

JELET-2024
MATHEMATICS
Category-I (Q 1 to 30)

(Carry 1 mark each. Only one option is correct. Negative marks : - ¼)

1. If A and B are real orthogonal matrices of same order and $\det(A) + \det(B) = 0$, then A + B is

- (A) a singular matrix. (B) a symmetric matrix.
(C) an orthogonal matrix. (D) $(A + B)^{-1}$ exists.

2. For the matrix $A = \begin{pmatrix} 1 & 0 & 3 \\ 4 & -1 & 5 \\ 2 & 0 & 6 \end{pmatrix}$, which of the following is correct ?

- (A) rank A = 0 (B) rank A = 1
(C) rank A = 2 (D) rank A = 3

3. If $A = \begin{pmatrix} 3 & -4 \\ 1 & -1 \end{pmatrix}$, then A^K (where K is any positive integer) is

- (A) $\begin{pmatrix} 1+2K & -4K \\ K & 1-2K \end{pmatrix}$ (B) $\begin{pmatrix} 1+2K & -4K \\ K & 1-3K \end{pmatrix}$
(C) $\begin{pmatrix} 1+K^2 & -4K^2 \\ K^2 & 1-3K^2 \end{pmatrix}$ (D) $\begin{pmatrix} K & 0 \\ 0 & K \end{pmatrix}$

4. If $p\lambda^4 + q\lambda^3 + r\lambda^2 + s\lambda + t = \begin{vmatrix} \lambda^2 + 3\lambda & \lambda - 1 & \lambda + 3 \\ \lambda + 1 & 2 - \lambda & \lambda - 3 \\ \lambda - 3 & \lambda + 4 & 3\lambda \end{vmatrix}$, then t =

- (A) 33 (B) 22
(C) 21 (D) -33



5. If $\Delta_1 = \begin{vmatrix} x & b & b \\ a & x & b \\ a & a & x \end{vmatrix}$ and $\Delta_2 = \begin{vmatrix} x & b \\ a & x \end{vmatrix}$ are the given determinants, then

- (A) $\Delta_1 = 3(\Delta_2)^2$ (B) $\frac{d}{dx}(\Delta_1) = 3\Delta_2$
 (C) $\frac{d}{dx}(\Delta_1) = 3(\Delta_2)^2$ (D) $\Delta_1 = 3(\Delta_2)^4$

6. If $\begin{vmatrix} a^2 & bc & ac+c^2 \\ a^2+ab & b^2 & ac \\ ab & b^2+bc & c^2 \end{vmatrix} = Ka^2b^2c^2$

Where a, b, c are real numbers, then K =

- (A) 2 (B) 4
 (C) 8 (D) 16

7. If $x = e^{i\theta}$ and $y = e^{i\phi}$, then the value of $\frac{x^m}{y^n} + \frac{y^n}{x^m}$, where m, n are integers is

- (A) $2 \cos(m\phi - n\theta)$ (B) $2 \cos(m\theta - n\phi)$
 (C) $2 \cos(m - n)\theta$ (D) $2 \cos(m - n)\phi$

8. If the ratio $\frac{Z-i}{Z-1}$ where Z represents a complex number, is purely imaginary,

then the point lies on

- (A) an ellipse (B) a circle
 (C) a hyperbola (D) a parabola

9. If the normal to the curve $xy = e^2$ at the point $\left(et_1, \frac{e}{t_1} \right)$ meets the curve again

at the point $\left(et_2, \frac{e}{t_2} \right)$, then which of the following is true ?

- (A) $(t_1 t_2)^2 + 1 = 0$ (B) $t_1^3 t_2 = -1$
 (C) $t_1^3 t_2 = 1$ (D) $(t_1 t_2)^2 - 1 = 0$



10. The length of the tangent drawn from any point on the circle $x^2 + y^2 + 2gx + 2fy + c = 0$ to the circle $x^2 + y^2 + 2gx + 2fy + c' = 0$, is

- (A) $(c - c')$ (B) $(c' - c)^{\frac{1}{2}}$
 (C) $(c - c')^{\frac{1}{2}}$ (D) $(c^2 + c'^2 - 2cc')^{\frac{1}{2}}$

11. If $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$, then the angle between the vectors \vec{A} and \vec{B} is,

- (A) π (B) $\frac{\pi}{2}$
 (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{4}$

12. Three vectors \vec{a} , \vec{b} , \vec{c} satisfy the condition $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, where $|\vec{a}| = 3$, $|\vec{b}| = 4$, $|\vec{c}| = 2$, then the value of $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$ is

- (A) $\frac{28}{3}$ (B) $-\frac{29}{2}$
 (C) $\frac{29}{2}$ (D) $\frac{26}{3}$

13. A particle acted on by constant forces $4\hat{i} + \hat{j} - 3\hat{k}$ and $3\hat{i} + \hat{j} - \hat{k}$ is displaced from the point $\hat{i} + 2\hat{j} + 3\hat{k}$ to the point $5\hat{i} + 4\hat{j} + \hat{k}$, then the work done by the forces is

- (A) 36 units (B) 40 units
 (C) 42 units (D) 60 units

14. The domain of the function $f(x) = \sin^{-1} \log_2 \left(\frac{x^2}{2} \right)$ is

- (A) $[-2, -1] \cup [1, 2]$ (B) $[-\sqrt{2}, -1] \cup [1, 2]$
 (C) $[-\sqrt{2}, -1] \cup [1, \sqrt{2}]$ (D) $[-2, -1] \cup [1, \sqrt{2}]$



15. If $f'(a)$ exist then $\lim_{h \rightarrow 0} \frac{f(a+h) - f(a-h)}{h}$ is equal to
 (A) $f(a)$ (B) $f'(a)$
 (C) $2f'(a)$ (D) $f(a) + f'(a)$
16. The value of $f(\pi)$ for which $f(x) = \frac{1 - \cos 7(x - \pi)}{x - \pi}$ is continuous is
 (A) 7 (B) $\frac{7}{2}$
 (C) -7 (D) 0
17. Let $f: [a, b] \rightarrow \mathbb{R}$ be a continuous function on $[a, b]$ and f is differentiable on (a, b) . If $f'(x) = 0$, for all $x \in (a, b)$, then which of the following is correct?
 (A) $f(x) = kx$, for some constant k and for all $x \in [a, b]$.
 (B) $f(x) = \text{constant}$, for all $x \in [a, b]$.
 (C) $f(x) = kx^2$, for some constant k and for all $x \in [a, b]$.
 (D) None of the above
18. The function $f(x) = 2 \log_e(x - 2) - x^2 + 4x + 1$, increases in the interval.
 (A) (1, 2) (B) (2, 3)
 (C) (1, 4) (D) (2, 4)
19. The maximum value of xy subject to the condition $3x + 4y = 5$, is
 (A) $\frac{26}{48}$ (B) $\frac{25}{48}$
 (C) $\frac{24}{48}$ (D) $\frac{23}{48}$
20. If $u = \tan^{-1} \frac{x^3 + y^3}{x - y}$, then
 (A) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \sin 2u$ (B) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \cos 2u$
 (C) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 2 \tan u$ (D) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 2 \cot u$



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21. If $u(x, y, z) = \log(x^3 + y^3 + z^3 - 3xyz)$, then $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$ is equal to

- (A) 0
 (B) $\frac{1}{x+y+z}$
 (C) $\frac{3}{x+y+z}$
 (D) $-\frac{3}{(x+y+z)^2}$

22. The value of $\int_{-1}^1 (|x| + e^{|x|}) dx$ is

- (A) $2(e-1)$
 (B) $2(e+1)$
 (C) $2e-1$
 (D) $2e+1$

23. If $\int \frac{\cos 4x + 1}{\cot x - \tan x} dx = k \cos 4x + c$, then $k =$

- (A) $-\frac{1}{2}$
 (B) $\frac{1}{2}$
 (C) $\frac{1}{4}$
 (D) $-\frac{1}{8}$

24. The value of $\int_0^{\pi/2} \frac{dx}{1 + \tan^3 x}$ is

- (A) 0
 (B) 1
 (C) $\frac{\pi}{2}$
 (D) $\frac{\pi}{4}$

25. The area in the first quadrant bounded by the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$, is

- (A) 2π sq. unit
 (B) 3π sq. unit
 (C) 4π sq. unit
 (D) 5π sq. unit



26. The equation of the curve passing through $\left(\frac{\pi}{2}, 1\right)$ and having slope $\frac{\sin x}{x^2} - \frac{2y}{x}$ at each point (x, y) with $x \neq 0$, is

(A) $-x^2y + \cos x = -\frac{\pi^2}{4}$

(B) $x^2y + \cos x = \frac{\pi^2}{4}$

(C) $x^2y - \sin x = \frac{\pi^2}{4} - 1$

(D) $x^2y + \sin x = \frac{\pi^2}{4} + 1$

27. The transformation $x = e^t$ reduces the differential equation

$x^2 \frac{d^2}{dx^2} y(x) - 2x \frac{d}{dx} y(x) + 2y(x) = x^3$ to $a \frac{d^2}{dt^2} y(t) + b \frac{d}{dt} y(t) + cy(t) = e^{3t}$, where a, b, c are

(A) $a = 1, b = -3, c = 2$

(B) $a = -1, b = 3, c = -2$

(C) $a = 1, b = 4, c = 3$

(D) $a = -1, b = -3, c = -2$

28. The solution of the differential equation $\frac{dy}{dx} = -\frac{x}{y}$, where $y(4) = 3$ is

(A) a circle

(B) a straight line

(C) an ellipse

(D) a parabola

29. A fair coin is tossed twice. The probability of getting at least one head is

(A) $\frac{1}{3}$

(B) $\frac{1}{4}$

(C) $\frac{3}{4}$

(D) 1

30. If $P(A) = P(B) = \frac{1}{2}$ and $P(A^c \cap B^c) = \frac{1}{3}$, then the value of $P(A^c \cup B^c)$ is

(A) $\frac{1}{3}$

(B) $\frac{2}{3}$

(C) 1

(D) $\frac{3}{4}$



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MATHEMATICS

Category-II (Q 31 to 40)

(Carry 2 mark each. One or more options are correct. No negative marks)

31. Consider two square matrices A and B such that $A^2 = A$ and $A + B = I$, where I is the identity matrix, then which of the following is/are true ?

- (A) $B^2 = B$
- (B) $AB = \theta$
- (C) $BA = \theta$
- ✓(D) only (A) and (B) are correct but (C) is false.

Where θ is the null matrix.

32. If the elements of a 3×3 matrix A are polynomial of x and if for $x = a$, three rows become identical then.

- (A) $(x - a)$ is a factor of $\det(A)$.
- ✓(B) $(x - a)^2$ is a factor of $\det(A)$.
- ✓(C) $(x - a)^3$ is a factor of $\det(A)$.
- (D) $(x - a)$ is not a factor of $\det(A)$.

33. Suppose Z is a complex number and \bar{Z} is the complex conjugate of Z. Then the values of $|Z|$ satisfying $iZ^2 - \bar{Z} = 0$ are

- (A) 0
- (B) 1
- ✓(C) 2
- (D) 3 or 4

34. Which of the following is/are a rectangular hyperbola ?

- ✓(A) $xy = c^2$
- (B) $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$
- (C) $\frac{x^2}{b^2} - \frac{y^2}{a^2} = 1$
- (D) $x^2 - y^2 = c^2$

35. The value of $[\vec{a} \times \vec{b} \quad \vec{b} \times \vec{c} \quad \vec{c} \times \vec{a}]$ is

- (A) $2[\vec{a} \quad \vec{b} \quad \vec{c}]$
- (B) $2[\vec{a} \quad \vec{b} \quad \vec{c}]^2$
- (C) $[\vec{a} \quad \vec{b} \quad \vec{c}]^2$
- ✓(D) 0 if $\vec{a}, \vec{b}, \vec{c}$ are coplanar.

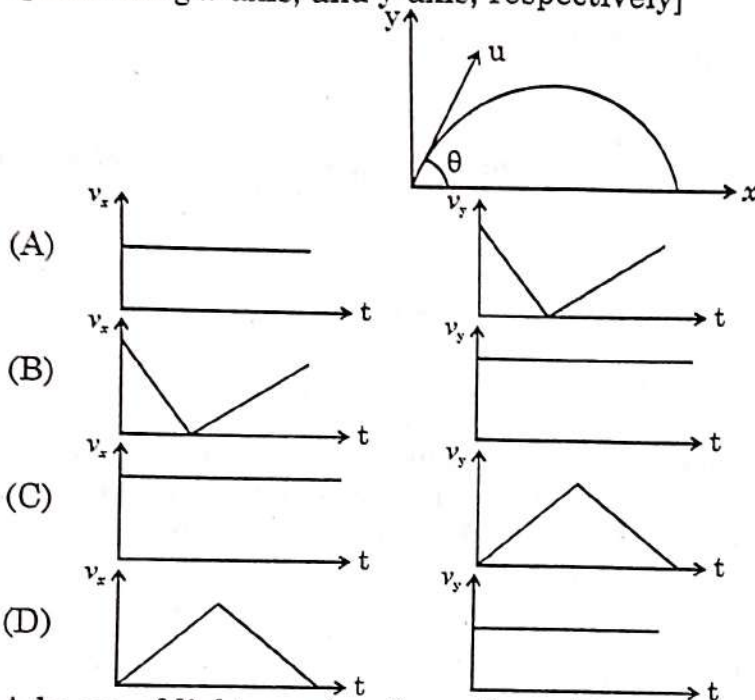


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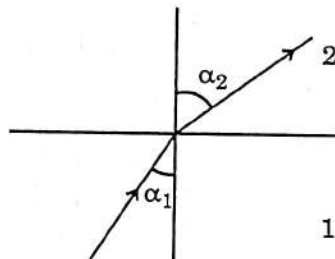
PHYSICS

Category-I (Q. 41 to 65)

41. (Carry 1 mark each. Only one option is correct. Negative marks : -¼)
 If velocity, time and force were chosen as basic quantities, then the dimension of mass will be
 (A) FT^2V^{-2} (B) FTV^{-1}
 (C) $F^2T^{-2}V^2$ (D) FTV
42. A particle is thrown with initial speed u at an angle θ with the horizontal line. It follows a parabolic path as shown in the figure. Which of the following represents the speed-time graphs [v_x and v_y are the speed along x-axis, and y-axis, respectively]



43. A beam of light moving through medium 1 is refracted in another medium 2 as shown in figure.

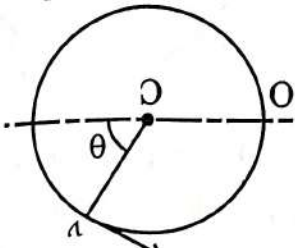


If the wavelength of the light in medium 1 is λ_1 and in medium 2 is λ_2 then

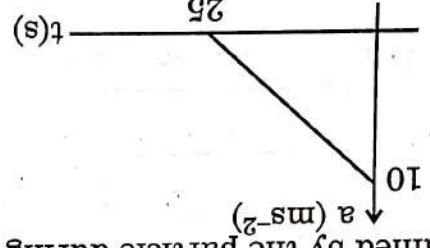
- (A) $\lambda_1 = \lambda_2$ (B) $\lambda_2 = \frac{\sin \alpha_2}{\sin \alpha_1} \lambda_1$
 (C) $\lambda_2 = \frac{\sin \alpha_1}{\sin \alpha_2} \lambda_1$ (D) $\lambda_2 = \frac{\cos \alpha_2}{\cos \alpha_1} \lambda_1$



44. A load of 4 kg is suspended from a ceiling through a steel wire of radius 2 mm. The tensile stress developed in the wire when equilibrium is achieved will be
 (A) $3.1 \times 10^6 \text{ Nm}^{-2}$
 (B) $2.8 \times 10^4 \text{ Nm}^{-2}$
 (C) $6.8 \times 10^8 \text{ Nm}^{-2}$
 (D) $9.8 \times 10^3 \text{ Nm}^{-2}$
 (Assume $g = 3.1\pi \text{ ms}^{-2}$)

45. A particle moves with constant speed v along a circle of radius R .

 If the angular momentum of the particle about centre C is L_c and about point O is L_o , then $\frac{L_o}{L_c}$ is
 (A) $\cos^2 \theta$
 (B) $1 + \cos \theta$
 (C) $\cos^2 \frac{\theta}{2}$
 (D) 1

46. A particle starts moving from rest in a straight line with acceleration a . The variation of acceleration vs. time graph is given below in the figure. The maximum velocity attained by the particle during the motion is



- (A) 225 ms^{-1}
 (B) 120 ms^{-1}
 (C) 100 ms^{-1}
 (D) 125 ms^{-1}

47. A drilling machine of power 'P' is used to drill a hole in a metal block of mass 'M' and specific heat 's' $\text{J kg}^{-1} \text{ } ^\circ\text{C}^{-1}$. If 20% of the power is lost due to heating of the machine, the rise in temperature of the block (in $^\circ\text{C}$) in 't' seconds will be

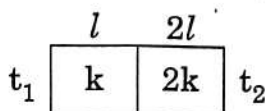
- (A) $\frac{0.4Pt}{Ms}$
 (B) $\frac{0.8Pt}{Ms}$
 (C) $\frac{0.8P}{Ms t}$
 (D) $\frac{0.2Pt}{Ms}$



48. Suppose same liquid is heated in two vessels A and B having coefficient of linear expansion α_A and α_B respectively. If co-efficient of apparent expansion of liquid in two vessels are γ_A^a and γ_B^a and if $\alpha_A > \alpha_B$ then

- (A) $\gamma_A^a > \gamma_B^a$ (B) $\gamma_A^a < \gamma_B^a$
 (C) $\gamma_A^a = \gamma_B^a$ (D) None of these

49. A metal rod consists of two parts of equal cross-section A, but length of one is l and that of the other is $2l$ and their thermal conductivities are respectively k and $2k$, as shown in the figure. The temperatures at the two ends of the rod and t_1 and t_2 ($t_1 > t_2$) as shown. What is the heat current at the steady state ?



- (A) $\frac{3kA(t_2 - t_1)}{2l}$ (B) $\frac{2kA(t_1 - t_2)}{l}$
 (C) $\frac{kA}{l}(t_1 - t_2)$ (D) $\frac{kA(t_1 - t_2)}{3l}$

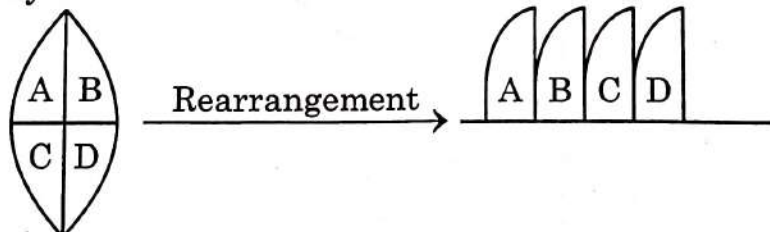
50. An Eye specialist prescribed spectacles of power +1.5 D to a patient of hypermetropic eye. What is the near point of his defective eye ?

- (A) 40 cm (B) 30 cm
 (C) 50 cm (D) 15 cm

51. The thermal conductivity of a rod depends on

- (A) length (B) mass
 (C) area of cross-section (D) material of the rod

52. An equiconvex lens of focal length f is broken into four parts and then rearranged as shown in the figure. After rearrangement, the equivalent focal length lens system is



- (A) $\frac{f}{2}$ (B) f
 (C) $\frac{f}{4}$ (D) $4f$



56. A solid cylinder of height H , radius R and density ρ , floats vertically on the surface of a liquid of density σ . The cylinder will be set into oscillatory motion by applying a small downward instantaneous force on it. The frequency of this small oscillation is

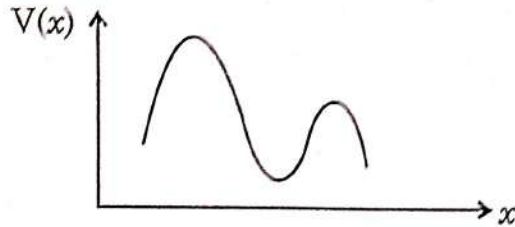
(A) $\omega = \sqrt{\frac{\sigma g}{\rho H}}$

(B) $\omega = \sqrt{\frac{\rho g}{\sigma H}}$

(C) $\omega = \sqrt{\frac{\sigma g}{\rho R}}$

(D) $\omega = \sqrt{\frac{\rho g}{\sigma R}}$

57. The figure shows the variation of potential energy $V(x)$ of a particle with distance x . The particle has



(A) Two equilibrium points, one stable and another unstable.

(B) Two equilibrium points, both stable.

(C) Three equilibrium points, one stable, two unstable.

(D) Three equilibrium points, two stable, one unstable.

58. The radius of the earth is approximately 6400 km. The height at which the acceleration due to gravity differs from g (acceleration due to gravity at the Earth's surface) by approximately 2% is

(A) 62.5 km

(B) 63.9 km

(C) 64.2 km

(D) 65.3 km

59. Two satellites S_1 and S_2 revolve round a planet in coplanar circular orbits in the same sense. Their periods of revolution are 1h and 8h, respectively. The radius of the orbit of S_1 is 10^4 km. When S_2 is closest to S_1 then the angular speed of S_2 as observed by an astronaut in S_1 is

(A) $\frac{\pi}{2}$ rad/h

(B) $\frac{\pi}{4}$ rad h^{-1}

(C) $\frac{\pi}{3}$ rad h^{-1}

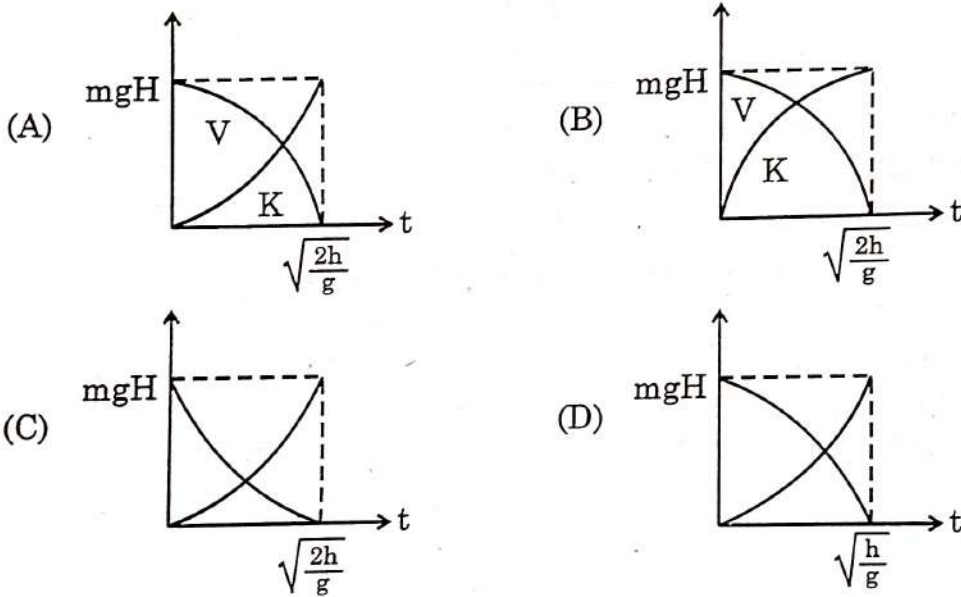
(D) π rad h^{-1}



60. A man standing on a road has to hold his umbrella at 30° with the vertical to keep the rain away. He throws the umbrella and starts running at 10 km/h. He finds that rain drops are hitting his head vertically. The speed of rain drops with respect to the road (V_{rg}) and the moving man (V_{rm}) are respectively.

- (A) $V_{rg} = 20 \text{ km/h}$, $V_{rm} = 10\sqrt{3} \text{ km/h}$
- (B) $V_{rg} = 10 \text{ km/h}$, $V_{rm} = 20 \text{ km/h}$
- (C) $V_{rg} = 10\sqrt{3} \text{ km/h}$, $V_{rm} = 20\sqrt{3} \text{ km/h}$
- (D) $V_{rg} = 10 \text{ km/h}$, $V_{rm} = 20\sqrt{3} \text{ km/h}$

61. A particle of mass m is falling freely under gravity from height H from rest. The variations of its potential energy (V) and kinetic energy (K) as a function of time (t) is



62. A particle is moving in a X-Y plane where X and Y coordinates are time dependent as follows :

$$X(t) = At^4 + Bt \text{ and } Y(t) = Ct^3 + D$$

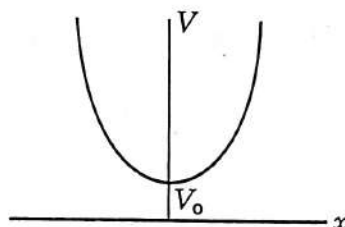
(Here $A = 1.00 \text{ m/s}^4$, $B = -2.00 \text{ m/s}$, $C = 2.00 \text{ m/s}^3$ and $D = 10 \text{ m}$). The position of the particle at $t = 2 \text{ sec}$ is

- (A) $(10 \text{ m})\hat{i} + (12 \text{ m})\hat{j}$
- (B) $(-5 \text{ m})\hat{i} + 15 \text{ m}\hat{j}$
- (C) $(-10 \text{ m})\hat{i} + (15 \text{ m})\hat{j}$
- (D) $(12 \text{ m})\hat{i} + (26 \text{ m})\hat{j}$



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63. A body of mass m is lifted up from the earth surface to a height R . The potential energy of the body with respect to the earth surface is [Assume acceleration due to gravity on earth surface is g_0]
- (A) mg_0R (B) $\frac{mg_0R}{2}$
 (C) $-\frac{mg_0R}{2}$ (D) $-mg_0R$
64. The mass of the bob of a simple pendulum (amplitude is small enough) is made doubled. Then the time period of the pendulum will be
 (A) Doubled (B) Four times of the original one
 (C) half of the original one (D) no change of time period
65. The dependence of the potential energy (V) of a particle on its displacement (x) is given in figure



The force (F) acting on the particle is

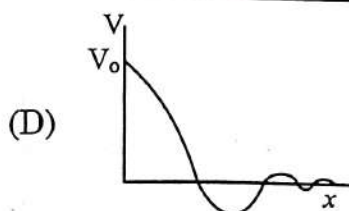
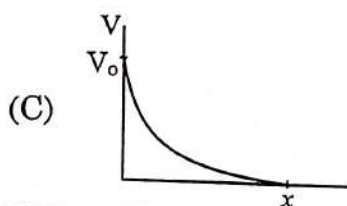
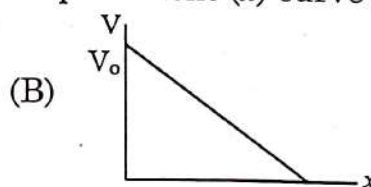
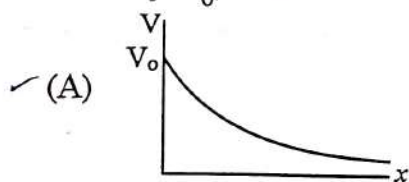
- (A) $F = -kx$
 (B) $F = +kx$
 (C) $F = -kx^2$
 (D) $F = -kx + F_0$, where F_0 is a constant depending on V_0 .
 (k is a constant)

PHYSICS

Category-II (Q 66 to 70)

(Carry 2 mark each. One or more options are correct. No negative marks)

66. A particle of mass m is moving along x -axis in a medium where the retarding force is proportional to its velocity. If the particle starts with an initial velocity V_0 , then velocity (V) versus displacement (x) curve will look like



CHEMISTRY

Category-I (Q 71 to 85)

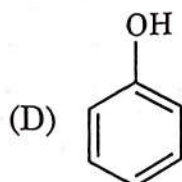
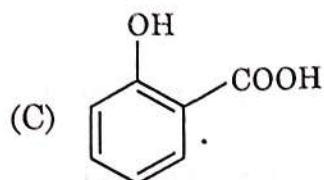
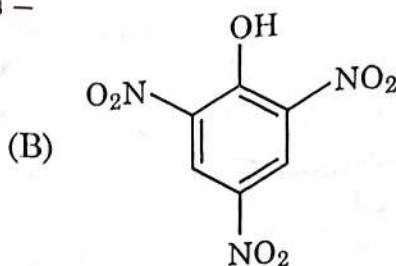
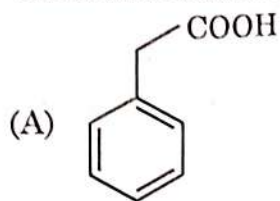
(Carry 1 mark each. Only one option is correct. Negative marks : - ¼)

71. The number of atoms in 52 gm of 'He' are
(A) 78.299×10^{24} (B) 7.82×10^{23}
(C) 7.829×10^{24} (D) 7.829×10^{22}
72. Which of the following explains the sequence of filling the electrons in different shells ?
(A) Aufbau principle (B) Pauli's exclusion principle
(C) Hund's rule (D) All of these
73. Radius of 1st Bohr orbit of 'H' is 0.529 \AA . The most probable radius (in pm) for finding the electron in He^+ is
(A) 0.0265 (B) 52.9
(C) 26.5 (D) 105.8
74. The edge length of NaCl crystal unit cell is 508 pm. If radius of Na^+ is 110 pm, the radius of Cl^- is
(A) 288 pm (B) 398 pm
(C) 144 pm (D) 618 pm
75. How many electrons are delivered at the cathode during electrolysis by a current of 1 A in 10 minutes. (charge of electron = $1.6 \times 10^{-19} \text{ C}$)
(A) 3.75×10^{21} (B) 3.75×10^{20}
(C) 7.50×10^{21} (D) 6.0×10^{23}
76. Phenol is treated with Bromine water : Choose the correct statement.
(A) Ortho-bromophenol is produced as major product.
(B) Para-bromophenol is produced as major product.
(C) 2, 4, 6 - tribromophenol is precipitated and reaction requires Fe/FeBr_3 as catalyst.
(D) 2, 4, 6 - tribromophenol is precipitated and reaction does not require any catalyst.
77. Number of stereoisomers of 2, 3-dibromobutane is
(A) 2 (B) 3
(C) 4 (D) 5

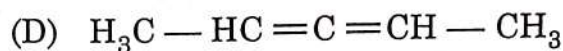
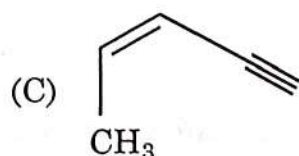
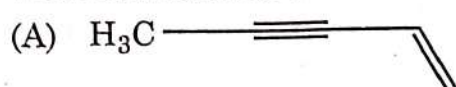


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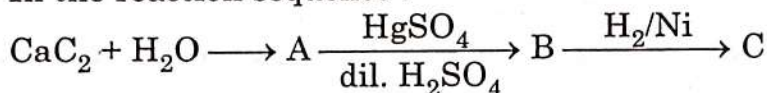
78. Chemical formula of carboic acid is -



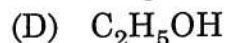
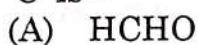
79. Which of the following compounds will give white precipitate when treated with ammoniacal silver nitrate solution?



80. In the reaction sequence :



'C' is -



81. The solubility of $BaSO_4$ in water is 2.33×10^{-3} gram/litre. Its solubility product will be (Mol. wt. of $BaSO_4 = 233$)

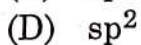
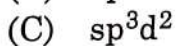
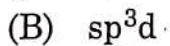
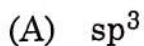
(A) 5.43×10^{-6}

(B) 1×10^{-10}

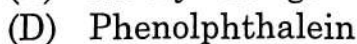
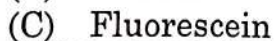
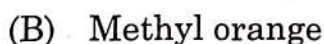
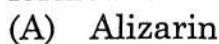
(C) 1×10^{-5}

(D) 1×10^{-20}

82. What is the hybridization of S in SF_4 ?



83. Phenol is allowed to react with phthalic anhydride in presence of H_2SO_4 and finally the reaction mixture is made alkaline with NaOH. The product formed is -



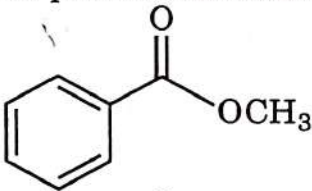
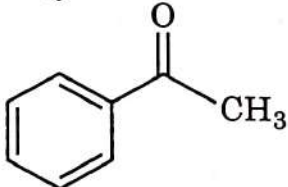
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84. Which of the following molecules have one lone pair of electrons ?
(A) SO_2 (B) XeF_2
(C) SiF_4 (D) H_2S
85. Smallest internuclear distance is found in
(A) O_2 (B) O_2^+
(C) O_2^- (D) O_2^{2-}

CHEMISTRY

Category-II (Q 86 to 90)

(Carry 2 mark each. One or more option are correct. No negative marks)

86. Correct statement(s) w.r.t. H_3BO_3 is/are
(A) It is a monobasic acid.
(B) It is a tribasic acid.
(C) It is a strong acid.
(D) It is a strong acid in presence of glycerol.
87. Which of the following species have linear geometry ?
(A) O_3 (B) N_3^\ominus
(C) I_3^\ominus (D) CO_2
88. Which of the following compounds will liberate hydrogen gas, when reacted with sodium metal ?
(A) Dimethyl ether (B) Methanol
(C) Propanoic acid (D) Methyl propanoate
89. Which of the following compounds will give positive iodoform test ?
- (A) CH_3OH (B) 
- (C) $\text{CH}_3\text{CH}_2\text{OH}$ (D) 
90. An organic saturated alcohol is optically active. Its IUPAC nomenclature may be
(A) 2-butanol (B) 2-methyl-2-butanol
(C) 3-methyl-2-butanol (D) 3-pentanol

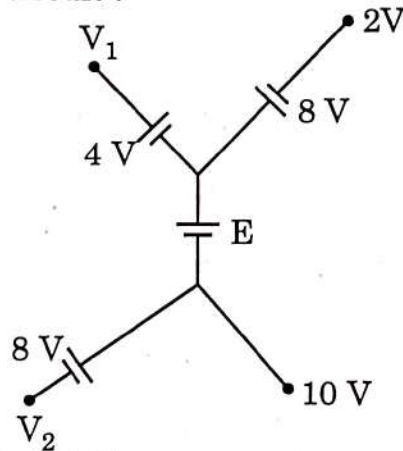


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**Fundamentals of Electrical & Electronics Engineering
Category-I (Q 91 to 100)**

(Carry 1 mark each. Only one option is correct. Negative marks: $-\frac{1}{4}$)

91. The cross-sectional area of the coil of a PMMC instrument with a spring constant of 0.28×10^{-6} Nm/rad is 7.2×10^{-4} m². The air gap flux density is 3.6 m Wb/m². The number of turns required to produce a deflection of 60° when a current of 10 mA flows through the coil would be
 (A) 136 (B) 44
 (C) 22 (D) 11
92. The leakage flux in a transformer depends on
 (A) applied voltage (B) load current
 (C) frequency (D) mutual flux
93. A single phase IM with identical main and auxiliary windings can be made self-starting by connecting.
 (A) a capacitor in series with the main winding.
 (B) a capacitor in series with the auxiliary winding.
 (C) a capacitor across the supply terminals.
 (D) the main and auxiliary winding in series.
94. Consider the following circuit :



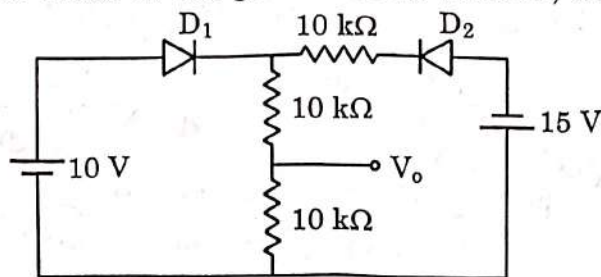
The node voltage V_1 , V_2 and E are respectively :

- (A) $V_1 = -14$ V, $V_2 = 18$ V, $E = -2$ V
 (B) $V_1 = +14$ V, $V_2 = -2$ V, $E = -2$ V
 (C) $V_1 = +14$ V, $V_2 = 2$ V, $E = 0$ V
 (D) $V_1 = -14$ V, $V_2 = -2$ V, $E = 0$ V
95. The voltage $V = 5 \cos(40 t + 60^\circ)$, is applied to a 0.5 H inductor. The steady state current through the inductor is
 (A) $i(t) = 4 \sin(40 t + 60^\circ)$ A (B) $i(t) = 0.25 \cos(40 t + 30^\circ)$ A
 (C) $i(t) = 0.25 \cos(40 t - 30^\circ)$ A (D) $i(t) = 0.25 \cos(wt + 60^\circ)$ A



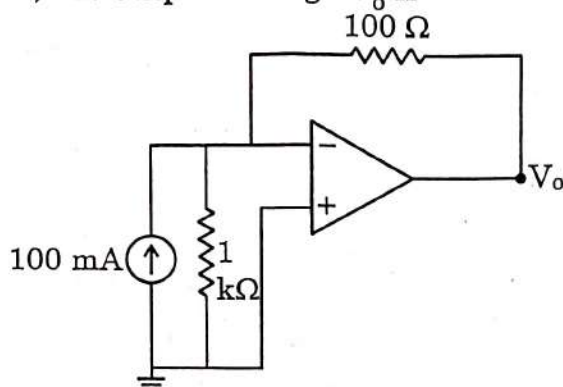
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96. Assuming that the diode in the given circuit is ideal, the voltage V_o is



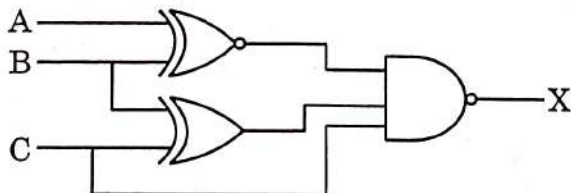
- (A) 4 V
(B) 5 V
(C) 7.5 V
(D) 12.1 V

97. In the circuit shown, the output voltage V_o is



- (A) -9 V
(B) -10 V
(C) +10 V
(D) +9 V

98. For the logic circuit shown, the required input condition (A, B, C) to make the output $X = 0$ is ?



- (A) 1, 1, 1
(B) 1, 0, 1
(C) 0, 1, 1
(D) 0, 0, 1

99. The phase angle between $v_1 = -10 \cos (wt + 40^\circ)$ and $v_2 = 8 \sin (wt - 20^\circ)$ is

- (A) 30°
(B) 60°
(C) -60°
(D) 20°

100. A DC motor develops a torque of 120 Nm at 20 rps. At 30 rps, the torque developed by the motor is

- (A) 160 Nm
(B) 120 Nm
(C) 80 Nm
(D) 40 Nm

