TARGET IIT-JEE

HINT & SOLUTIONS

ANSWER KEY WITH SOLUTION

CLASS XI (DATE 28-12-09)

MATHEMATICS

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

PHYSICS

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

CHEMISTRY

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

MATHEMATICS

1. C

Let $\left(15+4\sqrt{14}\right)^t = u \Rightarrow \left(15-4\sqrt{14}\right)^t = \frac{1}{u}$

Equation reduces to $u + \frac{1}{u} = 30$, $u^2 - 30u + 1 = 0$

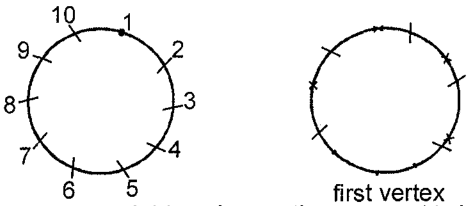
$\Rightarrow \quad u = 15 \pm 4\sqrt{14} \quad \Rightarrow t = \pm 1 \quad \Rightarrow$
$x^2 - 2|x| = 1$ or $x^2 - 2|x| = -1$

$\Rightarrow \quad |x| = 1 + \sqrt{2}$ or $(|x| - 1)^2 = 0$, $x = \pm 1$

$\Rightarrow \quad x = \pm\left(1+\sqrt{2}\right), \pm 1$

2. A

First vertex can be selected in $^{10}C_1$ ways.



first vertex

Now, two neighbouring vertices are not to be selected
Among the remaining 7 vertices 3 are to be selected & 4 are not to be selected.
Now mark the 4 vertices not to be selected by × sign and then these can be partitioned by 5 partitions from these partitions we are to select 3. This can be done in $^5C_3$ ways and these are the places where the remaining 3 vertices can be chosen

$\therefore \quad$ number of ways $= \frac{^{10}C_1 \times {}^5C_3}{4} = 25$

3. D

$\frac{N^r}{D^r} = \frac{a^4 - a^2 - 2a - 1}{a^2 - a - 1} \Rightarrow$ D is correct

4. C

$\alpha, \beta, \gamma, \delta$ are in G.P. $(r > 1)$
$\alpha + \beta = -p$; $\gamma + \delta = -q$
$\alpha\beta = 2$; $\gamma\delta = 32$
$\alpha(1 + r) = -p$; $\alpha(r^2 + r^3) = -q$
$\alpha^2 r = 2$; $\alpha r^2 . \alpha r^3 = 32$

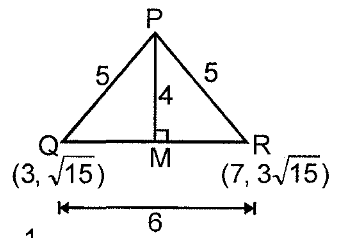
$\alpha = \pm 1$; $\frac{r^5}{r} = 16 \Rightarrow r = 2$

$p = \pm 3$, $q = \pm 12$
Roots are $\pm1, \pm2$ and $\pm4, \pm8$.

5. B

$x_1 = (\tan\theta)^{\cot\theta}$, $x_2 = (\cot\theta)^{\cot\theta}$
$x_3 = (\tan\theta)^{\tan\theta}$, $x_4 = (\cot\theta)^{\tan\theta}$ $\quad 0 < \theta < \pi/4$
$0 < \theta < \pi/4 \quad \Rightarrow \quad \tan\theta < \cot\theta$
$\therefore \quad x_1 < x_2 \; x_3 < x_2$
$x_1 < x_3$
$x_1 < x_3 < x_2$
$x_3 < x_4 < x_2$
$x_1 < x_3 < x_4 < x_2$

6. B



$A = \frac{1}{2} \times 6 \times PM$
area will be maximum when
PM will be maximum and for PM
to be maximum triangle will be isosceles.
Hence PM = 4
A = 12.

7. B

a, b, c, d are in G.P., let they are a, ar, ar^2, ar^3
$(a^2 + b^2 + c^2)(b^2 + c^2 + d^2)$
$= a^2 \times a^2[1 + r^2 + r^4][r^2 + r^4 + r^6]$
$= [a^4 r^2 [1 + r^2 + r^4]^2$
$= [a^2 r [1 + r^2 + r^4]]^2 \quad = (ab + bc + cd)^2$

8. C

$(x^2 - 2x) = (2x^2 + 2x + 3)$
$\Rightarrow \; x^2 + 4x + 3 = 0$
$\Rightarrow x = -3, -1$ which makes log not defined
$\Rightarrow x \in \phi$

9. B

Since $\cos^2\frac{\pi}{8} = \frac{\sqrt{2}+1}{2\sqrt{2}} \; \therefore$ the other root is $\frac{\sqrt{2}-1}{2\sqrt{2}}$
Sum of roots $= -b = 1 \quad , b = -1$

product of root $c = \frac{1}{8}$

$\Rightarrow \quad (b, c) = \left(-1, \frac{1}{8}\right)$

10. B

$a_1 \; a_2 \; a_3 \; ..... \; a_n \; ....$ in A.P.
$b_1 \; b_2 \; .... \; b_n \; ....$ in G.P.
1, (1+ d), ... , (1 + (n – 1)d), ... A.P.
1, r, r^2, ... , r^{n-1}, ... G.P.
$a_9 = b_9$
$1 + 8d = r^8$
$s_9 = 9/2\,[2 + (9 - 1)\,d] = 369 \Rightarrow 2 + 8d = 41 \times 2$
$d = 10 \quad \Rightarrow r^8 = 81$
$\Rightarrow \quad r^8 = (3)^4$
$r^8 = (\sqrt{3})^8$
$r = \sqrt{3}$

$b_7 = (\sqrt{3})^6 = 9 \times 3 = 27$

11. C

$\tan^2 x - 2\tan x + 2 = 5^{\sec^2 y}$

$(\tan x - 1)^2 + 1 = 5^{\sec^2 y}$ $\quad\therefore$

$y \neq (2n+1)\dfrac{\pi}{2}$

Since $\sec^2 y \geq 1$

$\therefore$ $(\tan x - 1)^2 + 1 \geq 5$

$(\tan x - 1 - 2)(\tan x - 1 + 2) \geq 0$

$\tan x \leq -1$ or $\tan x \geq 3$

$\tan x \leq -1$ or $\tan x \geq 3$

$\therefore$ $\tan x \notin (-1, 3)$

$\therefore$ $x \notin \left(n\pi - \dfrac{\pi}{4}, n\pi + \tan^{-1}(3)\right)$

12. D

$\Delta > 0$ and $D = b^2 - 4ac$ a, b, c $\in$ I

for $b^2x^2 - \Delta x + -4ac = 0$

$D = \Delta^2 + 4(4ac)\, b^2$

$= (b^2 + 4ac)^2$

Since D is perfect square so the roots will be rational and equal to $\dfrac{\Delta \pm (b^2 + 4ac)}{2b^2}$

$= \dfrac{b^2 - 4ac \pm (b^2 + 4ac)}{2b^2} = 1, \dfrac{-4ac}{b^2},$

So one integral root which is independ of a, b, c

13. A

Given $\sin\beta = \sqrt{\sin\alpha\cos\alpha}$

$\sin^2\beta = \sin\alpha \,.\, \cos\alpha$

$\cos 2\beta = 1 - 2\sin^2\beta = 1 - 2\sin\alpha\cos\alpha$

$= (\sin\alpha - \cos\alpha)^2 = 2\sin^2(\pi/4 - \alpha)$

14. D

$r - r_2 = r_3 - r_1$

$\dfrac{1}{s} - \dfrac{1}{s-b} = \dfrac{1}{s-c} - \dfrac{1}{s-a}$

$\dfrac{-b}{s(s-b)} = \dfrac{-a+c}{(s-a)(s-c)} \Rightarrow \dfrac{(s-a)(s-c)}{s(s-b)} = \dfrac{a-c}{b}$

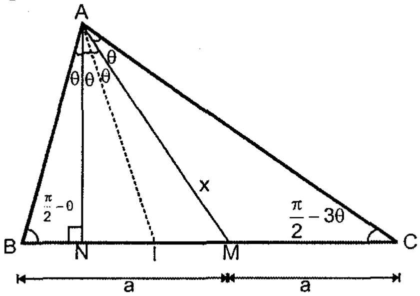
$\tan^2(B/2) = \dfrac{a-c}{b}$

But $\dfrac{B}{2} \in \left(\dfrac{\pi}{6}, \dfrac{\pi}{4}\right) \Rightarrow \tan^2\dfrac{B}{2} \in \left(\dfrac{1}{3}, 1\right)$

$\Rightarrow \dfrac{1}{3} < \dfrac{a-c}{b} < 1$

$b < 3a - 3c < 3b \Rightarrow b + 3c < 3a < 3b + 3c$

15. C



In ΔABM $\dfrac{x}{\cos\theta} = \dfrac{a}{\sin 3\theta}$ ...(i)

and in ΔAMC $\dfrac{a}{\sin\theta} = \dfrac{x}{\cos 3\theta}$ ....(ii)

From (i) and (ii)

$\sin\theta\cos\theta = \sin 3\theta\cos 3\theta$

$\Rightarrow \sin 2\theta = \sin 6\theta \Rightarrow 8\theta = \pi$

$\Rightarrow \theta = \pi/8 \Rightarrow C = \pi/8$, $B = 3\pi/8$ and $A = \pi/2$

16. D

a is A.M. between 1st and (2n + 1) th term

b is G.M. between 1st and (2n + 1)th term

c is H.M. between 1st and (2n + 1)th term

$\Rightarrow$ AM $\geq$ GM $\geq$ HM and A.M. × H.M. = $(GM)^2$

17. B

given $\alpha + \beta = p$; $\alpha\beta = -p - c$

$\alpha\beta = -(\alpha + \beta) - c$

$\alpha + \beta + \alpha\beta + 1 = 1 - c$

$(\alpha + 1)(\beta + 1) = 1 - c$

$\therefore$ $\dfrac{\alpha^2 + 2\alpha + 1}{\alpha^2 + 2\alpha + c} + \dfrac{\beta^2 + 2\beta + 1}{\beta^2 + 2\beta + c}$;

$= \dfrac{(\alpha+1)^2}{(\alpha+1)^2 - (\alpha+1)(\beta+1)} + \dfrac{(\beta+1)^2}{(\beta+1)^2 - (\alpha+1)(\beta+1)}$

$= \dfrac{\alpha+1}{(\alpha+1) - (\beta+1)} + \dfrac{\beta+1}{(\beta+1) - (\alpha+1)} = \dfrac{\alpha+1}{\alpha-\beta} + \dfrac{\beta+1}{\beta-\alpha} = 1$

18. D

99 × 97 × 95 × .... × 51

$= \dfrac{100!}{(100 \times 98 \times 96 \times \ldots\ldots \times 52)} \times \dfrac{1}{50!} = \dfrac{100! \times 25!}{2^{25} \times 50! \times 50!}$

maximum power of 3 in 100! = $\left[\dfrac{100}{3}\right] + \left[\dfrac{100}{9}\right] + \left[\dfrac{100}{27}\right] + \left[\dfrac{100}{81}\right]$ = 33 + 11 + 3 + 1 = 48.

maximum power of 3 in 50! = $\left[\dfrac{50}{3}\right] + \left[\dfrac{50}{9}\right] + \left[\dfrac{50}{27}\right]$ = 22

maximum power of 3 in 25! = $\left[\dfrac{25}{3}\right] + \left[\dfrac{25}{9}\right]$ = 8 + 2 = 10

$\therefore$ exponent of 3 = 48 + 10 – (22 × 2) = 14.

19. C

$(1 + x + x^{12})^6 = \sum \dfrac{6!}{p!\cdot q!\cdot r!} x^{q + 12r}$; where, p + q + r = 6

12r + 0	p + r = 6	7
12r + 1	p + r = 5	6
12r + 2	p + r = 4	5
12r + 3	p + r = 3	4
12r + 4	p + r = 2	3
12r + 5	p + r = 1	2
12r + 6	p + r = 0	1
		28

20. A

No. of positive terms

$$x_n = \frac{1}{4}\left[\frac{195}{{}^{n}P_n}\right] - \frac{{}^{n+3}P_3}{{}^{n+1}P_{n+1}}, (n \in N)\,;\ x_n = \frac{1}{4}\cdot\frac{195}{n!} - \frac{(n+3)!}{(n+1)!\,n!}$$

$$= \frac{1}{n!}\left[\frac{195}{4} - (n+3)(n+2)\right] > 0 \Rightarrow (n + 3)\ (n + 2) < 48.75$$

true for n = 1, 2, 3, 4 four positive terms.

21. D

$$(1 + 4x + 4x^2)^n = (1 + 2x)^{2n}$$

$a_r = {}^{2n}C_2\, 2^r \cdot a_{n+r} = {}^{2n}C_{n+r}\, 2^{n+r}$

$a_{n-r} = {}^{2n}C_{n-r}\, 2^{n-r},\ a_{2n-r} = {}^{2n}C_{2n-r}\, 2^{2n-r}$

22. C

16 things, 8 alike and 8 different

8 selections of things out of 16 , each one

8 alike or 8 different things.

$\Rightarrow {}^{8}C_0 + {}^{8}C_1 + {}^{8}C_2 + {}^{8}C_3 + {}^{8}C_4 + {}^{8}C_5 + {}^{8}C_6 + {}^{8}C_7$

$+ {}^{8}C_8 + = (1 + 1)^8 = 2^8 = 256$

23. B

Atleast one couple = (exactly one couple + exactly two couple) $= ({}^{6}C_1 . {}^{2}C_2) . ({}^{5}C_2 . {}^{2}C_1 . {}^{2}C_1) + {}^{6}C_2 . {}^{4}C_4$

$= 240 + 15 = 255$

24. B

Obviously ${}^{100}C_r \Rightarrow$ maximum value r = 50, ${}^{100}C_{50}$

25. C

coefficient of T_2, T_3, T_4 in AP.

i.e. ${}^{2n}C_1$, ${}^{2n}C_2$, ${}^{2n}C_3$ in A.P.

$2 . {}^{2n}C_2 = {}^{2n}C_1 + {}^{2n}C_3$

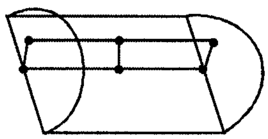
$$\Rightarrow 2 = \frac{{}^{2n}C_1}{{}^{2n}C_2} + \frac{{}^{2n}C_3}{{}^{2n}C_2} \Rightarrow 2 = \frac{2}{2n-1} + \frac{2n-2}{3}$$

$$\Rightarrow 6n - 3 = 2n^2 - 3n + 4 \Rightarrow (2n - 7)\ (n - 1) = 0$$

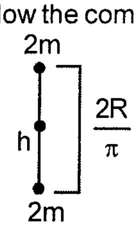
$$\Rightarrow n = \frac{7}{2} \text{ or } n = 1\ (n = 1 \text{ is rejected})$$

PHYSICS

1. B



COM of both half ring portion will lie at a height $\frac{2R}{\pi}$ from ground and com of both rods will lie at ground, below the com of rings



$$\Rightarrow h_{cm} = \frac{2R}{\pi}/2,\ h_{cm} = \frac{R}{\pi}\ ]$$

2. A

We take velocity of approach along line of collision.

In first case, $v_{app} \neq u_1 - u_2$

3 C

Correct equation is, $mv_0 \cos\theta$

$= mv + mv$ and $\frac{1}{2}mv_0^2 = \frac{1}{2}mv^2 + \frac{1}{2}mv^2 + mgh$

4. B

The forces involved are constant, path will be a parabola with axis along the direction of acceleration with respect to ground.

5. B $\dfrac{v_0^2\cos^2\theta}{g(\sin\theta\cos\theta + \sin^2\theta)}$

6. A

Energy released $= \frac{1}{2}(2.1) \times 10^3 \times 550^2$

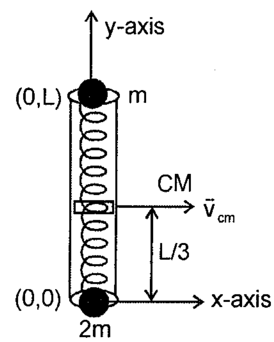
Also energy relased $= \frac{1}{2} \times \left(\frac{10 \times 10^3 \times 2.1 \times 10^3}{10 \times 10^3 + 2.1 \times 10^3}\right)(u + v)^2$

$\Rightarrow$ (u + v) = 550 × 1.1

$10 \times 10^3 v = 2.1 \times 10^3 u$ (By momentum conservation)

u = 500 m/sec

7. B



CM at height L/3 w.r.t. bottom.

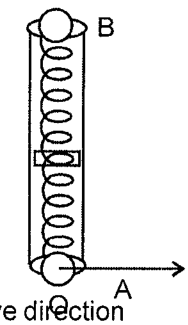
Kinetic Energy with respect to CM reference frame

$$K.E. = \frac{1}{2}mv_{1c}^2 + \frac{1}{2}mv_{2c}^2$$

$$\Rightarrow \frac{1}{2}m\left(\omega_0\frac{2L}{3}\right)^2 + \frac{1}{2}(2m)\left(\omega_0\frac{2L}{3}\right)^2$$

$$\Rightarrow \frac{1}{3}m\omega_0^2L^2$$

8. C



Total angular momentum of system about $= 0 = \vec{L}_A + \vec{L}_B$

$\vec{L}_A$ about (0) = zero as balls have negligible radius

speed of ball $B = \left(v_0 - \omega_0 . \frac{2L}{3}\right)\hat{i}$ in +ve direction

$\vec{L}_B$ about (0) = $m(\vec{r} \times \vec{v})$

$$= Lj \times m\left[\left(v_0 - \omega_0\left(\frac{2L}{3}\right)\right)\right]\hat{i} = -mL\left[v_0 - \frac{2}{3}\omega_0 L\right]\hat{k}\quad , \vec{L}_{sys} = \vec{L}_B$$

9. D

(A) Taking bodies + spring as one system then only force which would act would be spring force that will be internal forces. So net torque is zero.

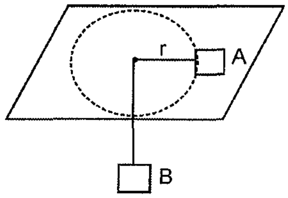
(B) In CM frame only force on each ball is central force (spring force) so angular momentum in conserved

(C) Total linear momentum is conserved as net external force acting on the system in table reference frame is zero.

(D) Net force on individual ball not zero, so momentum of individual ball is not conserved.

10. A

For (A) T = mg



For (B) $T = \frac{mv^2}{r}$

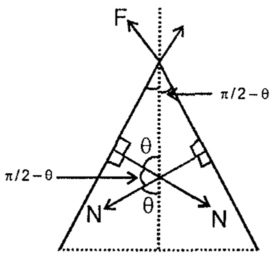
$= m\omega^2 r$

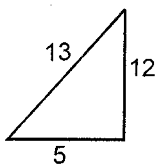
$m\omega^2 r = mg \quad \omega = \sqrt{\frac{g}{r}}$ ...(1)

K.E. of system $= \frac{1}{2}m_A v_A^2 = \frac{1}{2}(m)\left(\sqrt{\frac{g}{r}}\right)^2 = \frac{mgr}{2}$

(C) Tension is central force on A, so angular momentum remains conserved.

11. B





For equilibrium in vertical direction

$2f \sin\theta - 2N\cos\theta - mg = 0$ ...(1)

$2\mu N \sin\theta - 2N\cos\theta = mg$

$\tan\left(\frac{\pi}{2} - \theta\right) = \frac{5}{12}$, $\cot\theta = \frac{5}{12}$, $\sin\theta = \frac{12}{13}$

$\cos\theta = \frac{5}{12}$

$2(-5)\left(\frac{12}{13}\right) N - 2N \cdot \frac{5}{13} = (1)(10), N = 65$

12. D

$0 = m\Delta x_{1G} + 2m\Delta x_{2G} + 3m\Delta x_{3G}$

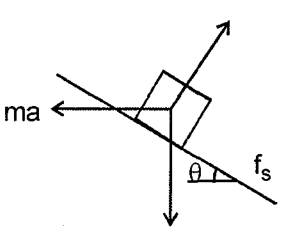
$= (\Delta x_{13} + \Delta x_{3G}) + 2(\Delta x_{23} + \Delta x_{3G}) + 3\Delta x_{3G}$

$= -2L + 2(2L) + 6\Delta x_{3G} \quad \therefore \quad \Delta x_{3G} = L/3$

13. D

$\vec{a}_{net}$ in curved path is always within curvature of trajectory.

14. A



$mg\sin\theta + f_s = ma\cos\theta$

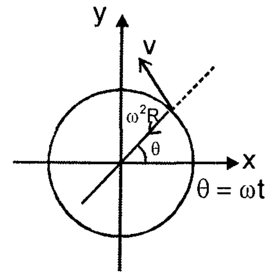
$f_s = m(a\cos\theta - g\sin\theta) \le \mu(mg\cos\theta + ma\sin\theta)$

$\therefore \quad \mu \ge \frac{a - g\tan\theta}{g + a\tan\theta} = \frac{1}{\sqrt{3}} = 0.577 \quad \Rightarrow \frac{9}{10} > 0.577$

15. A

Sol. (A) $F_y = -\omega^2 R \sin\theta$

$= -\omega^2 R \sin\omega t$

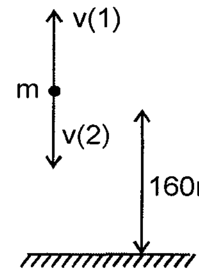


(B) $x = R\cos\theta$

(C) $\theta = \omega t$

(D) $v_x = v\sin\theta$

16. C

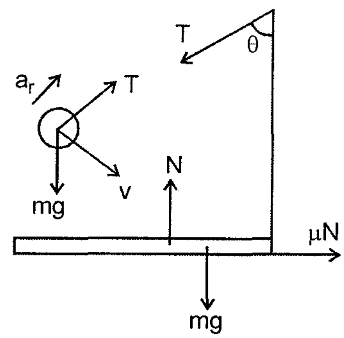


(1) : $0 = vt - \frac{1}{2}gt^2$

(2) : $160 = vt + \frac{1}{2}gt^2$

On solving, v = 20 m/s

17. A



$mg\,\ell\cos\theta = \frac{1}{2}mv^2 - 0$ ...(1)

$T - mg\cos\theta = \frac{mv^2}{\ell}$ ...(2)

$T\sin\theta \le \mu N$ ...(3)

$T\cos\theta + Mg = N$ ...(4)

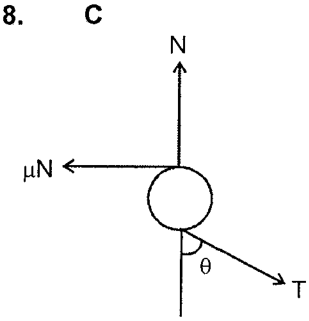
On solving

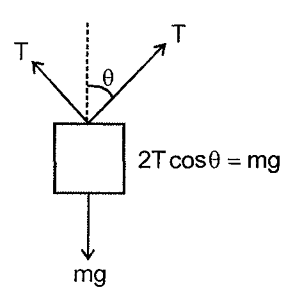
$\mu \ge \frac{\sin 2\theta}{2\left[\frac{M}{3m} + \cos^2\theta\right]}$

RHS is maximum when θ = 45°

$\mu \ge \frac{1}{\frac{2M}{3m} + 1} \simeq \frac{2m}{2M} = 3 \times 10^{-3}$

18. C





$N = T\cos\theta$
$\mu N = T\sin\theta$
$\therefore\ \tan\theta = \mu = 3/4$

$\sin\theta = \frac{3}{5} = \frac{2}{5}\quad \therefore\ d = 6m = 600\ cm$

19. B
From equilibrium $Mg = kx$
$\rho A x g = kx \Rightarrow k = 100\ N/m$

20. D
As angular displacement and angular velocity are different for different observes in the same frame, unlike displacement and velocity are same for two observers at different positions in same frame, correct options are (B) and (D).

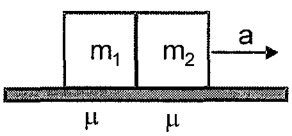
21. A
For downward motion,
$v^2 = u^2 + 2as = u^2 + 2g \times 15 = u^2 + 300$

$\therefore\ v = \sqrt{u^2 + 300}$

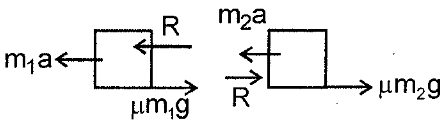
for upward motion, $u_1 = \frac{v}{2} = \frac{\sqrt{u^2+300}}{2}$

$0^2 = u_1^2 - 2g \times 15 \Rightarrow u_1^2 = 300$
$\therefore\ u = 30\ ms^{-1}$

22. B



Assume both are sliding w.r.t. platform



$\mu m_2 g + R = m_2 a$
$\mu m_1 g - R = m_1 a$

$\frac{\mu(m_1+m_2)g}{m_1+m_2} = a = \mu g$

$R = (\mu m_2 g - \mu m_2 g) = 0$

23. A
(A) Sum of three (momentum) vectors will be zero only if they are coplanar hence true in both 3 and 2 body case.
(B) & (C) In case of 3-particle collision in number of equation will be less than the number of unknowns
(D) Momentum is conserved in each case.

24. D
$U = 20 + (x-2)^2$
(A) at $x = 5$, $U = 20 + 3^2 = 29\ J$
$KE = 20\ J$
$\therefore$ Mechanical energy $= U + KE = 49\ J$
(C) $U_{min} = 20\ J$
$\therefore\ KE_{max} = 29\ J$
(B) $KE_{min} = 0$
$\therefore\ U_{max} = 49 = 20\ (x_{max} - 2)^2$
$\Rightarrow (x_{max} - 2)^2 = 29 \Rightarrow x_{max} = 2 \pm \sqrt{29}$

25. D
$v^2 = 100 - x^2$
differentiating w.r.t 'x', we get

$2v\frac{dv}{dx} = -2x \Rightarrow v\frac{dv}{dx} = -x$
$a = -x$ equations of S.H.M. $a = -\omega^2 x$

$\omega = 1\ rad/s$

$T = \frac{2\pi}{\omega} = \frac{2\times 22}{7}$

Time period, $T = \frac{44}{7} s$
$v^2 = 100 - x^2$ ....(1)
speed at position 'x'
$v^2 = \omega^2 (A^2 - x^2)$ ...(2)
comparing equation (1) & equation (2),
$A = 10\ m$
He will touch 'x' no. of times

$x = \frac{65\times 60}{T} = \frac{3900}{\left(\frac{44}{7}\right)} \simeq 621 \Rightarrow x = 621$

1. B

We have,

$$\frac{t_{mix}}{t_{O_2}} = \sqrt{\frac{M_{mix}}{M_{O_2}}} \Rightarrow \frac{234}{224} = \sqrt{\frac{M_{mix}}{32}} \; ; \; \therefore M_{mix} = 34.921$$

As the mixture contains 20% (mole %) of X, the molar ratio of O_2 and X may be represented as 0.8 n : 0.2 n, n being the total no. of moles.

$$\therefore \; M_{mix} = \frac{32 \times 0.8n + M_x \times 0.2n}{n} = 34.921$$

$\therefore$ M_x (mol. wt. of X) = 46.6

2. C **3.** C

4. C

$EuCl_2$ + $AgNO_3$ $\rightarrow$ AgCl

1 g 1.29 g

Since Cl atoms are conserved,

applying POAC for Cl atoms,

moles of Cl in $EuCl_2$ = moles of Cl in AgCl

2 × moles of $EuCl_2$ = 1 × moles of AgCl

$$2 \times \frac{1}{(x + 35.5 \times 2)} = 1 \times \frac{1.29}{(108 + 35.5)}$$

(where x ≡ atomic weight of Eu) $\therefore$ x = 151.48

5. D

Total volume of H_2 and O_2 which reacted with each other = (40 – 10) mL = 30 mL

Let the volume of H_2 which reacted be x mL.

H_2	+	O_2	$\rightarrow$	H_2O
x mL		(30 – x) mL		under similar condition of
x moles		(30 – x) moles		temperature and pressure

Applying POAC for H and O atoms,

2 × moles of H_2 = 2 × moles of H_2O ...(1)

2 × moles of O_2 = 1 × moles of H_2O ...(2)

From the eqns. (1) and (2),

moles of H_2 = 2 × moles of O_2

x = 2 × (30 – x) $\therefore$ x = 20

Total volume of hydrogen

= vol. of H_2 undergoing reaction + vol. of H_2 remained

= 20 mL + 10 mL = 30 mL

Now, total volume of gas is 40 mL.

$\therefore$ volume percentage of H_2 in the mixture

$$= \frac{30}{40} \times 100 = 75\%$$

and from Avogadro's law, mole percent of H_2 is also 75%.

6. A

[**Hint :** Wt of NO_2 = xg]

$\therefore$ obs. mol. wt. (wt./mole) =

$$\frac{\text{wt. in g}}{\text{total moles}} = \frac{100}{\left(\frac{x}{46} + \frac{100 - x}{92}\right)} = 2 \times 38.3$$

7. B

8. C

We know that, 1 amu = $\frac{1}{12}$ × weight of one ^{12}C atom

or weight of one ^{12}C atom = 12 amu

(at. wt. of C = 12 amu)

Similarly, as the atomic weight of He is 4 amu, weight of one He atom = 4 amu.

Thus, the number of atoms in 100 amu of He = $\frac{100}{4}$ = 25.

9. B

Since the hydrogen atom has only one orbit containing only one electron, the ionisation potential of the ground state of the hydrogen atom is the energy of the electron of the first orbit, i.e.,

$$E_1 = -2.17 \times 10^{-11} \text{ erg.}$$

Thus, $E_n = \frac{E}{n^2} = -\frac{2.17 \times 10^{-11}}{2^2}$ $\because$ n = 2

$\therefore$ energy of the radiation emitted,

$$\Delta E = E_2 - E_1$$

$$= -\frac{2.17 \times 10^{-11}}{2^2} - (-2.17 \times 10^{-11}) = 1.627 \times 10^{-11} \text{ erg.}$$

We know $\Delta E = h\nu = \frac{hc}{\lambda}$

Thus $\frac{hc}{\lambda} = 1.627 \times 10^{-11}$

$$\lambda = \frac{6.62 \times 10^{-27} \times 3 \times 10^{10}}{1.627 \times 10^{-11}} = 1.22 \times 10^{-5} \text{cm}$$

$$= 1220 \text{ Å} \; (1 \text{ Å} = 10^{-8} \text{ cm})$$

10. C

We have,

$$C = \sqrt{\frac{3RT_{SO_2}}{M_{SO_2}}} = \sqrt{\frac{3RT_{O_2}}{M_{O_2}}} \text{ or } \sqrt{\frac{3RT_{SO_2}}{64}} = \sqrt{\frac{3R.300}{32}}$$

$$T_{SO_2} = 600 \text{K}$$

11. C

Total pressure = 1.5 atm

Moles of A = $\frac{2}{M_A}$, Moles of B = $\frac{3}{M_B}$

Total moles = $\frac{2}{M_A} + \frac{3}{M_B}$

Partial pressure of A = $\frac{2/M_A}{2/M_A + 3/M_B} \times 1.5$

and partial pressure of B = $\frac{3/M_B}{2/M_A + 3/M_B} \times 1.5$

As given, partial pressure of A = 1 atm.

Partial pressure of B = 1.5 – 1 = 0.5 atm

Thus, $\frac{2/M_A}{2/M_A + 3/M_B} = \frac{1}{0.5} = 2$

$$\frac{3/M_B}{2/M_A + 3/M_B} \times 1.5 \text{ or } \frac{2}{3} \times \frac{M_B}{M_A} = 2 \text{ or } \frac{M_A}{M_B} = \frac{1}{2}$$

12. B

Mol. wt. of the mixture = density (g/L) × molar volume (L) = 1.3 × 22.4 = 29.12

Now let the no. of moles of O_2 and N_2 be n_1 and n_2 respectively.

$\therefore$ mol. wt. of the mixture = $\frac{32n_1 + 28n_2}{n_1 + n_2}$

$\therefore \frac{32n_1 + 28n_2}{n_1 + n_2} = 29.16$

from which, we get mole fraction of O_2

$= \frac{n_1}{n_1 + n_2} = 0.28$

At NTP, p = 1 atm

$\therefore$ partial pressure of $O_2 = \frac{n_1}{n_1 + n_2} \times p = 0.28 \times 1$

= 0.28 atm.

13. A

Central carbon form π bond with adjacent carbons by using its pure p - orbitals. Lets say using p_y & p_z respectively, then two flourine of first carbon will be in xz-plane while two flourines of 2nd carbon will be in xy-plane, as it has to use s + p_x + p_y to make three sp^2 hybridised orbitals.

14. B

15. C

If CO is added 2^{nd} equilibrium will proceede in the backward direction and concentration of Cl_2 will decrease.

This Cl_2 will be further formed by the decomposition of PCl_5.

16. C

$2\,KMnO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow K_2SO_4 + 2\,MnSO_4 + 8\,H_2O + 5O_2$

17. B 18. D 19. B

20. B

$$N_2O_2 \rightleftharpoons 2NO_2$$

Pressure at equilibrium 0.28 1.1

$$K_P = \frac{(P_{NO_2})^2}{P_{N_2O_4}} = \frac{4^2}{2} = 8\,atm$$

Now if volume of container is doubled, i.e., pressure decreases and will become half, the reaction will proceed in the direction where the reaction shows an increase in mole, i.e., decomposition of N_2O_4 is favoured.

New pressure at equilibrium

$$N_2O_4 \rightleftharpoons 2NO_2$$
$$(1-P) \qquad (2+2P)$$

Where reactant N_2O_2 equivalent to pressure P is used up in doing so.

Again, $8 = \frac{[2+2P]^2}{[1-P]} \Rightarrow P = 0.45$

$\therefore$ Now $P_{N_2O_4} = 1 - 0.45 = 0.55\,atm$

P_{NO_2} at new eq. = 2 + 0.9 = 2.9

21. B

Suppose each gas has a mass of X g.

Therefore, $O_2 : H_2 : CH_4$

Weight - X X X

No. of mole - $\frac{X}{32}$ $\frac{X}{2}$ $\frac{X}{16}$ (Rule 1)

Volume ratio - $\frac{X}{32} : \frac{X}{2} : \frac{X}{16}$ (Avogadro's principle)

Hence, $O_2 : H_2 : CH_4 = 1 : 16 : 2$.

22. B

Suppose the tribasic acid is H_3A

$$H_3A \longrightarrow Ag_3A \longrightarrow Ag$$

acid salt

0.607 gm 0.37 g

Since Ag atoms are conserved, applying POAC for Ag, atoms,

moles of Ag atoms in Ag_3A = moles of Ag atoms in the product

3 × moles of Ag_3A = moles of Ag in the product

$$3 \times \frac{0.607}{\text{mol. wt of } Ag_3A} = \frac{0.37}{108}$$

mol. wt. of Ag_3A = 531

$\therefore$ mol. weight of tribasic acid (H_3A)

= mol. wt of the salt (Ag_3A) – 3 × at. wt of Ag + 3 × at wt of H

$\Rightarrow$ 531 – 324 + 3 = 210

23. B

$$AB \longrightarrow A^+ + B^-$$

Let compound be 100% ionic

$\mu = q \times d = 4.8 \times 10^{-10} \times 1.5 \times 10^{-8}$

$= 4.8 \times 1.2$

$\therefore$ % Ionic character = $\frac{\mu_{obs}}{\mu_{ther}} \times 100$

$= \frac{1.2}{4.8 \times 1.5} \times 100 = 16.67\,\% \Rightarrow$ Covalent character

= 100 – 16.67 = 83.37%

24. A

25. B

$10FeC_2O_4 + 6KMnO_4 + 24\,H_2SO_4 \rightarrow 5Fe_2(SO_4)_3 + 20\,CO_2 + 6\,MnSO_4 + 3K_2SO_4 + 24\,H_2O$