DATE : 5/07/09 | ANSWER KEY | TEST - 2 (XI^{TH})

MATHS

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

PHYSICS

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

CHEMISTRY

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

HINT & SOLUTION

MATHEMATICS

1. **B**

Sol. Let $\tan\frac{3\pi}{11} + 4\sin\frac{2\pi}{11} = k$

$$\frac{3\tan\frac{\pi}{11} - \tan^3\frac{\pi}{11}}{1 - 3\tan^2\frac{\pi}{11}} + \frac{8\tan\frac{\pi}{11}}{1+\tan^2\frac{\pi}{11}} = k$$

$$\frac{3x - x^3}{1-3x^2} + \frac{8x}{1+x^2} = k \quad \left(where\ x = \tan\frac{\pi}{11}\right)$$

S.O.B.S.

$(11x - 22x^3 - x^5)^2 = k^2(1 - 2x^2 - 3x^4)^2$ ..... (1)

Again forming the equation whose roots are

$\pm\tan\frac{\pi}{11}$, $\pm\tan\frac{2\pi}{11}$, $\pm\tan\frac{3\pi}{11}$, $\pm\tan\frac{4\pi}{11}$,

$\pm\tan\frac{5\pi}{11}$, it is ......

$x^{10} - 55x^8 + 330x^6 - 462x^4 + 165x^2 - 11 = 0$

$\Rightarrow (11x - 22x^3 - x^5)^2 = 11(1 - 2x^2 - 3x^4)^2$ ...... (2)

Compare (1) & (2)

$k^2 = 11 \Rightarrow k = \sqrt{11}$

$\therefore \tan\frac{3\pi}{11} + 4\sin\frac{2\pi}{11} = \sqrt{11}$

2. B

Sol. $x = X\cos\theta - Y\sin\theta$

$y = X\sin\theta + Y\cos\theta$ $\qquad x^2 + 4xy + y^2$

$(X\cos\theta - Y\sin\theta)^2 + 4(X\cos\theta - Y\sin\theta)(X\sin\theta - Y\cos\theta)$

$+ (X\sin\theta - Y\cos\theta)^2$

$= X^2 + Y^2 + 4[X^2\cos\theta\sin\theta + XY(\cos^2\theta - \sin^2\theta) - Y^2\sin\theta\cos\theta]$

co-efficient of XY = 0 $\Rightarrow \cos^2\theta = \sin^2\theta$

or $\theta = \frac{\pi}{4}$

3. **B**

Sol. $\sin\frac{13\pi}{14} = \sin\left(\pi - \frac{\pi}{14}\right) = \sin\frac{\pi}{14}$

$\sin\frac{11\pi}{14} = \sin\left(\pi - \frac{3\pi}{14}\right) = \sin\frac{3\pi}{14}$

$\sin \frac{9\pi}{14} = \sin\left(\pi - \frac{5\pi}{14}\right) = \sin \frac{5\pi}{14}$

$\sin \frac{7\pi}{14} = \sin \frac{\pi}{2} = 1$

$\therefore \sin \frac{\pi}{14} . \sin \frac{3\pi}{14} . \sin \frac{5\pi}{14} . \sin \frac{7\pi}{14} . \sin \frac{9\pi}{14} .$

$\sin \frac{11\pi}{14} . \sin \frac{13\pi}{14} = \left(\sin \frac{\pi}{14} . \sin \frac{3\pi}{14} . \sin \frac{5\pi}{14}\right)^2$

$= \left[\cos\left(\frac{\pi}{2} - \frac{\pi}{14}\right) . \cos\left(\frac{\pi}{2} - \frac{3\pi}{4}\right) . \cos\left(\frac{\pi}{2} - \frac{5\pi}{10}\right)\right]^2$

$= \left[\cos \frac{6\pi}{14} . \cos \frac{4\pi}{14} . \cos \frac{2\pi}{14}\right]^2$

$= \left[-\cos \frac{\pi}{7} . \cos \frac{2\pi}{7} . \cos \frac{4\pi}{7}\right]^2$

$= \left[\frac{-\sin\left(2^3 \frac{\pi}{7}\right)}{2^3 \sin \frac{\pi}{7}}\right]^2 = \left[\frac{-\sin \frac{8\pi}{7}}{8 \sin \frac{\pi}{7}}\right]^2 = \left(\frac{1}{8}\right)^2 = \frac{1}{64}$

4. C

Sol. $3 \sin x - 4 \sin^2 x = k$, $\quad 0 < k < 1$

$k = \sin 3x$

$\sin 3A = k$ & $\sin 3B = k$

$\Rightarrow 0 < 3A < \pi$ & $0 < 3B < \pi$

Now $\sin 3A = k$ & $\sin 3B = k$

$\Rightarrow \sin 3A - \sin 3B = 0$

$\Rightarrow 2 \cos 3\left(\frac{A+B}{2}\right) = 0$ or $\sin 3\left(\frac{A-B}{2}\right) = 0$

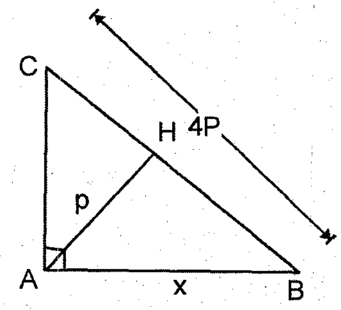
$\sin \frac{3}{2}(A - B) \neq 0$ $\quad [A > B$ & $0 < 3A < \pi$, $0 < 3B < \pi]$

Hence $\cos \frac{3}{2}(A + B) = 0$ $\quad \frac{3}{2}(A + B) = \frac{\pi}{2}$

$\Rightarrow A + B = \frac{\pi}{3}$ $\quad \therefore C = \pi (A + B) = \frac{2\pi}{3}$

5. B

Sol. Let AH be perpendicular from A to BC such that AH = p .



Then BC = 4p . Let AB = x , AC = y .

$x^2 + y^2 = (4p)2$

Δ ABH, $\quad p^2 + BH^2 = x^2$

$\Rightarrow p^2 + (4p - k)^2 = x^2$ where $k = CH$

Δ ACH $\quad p^2 + CH^2 = y^2 \Rightarrow p^2 + k^2 = y^2$

$\Rightarrow 2p^2 + (4p - k)^2 = (4p)^2$

$\Rightarrow k = 2p - \sqrt{3}\, p$. $BH = 2p + \sqrt{3}\, p$

$\therefore \tan B = 2 - \sqrt{3}$ $\quad B = 15°$ or $75°$.

6. B

Sol. $\cos A + \cos B + \cos C = \sin A + \sin B + \sin C = 0$

or $(\cos A + \cos B + \cos C)^2 + (\sin A + \sin B + \sin C)^2 = 0$

or $(\cos^2 A + \cos^2 B + \cos^2 C + 2 \cos B \cos C + 2 \cos C \cos A + 2 \cos A \cos B)$
$+(\sin^2 A + \sin^2 B + \sin^2 C + 2 \sin B \sin C + 2 \sin C \sin A + 2 \sin A \sin B) = 0$

or $(\cos^2 A + \sin^2 A) + (\sin^2 B + \cos^2 B) + (\sin^2 C + \cos^2 C) + 2(\cos C \cos A + \sin C \sin A)$
$+ 2(\cos A \cos B + \sin A \sin B) + 2(\cos B \cos C + \sin B \sin C) = 0$

or $2[\cos(B - C) + \cos(C - A) + \cos(A - B)] = -3$

$\therefore \cos(A - B) + \cos(B - C) + \cos(C - A) = -\frac{3}{2}$

7. B

Sol. Since $\alpha < \beta < \gamma < \delta$ and

$\sin\alpha = \sin\beta = \sin\gamma = \sin\delta = k$

$\therefore \beta = \pi - \alpha \quad \gamma = 2\pi + \alpha, \quad \delta = 3\pi - \alpha$

$\Rightarrow 4 \sin \frac{\alpha}{2} + 3 \sin \frac{\beta}{2} + 2 \sin \frac{\gamma}{2} + \sin \frac{\delta}{2}$

$\Rightarrow 4 \sin \frac{\alpha}{2} + 3 \cos \frac{\alpha}{2} - 2 \sin \frac{\alpha}{2} + \sin \frac{\alpha}{2}$

$\Rightarrow 2 \sin \frac{\alpha}{2} + 2 \cos \frac{\alpha}{2} = 2\sqrt{1 + \sin\alpha}$

$= 2\sqrt{1 + k}$

8. **A**

Sol. $\sin x + \sin^2 x = 1 \qquad \sin x = \cos^2 x$

$= \cos^6 x\,(\cos^6 x + 3\cos^4 x + 3\cos^2 x + 1) - 1$

$= \cos^6 x\,(\cos^2 x + 1)^3 - 1 = \sin^3 x\,(\sin x + 1)^3 - 1$

$= (\sin^2 x + \sin x)^3 - 1 = 1 - 1 = 0$

9. **C**

Sol. $\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1-\cos\frac{3\pi}{8}\right)\left(1-\cos\frac{\pi}{8}\right)$

$\Rightarrow\left(1-\cos^2\frac{\pi}{8}\right)\left(1-\cos^2\frac{3\pi}{8}\right)=\left(\sin\frac{\pi}{8}.\sin\frac{2\pi}{8}\right)^2$

$= \frac{1}{4}\left(2\sin\frac{3\pi}{8}.\sin\frac{\pi}{8}\right)^2 = \frac{1}{4}\left(\cos\frac{\pi}{4}-\cos\frac{\pi}{2}\right)^2 = \frac{1}{8}$

10. D

Sol. $2\cos^2\frac{x}{2}\sin^2 x = x^2 + \frac{1}{x^2}$

L H S has maximum value = 2

R H S has minimum value = 2 at x = 1

$\therefore$ no solution .

11. D

Sol. $20\sin^2\theta + 21\cos\theta - 24 = 0$

$\Rightarrow 20\cos^2\theta - 21\cos\theta + 4 = 0$

$\cos\theta = \frac{21 \pm 11}{40} \quad = \frac{4}{5}$ or $\frac{1}{4}$

rejecting $\frac{1}{4}$ since it is not in range $\frac{7\pi}{4} < \theta < 2\pi$

$\cos\theta = \frac{4}{5} \Rightarrow \cos\frac{\theta}{2} = \frac{3}{\sqrt{10}} \Rightarrow \sin\frac{\theta}{2} = -\frac{1}{\sqrt{10}}$

$\therefore \cot\frac{\theta}{2} = -3$

12. C

Sol. $[x] + \sum_{r=1}^{2000}\frac{\{x+r\}}{2000}$ for r = 1 $\{x+1\} = \{x\}$

r = 2 $\{x+2\} = \{x\}$

So, $\sum_{r=1}^{2000}\frac{\{x+r\}}{2000} = \left[\frac{\{x\}}{2000}+\frac{\{x\}}{2000}+\ldots\ldots+2000\text{ times}\right]$

$= \frac{2000\{x\}}{2000} = \{x\}$ So, $[x] + \sum_{r=1}^{2000}\frac{\{x+r\}}{2000} = [x]+\{x\}=x$

So, (C) is correct .

13. **D**

Sol. Let $a = \frac{x}{x-1}$ and $b = x \quad a+b = \frac{x^2}{x-1}$

The given equation becomes

$|a| + |b| = |a+b|$

But this equality holds if, $ab \geq 0 \quad \frac{x^2}{x-1} \geq 0$

Critical points are 0, 1 $\therefore x \in \{0\} \cup (1.\infty)$

14. **A**

Sol. $\frac{1}{\log_{bc^2} abc} = \frac{1}{\frac{\log abc}{\log bc^2}} \Rightarrow \frac{\log bc^2}{\log abc}$

$\frac{\log bc^2}{\log abc}+\frac{\log ca^2}{\log abc}+\frac{\log ab^2}{\log abc} = \frac{\log a^3b^3c^3}{\log abc} = 3$

15. **C**

Sol. $|x-2|^{10x^2-1} = |x-2|^{3x} \quad x - 2 = 0 \Rightarrow \quad x = 2$

$10x^2 - 1 = 3x \qquad 10x^2 - 3x - 1 = 0$

$x = -1/5 \qquad x = 1/2$

16. **D**

Sol. $\frac{2^{4\log_2 a} - 3^{1/3\log_3 (a^2+1)^3} - 2a}{7^{2\log_7 a} - a - 1}$

$\Rightarrow \frac{a^4 - a^2 - 2a - 1}{a^2 - a - 1}$

$= \frac{a^4 - (a+1)^2}{a^2 - a - 1} = a^2 + a + 1$

17. **C**

Sol. $\log_{10}\left(\frac{3x^2+12x+19}{3x+4}\right) = 1$

$\Rightarrow 3x^2 + 12x + 9 = 30x + 40$

$3x^2 - 18x - 21 = 0 \qquad x^2 - 6x - 7 = 0$

$\Rightarrow x = 7$ or $x = -1$

18. D

SoL $2 - \log^2 (x^2 + 3x) \geq 0 \quad \log_2 (4/x^2 + 3x) \geq 0$

$4/x^2 + 3x - 1 \geq 0 \Rightarrow \dfrac{(x^2 + 3x - 4)}{(x^2 + 3x)} \leq 0$

$\Rightarrow \dfrac{(x + 4)(x - 1)}{(x + 3)} \leq 0$ but $x(x + 3) > 0$

19. B

Sol. A $\log_{200}5$ + B $\log_{200}2$ = C

$\dfrac{A \log 5}{\log 200} + \dfrac{B \log 2}{\log 200} = C$

A log 5 + B log 2 = C log 200 = C log(5^2 2^3) = 2C log 5 + 3 C log 2

hence, A = 2C

B = 3C

for no common factor greater than 1, C = 1

∴ A = 2; B = 3 ⇒ A + B + C = 6 Ans.]

20. A

Sol. $60^a = 3 \Rightarrow a = \log_{60}3$

$60^b = 5 \Rightarrow b = \log_{60}5$

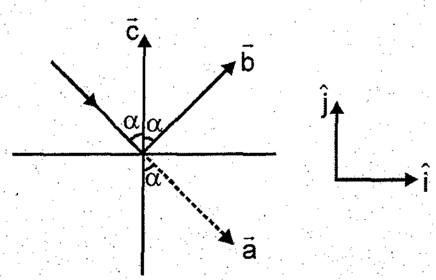
let $x = 12^{\frac{1-a-b}{2(1-b)}}$

$\log_{12}x = \dfrac{1-a-b}{2(1-b)} = \dfrac{1-(\log_{60}15)}{2(1-\log_{60}5)}$

∴ $\log_{12}x = \log_{144}4 = \log_{12}2 \Rightarrow x = 2$ Ans.]

PHYSICS

1. $\vec{a}, \vec{b}$ and $\vec{c}$ are shown in figure. Let α be the angle of incidence, which is also equal to the angle of reflection.



$\vec{a} = \sin\alpha\,\hat{i} - \cos\alpha\,\hat{j}$

$\vec{b} = \sin\alpha\,\hat{i} + \cos\alpha\,\hat{j}$

∴ $\vec{b} - \vec{a} = 2\cos\alpha\,\hat{j}$

or $\vec{b} = \vec{a} + 2\cos\alpha\,\hat{j}$

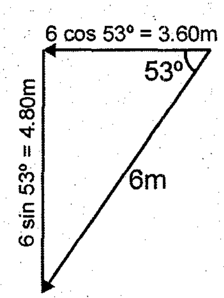
now $\vec{a}.\vec{c}$ = (1) (1) cos (180° – α) = – cos α

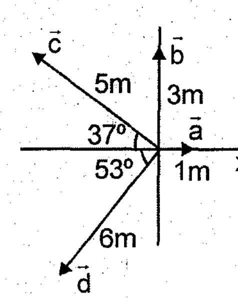
∴ $\vec{b} = \vec{a} - 2(\vec{a}.\vec{c})\,\hat{j}$

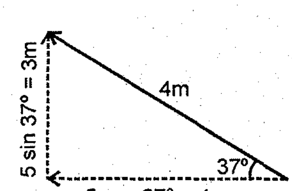
or $\vec{b} = \vec{a} - 2(\vec{a}.\vec{c})\vec{c}$ $(\hat{j} = \vec{c})$

2. We can slide a vector to any convenient position as long as we do not change the direction and magnitude of the vector. This process is called **vector translation.** We can place the tails of all the three vectors at the origin of the coordinate system. We label the vectors as a, b, c and d. We find the components of the vectors. Components of vectors c and d have been shown in figure (a) and (b).

	a	b	c	d
x-components	+ 1	0	– 4	– 3.60
y-components	0	+ 3	3	– 4.80







Any compment of vector directed along a positive axis has a positive component, but any component vector whose direction is along a negative axis has a minus sign associated with the corresponding component.

$R_x = 1 + 0 - 4 - 3.60 = -6.60$ m

$R_y = 0 + 3.00 + 3.00 - 4.80 = +1.20$

Magnitude of resultant,

$$|\vec{R}| = \sqrt{R_x^2 + R_y^2} = \sqrt{(6.60)^2 + (1.20)^2} = 6.708 \text{ m}$$

3. We know that

$$\vec{v} = \vec{u} + \vec{a}t$$

$$\Rightarrow \quad v = \sqrt{u^2 + (at)^2 + 2u(at)\cos\theta}$$

Here, $\theta = 90°$

$$\Rightarrow \quad v = \sqrt{(0.4)^2 + (0.2 \times 4)^2}$$

$$\Rightarrow \quad v = \sqrt{0.8} \text{ m/s}$$

4. Given that

$$\frac{dv}{dt} = \sin t + \frac{1}{(t+1)^2}$$

$$\Rightarrow v = -\cos t - \frac{1}{(t+1)} + C_1$$

When $t = 0$, $v = 0$

$\Rightarrow \quad C_1 = 2$

Therefore equation (i) becomes

$$v = 2 - \cos t - \frac{1}{t+1}$$

or $$\frac{ds}{dt} = 2 - \cos t - \frac{1}{t+1}$$

$$\Rightarrow \quad \int_0^S dS = \int_0^{2\pi} \left(2 - \cos t - \frac{1}{t+1}\right) dt$$

$\Rightarrow \quad S = 4\pi - \log[2\pi + 1]$

5. $a = v.\dfrac{dv}{ds} \Rightarrow \dfrac{dv}{ds} = 1s^{-1}$ (constant)

$\therefore \quad a = v$

or acceleration versus velocity graph will be a straight line passing through origin with slope $1s^{-1}$.

6. When a ball is dropped on a floor then

$$y = \frac{1}{2}gt^2 \qquad ...(1)$$

So, the graph between y and t is a parabola and here y is decreases as time is increase and when the ball is bounces back then

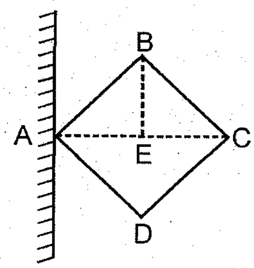
$$y = ut - \frac{1}{2}gt^2 \qquad ...(2)$$

Eq. (ii) is also the form of a general equation of parabola. So the graph between y and t be a parabola. Here, y is increases when time is increase. Hence, the require graph between y and t is given as

So, the correct answer is (B)

7. Let AC = x and BE = y

Then, $BE^2 + AE^2 = l^2$



or $$y^2 + \left(\frac{x}{2}\right)^2 = l^2$$

$$\therefore \quad 2y\left(\frac{dy}{dt}\right) + \frac{x}{2}.\frac{dx}{dt} = 0$$

$$\therefore \quad \left(-\frac{dy}{dt}\right) = \frac{1}{2}\left(\frac{x}{2y}\right).\frac{dx}{dt}$$

x = 2y, when the rhombus is a square.

Hence, $v_B = \dfrac{1}{2}v_c = \dfrac{v}{2}$

8. a = ks (k = positive constant)

$$\therefore \quad v.\frac{dv}{ds} = ks$$

or $v \,.\, dv = ks \,.\, ds \quad \therefore \quad v = (\sqrt{k})s$

i.e., v-s graph will be a straight line the passing through origin.

9. If 'n' balls are thrown vertically upward each second, next ball being thrown when the first reaches at its highest point i.e., at max. height 'h', then time taken by one ball to reach highest point is given by :

$$t = \left(\frac{1}{n}\right)s \qquad ...(1)$$

Now, at highest point, final velocity = v = 0 ...(2)

Therefore using equation,

v = u + at, we have

$0 = u - (g)(1/n)$ [Using (1) & (2)]

$$\Rightarrow \quad u = \frac{g}{n} \qquad ...(3)$$

Also, $v^2 = u^2 + 2aS$

or $0 = u^2 - 2gh$ [Using (2)]

$\Rightarrow$ $h = (u^2/2g)$

or $h = \frac{g}{2n^2}$ [Using (3)]

$\Rightarrow$ $n = \left[\frac{g}{2h}\right]^{1/2}$

Substituting g = 10 ms^{-2}; h = 5 m, we get n = 1 ball per second that is 60 balls per minute.

10. Let, v = maximum velocity attained by motor cycle

x_1 = distance covered during acceleration 'α'

x_2 = distance covered during retardation 'β'

Then we have :

$$v^2 = 2\alpha x_1 \Rightarrow x_1 = \frac{v^2}{2\alpha} \quad ...(1)$$

Also, $v^2 = 2\beta x_2 \Rightarrow x_2 = \frac{v^2}{2\beta}$ ...(2)

Now, total distance is given by :

$$x = x_1 + x_2 = \frac{v^2}{2\alpha} + \frac{v^2}{2\beta} \quad \text{[Using (1) and (2)]}$$

Substituting x = 1500 m; α = 5 ms^{-2}; β = 10 ms^{-2}, we get

$$v = 100\ ms^{-1} \quad ...(3)$$

Futher, let t_1 = time taken for acceleration α

t_2 = time taken for retardation β.

Then, we have :

$$v = \alpha t_1 \Rightarrow t_1 = \frac{v}{\alpha} \quad ...(4)$$

$$v = \beta t_2 \Rightarrow t_2 = \frac{v}{\beta} \quad ...(5)$$

Now, total time t is given by :

$$t = t_1 + t_2 = \frac{v}{\alpha} + \frac{v}{\beta} \quad \text{[Using (4) and (5)]}$$

Substituting v = 100 ms^{-1} [from (3)],

$$\alpha = 5\,ms^{-2},\ \beta = 10\,ms^{-2}$$

we get t = 30 s.

11. First velocity increases and then decreases after opening of the parachute.

12. Graph depicts two displacements for the particles at certain instant.

13. Time taken to cover n metres is given by

$n = \frac{1}{2}gt_n^2$. That is $t_n = \sqrt{\frac{2n}{g}}$

Time taken to cover (n + 1) metres is given by

$$t_{n+1} = \sqrt{\frac{2(n+1)}{g}}$$

$$t_{n+1} - t_n = \sqrt{\frac{2(n+1)}{g}} - \sqrt{\frac{2n}{g}} = \sqrt{\frac{2}{g}}[\sqrt{n+1} - \sqrt{n}]$$

This gives ratio as :

$\sqrt{1}, \sqrt{2} - \sqrt{1}, \sqrt{3} - \sqrt{2}$ etc.

14. Interval of the ball thrown = 2 s

Now, for more than two balls (i.e., minimum three) to be in air, we have time of flight of first ball > 4s

i.e., T = 4

or $\frac{2u}{g} > 4 \Rightarrow u > 19.6\,ms^{-1}$

15. $T_0 = \frac{2L}{V}$ and $T = \frac{L}{V+v} + \frac{L}{V-v} = \frac{2LV}{V^2 - v^2}$

Hence $T/T_0 = 1/(1 - v^2/V^2)$.

16. The velocity first decreases and then becomes constant (terminal velocity)

17. $v_x = \frac{dx}{dt} = \frac{dy}{dt}\cdot\frac{dx}{dy}$

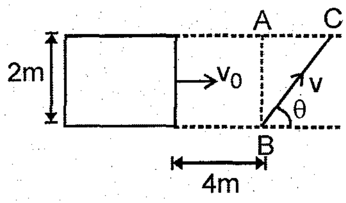
Since $x = \sqrt{l^2 - y^2}$

$\therefore$ $\frac{dx}{dy} = -\frac{y}{\sqrt{l^2 - y^2}}$

$\therefore$ $v_x = -\frac{y}{\sqrt{l^2 - y^2}}\cdot\frac{dy}{dt} = \frac{y\,|v_y|}{\sqrt{l^2 - y^2}}$

Thus, the speed of the lower end gets smaller and smaller and vanishes at y = 0

18. Let the man starts crossing the road at an angle θ as shown in figure. For safe crossing the condition is that the man must cross the road by the time the truck describes the distance 4 + AC or 4 + 2 cot θ.

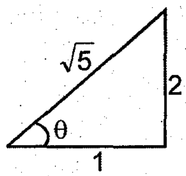


$$\therefore \frac{4+2\cot\theta}{8}=\frac{2/\sin\theta}{v}$$

or $v=\dfrac{8}{2\sin\theta+\cos\theta}$ ..(1)

For minimum v, $\dfrac{dv}{d\theta}=0$

or $\dfrac{-8(2\cos\theta-\sin\theta)}{(2\sin\theta+\cos\theta)^2}=0$



or $2\cos\theta-\sin\theta=0$

or $\tan\theta=2$

From eq. (1)

$$v_{min}=\frac{8}{2\left(\frac{2}{\sqrt{5}}\right)+\frac{1}{\sqrt{5}}}=\frac{8}{\sqrt{5}}=3.57\,m/s$$

19. Figure shows the initial and final positions of straight lins AB and CD. AB moves with veloicty v_1 and CD with v_2 respectively.

The point of intersection of the two lines will travel to O′.

$$OF=\frac{v_1\Delta t}{\sin\alpha}=EO'$$

$$OE=\frac{v_2\Delta t}{\sin\alpha}=FO'$$

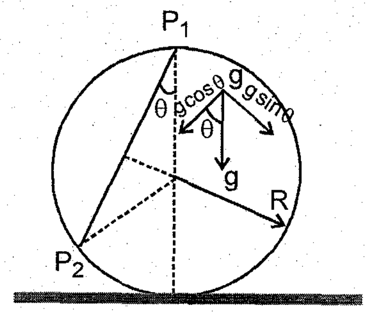
Hence

$OO'=\sqrt{OF^2+OE^2+2OF.OE\cos\theta}=v\Delta t$

where v is velocity of point of intersection.

$$v=\frac{1}{\sin\alpha}\sqrt{v_1^2+v_2^2+2v_1v_2\cos\alpha}$$

20.



Length of the chord $P_1P_2 = 2R\cos\theta$

Acceleration of beam along wire = $g\cos\theta$

From equation, $v_f^2=v_i^2+2ax$

$= 0^2 + 2(g\cos\theta)(2R\cos\theta)$

or $v_f=2\sqrt{gR}\cos\theta$

CHEMISTRY

1. $C_2H_6 + C_3H_6 + O_2 \rightarrow CO_2 + H_2O$

x 2x V

POAC on C

$2x + 6x$ = volume of CO_2

$8x = 80 \Rightarrow x = 10$

POAC on H

$6x + 12x = 2 \times$ moles of H_2O

$\dfrac{18x}{2}$ = moles of $H_2O \Rightarrow$ moles of $H_2O = 9x$

POAC on O

$2 \times V = 2 \times 80 + 9x$

$2V = 160 + 9x$

$= 160 + 90 = 250$

$\Rightarrow V = 125$ ml

2. 1000 ml solution ———— M moles of NaOH

1000 × 1.2 gm sol. ———— M moles of NaOH

1200 gm sol. ———— M × 40 gm NaOH

(1200 – 40 M) gm solvent

$$X_{NaOH}=\frac{M}{M+\frac{1200-40M}{18}}$$

$$X_{H_2O}=\frac{(1200-40M)/18}{M+\frac{1200-40M}{18}} \Rightarrow \frac{0.2}{0.8}=\frac{M\times18}{1200-40M}$$

$72M = 1200 - 40M$

$M = 10.7$

3. wt of NaOH = $100\times\frac{30}{100}+100\times\frac{90}{100}=120\,gm$

moles of NaOH = $\frac{120}{40}$ = 3

molarity = $\frac{3}{0.2}$ = 15

4. $Fe + O_2 \rightarrow FeO + Fe_2O_3$

1 0.65 0 0

x y

1 = x + 2y ...(1)

2 × 0.65 = x + 3y

1.30 = x + 3y ...(2)

$\frac{x}{y}=\frac{4}{3}$

5. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

v ml 80 ml

v + 80 – (volume of CO_2 + unreacted O_2) = x

reacted O_2 = x ml

Unreacted O_2 = 80 – x = 20

x = 60

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

V 60

volume of CO_2 formed = 30 ml

v = 30

volume of CO_2 in the original mix = 10 ml

6. $2x + 3y \rightarrow x_2$ 1/3

$\frac{w}{36}$ $\frac{w}{24}$

both x & y are limiting

mass of x_2O_3 = $\frac{w}{36}\frac{1}{2}=\frac{w}{72}$

wt of x_2o_3 = $\frac{w}{72}\times(72+72)$ = 2w

B and c both are correct.

7. $2H_3PO_4 + 3Mg(OH)_2 \rightarrow Mg_3(PO_4)_2 + H_2O$

n mole $\frac{58}{58}$ = 1mole

moles of H_3PO_4 = 2/3

wt. of H_3PO_4 = $\frac{2}{3}\times 98$

= 65.3 gm

12. $NH_3 + HNO_2 \rightarrow NH_4NO_2$

$\frac{34}{17}$ = 2mole $\frac{70.5}{47}$ = 1.5mole $\downarrow\Delta$

N_2

HNO_2 is the limiting reactant

moles of N_2 = 1.5

volume of N_2 at S.T.P

= 1.5 × 22.4 = 33.6 lit

14. $C_2H_6 + C_2H_2 + O_2 \rightarrow CO_2 + H_2O$

n n 200

volume of CO_2 = 4 n

unreacted O_2 = 4n

reacted O_2 = (200 – 4n)

POAC on H

6n + 2n = 2 × moles of H_2O

4n = moles of H_2O

POAC on O

(200 – 4n) × 2 = 2 × 4n + 4n

200 – 4n = 4n + 2n

200 = 10n

n = 20

reduction in volume = 2n + 200 – 4n – 4n

= 200 – 6n = 200 – 120

= 80 ml.

17. 100 ml sol. ⟶ 2 gm NaCl + 4gm $CaCl_2$ + 6 gm NH_4Cl

100 ml sol. ⟶ $\frac{2}{58.5}$ moles NaCl + $\frac{4}{111}$ moles of $COCl_2$ + $\frac{6}{53.5}$ moles NH_4Cl

moles of Cl^- = $\frac{2}{58.5}+\frac{4}{111}\times2+\frac{6}{53.5}$

Molarity = $\frac{\text{moles of } Cl^-}{0.1}$ = 2.18

20. $SO_3 + H_2O \rightarrow H_2SO_4$

$\frac{13.5}{18}=0.75$

wt. of SO_3 = 0.75 × 80 = 60

% of SO_3 in oleum sample = 60