text{sp}^3, \text{sp}^3$  (b)  $\text{sp}^3, \text{dsp}^2$  (c)  $\text{dsp}^2, \text{sp}^3$  (d)  $\text{dsp}^2, \text{dsp}^2$
94. To get DDT, chlorobenzene has to react with the following compound in presence of concentrated sulphuric acid  
 (a) Trichloroethane (b) Dichloroacetone  
 (c) Dichloroacetaldehyde (d) Trichloroacetaldehyde
95. Product obtained by heating  $\text{C}_2\text{H}_5\text{Br}$  in presence of dry silver oxide is  
 (a)  $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$  (b)  $\text{C}_2\text{H}_5\text{COOH}$  (c)  $\text{C}_2\text{H}_5\text{OH}$  (d)  $\text{C}_2\text{H}_5\text{CHO}$
96. In Tollen's test, an aldehyde is treated with ammoniacal silver nitrate solution. As a result the aldehyde  
 (a) is converted to corresponding carboxylate anion  
 (b) is converted to corresponding alcohol  
 (c) undergoes self-condensation to give an aldol  
 (d) is converted to the silver salt of the corresponding carboxylic acid
97. The correct increasing order of the basic strength of the following is  $\text{C}_6\text{H}_5\text{NH}_2$ ,  $\text{C}_2\text{H}_5\text{NHCH}_3$ ,  $\text{C}_2\text{H}_5\text{NH}_2$ ,  $(\text{C}_2\text{H}_5)_2\text{NH}$  is  
 (a)  $\text{C}_6\text{H}_5\text{NH}_2 < \text{C}_2\text{H}_5\text{NHCH}_3 < \text{C}_2\text{H}_5\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH}$   
 (b)  $\text{C}_6\text{H}_5\text{NH}_2 < \text{C}_2\text{H}_5\text{NH}_2 < \text{C}_2\text{H}_5\text{NHCH}_3 < (\text{C}_2\text{H}_5)_2\text{NH}$   
 (c)  $\text{C}_2\text{H}_5\text{NH}_2 < \text{C}_6\text{H}_5\text{NH}_2 < \text{C}_2\text{H}_5\text{NHCH}_3 < (\text{C}_2\text{H}_5)_2\text{NH}$   
 (d)  $\text{C}_2\text{H}_5\text{NHCH}_3 < \text{C}_6\text{H}_5\text{NH}_2 < \text{C}_2\text{H}_5\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH}$
98. Which of the following changes does not involve any electron transfer?  
 (a)  $\text{Na} \rightarrow \text{Na}^+$  (b)  $\text{Zn}^{2+} \rightarrow \text{Zn}$  (c)  $\text{Cr}_2\text{O}_7^{2-} \rightarrow \text{CrO}_4^{2-}$  (d)  $\text{VO}^{2+} \rightarrow \text{V}_2\text{O}_3$
99. Alkali metal hydrides follow the thermal stability order  
 (a)  $\text{LiH} < \text{NaH} < \text{KH} < \text{RbH}$  (b)  $\text{RbH} < \text{KH} < \text{NaH} < \text{LiH}$   
 (c)  $\text{NaH} < \text{LiH} < \text{KH} < \text{RbH}$  (d)  $\text{RbH} < \text{KH} < \text{LiH} < \text{NaH}$
100. The formulas of the following compounds respectively are Bleaching powder ; Quicklime; Plaster of Paris; Slaked lime  
 (a)  $\text{CaO}$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{Ca}(\text{OCl})_2$ ,  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$   
 (b)  $\text{Ca}(\text{OCl})_2$ ,  $\text{CaO}$ ,  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ ,  $\text{Ca}(\text{OH})_2$   
 (c)  $\text{Ca}(\text{OCl})_2$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ ,  $\text{CaO}$   
 (d)  $\text{Ca}(\text{OH})_2$ ,  $\text{CaO}$ ,  $\text{Ca}(\text{OCl})_2$ ,  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$

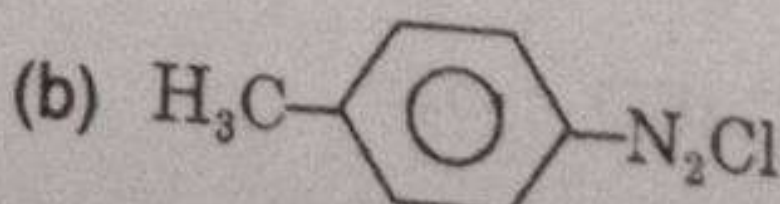
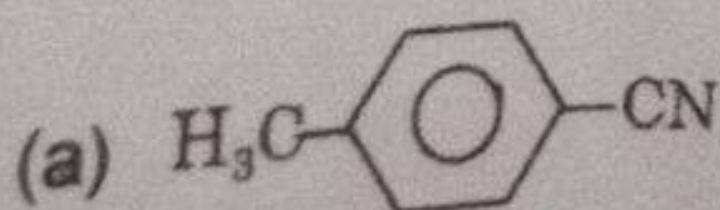
101. If steam is passed over red hot coke  
 (a)  $\text{CO}_2$  and  $\text{H}_2$  are produced  
 (b)  $\text{CO}$  and  $\text{N}_2$  are produced  
 (c)  $\text{CO}$  and  $\text{H}_2$  are produced  
 (d)  $\text{CH}_3\text{COOH}$  is produced
102. The widely used method for desalination of sea water to meet the requirement of potable water is  
 (a) Osmosis  
 (b) Reverse osmosis  
 (c) Filtration  
 (d) Precipitation
103. Hydrolysis of ester is a first order reaction. For this reaction, the correct statement is  
 (a) the rate depends only on concentration of water  
 (b) the amount of ester present in the reaction mixture is very high  
 (c) the amount of water present in the reaction mixture is very high  
 (d) the rate is proportional to the square root of concentration of both
104. The number of peptide bond, present in a tetrapeptide is  
 (a) 2  
 (b) 3  
 (c) 4  
 (d) 5
105. A metal crystallizes with face centred cubic lattice. The edge of the unit cell is 408 pm. The diameter of the metal atom is  
 (a) 288 pm  
 (b) 408 pm  
 (c) 144 pm  
 (d) 204 pm
106. A 0.0020 m aqueous solution of an ionic compound freezes at  $-0.00732^\circ\text{C}$ . Number of moles of ions which one mole of the ionic compound produces on being dissolved in water will be ( $K_f = 1.86 \text{ K kg mol}^{-1}$ )  
 (a) 3  
 (b) 4  
 (c) 1  
 (d) 2
107. The product obtained for the following reaction is

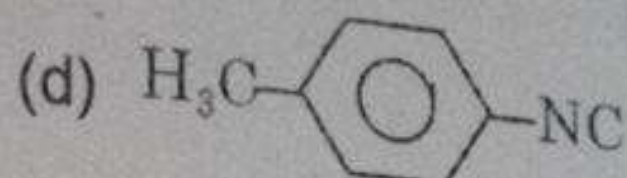
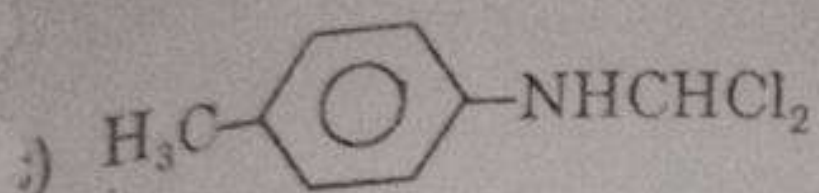


108. Acetaldehyde, upon treated with dil.  $\text{NaOH}$  forms



109. The reaction of chloroform with alcoholic  $\text{KOH}$  and p-toluidine forms





The base present in RNA, but not in DNA is

- (a) Uracil (b) Thymine (c) Cytosine (d) Guanine

111. PHBV is formed by the polymerization of

- (a) 3-hydroxybutanoic acid and 3-hydroxypentanoic acid  
 (b) 3-hydroxybutanoic acid  
 (c) 3-hydroxypentanoic acid  
 (d) Glycollic acid and lactic acid

112. The most common method, used for extraction of metals from oxide ores involves

- (a) reduction with hydrogen (b) reduction with aluminium  
 (c) reduction with carbon (d) electrolytic method

113. Anomalous behaviour of nitrogen is due to

- (a) small size and high electronegativity  
 (b) non-availability of d-orbitals in valency shells  
 (c) ease of multiple bond formation  
 (d) all of the above

114. When one Faraday of electricity is passed through  $\text{CuSO}_4$  solution, number of atoms formed at cathode will be

- (a)  $6.02 \times 10^{23}$  (b)  $3.01 \times 10^{23}$  (c) 2 (d)  $6.02 \times 10^{-23}$

115. The rate constant for the reaction  $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$  is  $3.0 \times 10^{-4} \text{ s}^{-1}$ . If the rate is  $2.4 \times 10^{-5} \text{ mol l}^{-1} \text{ s}^{-1}$  at room temperature, then the concentration of  $\text{N}_2\text{O}_5$  in  $\text{mol l}^{-1}$  is

- (a) 1.4 (b) 1.2 (c) 0.02 (d) 0.08

116. Among the electrolytes  $\text{Na}_2\text{SO}_4$ ,  $\text{CaCl}_2$ ,  $\text{Al}_2(\text{SO}_4)_3$  and  $\text{NH}_4\text{Cl}$ , the most effective coagulating agent for  $\text{Sb}_2\text{S}_3$  sol is

- (a)  $\text{Na}_2\text{SO}_4$  (b)  $\text{CaCl}_2$  (c)  $\text{Al}_2(\text{SO}_4)_3$  (d)  $\text{NH}_4\text{Cl}$

117. The set of quantum numbers representing the highest energy of an atom is

- (a)  $n = 3, l = 2, m = 1, s = +\frac{1}{2}$  (b)  $n = 3, l = 1, m = 1, s = +\frac{1}{2}$   
 (c)  $n = 4, l = 0, m = 0, s = +\frac{1}{2}$  (d)  $n = 3, l = 0, m = 0, s = +\frac{1}{2}$

118. The ion that is isoelectronic with CO is

- (a)  $\text{O}_2^-$  (b)  $\text{N}_2^+$  (c)  $\text{CN}^-$  (d)  $\text{O}_2^+$

119. The liquid having maximum surface tension is

- (a)  $\text{CH}_3\text{OH}$  (b)  $\text{C}_2\text{H}_5\text{OH}$  (c)  $\text{C}_6\text{H}_6$  (d)  $\text{H}_2\text{O}$

120. The bond dissociation enthalpy of gaseous  $\text{H}_2$ ,  $\text{Cl}_2$  and  $\text{HCl}$  are 435, 243 and 431  $\text{kJ mol}^{-1}$  respectively. In the same unit, enthalpy of formation of  $\text{HCl}$  gas is

- (a) -92 (b) -184 (c) +92 (d) +184