

S1. Ans.(c)

Sol. We can not determine the maximum value of given function.

S2. Ans.(b)

Sol.

$$\frac{\sin(y-z)+\sin(y+z)+2\sin y}{\sin(x-z)+\sin(x+z)+2\sin x}$$

$$\Rightarrow \frac{\sin y \cos z - \cos y \sin z + \sin y \cos z + \cos y \sin z + 2\sin y}{\sin x \cos z - \cos x \sin z + \sin x \cos z + \cos x \sin z + 2\sin x}$$

$$\Rightarrow \frac{2\sin y \cos z + 2\sin y}{2\sin x \cos z + 2\sin x} \Rightarrow \boxed{\frac{\sin y}{\sin x}}$$

Alternate Method

options are independent of z

so put z = 0

hence equation becomes =  $\boxed{\frac{\sin y}{\sin x}}$

S3. Ans.(b)

Sol.

$$\frac{\sin(x+y)-2\sin x+\sin(x-y)}{[\cos(x-y)+\cos(x+y)-2\cos x]} \times \frac{\sin 10x-\sin 8x}{\cos 10x+\cos 8x}$$

$$\Rightarrow \frac{2\sin x \cos y - 2\sin x}{2\cos x \cos y - 2\cos x} \times \frac{\sin 10x - \sin 8x}{\cos 10x + \cos 8x}$$

( $\sin A - \sin B = \cos(A+B)/2 \cdot \sin(A-B)/2$  &  $\cos A + \cos B = \cos(A+B)/2 \cdot \cos(A-B)/2$ )

$$\Rightarrow \frac{2\sin x \cos y - 2\sin x}{2\cos x \cos y - 2\cos x} \times \frac{2\cos 9x \times \sin x}{2\cos 9x \times \cos x}$$

$$\Rightarrow \frac{\sin x}{\cos x} \times \frac{\sin x}{\cos x} = \boxed{\tan^2 x}$$

S4. Ans.(b)

Sol.

By Hit and Trial

$$b^2x^2 - a^2y^2 = a^2b^2 \dots(i)$$

Now, putting the value of x and y in Eq. (i), we get

$$\Rightarrow b^2(a \sec \theta)^2 - a^2(b \tan \theta)^2 = a^2b^2$$

$$\Rightarrow b^2a^2 \sec^2 \theta - a^2b^2 \tan^2 \theta = a^2b^2$$

$$\Rightarrow a^2b^2(\sec^2 \theta - \tan^2 \theta) = a^2b^2$$

$$\therefore a^2b^2 = a^2b^2$$

$$[\because \sec^2 \theta - \tan^2 \theta = 1]$$

Hence, option (b) is the right answer.

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S5. Ans.(b)

Sol.

$$\Rightarrow \frac{2 \sin\left(\frac{x+y}{2}\right) \cos\left(\frac{x-y}{2}\right) \times 2 \sin\left(\frac{x-y}{2}\right) \times \cos\left(\frac{x+y}{2}\right)}{2 \cos\left(\frac{x+y}{2}\right) \cdot \cos\left(\frac{x-y}{2}\right) \cdot 2 \sin\left(\frac{x+y}{2}\right) \sin\left(\frac{x-y}{2}\right)}$$

$$\Rightarrow 1$$

Method-2

$$\frac{[(\sin x + \sin y)(\sin x - \sin y)]}{[(\cos x + \cos y)(\cos y - \cos x)]}$$

$$\Rightarrow \frac{\sin^2 x - \sin^2 y}{\cos^2 y - \cos^2 x}$$

$$\Rightarrow \frac{(\sin^2 x - \sin^2 y)}{[-(1 - \sin^2 x) + (1 - \sin^2 y)]}$$

$$\Rightarrow \frac{\sin^2 x - \sin^2 y}{(\sin^2 x - \sin^2 y)}$$

$$= 1$$

S6. Ans.(b)

Sol.

$$3 \sin^2 \phi + 4 \cos^2 \phi$$

$$\text{or } 3 \sin^2 \phi + 3 \cos^2 \phi + \cos^2 \phi$$

$$= 3 + \cos^2 \phi \quad (\because \text{maximum value of } \cos^2 \phi = 1)$$

$$= 3 + 1 = 4$$

S7. Ans.(b)

Sol.

$$\begin{aligned} &\Rightarrow \frac{\frac{\sin 5\theta}{\cos 5\theta} + \frac{\sin 3\theta}{\cos 3\theta}}{4 \cos 4\theta \left( \frac{\sin 5\theta}{\cos 5\theta} - \frac{\sin 3\theta}{\cos 3\theta} \right)} \\ &\Rightarrow \frac{\sin 5\theta \cos 3\theta + \sin 3\theta \cos 5\theta}{4 \cos 4\theta (\cos 3\theta \sin 5\theta - \sin 3\theta \cos 5\theta)} \\ &\Rightarrow \frac{\sin 2 \times 4\theta}{4 \cos 4\theta \cdot \cos 2\theta} \\ &\Rightarrow \frac{2 \sin 4\theta \cos 4\theta}{4 \cos 4\theta \cdot \sin 2\theta} \Rightarrow \frac{2 \times 2 \sin 2\theta \cdot \cos 2\theta}{4 \sin 2\theta} \\ &\Rightarrow \cos 2\theta \end{aligned}$$

S8. Ans.(c)

Sol.

Given: Vertical pole = AB; Middle point of AB = C or

$AC = \frac{AB}{2}$ ; Angle  $\angle APC = \beta$  and  $BP = n AB$ .

Let  $\angle CPB = \alpha$ .

Therefore  $\angle APB = \alpha + \beta$ .

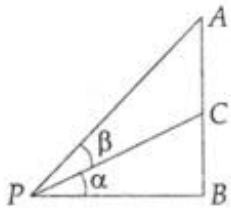
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We know that in  $\triangle CPB$ ,  $\tan \alpha = \frac{CB}{BP} = \frac{CB}{\frac{AB}{2n}} = \frac{AB}{2nAB} = \frac{1}{2n}$ .

Similarly, in  $\triangle APB$ ,  $\tan (\alpha + \beta) = \frac{AB}{BP} = \frac{AB}{\frac{AB}{n}} = \frac{1}{n}$ .

We also know that  $\beta = \alpha + \beta - \alpha$  or  $\tan \beta = \tan \{(\alpha + \beta) - \alpha\}$

$$= \frac{\tan(\alpha + \beta) - \tan \alpha}{1 + \tan(\alpha + \beta) \tan \alpha} = \frac{\frac{1}{n} - \frac{1}{2n}}{1 + \frac{1}{n} \times \frac{1}{2n}} = \frac{n}{2n^2 + 1}$$

$$\therefore \left\{ \tan(x - y) = \frac{\tan x - \tan y}{1 + \tan x \tan y} \right\}$$

S9. Ans.(d)

Sol.

Given,  $\tan \theta = \frac{3}{4} = \frac{p}{b}$

Then,

$$h = \sqrt{p^2 + b^2} = \sqrt{9 + 16} = \sqrt{25} = 5$$

$$\therefore \sin \theta = \frac{p}{h} = \frac{3}{5}$$

$$\cos \theta = \frac{b}{h} = \frac{4}{5}$$

Now,

$$25x \sin^2 \theta \cos \theta = \tan^2 \theta$$

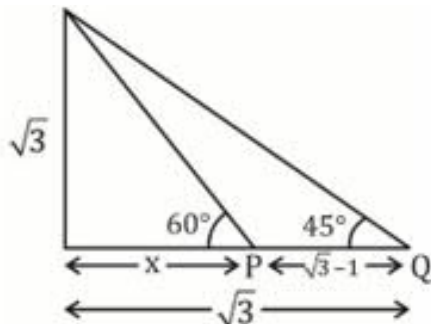
$$\Rightarrow 25 \cdot x \cdot \left(\frac{3}{5}\right)^2 \cdot \frac{4}{5} = \left(\frac{3}{4}\right)^2$$


$$\Rightarrow 25 \cdot x \cdot \frac{9}{25} \cdot \frac{4}{5} = \frac{9}{16}$$


$$\therefore x = \frac{5}{64}$$

S10. Ans.(a)

Sol.




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Let height of light house =  $\sqrt{3}$

$\tan 45 = \text{height/base}$

Base =  $\sqrt{3}$

$\tan 60 = \frac{\sqrt{3}}{x}$

$x = 1$ , therefore,

$(\sqrt{3} - 1) \text{ distance} \rightarrow 60 \times 4 (\sqrt{3} - 1)$

$1 \rightarrow 240$

HENCE, (height)  $\sqrt{3} \rightarrow 240\sqrt{3}$

S11. Ans.(a)

Sol.

$$\begin{aligned} & \frac{1}{\sin^4(90-\theta)} + \frac{1}{[\cos^2(90-\theta)]-1} \\ &= \frac{1}{\cos^4\theta} + \frac{1}{\sin^2\theta - 1} \\ &= \frac{1}{\cos^4\theta} \frac{\cos^2\theta}{\cos^2\theta} \\ &= \frac{\sin^2\theta}{\cos^4\theta} = \tan^2\theta \sec^2\theta \end{aligned}$$

Alternate (putting method)

Put  $\theta = 45$

$$\begin{aligned} &= \frac{1}{\sin^4 45} + \frac{1}{\cos^2 45 - 1} \\ &= 2 \times 2 - \frac{1}{\frac{1}{2} - 1} \\ &= 4 - 2 = (2) \end{aligned}$$

Option (1) Satisfying =  $1 \times (\sqrt{2})^2 = 2$

S12. Ans.(c)

Sol.

$$\begin{aligned} \sin \theta + \sin^2 \theta + \sin^3 \theta &= 1 \\ \sin \theta + \sin^3 \theta &= \cos^2 \theta \\ \sin \theta (1 + \sin^2 \theta) &= \cos^2 \theta \\ \sin^2 \theta (1 + \sin^2 \theta)^2 &= \cos^4 \theta \\ (1 - \cos^2 \theta)(1 + (1 - \cos^2 \theta))^2 &= \cos^4 \theta \\ (1 - \cos^2 \theta)(2 - \cos^2 \theta)^2 &= \cos^4 \theta \\ (1 - \cos^2 \theta)(4 + \cos^4 \theta - 4 \cos^2 \theta) &= \cos^4 \theta \\ 4 + \cos^4 \theta - 4 \cos^2 \theta - 4 \cos^2 \theta - \cos^6 \theta + 4 \cos^4 \theta &= \cos^4 \theta \\ \cos^6 \theta - 4 \cos^4 \theta + 8 \cos^2 \theta &= 4 \end{aligned}$$



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S13. Ans.(c)

Sol.

$$\frac{[\tan(90-A) + \cot(90-A)]^2}{2 \sec^2(90-2A)}$$

Put  $A = 30$  or  $45^\circ$

$$= \frac{[1+1]^2}{2} = 2$$

S14. Ans.(a)

Sol.

$$\sin(90-x)\cos[\pi-(x-y)] + \cos(90-x)\sin[\pi-(y-x)]$$

Put  $x = y = 45$

$$\sin 45 \times -\cos 0 + \cos 45 \times 0$$

$$= -\frac{1}{\sqrt{2}} = \text{Option (1)}$$

= - Cos y

Alternate method

$$-\cos x \cos(x-y) - \sin x(\sin(x-y))$$

$$\text{as } (\cos a \cos b + \sin a \sin b = \cos(a-b))$$

$$-[\cos x \cos(x-y) + \sin x(\sin(x-y))]$$

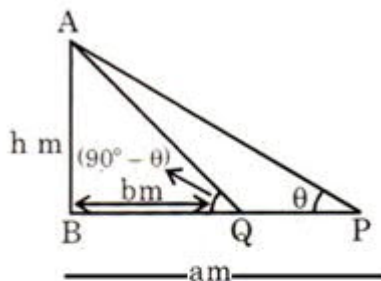
$$-\cos[x-x+y] = -\cos y$$

Option (1)

S15. Ans.(c)

Sol.

Let  $AB = h$  m



$$\angle APB = \theta^\circ$$

From  $\Delta ABP$ ,

$$\tan \theta = \frac{AB}{BP} = \frac{h}{a} \dots\dots\dots(i)$$

From  $\Delta ABQ$ ,

$$\tan(90^\circ - \theta) = \frac{AB}{BQ}$$


$$\cot \theta = \frac{h}{b}$$

$$\tan \theta = \frac{b}{h} \dots\dots\dots(ii)$$

From equation (i) and (ii),

$$\frac{h}{a} = \frac{b}{h}$$

$$h^2 = ab$$



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$$\therefore h = \sqrt{ab} \text{ m}$$

$$AQ = \sqrt{ab + b} = \sqrt{b(a + 1)}$$

S16. Ans.(d)

Sol.

Let  $A = B = C = D$

So,

$$\sin 0 \cos 0 + \sin 0 \cos 0 + \sin 0 \cos 0$$

$$= 0$$

S17. Ans.(b)

Sol.

$$\Rightarrow \frac{4 \sin A \cos^3 A - 4 \cos A \sin^3 A}{-\sin 4A}$$

$$\Rightarrow \frac{4 \sin A \cos A (\cos^2 A - \sin^2 A)}{-2 \sin 2A \cos 2A}$$

$$\Rightarrow \frac{4 \sin A \cos A \cos 2A}{-2 \sin 2A \cos 2A}$$

$$\Rightarrow -1 \quad \text{since } [\sin 2A = 2 \sin A \cos A]$$

S18. Ans.(b)

Sol.

Pythagorean triplets, we know that (8, 15, 17) is

$$\therefore 17 \left( \frac{8}{17} \cos A + \frac{15}{17} \sin A \right)$$

$$\text{Let there be a angle B for which } \sin B = \frac{8}{17}, \cos B = \frac{15}{17}$$

$$= 17(\sin B \cos A + \cos B \sin A) + 15$$

$$= |17 \sin(A + B)| + 15$$

We know that

$$\sin(A + B)_{\max} = 1$$

$$\sin(A + B)_{\min} = -1$$

$$\therefore \text{max value} = 17 \times 1 + 15 = 32$$

$$\text{Min value} = 17 \times (-1) + 15 = -2$$

S19. Ans.(b)

Sol.

$$\sin \frac{\theta}{2} \sin \frac{9\theta}{2} + \cos \frac{3\theta}{2} \cos \frac{13\theta}{2}$$

$$= \frac{1}{2} \left[ 2 \sin \frac{\theta}{2} \sin \frac{9\theta}{2} + 2 \cos \frac{3\theta}{2} \cos \frac{13\theta}{2} \right]$$

$$\left[ \begin{array}{l} \text{As we know } 2 \sin A \sin B = \cos(A - B) - \cos(A + B) \\ 2 \cos A \cos B = \cos(A + B) + \cos(A - B) \end{array} \right]$$


$$\Rightarrow \frac{1}{2} [\cos 4\theta - \cos 5\theta + \cos 8\theta + \cos 5\theta]$$

$$\Rightarrow \frac{1}{2} [\cos 4\theta + \cos 8\theta]$$

$$= \frac{1}{2} \times 2 \cos 6\theta \cdot \cos 2\theta \quad \text{since } (\cos A + \cos B = 2 \cos \frac{A+B}{2} \cdot \cos \frac{A-B}{2})$$

$$= \cos 6\theta \cdot \cos 2\theta$$

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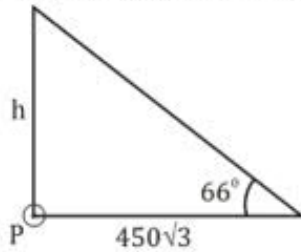
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S20. Ans.(b)

Sol.

Given below fig is drawn according to question



$$\tan 60 = \frac{h}{450\sqrt{3}}$$

$$h = 450\sqrt{3} \times \sqrt{3}$$

in 6 minutes, it achieved a height of 1350 m

$$\text{speed} = \frac{450 \times 3}{6 \times 60} = 3.75 \text{ m/s}$$

S21. Ans.(b)

Sol.

$$\frac{\text{Speed of Man}_1}{\text{Speed of Man}_2} = \sqrt{\frac{\text{Time taken by Man}_2}{\text{Time taken by Man}_1}}$$

$$\frac{8}{\text{Speed of Man}_2} = \sqrt{\frac{4\frac{4}{5}}{3\frac{1}{3}}} = \sqrt{\frac{24}{5} \times \frac{3}{10}} = \sqrt{\frac{36}{25}}$$

$$\text{Speed of Man}_2 = \frac{5}{6} \times 8 = \frac{20}{3} \text{ km/hr}$$

$$= 6\frac{2}{3} \text{ km/hr}$$

S22. Ans. (b)

Sol.

Let slower speed = x

$$x \times 4.5 \text{ hr} = (x + 5) \times (4.5 - 0.5) \text{ hr.}$$

$$x = 40 \text{ km/hr.}$$

S23. Ans.(b)

Sol.

Speed of boat in still water = x km/h (say)

and that of stream = y km/h

Then,

$$x + y = \frac{1}{\frac{7.5}{60}} = \frac{1 \times 600}{75} = 8$$

$$x + y = 8 \text{ and } x - y = 5$$

$$\text{So, Speed of boat} = \frac{1}{2}(8 + 5)$$

$$= 6.5 \text{ km/h}$$

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S24. Ans.(b)

Sol.

$$\text{Speed} = 72 \text{ km/hr}$$

$$T = 9 \text{ min}$$

$$D = S \times T$$

$$D = 72 \times \frac{9}{60} = \frac{54}{5} \text{ km}$$

To get in 8 min

$$\text{Speed should be} = \frac{54 \times 60}{5 \times 8} = 81 \text{ km/hr}$$

$$\text{increased speed} = (81 - 72) = 9 \text{ km/hr}$$

S25. Ans.(a)

Sol.

1st case

$$T_A \quad T_B$$

$$x+1 \quad x$$

On engines failure for train B

	Old	New	
$S_B \rightarrow$	3	2	
$T_B \rightarrow$	2	3	
	$\times 4$	$1 = (3+1)$	
	4 hour		

B takes 8 hour

So, A takes 9 hour

$$\text{Speed of A} = \frac{720}{9} = 80 \text{ km/hr}$$

S26. Ans.(b)

Sol.

$$S_1 = 60, S_2 = 108$$

ACCORDING TO QUESTION

$$\frac{D}{60} - \frac{D}{108} = 2$$

$$48D = 2 \times 60 \times 108$$

$$D = 270 \text{ km}$$

Alternate

$S_A : S_B$	$T_A : T_B$
$60 : 108$	$9 : 5$
$5 : 9$	$\times \frac{1}{2}$
	$4 = 2 \text{ hour}$
	$1 = \frac{1}{2} \text{ hour}$

$$\text{Distance} = 9 \times \frac{1}{2} \times 60 = 270$$

Or

$$\text{Distance} = 5 \times \frac{1}{2} \times 108 = 270$$

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S27. Ans. (b)

Sol.

Let's 't' time taken to arise the water level by 7 cm.

$$\text{Now radius of Pipe} = \frac{14}{2} = 7 \text{ cm}$$

⇒ water flow by pipe = volume of tank

$$\pi \times \frac{7}{100} \times \frac{7}{100} \times 5 \times \frac{5}{18} \times t = 50 \times 44 \times \frac{7}{100}$$

$$t = 7200 \text{ sec}$$

$$t = \frac{7200}{60 \times 60} = 2 \text{ h}$$

S28. Ans.(b)

Sol.

Suppose the distance b/w X & Y be K km.

Then, it takes  $\frac{3K}{B}$  hours to cover  $\frac{3}{4}$  K km.

& It takes  $\frac{1K}{S}$  hrs to cover  $\frac{1}{4}$  K km

Average Speed

$$\begin{aligned} &= \frac{\frac{3}{4}K + \frac{1}{4}K}{\frac{\frac{3}{4}K}{B} + \frac{\frac{1}{4}K}{S}} = \frac{K(BS)}{\frac{3}{4}KS + \frac{1}{4}KB} \\ &= \frac{4BS}{3S+B} \text{ km/hr} \end{aligned}$$

S29. Ans.(c)

Sol.

Distance is  $12 \times \frac{9}{2} = 54$  km

New time = 3 hr

Therefore, new speed =  $\frac{54}{3} = 18$  km/hr

S30. Ans.(d)

Sol.

ATQ,

Length are same

$$(x - 6) \times 5 = (x - 7.5) \times 5.5$$

$$x = 22.5 \text{ km/hr}$$

$$\text{And length} = (22.5 - 6) \times 5 \times 5/18$$

$$= 22.92 \text{ metre}$$



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