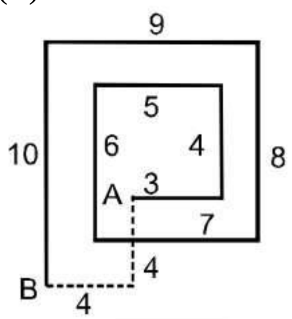
IIT – JEE: 2025 **TW TEST** **DATE: 08/07/23**

TOPIC: KINEMATICS – I & II

SOLUTIONS

1. (B)



$AB = \sqrt{4^2+4^2} = 4\sqrt{2}$

2. (C)

$S_1 = \frac{1}{2}a(10)^2$

$S_1 + S_2 = \frac{1}{2}a(20)^2$

$\Rightarrow S_2 = 3\times\frac{1}{2}a(10)^2$

$\therefore \frac{S_2}{S_1} = 3$

3. (B)

$\vec{v} = -\hat{i} + \hat{j} + 2\hat{k}$

$\vec{a} = \hat{i} - \hat{j} + \hat{k}$

$\vec{a}\cdot\vec{v} = -3 - 1 + 2 < 0$

Hence $\theta > 90°$ between $\vec{a}$ and $\vec{v}$

So, speed is decreasing

4. (B)

Let a be the retardation produced by resistive force, t_a and t_d be the time assent and descent respectively.

If the particle rises upto a height h then

$h = \frac{1}{2}(g+a)t_a^2$ and $h = \frac{1}{2}(g-a)t_d^2$

$\frac{t_a}{t_d} = \sqrt{\frac{g-a}{g+a}} = \sqrt{\frac{10-2}{10+2}} = \sqrt{\frac{2}{3}}$

5. (D)

$$v\frac{dv}{dx} = -9x \quad \Rightarrow \int_6^v v\ dv = \int_0^2 -9x\ dx$$

$$\Rightarrow \frac{v^2 - 6^2}{2} = -18 \text{ or } v = 0$$

6. (A)

$$R_{max} = R = \frac{u^2}{g}\left(\text{at an angle of } 45°\right)$$

$$u^2 = Rg$$

Using Range $= \dfrac{u^2 \sin 2\theta}{g}$ then $\dfrac{R}{2} = (Rg)\dfrac{\sin 2\theta}{g}$

$$\sin 2\theta = \frac{1}{2}$$

$$2\theta = 30° \Rightarrow \theta = 15°$$

7. (A)

Let the total distance = 3x,
The travel takes place in 3 parts:
x distance at 2 ms^{-1}
x distance at 3 ms^{-1}
x distance at 6 ms^{-1}
The time taken in each individual travel is :

$$t_1 = \frac{x}{2}$$

$$t_2 = \frac{x}{3}$$

$$t_3 = \frac{x}{6}$$

Hence the total time taken is :

$$t_1 + t_2 + t_3 = x$$

Total distance travelled = 3x

Average velocity $= \dfrac{3x}{x} = 3\, ms^{-1}$

8. (A)

He moves 5 steps forward and 3 steps backward in 8 sec after that he is 2 m away from an initial position

$\Rightarrow\ x = 5 - 3 = 2\text{ m}$ in 8 sec

After 24 sec he will 6 m away from an initial position
He moves further 5 m forward then he falls in a pit which is 11 m away from the initial positon.
total time $\Rightarrow\ T = 24 + 5 = 29\text{ sec}$.

9. (D)

Velocity increases when acceleration is applied in the same direction.

10. (B)

$s = ut + \frac{1}{2}at^2$

As the initial velocity $u = 0$ and $a = 10\ m/s^2$

$320 = 0 + \frac{1}{2} \times 10 \times t^2$

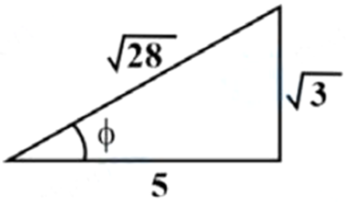
Superman arrives after 5s, so he has (8 – 5) = 3s
Save the student from reaching the ground.

$320 = (u \times 3) + \frac{1}{2} \times 10 \times 3 \times 3$

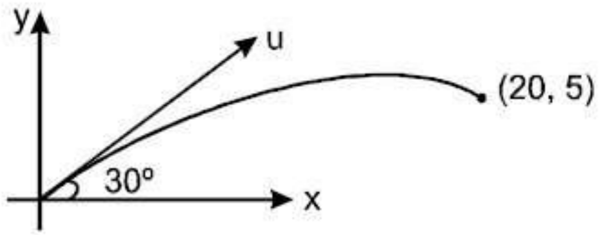
$u = \frac{275}{3} \Rightarrow 91.66\ m$

11. (C)

$\vec{\upsilon}_b = \vec{\upsilon}_{bT} + \vec{\upsilon}_T$



12. (A)

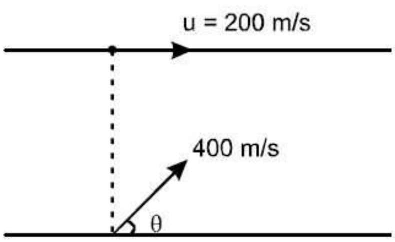


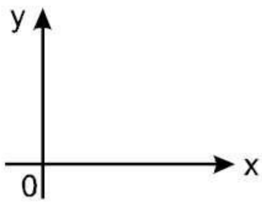
$y = x\tan\theta - \frac{1}{2} g \frac{x^2}{u^2 \cos^2\theta}$

$5 = 20\tan 30° - \frac{1}{2} \times \frac{10 \times 20^2}{u^2 \cos^2 30°}$

$\Rightarrow u^2 = \frac{1600}{\sqrt{3}(4 - \sqrt{3})} = \frac{1600}{13\sqrt{3}}(4 + \sqrt{3}) \Rightarrow u = 40\sqrt{\frac{(4+\sqrt{3})}{13\sqrt{3}}}$ m/s

13. (B)



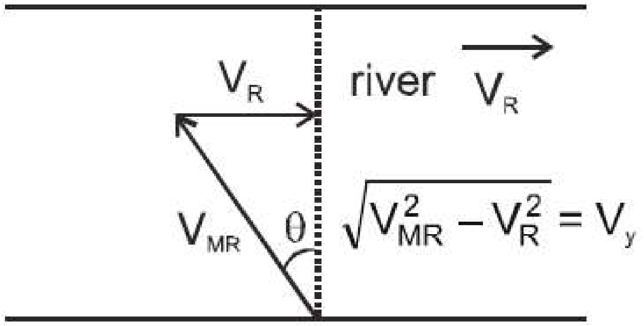


To hit, $400\cos\theta = 200$

{$\because$ Both travel equal distance along horizontal, from their start and coordinates of x axis are same}

14. (B)

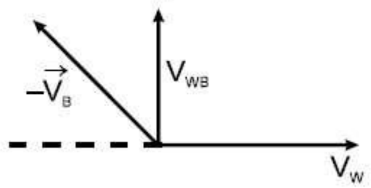
$15\text{ min} = \frac{1}{4}\text{hr.}$



$$t = \frac{d}{V_y} \Rightarrow \frac{1}{4} = \frac{1}{\sqrt{V_{MR}^2 - V_R^2}} = \frac{1}{4} = \frac{1}{\sqrt{5^2 - V_R^2}} \Rightarrow V_R = 3\text{ km/h}$$

15. (C)

Flag will flutter in the direciton of wind with respect to bus and $\vec{V}_{AB} = \vec{V}_W - \vec{V}_B = \vec{V}_W + \left(-\vec{V}_B\right)$



(addition of two vector always lies between them) $\left(-\vec{V}_B\right)$ must lies in any direciton between north & west. So bus will be moving in any direciton between south east.

16. (C)

$$< v > = \frac{\vec{V}_1 + \vec{V}_2}{2} = \frac{\left(10\cos 37°\hat{i} + 10\sin 37°\hat{j} + 10\cos 37°\hat{i}\right)}{2} \Rightarrow < \vec{v} > = 8\hat{i} + 3\hat{j}$$

17. (A)

$v\,dv = ads$

$$\therefore \int_0^v v\,dv = \int_0^{12\text{ m}} a\,ds$$

$\therefore \frac{v^2}{2} =$ area under a-s graph from s = 0 to s = 16m.

$= 2 + 12 + 6 + 12$

$= 32\ \text{m/s}$

or $v = \sqrt{64}$ m/s = 8 m/s

18. (D)

At $t = 4\text{ sec}, V = 0 + (4)(4) = 16\text{ m/sec}$.

At $t = 8\text{ sec}, V = 16\text{ m/sec}$.

At $t = 12\text{ sec}, V = 16 - 4(12 - 8) = 0$

For 0 to 4 sec $s_1 = \frac{1}{2}at^2 = \frac{1}{4}(4)(4)^2 = 32\text{ m}$

For 4 to 8 sec $s_2 = 16(8 - 4) = 64\text{ m}$

For 8 to 12 sec $s_3 = 16(4) - \frac{1}{2}(4)(4)^2 = 32\text{ m}$

So, $s_1 + s_2 + s_3 = 32 + 64 + 32 = 128\text{ m}$

19. (B)

$\vec{v}_{0,2} = \vec{v}_{0,1} - \vec{v}_{2,1} \Rightarrow \vec{v}_2 = \vec{v}_1 - \vec{v}$

20. (C)

If speed of a particle changes, the velcoity of the particle definitely changes and hence the acceleraiton of the particle is non-zero. When speed of a particle varies, its velocity cannot be constant.

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TOPIC: ATOMIC STRUCTURE

SOLUTIONS

21. (A)
$^{1}_{1}H$

22. (C)
Factual

23. (A)
$\frac{r_A}{r_N} = 10^5$
$\frac{V_A}{V_N} = \left(\frac{r_A}{r_N}\right)^3 = \left(10^5\right)^3 = 10^{15}$
$\Rightarrow \frac{V_N}{V_A} = 10^{-15}$

24. (A)
Species with same no. of electron are as known as isoelectronic.

25. (C)
$R = R_0 A^{1/3} = 1.33\times10^{-13} \times (64)^{1/3}$ cm
$= 5.32\times10^{-13}$ cm
$\because$ 1 fm $= 10^{-15}$ $R \approx 5$ fm

26. (A)
$\lambda = \frac{C}{\nu} = \frac{3\times10^8}{400\times10^6} = 0.75$ m

27. (C)
$\xrightarrow{\text{VIBGYOR}}$
$E\downarrow \nu\downarrow \lambda\uparrow$

28. (A)
$V_n = 2.188\times10^6 \times \frac{Z}{n}$ m/sec.

$$\frac{V_3\left(Li^{2+}\right)}{V_1(H)} = \frac{Z_3/n_3}{Z_1/n_1} = \frac{3/3}{1/1}, \qquad V\left(Li^{2+}\right) = V$$

29. (A)

$$E_5 = -13.6 \times \frac{1}{(5)^2} = -0.54\ \text{eV}$$

30. (B)
Lines of 1st series (here Lyman series) = n – 1 where n = no. of energy levels involved.

31. (C)
H & He^+ both have same no. of electron so spectrum pattern will be similar.

32. (D)

$$\lambda = \frac{h}{\sqrt{2mqV}} \qquad \lambda \propto \frac{1}{\sqrt{V}}$$

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{V_2}{V_1}} = \sqrt{\frac{200}{50}} = \frac{2}{1}$$

33. (C)

$$\Delta x.\Delta p = \frac{h}{4\pi}$$

Put value $\Delta p = 1.0 \times 10^{-5}$ kg ms^{-1}

34. (A)
Orbital angular momentum $= \sqrt{\ell(\ell+1)} \cdot \frac{h}{2\pi}$ for $\ell = 0$ (s-subshell) is zero.

35. (D)
E.C. (Cu) = [Ar] $4s^1\ 3d^{10}$

36. (B)

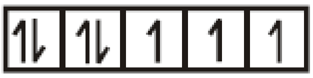
$_{30}Zn^{2+} = 1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6\ 3d^{10}$ (unpaired d $e^- = 0$)

$_{26}Fe^{2+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6$ (unpaired d $e^- = 4$)

$_{28}Ni^{3+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^7$ (unpaired d $e^- = 3$)

$_{29}Cu^{+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}$ (unpaired d $e^- = 0$)

37. (D)

d^7 = 

Total spin $= +\frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{3}{2}$

38. (A)

$K = 2e^- = 1s^2$

$L = 8e^- = 2s^2\ 2p^6$

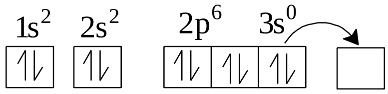
$M = 11e^- = 3s^2\ 3p^6\ 3d^3$

$N = 2e^- = 4s^2$

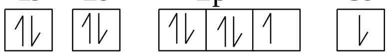
For d, $\ell = 2, 3d^3 \Rightarrow d_{e^-} = 3$

39. (C)

Ne :- $1s^2$ $2s^2$ $2p^6$ $3s^0$



Ne* :- $1s^2$ $2s^2$ $2p^5$ $3s^1$



40. (D)

$Cl^- = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

For last e^-, $n = 3, \ell = 1, m = \pm 1$

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TOPIC: QUADRATIC EQUATION

SOLUTIONS

41. (B)
More than two roots. So, all coefficients are simultaneously 0.
$p^2 - 3p + 2 = 0 \Rightarrow (p - 1)(p - 2) = 0 \Rightarrow p = 1, 2$
$p^2 - 5p + 4 = 0 \Rightarrow (p - 1)(p - 4) = 0 \Rightarrow p = 1, 4$
$p - p^2 = 0 \Rightarrow p(1 - p) = 0 \Rightarrow p = 0, 1$
common value is $p = 1$

42. (C)
$y = -2x^2 - 6x + 9$ and $a < 0$
$y_{\max} = \dfrac{-D}{4a} = 13.5$ at $x = \dfrac{-b}{2a} = -1.5$

43. (B)
$D = 81 \Rightarrow 25 + 8k = 81 \Rightarrow k = 7$

44. (B)
Equation is $\dfrac{2x + a + b}{x^2 + ax + bx + ab} = \dfrac{1}{k}$
On cross multiplying and further simplification,
we get the equation as $x^2 + (a + b - 2k)x + (ab - k(a + b)) = 0$
Sum of roots $= 0 \Rightarrow -(a + b - 2k) = 0 \Rightarrow a + b = 2k \Rightarrow k = \dfrac{a+b}{2}$
Product of roots $= ab - k(a+b) = ab - \dfrac{a+b}{2}(a+b) = \dfrac{2ab - (a+b)^2}{2} = -\dfrac{a^2 + b^2}{2}$

45. (B)
Max got the coefficient of x correct ⇒ Max got the sum of roots correct ⇒ Sum of roots = 4 + 3 = 7.
Lewis got the constant term correct ⇒ Lewis got the product of roots correct ⇒
Product of roots = 3 * 2 = 6.
So, the correct Quadratic Equation is $x^2 - 7x + 6 = 0$.
The correct roots are 1 and 6.

46. (A)
$D \ge 0 \Rightarrow 1 - 4a \ge 0 \Rightarrow a \le \dfrac{1}{4}$

$\frac{-b}{2a} > a \Rightarrow -\frac{1}{2} > a \Rightarrow a < -\frac{1}{2}$

$f(a) > 0 \Rightarrow a^2 + 2a > 0 \Rightarrow a(a+2) > 0 \Rightarrow a \in (-\infty, -2) \cup (0, \infty)$

Intersection of these three intervals is $a < -2$

47. (D)
Let the other roots be $4p$ and $3p$, and the common root be q.
From the first equation, the Sum of roots = 6. So, $4p + q = 6 \Rightarrow q = 6 - 4p$
From the second equation, the Product of roots = 6. So $(3p)q = 6$
Putting the value of q, we get $3p(6 - 4p) = 6$. Solving this we get $p = 1$ and $\frac{1}{2}$
But since the other roots are given as integers, $p = 1$ is the only valid solution.
If $p = 1$, then $q = 6 - 4p = 2$. So the common root is 2.

48. (A)
$D = 64(a + b)^2 + 64(a - b)^2 = 64(a^2 + b^2)$
Since $a \neq b$, $a^2 + b^2$ is strictly positive.
So, $D > 0 \Rightarrow$ roots are real and distinct

49. (A)
The quadratic equation is $x^2 -$ (sum of roots)x + (product of roots) = 0
Sum of roots = 4
Product of roots = –1
The Quadratic Equation is $x^2 - 4x - 1 = 0$

50. (C)
Roots are equal if $D = 0$
So $1 - 4ab = 0$
$ab = \frac{1}{4}$

51. (B)
Substitute $x^2 = t$.
Hence, $t^2 - 8t - 9 = 0 \Rightarrow (t - 9)(t + 1) = 0 \Rightarrow t = 9$ and $t = -1$
$t = 9 \Rightarrow x^2 = 9 \Rightarrow x = \pm 3$
$t = -1 \Rightarrow x^2 = -1 \Rightarrow x = \pm i$

52. (D)
Maximum of $-2x^2 + 5x + 4 = 0 = \frac{-D}{4a} = \frac{57}{8}$
Minimum of $x^2 + x + 1 = 0 = \frac{-D}{4a} = \frac{3}{4}$
Difference $= \frac{51}{8}$

53. (A)
y-intercept is positive $\Rightarrow$ Quadratic Expression at $x = 0$ is positive $\Rightarrow$ c is positive

54. (C)
One root is positive, and one root is negative $\Rightarrow$ zero lies between the roots
By location of roots, $(k - 2) * f(0) < 0 \Rightarrow (k - 2)(k + 5) < 0$

$k \in (-5, 2)$

55. (D)
$(x^2 + x + 2)$ $(x2 + x + 3) = 0 \Rightarrow x^2 + x + 2 = 0$ or $x^2 + x + 3 = 0$
Sum of roots of $x^2 + x + 2 = 0$ is $\frac{-b}{a} = -1(S_1)$
Sum of roots of $x^2 + x + 3 = 0$ is $\frac{-b}{a} = -1(S_1)$
Answer $= S_1 + S_2 = -2$

56. (C)
$D = 45 \Rightarrow D > 0$ and not a perfect square. So both roots are irrational.

57. (A)
Graph is concave up $\Rightarrow a > 0$
Vertex lies in third quadrant $\Rightarrow \frac{-b}{2a} < 0 \Rightarrow -b < 0 \Rightarrow b > 0$

58. (A)
$D = 12 - 4 = 8 \Rightarrow D > 0 \Rightarrow$ roots are real and distinct

59. (A)
In the Quadratic Expression, $a > 0$ and $D < 0$.
So, $f(x) > 0 \; \forall \; x \in R$.
So $f(9453)$ is positive.

60. (D)
$p(x)$ can be generalized as $p(x) = (x - 2)(x - 5)\, g(x) + (ax + b)$, where $(a, b) \in R$
By remainder theorem, $p(2) = 5 \Rightarrow 2a + b = 5$
$p(5) = 2 \Rightarrow 5a + b = 2$
Solving for a and b, we get $a = -1$ and $b = 7$
The required answer is $ax + b = -x + 7$