ICON Educational Institutions
JEE (Mains & Advanced) & NEET

Max Marks: 300 | **JR_WEEK-8 (03-08-2026)** | Time: 180 mins

Chemistry

1. Match List-I Molecule with List-II Shape.

List-I Molecule	List-II Shape
(A) BrF_5	(I) T-shape
(B) H_2O	(II) See saw
(C) ClF_3	(III) Bent
(D) SF_4	(IV) Square pyramidal

A) (A)-I, (B)-II, (C)-IV, (D)-III **B)** (A)-II, (B)-I, (C)-III, (D)-IV
C) (A)-III, (B)-IV, (C)-II, (D)-I **D)** (A)-IV, (B)-III, (C)-I, (D)-II

2. Match List I with List II:

List I	List II
A. XeF_4	I. See - saw
B. SF_4	II. Square planar
C. NH_4^+	III. Bent T– shaped
D. BrF_3	IV. Tetrahedral

Choose the correct answer from the options given below :

A) A-IV, B-III, C-II, D-I **B)** A-II, B-I, C-III, D-IV
C) A-IV, B-I, C-II, D-III **D)** A-II, B-I, C-IV, D-III

3. Match List I (molecules/ions) with List II (No. of lone pairs of e^- on central atom):

LIST-I (molecules/ions)	LIST-II (No. of lone pairs of e^- on central atom)
(A) IF_7	I. Three
(B) ICl_4^-	II. One
(C) XeF_6	III. Two
(D) XeF_2	IV. Zero

Choose the correct answer from the options given below :

A) A-II, B-III, C-IV, D-I **B)** A-IV, B-III, C-II, D-I
C) A-II, B-I, C-IV, D-III **D)** A-IV, B-I, C-II, D-III

4. Match list I with list II:

List I Species	List II Geometry/ Shape
A. H_3O^+	I. Tetrahedral
B. Acetylide anion	II. Linera
C. NH_4^+	III. Pyramidal
D. ClO_2^-	IV. Bent

Choose correct answer from the options given below:

A) A-III, B-IV, C-I, D-II **B)** A-III, B-IV, C-II, D-I
C) A-III, B-I, C-II, D-IV **D)** A-III, B-II, C-I, D-IV

5. Given below are two statements : Statement I: SO_2 and H_2O both possess V-shaped structure. Statement II: The bond angle of SO_2 is less than that of H_2O. In the light of the above statements, choose the most appropriate answer from the options given below :

A) Both Statements I and II are incorrect **B)** Both Statement I and II are correct
C) Statement I is correct but Statement II is incorrect **D)** Statement I is incorrect but Statement II is correct

6. Amongst SF_4, XeF_4, CF_4 and H_2O, the number of species with two lone pairs of electrons is:

A) 3 **B)** 2
C) 7 **D)** 1

7. Based upon VSEPR theory, match the shape (geometry) of the molecules in List-I with the molecules in List-II and select the most appropriate option.

	List - I (Shape)		List - II (Molecules)
(A)	T-shaped	(I)	XeF_{44}
(B)	Trigonal planar	(II)	SF_{44}
(C)	Square planar	(III)	ClF_{33}
(D)	See-saw	(IV)	BF_{33}

A) (A)-(I), (B)-(II), (C)-(III), (D)-(IV) **B)** (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
C) (A)-(III), (B)-(IV), (C)-(II), (D)-(I) **D)** (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

8. In the structure of SF_4, the lone pair of electrons on S is in:

A) equatorial position and there are two lone pair - bond pair repulsions at $90°$.

B) equatorial position and there are three lone pair - bond pair repulsions at $90°$.

C) axial position and there are three lone pair - bond pair repulsion at $90°$.

D) axial position and there are two lone pair - bond pair repulsion at $90°$.

9. Consider the species CH_4, NH_4^+ and BH_4^-. Choose the correct option with respect to these species.

A) They are isoelectronic and only two have tetrahedral structures.

B) They are isoelectronic and all have tetrahedral structures.

C) Only two are isoelectronic and all have tetrahedral structures.

D) Only two are isoelectronic and only two have tetrahedral structures.

10. The number of molecule(s) or ion(s) from the following having non-planar structure is:
$NO_3^-, H_2O_2, BF_3, PCl_3, XeF_4, SF_4, XeO_3, PH_4^+, SO_3, [Al(OH)_4]^-$
.

A) 6

B) 9

C) 1

D) 7

11. Consider $PF_5, BrF_5, PCl_3, SF_6, [ICl_4]^-, ClF_3$ and IF_5. Amongst the above molecule(s)/ion(s). The number of molecule(s)/ion(s) having sp^3d^2 hybridisation is:

A) 3

B) 8

C) 7

D) 4

12. The number of species below that have two lone pairs of electrons in their central atom is _____ (Round off to the nearest integer)
$SF_4, BF_4^-, ClF_3, AsF_3, PCl_5, BrF_5, XeF_4, SF_6$.

A) 3

B) 2

C) 7

D) 1

13. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A): The $H-O-H$ bond angle in water molecule is $104.5°$. Reason (R): The lone pair - lone pair repulsion of electrons is higher than the bond pair - bond pair repulsion.

A) A is false but R is true.

B) Both A and R are true, but R is not the correct explanation of A.

C) A is true but R is false.

D) Both A and R are true, and R is the correct explanation of A.

14. Match List-I with List-II:

List-I (Species)	List-II (Hybrid Orbitals)
(a) SF_4	(i) sp^3d^2
(b) IF_5	(ii) d^2sp^3
(c) NO_2^+	(iii) sp^3d
(d) NH_4^+	(iv) sp^3
	(v) sp

Choose the correct answer from the options given below :

A) (a)-(i), (b)-(ii), (c)-(v) and (d)-(iii)

B) (a)-(ii), (b)-(i), (c)-(iv) and (d)-(v)

C) (a)-(iii), (b)-(i), (c)-(v) and (d)-(iv)

D) (a)-(iv), (b)-(iii), (c)-(ii) and (d)-(v)

15. The hybridisations of the atomic orbitals of nitrogen inNO_2^-, NO_2^+ and NH_4^+ respectively are:

A) sp^3, sp^2 and sp

B) sp, sp^2 and sp^3

C) sp^3, sp and sp^2

D) sp^2, sp and sp^3

16. The shape/structure of $[XeF_5]^-$ and XeO_3F_2, respectively, are:

A) pentagonal planar and trigonal bipyramidal

B) octahedral and square pyramidal

C) trigonal bipyramidal and pentagonal planar

D) trigonal bipyramidal and trigonal bipyramidal

17. The structure of PCl_5 in the solid state is:

A) tetrahedral $[PCl_4]^+$ and octahedral $[PCl_6]^-$

B) square planar $[PCl_4]^+$ and octahedral $[PCl_6]^-$

C) square pyramidal

D) trigonal bipyramidal

18. The correct statement about ICl_5 and ICl_4^- is:

A) ICl_5 is sp^3d^2 hybridised (5bp, 1lp) and ICl_4^- is sp^3d^2 hybridised (4bp, 2lp).

B) ICl_5 is trigonal bipyramidal and ICl_4^- is tetrahedral.

C) ICl_5 is square pyramidal and ICl_4^- is tetrahedral.

D) ICl_5 is square pyramidal and ICl_4^- is square planar.

19. Which of the following conversions involves change in both shape and hybridisation?

A) $H_2O \rightarrow H_3O^+$

B) $BF_3 \rightarrow BF_4^-$

C) $CH_4 \rightarrow C_2H_6$

D) $NH_3 \rightarrow NH_4^+$

20. Identify the pair in which the geometry of the species is T-shape and square pyramidal, respectively:

A) ICl_2^- and ICl_5

B) IO_3^- and $IO_2F_2^-$

C) ClF_3 and IO_4^-

D) $XeOF_2$ and $XeOF_4$

21. The number of species from the following in which the central atom uses sp^3 hybrid orbitals in its bonding is:
$NH_3, SO_2, SiO_2, BeCl_2, CO_2, H_2O, CH_4, BF_3$.

22. Amongst the following, the number of species having the linear shape is:
$XeF_2, I_3^+, C_3O_2, I_3^-, CO_2, SO_2, BeCl_2, BCl_2^-$.

23. The number of species from the following which have square pyramidal structure is:
$PF_5, BrF_4^-, IF_5, BrF_5, XeOF_4, ICl_4^-$.

24. The maximum number of lone pairs of electrons on the central atom from the following species is:
ClO_3^-, XeF_4, SF_4 and I_3^-.

25. The number of species from the following carrying a single lone pair on central atom Xenon is:
$XeF_5^+, XeO_3, XeO_2F_2, XeF_5^-, XeO_3F_2, XeOF_4, XeF_4$
.

Maths

26. If A, B, C are matrices of order 1×3, 3×3 and 3×1 respectively, the order of ABC will be -

A) 3×3
B) 1×3
C) 1×1
D) 3×1

27. Matrix $A = \begin{bmatrix} 1 & -3 & -4 \\ -1 & 3 & 4 \\ 1 & -3 & -4 \end{bmatrix}$ is -

A) Involutory
B) idempotent
C) nilpotent
D) orthogonal

28. If A and B are any two square matrices of the same order, then

A) $(AB)' = A'B'$
B) $adj(AB) = adj(A)adj(B)$
C) $(AB)' = B'A'$
D) $AB = O \Rightarrow A = O \text{ or } B = O$

29. Let A and B be two non-singular square matrices, A^T and B^T are the transpose matrices of A and B respectively, then which of the following is correct

A) B^TAB is symmetric matrix if and only if A is symmetric
B) B^TAB is symmetric matrix if and only if B is symmetric
C) B^TAB is skew symmetric matrix for every matrix A
D) B^TAB is skew symmetric matrix if B is skew symmetric

30. If $A = [a_{ij}]_{4\times4}$ such that $a_{ij} = \begin{cases} 2, & \text{when } i = j \\ 0, & \text{when } i \neq j \end{cases}$, then $\left\{ \frac{\det(\operatorname{adj}(\operatorname{adj} A))}{7} \right\}$ is (where $\{.\}$ represents fractional part function)

A) $1/7$
B) $2/7$
C) $3/7$
D) $4/7$

31. If A and B are square matrices of order 3×3, where $|A| = 2$ and $|B| = 3$, then $|(A^{-1}) \cdot \operatorname{adj}(B^{-1}) \cdot \operatorname{adj}(2A^{-1})| =$

A) $8/9$
B) $7/9$
C) $2/3$
D) $5/3$

32. If $A = \begin{bmatrix} \cos\theta & \sin\theta \\ \sin\theta & -\cos\theta \end{bmatrix}$, $B = \begin{bmatrix} 1 & 0 \\ -1 & 1 \end{bmatrix}$, $C = ABA^T$, and A^TC^nA equals to $(n \in I^+)$, then

A) $\begin{bmatrix} -n & 1 \\ 1 & 0 \end{bmatrix}$
B) $\begin{bmatrix} 1 & -n \\ 0 & 1 \end{bmatrix}$
C) $\begin{bmatrix} 0 & 1 \\ 1 & -n \end{bmatrix}$
D) $\begin{bmatrix} 1 & 0 \\ -n & 1 \end{bmatrix}$

33. If $P = \begin{bmatrix} \frac{\sqrt{3}}{2} & \frac{1}{2} \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} \end{bmatrix}$ and $Q = PAP^T$, then $P^T(Q^{2005})P$ is equal to

A) $\begin{bmatrix} 1 & 2005 \\ 0 & 1 \end{bmatrix}$
B) $\begin{bmatrix} \frac{\sqrt{3}}{2} & 2005 \\ 1 & 0 \end{bmatrix}$
C) $\begin{bmatrix} 1 & \frac{\sqrt{3}}{2} \\ 0 & 2005 \end{bmatrix}$
D) $\begin{bmatrix} 1 & 0 \\ 2005 & 1 \end{bmatrix}$

34. If A and B are square matrices of the same order and A is non-singular, then for a positive integer n, $(A^{-1}BA)^n$ is equal to

A) $A^{-n}B^nA^n$
B) $A^nB^nA^{-n}$
C) $A^{-1}B^nA$
D) $n(A^{-1}BA)$

35. $|A_{3\times3}| = 3, |B_{3\times3}| = -1$, and $|C_{2\times2}| = +2$, then $|2ABC|$ is equal to

A) $2^3(6)$
B) $2^3(-6)$
C) $2(-6)$
D) none of these

36. If $k \begin{bmatrix} -1 & 2 & 2 \\ 2 & -1 & 2 \\ 2 & 2 & -1 \end{bmatrix}$ is an orthogonal matrix, then k is equal to

A) 1
B) $1/3$
C) $1/2$
D) none of these

37. If $P + Q = \begin{bmatrix} 1 & 6 \\ 7 & 2 \end{bmatrix}$, where P is a symmetric matrix and Q is a skew-symmetric matrix, then $P =$

A) $\begin{bmatrix} 1 & -\frac{13}{2} \\ -\frac{13}{2} & 0 \end{bmatrix}$
B) $\begin{bmatrix} 1 & \frac{13}{2} \\ \frac{13}{2} & 2 \end{bmatrix}$
C) $\begin{bmatrix} 0 & \frac{13}{2} \\ \frac{13}{2} & 0 \end{bmatrix}$
D) $\begin{bmatrix} 0 & -\frac{13}{2} \\ \frac{13}{2} & 0 \end{bmatrix}$

38. If A, B are symmetric matrices of the same order then $AB - BA$ is:

A) symmetric matrix
B) skew symmetric matrix
C) Diagonal matrix
D) identity matrix

39. If $A = [a_{ij}]_{3\times3}$ is a square matrix so that $a_{ij} = i^2 - j^2$, then A is a:

A) unit matrix
B) symmetric matrix
C) skew symmetric matrix
D) orthogonal matrix

40. For a 2×3 matrix $A = [a_{ij}]$ whose elements are given by $a_{ij} = \frac{(i+j)^2}{2}$, then A is equal to

A) $\begin{bmatrix} 2 & 8 & \frac{9}{2} \\ 8 & \frac{9}{2} & \frac{25}{2} \end{bmatrix}$

B) $\begin{bmatrix} 2 & \frac{9}{2} & 8 \\ \frac{9}{2} & 8 & \frac{25}{2} \end{bmatrix}$

C) $\begin{bmatrix} 2 & \frac{9}{2} & 8 \\ 8 & \frac{9}{2} & \frac{25}{2} \end{bmatrix}$

D) $\begin{bmatrix} 2 & \frac{25}{2} & 8 \\ \frac{9}{2} & \frac{9}{2} & 8 \end{bmatrix}$

41. If $A = \begin{bmatrix} 1 & 2 \\ 2 & 5 \end{bmatrix}$, $B = \begin{bmatrix} 4 & 3 \\ 0 & 2 \end{bmatrix}$ and $2A + C = B$, then $C =$

A) $\begin{bmatrix} 6 & 7 \\ 4 & 12 \end{bmatrix}$

B) $\begin{bmatrix} 2 & -1 \\ -4 & -8 \end{bmatrix}$

C) $\begin{bmatrix} 3 & -1 \\ -4 & 8 \end{bmatrix}$

D) $\begin{bmatrix} -6 & -7 \\ -4 & -12 \end{bmatrix}$

42. If $3A + 4B^T = \begin{bmatrix} 7 & -10 & 17 \\ 0 & 6 & 31 \end{bmatrix}$ and $2B - 3A^T = \begin{bmatrix} -1 & 4 \\ 18 & -6 \\ -5 & -7 \end{bmatrix}$, then $B =$

A) $\begin{bmatrix} 1 & 3 \\ -1 & 0 \\ -2 & -4 \end{bmatrix}$

B) $\begin{bmatrix} 1 & 3 \\ 1 & 0 \\ 2 & 4 \end{bmatrix}$

C) $\begin{bmatrix} 1 & 3 \\ -1 & 0 \\ 2 & 4 \end{bmatrix}$

D) $\begin{bmatrix} 1 & -3 \\ 1 & 0 \\ 2 & 4 \end{bmatrix}$

43. If $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} + 2X = \begin{bmatrix} 3 & 5 \\ 5 & 9 \end{bmatrix}$, then $X =$

A) $\begin{bmatrix} 2 & 3 \\ 2 & 5 \end{bmatrix}$

B) $\begin{bmatrix} 1 & \frac{3}{2} \\ 1 & \frac{5}{2} \end{bmatrix}$

C) $\begin{bmatrix} -2 & -3 \\ 2 & 5 \end{bmatrix}$

D) $\begin{bmatrix} 1 & \frac{3}{2} \\ -1 & -\frac{5}{2} \end{bmatrix}$

44. If $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ then $A^{2016} =$

A) I

B) 0

C) A

D) A^2

45. If $P = \begin{bmatrix} 1 \\ 3 \\ 4 \end{bmatrix}$ and $Q = [2 \quad -1 \quad 5]$, then $PQ =?$

A) $\begin{bmatrix} 2 & -1 & 5 \\ 6 & -3 & 15 \\ 8 & -4 & 20 \end{bmatrix}$

B) $[2 \quad -3 \quad 20]$

C) $\begin{bmatrix} 2 \\ -3 \\ 20 \end{bmatrix}$

D) $[19]$

46. If $\mathrm{Tr}(A) = 6 \implies \mathrm{Tr}(4A) =$

47. If $A = \begin{bmatrix} 2 & x-3 & x-2 \\ 3 & -2 & -1 \\ 4 & -1 & -5 \end{bmatrix}$ is a symmetric matrix, then $x =$

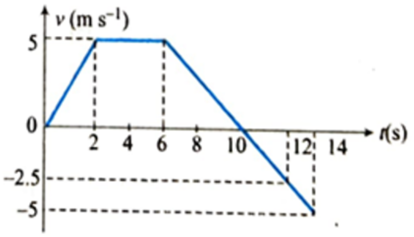
48. If the matrix $\begin{bmatrix} 1 & 3 & a+2 \\ 2 & 4 & 8 \\ 3 & 5 & 10 \end{bmatrix}$ is singular, then a=

49. If A is a square matrix of order 3 such that $|A| = 2$, then $|(\mathrm{adj}\, A^{-1})^{-1}|$ is

50. If A is a square matrix of order n such that $|\mathrm{adj}(\mathrm{adj}\, A)| = |A|^9$, then the value of n can be

Physics

51. The variation of velocity of a particle moving along a straight line is shown in the figure. The distance travelled by the particle in 12 s is:



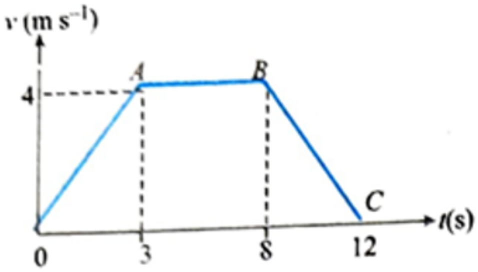
A) 37.5 m

B) 32.5 m

C) 35.0 m

D) None of these

52. From the velocity–time graph, given in figure of a particle moving in a straight line, one can conclude that:



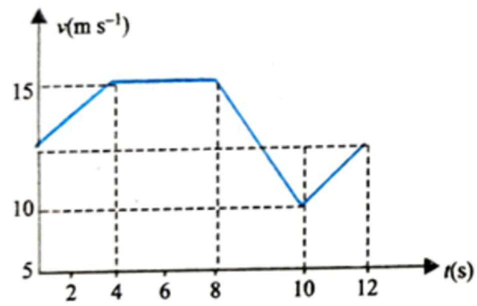
A) Its average velocity during the 12 s interval is $24/7\ \mathrm{m\,s^{-1}}$.

B) Its velocity for the first 3 s is uniform and is equal to $4\ \mathrm{m\,s^{-1}}$.

C) The body has a constant acceleration between $t = 3$ s and $t = 8$ s.

D) The body has a uniform retardation from $t = 8$ s to $t = 12$ s.

53. The velocity–time graph of a particle moving in a straight line is shown in figure. The acceleration of the particle at $t = 9$ s is:



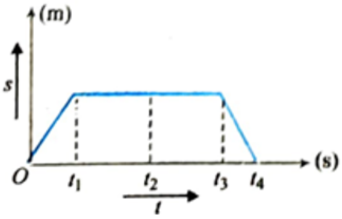
A) Zero

B) $5\ \mathrm{m\,s^{-2}}$

C) $-5\ \mathrm{m\,s^{-2}}$

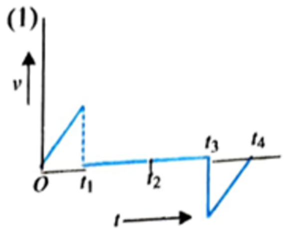
D) $-2\ \mathrm{m\,s^{-2}}$

54. The displacement–time graph of a body is shown in

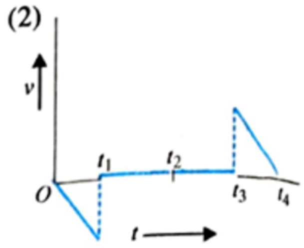


the figure. The corresponding velocity–time graph of the motion of the body will be:

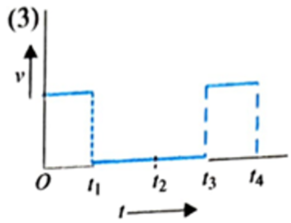
A)



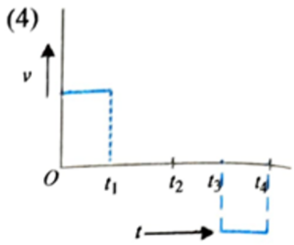
B)



C)

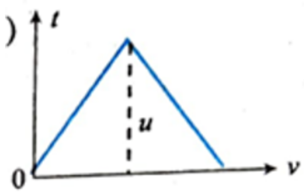


D)

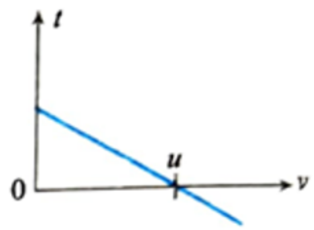


55. An object is thrown up vertically. The velocity–time graph for the motion of the particle is:

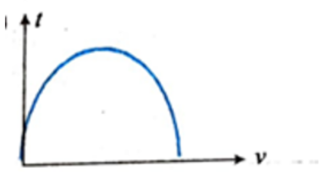
A)



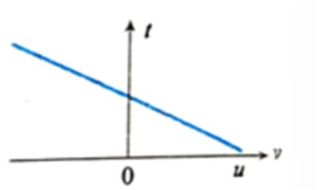
B)



C)

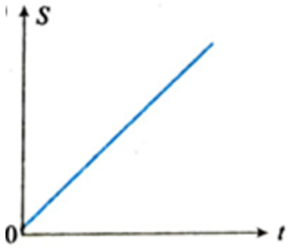


D)

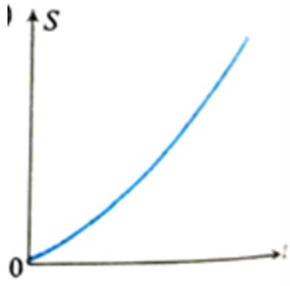


56. From a high tower, at time $t = 0$, one stone is dropped from rest and simultaneously another stone is projected vertically up with an initial velocity. The graph of distance S between the two stones plotted against time t will be:

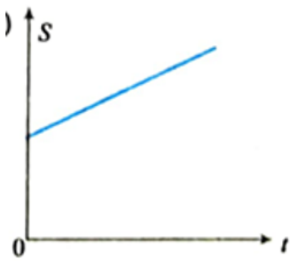
A)



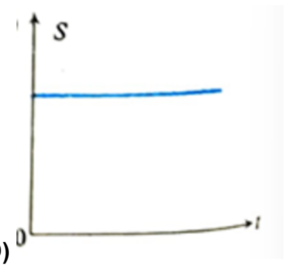
B)



C)

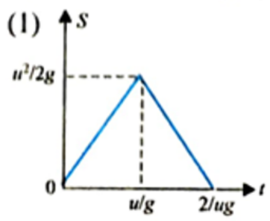


D)

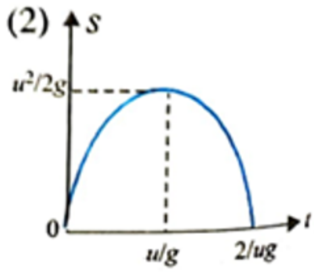


57. An object is vertically thrown upwards. Then the displacement–time graph for the motion is as shown in

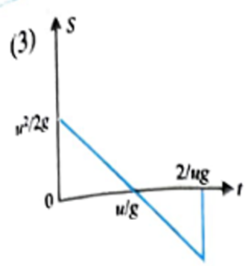
A)



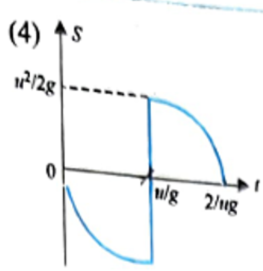
B)



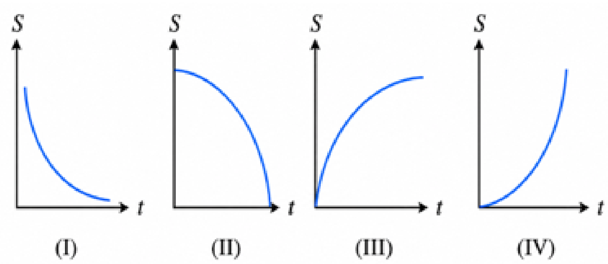
C)



D)



58. The acceleration will be positive in



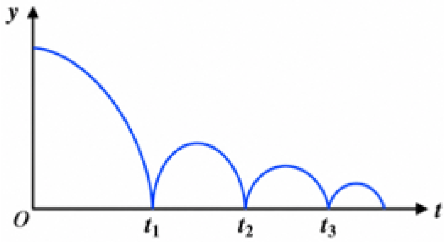
A) (I) and (III)

B) (I) and (IV)

C) (II) and (IV)

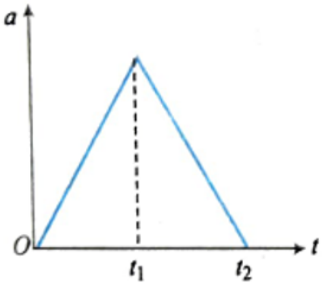
D) None of these

59. The graph as shown in figure below describes the motion of a ball rebounding from a horizontal surface being released from a point above the surface. Assume that the ball collides each time with the floor inelastically. The quantity represented on the y-axis is the ball's (take upward direction as positive)

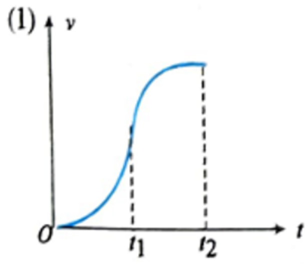


A) Displacement
B) Velocity
C) Acceleration
D) Momentum

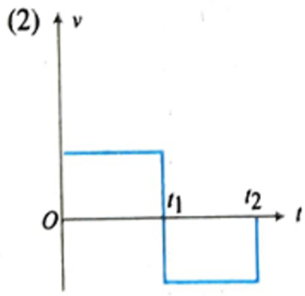
60. The acceleration versus time graph of a particle is shown in figure. The respective $v-t$ graph of the particle is:



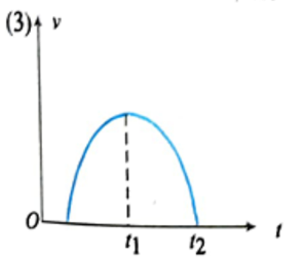
A)



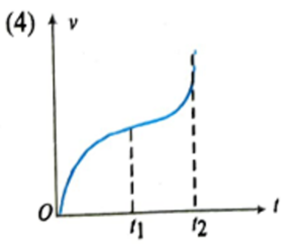
B)



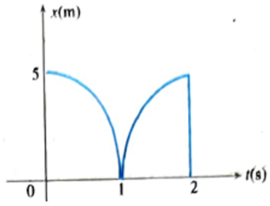
C)



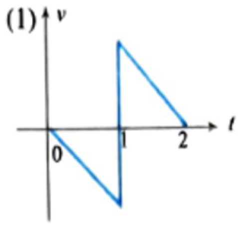
D)



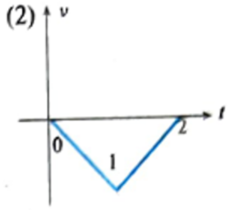
61. The displacement–time graph of a moving particle with constant acceleration is shown in figure. The velocity–time graph is given by



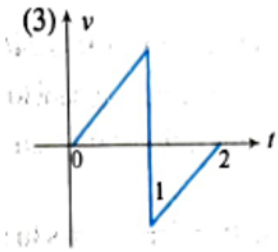
A)



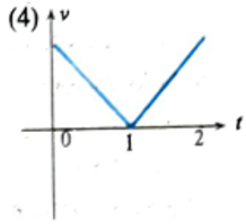
B)



C)

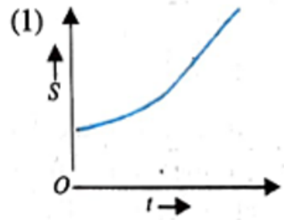


D)

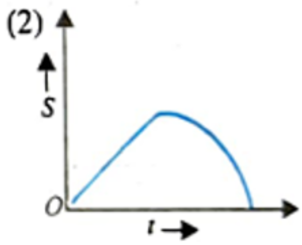


62. Two balls are dropped from the top of a high tower with a time interval of t_0 second, where t_0 is smaller than the time taken by the first ball to reach the floor, which is perfectly inelastic. The distance S between the two balls, plotted against the time t from the instant of dropping the second ball, is best represented by:

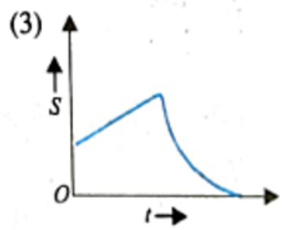
A)



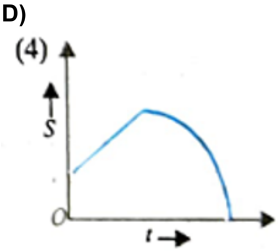
B)



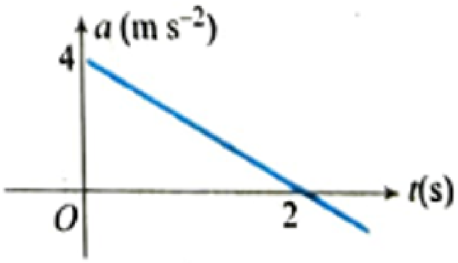
C)



D)

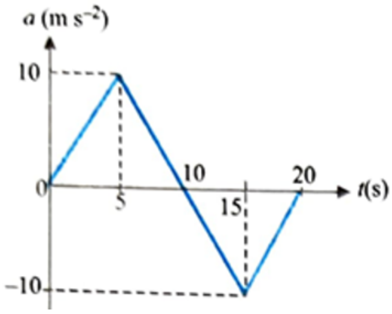


63. The acceleration versus time graph of a particle moving in a straight line is shown in the figure. The velocity–time graph of the particle would be:

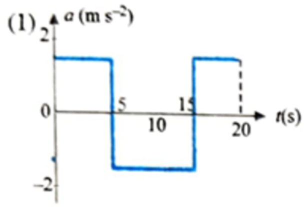


A) A straight line **B)** A parabola
C) A circle **D)** An ellipse

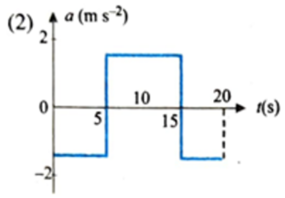
64. Plot the acceleration–time graph of the velocity–time graph given in figure.



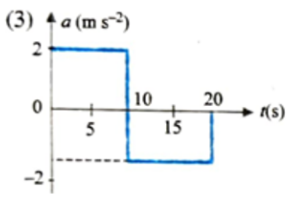
A)



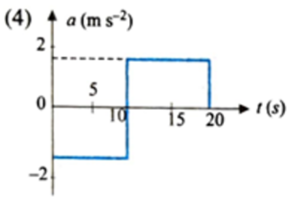
B)



C)



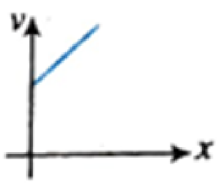
D)



65. A point moves such that its displacement as a function of time is given by $x^3 = t^3 + 1$. Its acceleration as a function of time t will be

A) $\frac{2}{x^5}$ **B)** $\frac{2t}{x^5}$
C) $\frac{2t}{x^4}$ **D)** $\frac{2t^2}{x^5}$

66. Velocity versus displacement graph of a particle moving in a straight line as shown in figure. The



acceleration of the particle

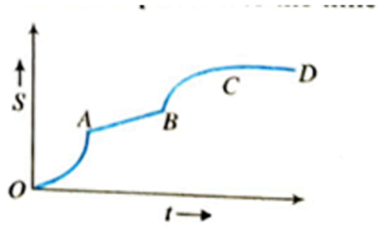
A) is constant **B)** increases linearly with x
C) increases parabolically with x **D)** None of these

67. A particle moving along a straight line such that displacement S varies with time t as $S = a + bt + gt^2$.

Column I	Column II
i. Acceleration at $t = 2$ s	a. $\beta + 5\gamma$
ii. Average velocity during third second	b. 2γ
iii. Velocity at $t = 1$ s	c. α
iv. Initial displacement	d. $\beta = 2\gamma$

A) i-b, ii-a, iii-d, iv-c **B)** i-a, ii-b, iii-c, iv-d
C) i-c, ii-d, iii-a, iv-b **D)** i-d, ii-c, iii-b, iv-a

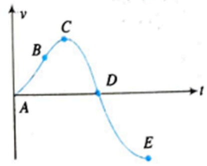
68. The displacement versus time curve is given. Sections OA and BC are parabolic. CD is parallel to the time axis.



Column I	Column II
i. (OA)	a. Velocity increases with time linearly
ii. (AB)	b. Velocity decreases with time
iii. (BC)	c. Velocity is independent of time
iv. (CD)	d. Velocity is zero

A) i-a, ii-c, iii-b, iv-d **B)** i-b, ii-a, iii-d, iv-c
C) i-c, ii-d, iii-a, iv-b **D)** i-d, ii-b, iii-c, iv-a

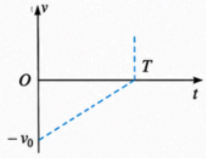
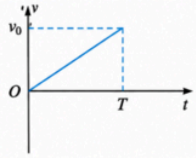
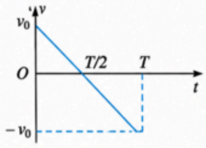
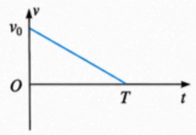
69. From the image given below, the velocity-time graph of a particle moving along the x-axis is shown. Match the entries of Column I with the entries of Column II.



Column I	Column II
i. For (AB), the particle is	a. moving in positive (x)-direction with increasing speed
ii. For (BC), the particle is	b. moving in positive (x)-direction with decreasing speed
iii. For (CD), the particle is	c. moving in negative (x)-direction with increasing speed
iv. For (DE), the particle is	d. moving in negative (x)-direction with decreasing speed

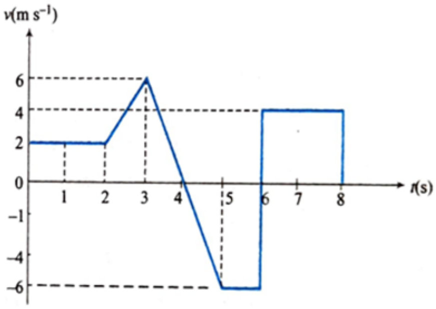
A) i-a, ii-b, iii-c, iv-d **B)** i-a, ii-a, iii-b, iv-c
C) i-b, ii-a, iii-d, iv-c **D)** i-c, ii-d, iii-a, iv-b

70. Study the following v-t graphs in Column I carefully and match appropriately with the statements given in Column II. Assume that motion takes place from time 0 to T

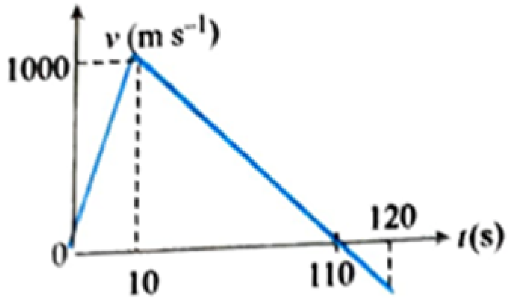
	Column I		Column II
i.		a.	Net displacement is positive, but not zero.
ii.		b.	Net displacement is negative, but not zero.
iii.		c.	Particle returns to its initial position again.
iv.		d.	Acceleration is positive.

A) i-b, ii-a, iii-c, iv-d
B) i-a, ii-b, iii-c, iv-d
C) i-c, ii-d, iii-a, iv-b
D) i-d, ii-c, iii-b, iv-a

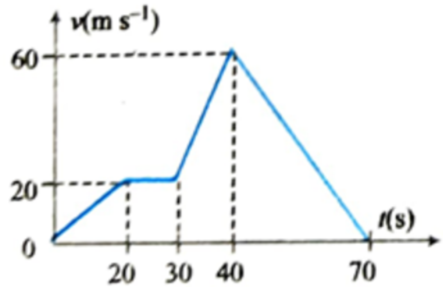
71. The velocity–time graph of a body is shown in the figure. The displacement of the body in $8\ \mathrm{s}$ is___m:



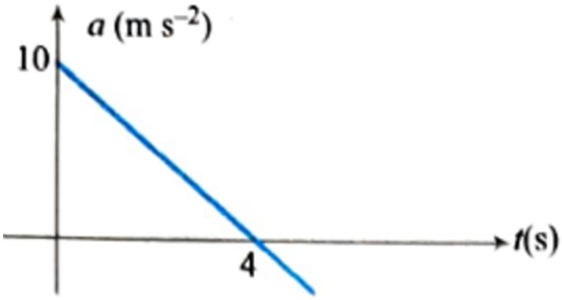
72. The following graph figure shows the variation of velocity of a rocket with time. Then the maximum height attained by the rocket is___km:



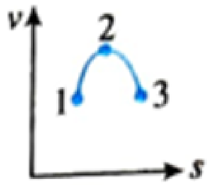
73. The velocity–time graph of a body is given in figure. The maximum acceleration in ms^{-2} is:



74. The acceleration–time graph of a particle moving along a straight line is as shown in the figure. At what time does the particle acquire its initial velocity? (In seconds)



75. Figure below shows the velocity–displacement curve for an object moving along a straight line. At which of the points marked is the object speeding up?



ANSWER KEY

Chemistry

1.	**4**	8.	**1**	15.	**4**	22.	**5**
2.	**4**	9.	**2**	16.	**1**	23.	**3**
3.	**2**	10.	**1**	17.	**1**	24.	**1**
4.	**4**	11.	**4**	18.	**4**	25.	**4**
5.	**3**	12.	**2**	19.	**2**		
6.	**2**	13.	**4**	20.	**4**		
7.	**2**	14.	**3**	21.	**4**		

Maths

26.	**3**	33.	**1**	40.	**2**	47.	**6**
27.	**3**	34.	**3**	41.	**2**	48.	**4**
28.	**3**	35.	**4**	42.	**3**	49.	**4**
29.	**1**	36.	**2**	43.	**2**	50.	**4**
30.	**1**	37.	**2**	44.	**1**		
31.	**1**	38.	**2**	45.	**1**		
32.	**4**	39.	**3**	46.	**24**		

Physics

51.	**1**	58.	**2**	65.	**2**	72.	**55**
52.	**4**	59.	**1**	66.	**2**	73.	**4**
53.	**3**	60.	**1**	67.	**1**	74.	**8**
54.	**3**	61.	**1**	68.	**1**	75.	**1**
55.	**4**	62.	**4**	69.	**2**		
56.	**1**	63.	**2**	70.	**1**		
57.	**1**	64.	**1**	71.	**10**		

SOLUTIONS

Q1.

Answer: D

Explanation:

Shapes are determined by the number of bond pairs and lone pairs on the central atom according to VSEPR theory.

Q2.

Answer: D

Explanation:

Matching molecules with their specific molecular geometries based on LP-BP repulsions.

Q3.

Answer: B

Explanation:

Lone pairs are calculated as
$\mathrm{LP} = \frac{1}{2}(\text{Valence electrons} - \text{Total bonds} - \text{Charge})$.

Q4.

Answer: D

Explanation:

Geometry and shape are identified using the number of sigma bonds and lone pairs on the central atom.

Q5.

Answer: C

Explanation:

Both molecules are bent, but the bond angle depends on hybridization and repulsion.

Q6.

Answer: B

Explanation:
Count the lone pairs on the central atom for each molecule.

Q7.

Answer: B

Explanation:

Match molecular structures based on the count of electron domains.

Q8.

Answer: A

Explanation:
In sp^3d hybridization, lone pairs occupy equatorial positions to minimize repulsion.

Q9.

Answer: B

Explanation:
Species with the same total number of electrons and central atoms with 4 sigma bonds are isoelectronic and isostructural.

Q10.

Answer: A

Explanation:
Identify molecules with 3D geometries like pyramidal, see-saw, open-book, or tetrahedral.

Q11.

Answer: D

Explanation:
Identify molecules with a steric number of 6 (sum of bonds and lone pairs).

Q12.

Answer: B

Explanation:
Counting lone pairs on the central atom of each species.

Q13.

Answer: D

Explanation:

VSEPR theory explains why lone pair repulsions shrink the ideal tetrahedral angle in water.

Q14.

Answer: C

Explanation:

Matching molecules with their corresponding hybridization.

Q15.

Answer: D

Explanation:

Steric number calculation for nitrogen in different ions.

Q16.

Answer: A

Explanation:
Identify geometry from bond pairs and lone pairs using steric number.

Q17.

Answer: A

Explanation:
In the solid state, PCl_5 exists as an ionic compound consisting of cationic and anionic species.

Q18.

Answer: D

Explanation:
Both species have sp^3d^2 hybridization but different numbers of lone pairs, leading to different shapes.

Q19.

Answer: B

Explanation:
BF_3 is trigonal planar (sp^2) and becomes tetrahedral (sp^3) as BF_4^-.

Q20.

Answer: D

Explanation:
Matching geometric pairs based on electron domains.

Q21.

Answer: 4

Explanation:
Hybridization is determined by the steric number (sum of sigma bonds and lone pairs). Species with a steric number of 4 use sp^3 orbitals.

Q22.

Answer: 5

Explanation:
Linear molecules have a bond angle of 180°, typically with sp hybridization or sp^3d with 3 lone pairs.

Q23.

Answer: 3

Explanation:
Square pyramidal structure requires 5 bond pairs and 1 lone pair (sp^3d^2 hybridization).

Q24.

Answer: 1

Explanation:
Identify the species with the highest number of lone pairs on the central atom.

Q25.

Answer: 4

Explanation:
Determining the lone pairs on Xe by calculating valence electrons minus used electrons for bonds. .

Q26.

Answer: C

Explanation:
For matrix multiplication $(m \times n) \times (n \times p)$, the resulting matrix has the order $(m \times p)$.

Q27.

Answer: C

Explanation:
A matrix is nilpotent if $A^k = O$ (zero matrix) for some positive integer k.

Q28.

Answer: C

Explanation:
The transpose of the product of two matrices is equal to the product of their transposes taken in reverse order, which is a fundamental property of matrix transposition.

Q29.

Answer: A

Explanation:
Taking the transpose of the matrix expression B^TAB and simplifying it using transpose properties shows that it equals itself if and only if A is symmetric.

Q30.

Answer: A

Explanation:
Using the properties of the determinant of adjoint matrices for an $n \times n$ matrix where $n = 4$, we compute $\det(\operatorname{adj}(\operatorname{adj} A)) = 2^{36}$. Dividing this by 7 and finding the fractional part using binomial expansion yields $1/7$.

Q31.

Answer: A

Explanation:
Using standard matrix determinant properties for inverses and adjoints of order $n = 3$, simplify each term individually and substitute the given values $|A| = 2$ and $|B| = 3$.

Q32.

Answer: D

Explanation:
By repeatedly substituting the recursive relation derived from $C = ABA^T$ and utilizing the orthogonal property $AA^T = I$, the expression A^TC^nA simplifies to B^n, which evaluates to the lower triangular matrix with $-n$.

Q33.

Answer: A

Explanation:
Using orthogonal matrix properties where $P^TP = I$, expand and telescope the terms of $P^T(Q^{2005})P$ to simplify it into A^{2005}, which evaluates to the desired matrix.

Q34.

Answer: C

Explanation:
By expanding the power via repeated multiplication, interior terms like AA^{-1} cancel out due to the non-singularity of A, leaving a telescoping product that simplifies to $A^{-1}B^nA$.

Q35.

Answer: D

Explanation:
For matrix multiplication to be defined, the number of columns of the first matrix must match the number of rows of the subsequent matrices. Here, the inner dimensions do not match, making the product undefined.

Q36.

Answer: B

Explanation:
For a matrix M to be orthogonal, $MM^T = I$, which means the sum of squares of elements in any row or column divided by the square of the scalar multiplier must equal 1.

Q37.

Answer: B

Explanation:
Any square matrix can be expressed as the sum of a symmetric part and a skew-symmetric part, where the symmetric part is given by the formula $P = \frac{1}{2}(A + A^T)$.

Q38.

Answer: B

Explanation:
For symmetric matrices A and B, $A^T = A$ and $B^T = B$. By taking the transpose of the expression $AB - BA$, we find it equals its own negative, which is the defining property of a skew-symmetric matrix.

Q39.

Answer: C

Explanation:
A matrix is skew-symmetric if $a_{ji} = -a_{ij}$ for all i, j and its diagonal elements a_{ii} are zero. For the rule $a_{ij} = i^2 - j^2$, both conditions are satisfied.

Q40.

Answer: B

Explanation:

Compute each element of the 2×3 matrix using the given formula $a_{ij} = \frac{(i+j)^2}{2}$ for $i \in \{1, 2\}$ and $j \in \{1, 2, 3\}$.

Q41.

Answer: B

Explanation:
Rearrange the matrix equation to solve for C as $C = B - 2A$ and perform matrix subtraction.

Q42.

Answer: C

Explanation:
Transpose the second matrix equation and solve the resulting system of linear matrix equations for matrix B.

Q43.

Answer: B

Explanation:
Rearrange the matrix equation to solve for 2X by subtracting the first matrix from both sides, then divide the resulting matrix by 2.

Q44.

Answer: A

Explanation:
Compute successive powers of matrix A to find a repeating cycle, and use the pattern to evaluate A^{2016}.

Q45.

Answer: A

Explanation:
Matrix multiplication involves multiplying the rows of the first matrix by the columns of the second matrix. Since P is a 3×1 matrix and Q is a 1×3 matrix, their product PQ will result in a 3×3 matrix. Each element (i, j) in the resulting matrix is obtained by multiplying the i-th row of P by the j-th column of Q.

Q46.

Answer: 24

Explanation:
Use the linearity property of the trace of a matrix, which states that $\mathrm{Tr}(kA) = k \cdot \mathrm{Tr}(A)$ for any scalar k.

Q47.

Answer: 6

Explanation:
A matrix is symmetric if $A = A^T$, which means elements $a_{ij} = a_{ji}$. Use this property to set up an equation for x.

Q48.

Answer: 4

Explanation:
For a matrix to be singular, its determinant must be equal to zero. Expanding the determinant and solving for a gives the correct value.

Q49.

Answer: 4

Explanation:
Apply the properties of matrix inversion and adjoint determinants step-by-step for a matrix of order 3.

Q50.

Answer: 4

Explanation:
Use the general formula for the determinant of a double adjoint matrix, $|\,\mathrm{adj}(\mathrm{adj}\,A)| = |A|^{(n-1)^2}$, and equate the exponent to the given power of 9.

Q51.

Answer: A

Explanation:

The total distance travelled by a particle is the sum of the magnitudes of the areas (total area) under the velocity–time graph. Area above the time axis ($t = 0$ s to $t = 10$ s): Sum of the initial triangle, central rectangle, and decreasing triangle gives $5 + 20 + 10 = 35.0 \text{ m}$. Area below the time axis ($t = 10$ s to $t = 12$ s): The triangular area below the axis gives $\frac{1}{2} \times 2 \times 2.5 = 2.5 \text{ m}$. Total distance = $35.0 \text{ m} + 2.5 \text{ m} = 37.5 \text{ m}$.

Q52.

Answer: D

Explanation:

From $t = 8$ s to $t = 12$ s, the velocity-time graph is a straight line sloping downwards. A constant negative slope on a $v - t$ graph indicates a constant negative acceleration, which is uniform retardation.

Q53.

Answer: C

Explanation:

The acceleration at any instant is given by the slope of the velocity–time graph at that instant. Between $t = 8$ s and $t = 10$ s, the graph is a straight line sloping downwards from $v = 15 \text{ m s}^{-1}$ to $v = 5 \text{ m s}^{-1}$. Since $t = 9$ s lies in this interval, the acceleration at $t = 9$ s is equal to the constant slope of this line segment, which is -5 m s^{-2}.

Q54.

Answer: C

Explanation:

Velocity is the slope of the displacement–time graph. From 0 to t_1, the displacement increases linearly, so the slope is constant positive. From t_1 to t_3, the displacement is constant, so the slope is zero. From t_3 to t_4, the displacement decreases linearly, so the slope is constant negative. Hence, the velocity–time graph must show positive constant velocity, then zero velocity, then negative constant velocity, which is Graph (3).

Q55.

Answer: D

Explanation:

When an object is thrown vertically upwards with an initial velocity u, it experiences a constant downward acceleration due to gravity ($a = -g$). The equation of motion is linear: $v = u - gt$. This represents a straight line with a positive y-intercept (u) and a negative slope ($-g$), passing through zero at the highest point and becoming negative as the object moves downwards, which matches Graph D).

Q56.

Answer: A

Explanation:

Since both stones experience the same downward acceleration due to gravity (g), their relative acceleration is zero ($\mathbf{a}_{\text{rel}} = 0$). Consequently, the relative velocity between them remains constant over time ($\mathbf{v}_{\text{rel}} = u$). Therefore, the distance between the two stones S increases linearly with time ($S = u \cdot t$), which corresponds to a straight line passing through the origin as shown in Graph A).

Q57.

Answer: A

Explanation:

For an object thrown vertically upward, the displacement first increases until the highest point and then decreases back to zero. According to the given answer key, the correct option is A.

Q58.

Answer: B

Explanation:

In a displacement–time (S--t) graph, the curvature (concavity) indicates the sign of acceleration ($a = \frac{d^2S}{dt^2}$). A graph that is concave upwards (shaped like a cup,) has a positive second derivative, meaning positive acceleration. Graph (I) and Graph (IV) are both concave upwards, so the acceleration is positive in both.

Q59.

Answer: A

Explanation:

When a ball is released from above the floor, its initial position is above the floor ($y > 0$). As it falls, its height decreases to 0 at the floor (t_1). Upon rebounding inelastically, it rises to a smaller height, and after subsequent bounces, the maximum height reached decreases further. Since all values on the y-axis remain positive ($y \geq 0$) and represent height above the floor, the quantity represented on the y-axis is displacement (or position y).

Q60.

Answer: A

Explanation:

The slope of a velocity–time graph represents the acceleration ($\frac{dv}{dt} = a$). 1. From $t = 0$ to t_1, the acceleration a increases linearly with time ($a > 0$). Thus, the velocity curve must be concave upwards with an increasing positive slope. 2. From t_1 to t_2, the acceleration a decreases linearly back to zero ($a > 0$). Thus, the velocity continues to increase, but its slope decreases until it flattens at t_2, producing a curve that is concave downwards. This combination of an inflection point at t_1 and a peak/flat slope at t_2 matches Graph A).

Q61.

Answer: A

Explanation:

The velocity is the slope of the displacement–time graph. From $t = 0$ to $t = 1$, the slope changes uniformly from zero to a negative value, so the velocity decreases linearly. At $t = 1$, the direction of motion changes abruptly, so the velocity changes suddenly from negative to positive. From $t = 1$ to $t = 2$, the positive velocity decreases linearly to zero. Hence, the correct velocity–time graph is Option A.

Q62.

Answer: D

Explanation:

When the second ball is released, the first ball already has a head start. Since both balls have the same acceleration due to gravity, their relative acceleration is zero, so the separation increases linearly. After the first ball hits the ground and sticks there, the separation equals the height of the second ball above the ground, which decreases parabolically to zero.

Q63.

Answer: B

Explanation:
Since acceleration a varies linearly with time t (i.e., $a(t)$ is a first-degree polynomial in t), integrating acceleration to find velocity $v = \int a\, dt$ yields a quadratic equation in terms of t (degree 2). A quadratic function of velocity with respect to time represents a parabola.

Q64.

Answer: A

Explanation:

The slope of a velocity–time ($v - t$) graph gives the acceleration ($a = \frac{dv}{dt}$). Since the given $v - t$ graph consists of three straight-line segments, the slope in each region is constant, which results in constant acceleration values (a step-function graph) across the three intervals: $2\ \mathrm{m/s^2}$ for $t \in [0, 5]\ \mathrm{s}$, $-2\ \mathrm{m/s^2}$ for $t \in [5, 15]\ \mathrm{s}$, and $2\ \mathrm{m/s^2}$ for $t \in [15, 20]\ \mathrm{s}$.

Q65.

Answer: B

Explanation:
Differentiate the given relation implicitly to obtain velocity.
Differentiate the velocity once more and use the relation $x^3 = t^3 + 1$ to simplify the result.

Q66.

Answer: B

Explanation:

From the given $v \to x$ graph, the velocity v is a straight line passing through the origin, which can be written as $v = kx$ (where $k > 0$ is a constant slope). Acceleration is given by $a = v\frac{dv}{dx}$. Substituting $v = kx$ into the equation gives $a = (kx)(k) = k^2x$, which shows that acceleration a is directly proportional to x. Therefore, acceleration increases linearly with x.

Q67.

Answer: A

Explanation:

Differentiating displacement with respect to time gives velocity $v(t) = b + 2\gamma t$ and constant acceleration $a(t) = 2\gamma$. Evaluating these functions at the specified times and calculating the displacement change between $t = 2$ s and $t = 3$ s yields the corresponding matches.

Q68.

Answer: A

Explanation:

The slope of a displacement-time graph represents instantaneous velocity$v = \frac{dS}{dt}$. Parabolic section OA has a linearly increasing slope, straight section AB has a constant slope, parabolic section BC has a decreasing slope, and horizontal section CDhas a zero slope.

Q69.

Answer: B

Explanation:

The sign of velocity indicates the direction of motion, while the sign of acceleration (slope of the $v - t$ graph) relative to velocity determines whether the particle is speeding up or slowing down.

Q70.

Answer: A

Explanation:

Net displacement is calculated as the area bounded by the $v - t$ graph and the time axis (taking area above the axis as positive and below as negative). A positive slope indicates positive acceleration.

Q71.

Answer: 10

Explanation:

Displacement is the area under the velocity–time graph from $t = 0$ to $t = 8, \mathrm{s}$.

Q72.

Answer: 55

Explanation:

The maximum height attained by a rocket moving vertically corresponds to the total distance traveled until its velocity becomes zero. On a velocity–time ($v - t$) graph, this total distance is given by the area under the $v - t$ curve for the duration when $v \geq 0$.

Q73.

Answer: 4

Explanation:

Acceleration is represented by the slope of the velocity–time ($v \to t$) graph. By calculating the slopes of all line segments with positive slope (increasing velocity), we find that the segment from $t = 30\ \mathrm{s}$ to $t = 40\ \mathrm{s}$ has the maximum slope of $4\ \mathrm{m/s}^2$.

Q74.

Answer: 8

Explanation:

The particle regains its initial velocity when the net change in velocity is zero. Since the change in velocity equals the area under the acceleration–time graph, the positive and negative areas must cancel each other.

Q75.

Answer: 1

Explanation:

An object is speeding up when its speed v is increasing with time t, which means its acceleration a and velocity v must have the same sign ($a \cdot v > 0$). Using $a = v\frac{dv}{ds}$, at point 1, velocity $v > 0$ and slope $\frac{dv}{ds} > 0$, giving a positive acceleration $a > 0$, so speed is increasing. At point 2, $\frac{dv}{ds} = 0$, so $a = 0$ (speed is stationary/maximum). At point 3, $v > 0$ but $\frac{dv}{ds} < 0$, giving $a < 0$, so it is slowing down.