QB

# X TRIGONOMETRIC RATIOS

1) Which of the following is not defined?
(a) $\cos 0°$ (b) $\tan 45°$ (c) $\sec 90°$ (d) $\sin 90°$

ans:- $\cos 90° = 0$
$\sec 90°$ = not defined (c)

2) The maximum value of $\frac{1}{\operatorname{cosec}\theta}$ $(0° \le \theta \le 90°)$ is
(a) 1 (b) 0 (c) $\frac{1}{2}$ (d) $\sqrt{3}/2$

ans:- $1/\operatorname{cosec}\theta = \sin\theta$

| | | | | | |
|---|---|---|---|---|---|
| | $0°$ | $30°$ | $45°$ | $60°$ | $90°$ |
| $\theta$ | 0 | $\frac{1}{2}$ | $\frac{1}{\sqrt{2}}$ | $\frac{\sqrt{3}}{2}$ | 1 |

$\therefore$ maximum value is 1 (a)

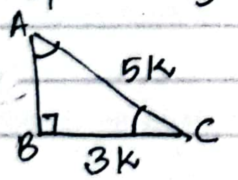
3) If $\tan A = \frac{3}{4}$ and A is acute, then the value of $\cos A$ is
(a) $\frac{5}{4}$ (b) $\frac{5}{3}$ (c) $\frac{3}{5}$ (d) $\frac{4}{5}$

ans:- $\tan A = \frac{3}{4}$

$\sec^2 A = 1 + \tan^2 A = 1 + \frac{9}{16} = \frac{25}{16} \Rightarrow \sec A = \frac{5}{4}$

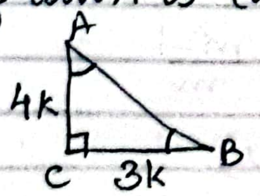
$\therefore \cos A = \frac{1}{\sec A} = \frac{4}{5}$ (d)

4) In $\triangle ABC$, if $\angle B = 90°$, $\sin A = \frac{3}{5}$, then the value of $\cos C$ is
(a) $\frac{5}{4}$ (b) $\frac{4}{5}$ (c) $\frac{3}{5}$ (d) $\frac{5}{3}$

ans:-



$\cos C = \frac{BC}{AC} = \frac{3k}{5k} = \frac{3}{5}$ (c)

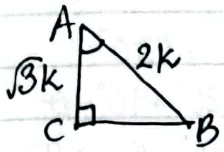
5) In $\triangle ABC$, if $\angle A + \angle B = 90°$, $\cot B = \frac{3}{4}$, then the value of $\tan A$ is (a) $\frac{4}{5}$ (b) $\frac{3}{4}$ (c) $\frac{4}{3}$ (d) $\frac{3}{5}$

ans:-


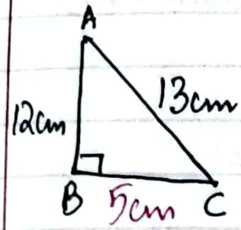

$\tan A = \frac{BC}{AC} = \frac{3k}{4k} = \frac{3}{4}$ (b)

6) If $\sec A = \frac{2}{\sqrt{3}}$ and $\angle A + \angle B = 90°$, then the value of $\operatorname{cosec} B$ is

(a) $\frac{1}{\sqrt{3}}$ (b) $\frac{\sqrt{3}}{2}$ (c) $\frac{2}{\sqrt{3}}$ (d) $\sqrt{3}$

ans:- 


$\operatorname{cosec} B = \frac{AB}{AC} = \frac{2k}{\sqrt{3}k} = \frac{2}{\sqrt{3}}$ (c)

7) 


$\tan A - \cot C$ is equal to

(a) $\frac{7}{13}$ (b) $-\frac{7}{13}$ (c) $\frac{5}{12}$ (d) 0

ans:- Using Pythagoras Theorem in rt. $\angle\triangle ABC$, $BC^2 = AC^2 - AB^2$

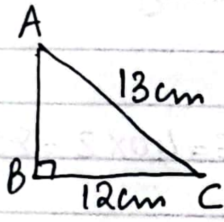
$= 13^2 - 12^2$

$= 169 - 144 = 25$

$BC = 5cm$

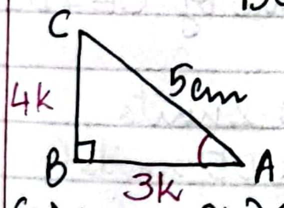
$\tan A = \frac{BC}{AB} = \frac{5}{12}$ ; $\cot C = \frac{BC}{AB} = \frac{5}{12}$

$\therefore \tan A - \cot C = \frac{5}{12} - \frac{5}{12} = 0$ (d)

8) 


In the figure, $AC = 13cm$, $BC = 12cm$, then $\sec C$ is equal to (a) $\frac{13}{12}$ (b) $\frac{5}{12}$ (c) $\frac{12}{13}$ (d) $\frac{5}{13}$

ans:- $\sec C = \frac{AC}{BC} = \frac{13}{12}$ (a)

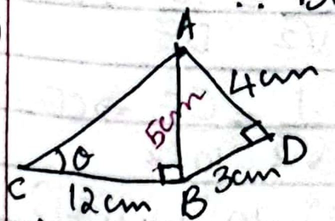
9) 


In the given figure, $\triangle ABC$ is right-angled at B and $\tan A = \frac{4}{3}$. If $AC = 5cm$, the length of BC is

(a) 4cm (b) 3cm (c) 12cm (d) 9cm

ans:- $\tan A = \frac{BC}{AB} = \frac{4k}{3k} = \frac{4}{3}$ ; $k = 1$

$\therefore BC = 4cm$ (a)

10) 

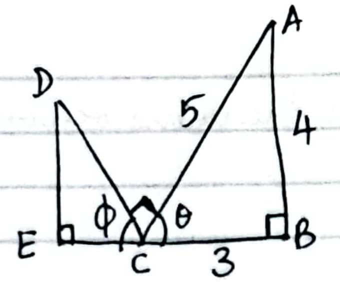

In the given figure, $AD = 4cm$, $BD = 3cm$ and $CB = 12cm$, the value of $\cot\theta$ is

(a) $\frac{12}{5}$ (b) $\frac{5}{12}$ (c) $\frac{13}{12}$ (d) $\frac{12}{13}$

Ans:- In rt. $\triangle ABD$, $AB^2 = AD^2 + BD^2 = 4^2 + 3^2 = 16 + 9 = 25$

$AB = 5cm$

$\therefore \cot\theta = \frac{BC}{AB} = \frac{12}{5}$ (a)

11) 


In the given figure, the value of $\cos\phi$ is (a) $\frac{5}{4}$ (b) $\frac{5}{3}$ (c) $\frac{3}{5}$ (d) $\frac{4}{5}$

Ans:- Since ECB is a straight line, $\phi + 90^\circ + \theta = 180^\circ$

$\Rightarrow \phi = 180^\circ - 90^\circ - \theta$

$\Rightarrow \phi = 90^\circ - \theta \rightarrow (1)$

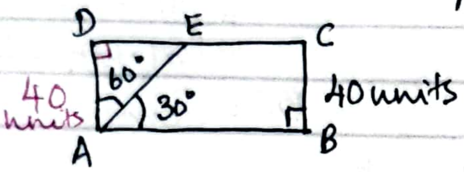
In rt. $\triangle ABC$, $\angle A + \theta + 90^\circ = 180^\circ$

$\Rightarrow \angle A = 180^\circ - 90^\circ - \theta$

$\Rightarrow \angle A = 90^\circ - \theta \rightarrow (2)$

From (1) and (2), $\phi = \angle A$

$\therefore \cos\phi = \cos A = \frac{AB}{AC} = \frac{4}{5}$ (d)

12) 


If ABCD is a rectangle, then AE is equal to

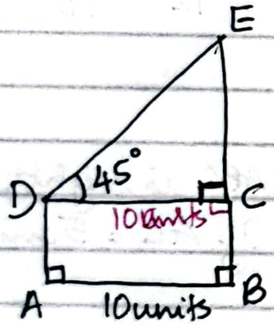
(a) 80units (b) 90units

(c) 85units (d) 70units.

Ans:- $BC = AD = 40$ units (opposite sides of rectangle ABCD)

In $\triangle ADE$, $\cos A = \frac{AD}{AE} \Rightarrow \cos 60^\circ = \frac{40}{AE}$

$\Rightarrow \frac{1}{2} = \frac{40}{AE} \Rightarrow AE = 40 \times 2 = 80$ units (a)

13) 


In the figure, the value of CE + DE (using $\sqrt{2} = 1.41$) is

(a) 36.15units (b) 48.2units

(c) 24.1 units (d) 12.05 units.

Ans:- In rectangle ABCD, $AB = CD = 10$ units

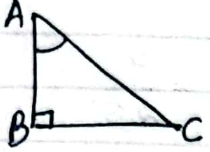
In rt. $\triangle DCE$, $\cos 45^\circ = \frac{DC}{DE} \Rightarrow \frac{1}{\sqrt{2}} = \frac{10}{DE} \Rightarrow DE = 10\sqrt{2}$ units

$\sin 45^\circ = \frac{CE}{DE} \Rightarrow \frac{1}{\sqrt{2}} = \frac{CE}{10\sqrt{2}} \Rightarrow CE = 10$ units

$\therefore CE + DE = 10 + 10\sqrt{2} = 10(1+\sqrt{2}) = 10(1+1.41)$

$= 10 \times 2.41 = 24.1$ units (c)

14) If A is an acute angle in a right $\triangle ABC$, right-angled at B, then the value of $\sin A + \cos A$ is
(a) equal to 1 (b) greater than 1 (c) less than 1 (d) 2

ans:- 

$$\sin A + \cos A = \frac{BC}{AC} + \frac{AB}{AC} = \frac{BC+AB}{AC}$$

Since $BC + AB > AC$, $\sin A + \cos A > 1$ (b)

15) If $\cos\theta = \frac{1}{2}$, then the value of $\cos\theta - \sec\theta$ is

(a) $\frac{3}{2}$ (b) $-\frac{3}{2}$ (c) $\frac{\sqrt{3}}{2}$ (d) $-\frac{\sqrt{3}}{2}$

ans: $\cos\theta = \frac{1}{2} \Rightarrow \theta = 60°$

$\therefore \cos 60° - \sec 60° = \frac{1}{2} - 2 = \frac{1-4}{2} = -\frac{3}{2}$ (b)

16) If $\cot A = \frac{12}{5}$, then the value of $(\sin A + \cos A) \times \operatorname{cosec} A$ is

(a) $\frac{13}{5}$ (b) $\frac{17}{5}$ (c) $\frac{14}{5}$ (d) 1

ans:- $(\sin A + \cos A)\operatorname{cosec} A = \sin A \cdot \operatorname{cosec} A + \cos A \cdot \operatorname{cosec} A$

$$= \frac{\cancel{\sin A}^{1}}{\cancel{\sin A}_{1}} + \frac{\cos A}{\sin A}$$

$$= \cot A + 1 = \frac{12}{5} + 1 = \frac{12+5}{5} = \frac{17}{5} \text{ (b)}$$

17) If $\operatorname{cosec} A = 2$, then the value of $\cot A + \frac{\sin A}{1+\cos A}$ is

(a) $\frac{2}{3}$ (b) $\frac{3}{2}$ (c) 2 (d) $\frac{1}{2}$

ans:- $\cot A + \frac{\sin A}{1+\cos A} = \frac{\cos A}{\sin A} + \frac{\sin A}{1+\cos A} = \frac{\cos A(1+\cos A)+\sin^2 A}{\sin A(1+\cos A)}$

$$= \frac{\cos A + (\cos^2 A + \sin^2 A)}{\sin A\,(1+\cos A)}$$

$$= \frac{\cancel{\cos A + 1}}{\sin A\,\cancel{(1+\cos A)}} = \frac{1}{\sin A} = \operatorname{cosec} A = 2 \text{ (c)}$$

18) If $\sec\alpha = \frac{5}{4}$, then the value of $\frac{1-\tan\alpha}{1+\tan\alpha}$ is

(a) 2 (b) 7 (c) $\frac{1}{7}$ (d) $\frac{2}{7}$

Ans:- $\tan^2\alpha = \sec^2\alpha - 1 = \frac{25}{16} - 1 = \frac{25-16}{16} = \frac{9}{16}$

$\therefore \tan\alpha = \frac{3}{4}$

Then, $\frac{1-\tan\alpha}{1+\tan\alpha} = \frac{1-\frac{3}{4}}{1+\frac{3}{4}} = \frac{\frac{4-3}{4}}{\frac{4+3}{4}} = \frac{1}{4} \times \frac{4}{7}$

$= \frac{1}{7}$ (c)

19) If $\sec\theta = \frac{3}{2}$, then $\tan^2\theta$ is equal to

(a) $\frac{5}{4}$ (b) $\frac{9}{4}$ (c) $\frac{3}{4}$ (d) $\frac{1}{4}$

Ans:- $\tan^2\theta = \sec^2\theta - 1$

$= \left(\frac{3}{2}\right)^2 - 1 = \frac{9}{4} - 1 = \frac{9-4}{4} = \frac{5}{4}$ (a)

20) If $\cot\theta = \sqrt{5}$, then the value of $\frac{\operatorname{cosec}^2\theta - \sec^2\theta}{\operatorname{cosec}^2\theta + \sec^2\theta}$ is

(a) $\frac{2}{3}$ (b) $\frac{2}{5}$ (c) $\frac{3}{2}$ (d) $\frac{5}{2}$

ans:- $\operatorname{cosec}^2\theta = 1 + \cot^2\theta = 1 + 5 = 6$

$\therefore \operatorname{cosec}\theta = \sqrt{6}$

$\Rightarrow \sin\theta = \frac{1}{\sqrt{6}}$

$\therefore \cos^2\theta = 1 - \sin^2\theta = 1 - \frac{1}{6} = \frac{6-1}{6} = \frac{5}{6}$

$\Rightarrow \sec^2\theta = \frac{1}{\cos^2\theta} = \frac{6}{5} \Rightarrow \sec\theta = \sqrt{\frac{6}{5}}$

$\therefore \frac{\operatorname{cosec}^2\theta - \sec^2\theta}{\operatorname{cosec}^2\theta + \sec^2\theta} = \frac{6 - \frac{6}{\cancel{25}\,5}}{6 + \frac{6}{25}} = \frac{\frac{30-6}{\cancel{5}}}{\frac{30+6}{\cancel{5}}} = \frac{24}{36}$

$= \frac{2}{3}$ (a)

21) The value of $\frac{\tan 45^\circ}{\sin 30^\circ + \cos 60^\circ}$ is

(a) $1/\sqrt{2}$ (b) 2 (c) $\sqrt{2}$ (d) 1

ans:- $\frac{1}{\frac{1}{2}+\frac{1}{2}} = \frac{1}{1} = 1$ (d)

22) The value of $\operatorname{Cosec} 30^\circ + \operatorname{Cot} 45^\circ$ is

(a) $-1$ (b) 2 (c) 3 (d) 2

ans:- $2 + 1 = 3$ (c)

23) The value of $\sin^2 30^\circ - \cos^2 30^\circ$ is

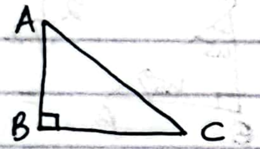
(a) $-1/2$ (b) $\sqrt{3}/2$ (c) $3/2$ (d) $2/3$

ans:- $\left(\frac{1}{2}\right)^2 - \left(\frac{\sqrt{3}}{2}\right)^2 = \frac{1}{4} - \frac{3}{4} = -\frac{2}{4} = -\frac{1}{2}$ (a)

24) In $\Delta ABC$ right angled at B, the value of $\cos(A+C)$ is

(a) $1/\sqrt{2}$ (b) $1/2$ (c) 0 (d) 1

ans:-




Using angle sum property,

$\angle A + \angle C = 90^\circ$

$\cos(A+C) = \cos 90^\circ = 0$ (c)

25) If $\theta = 30^\circ$, then the value of $\frac{1-\tan^2\theta}{1+\tan^2\theta}$ is

(a) $3/2$ (b) $1/3$ (c) $1/2$ (d) $2/3$

ans:- $\frac{1-\left(\frac{1}{\sqrt{3}}\right)^2}{1+\left(\frac{1}{\sqrt{3}}\right)^2} = \frac{1-\frac{1}{3}}{1+\frac{1}{3}} = \frac{\frac{3-1}{\cancel{3}\,1}}{\frac{3+1}{\cancel{3}\,1}} = \frac{2}{4} = \frac{1}{2}$ (c)

26) If $\sin A = \frac{1}{2}$ and $\cos B = \frac{1}{2}$, then the value of $A+B$ is equal to

(a) $0^\circ$ (b) $60^\circ$ (c) $90^\circ$ (d) $30^\circ$

ans:- $\sin A = \frac{1}{2} \Rightarrow A = 30^\circ$

$\cos B = \frac{1}{2} \Rightarrow B = 60^\circ$

$\therefore A+B = 30^\circ + 60^\circ = 90^\circ$ (c)

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27) If $\sin 2A = 1$, $0° < A < 90°$, then the value of A is
(a) 30° (b) 45° (c) 60° (d) 90°

ans:- $\sin 2A = 1 \Rightarrow 2A = 90°$
$\Rightarrow A = \frac{90°}{2} = 45°$ (b)

28) If $2\cos 3A = 1$, then the value of A is
(a) 40° (b) 60° (c) 80° (d) 20°

ans:- $2\cos 3A = 1 \Rightarrow \cos 3A = \frac{1}{2}$

$\therefore 3A = 60° \Rightarrow A = 20°$ (d)

29) If $\tan 3\theta = \sin 30° + \cos 45° \sin 45°$, then the value of $\theta$
(a) 15° (b) 30° (c) 45° (d) 60°

ans:- $\tan 3\theta = \frac{1}{2} + \frac{1}{\sqrt{2}} \times \frac{1}{\sqrt{2}} = \frac{1}{2} + \frac{1}{2} = 1$

$\therefore 3\theta = 45° \Rightarrow \theta = \frac{45°}{3} = 15°$ (a)

30) If some angle $\theta$, $\cot 2\theta = \frac{1}{\sqrt{3}}$, then the value of $\sin 3\theta$, where $3\theta \le 90°$ is (a) $\frac{1}{\sqrt{2}}$ (b) 1 (c) 0 (d) $\frac{\sqrt{3}}{2}$

ans:- $\cot 2\theta = \frac{1}{\sqrt{3}} \Rightarrow 2\theta = 60°$
$\therefore \theta = 30°$

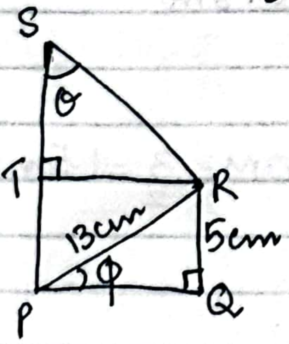
Then, $\sin 3\theta = \sin 90°$
$= 1$ (b)

31) If $\operatorname{cosec}\theta = 2$, $\cot\theta = \sqrt{3}p$, then the value of p is
(a) $\sqrt{3}$ (b) 2 (c) $\frac{2}{\sqrt{3}}$ (d) 1

ans:- $\operatorname{cosec}^2\theta - \cot^2\theta = 1$
$4 - 3p^2 = 1$
$4 - 1 = 3p^2$
$3p^2 = 3$
$p^2 = 1 \Rightarrow p = 1$ (d)

Or

$\operatorname{cosec} = 2$
$\Rightarrow \sin\theta = \frac{1}{2}$
$\therefore \theta = 30°$
Then $\cot 30° = \sqrt{3}p$
$\Rightarrow \sqrt{3} = \sqrt{3}p$
$\therefore p = 1$

32) 

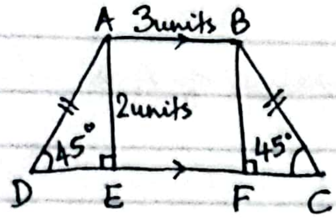
PS = 14 cm, the value of $\tan\theta$ is (a) $\frac{14}{3}$ (b) $\frac{4}{3}$ (c) $\frac{5}{3}$ (d) $\frac{13}{3}$

Soln:- Using Pythagoras Theorem, $PQ^2 = 13^2 - 5^2 = 169 - 25$
$PQ = \sqrt{144} = 12$ cm

Since TPQR is a rectangle, $PQ = TR = 12$ cm
$RQ = TP = 5$ cm

$ST = SP - TP = 14 - 5 = 9$ cm

$\therefore \tan\theta = \frac{TR}{ST} = \frac{12}{9} = \frac{4}{3}$ (b)

33) 


If ABCD is an isosceles trapezium, its perimeter (using $\sqrt{2} = 1.41$) is
(a) 17.64 units (b) 18.64 units
(c) 15.64 units (d) 16.64 units

Ans:- In rt. $\triangle AED$, $\sin 45° = \frac{AE}{AD}$

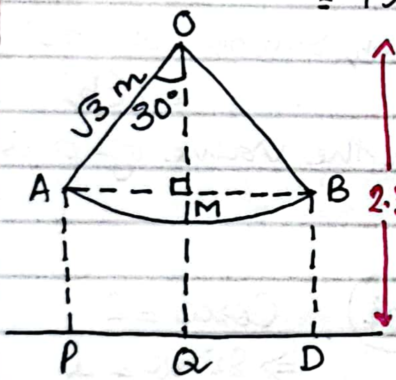
$$\Rightarrow \frac{1}{\sqrt{2}} = \frac{2}{AD} \Rightarrow AD = 2\sqrt{2} \text{ units}$$

Also, $\tan 45° = \frac{AE}{DE}$

$$\Rightarrow 1 = \frac{2}{DE} \Rightarrow DE = 2 \text{units}$$

Thus, $DE = FC = 2$ units
$AD = BC = 2\sqrt{2}$ units
$AB = EF = 3$ units

$\therefore$ Perimeter $= AB + BC + CF + EF + DE + AD$
$= 3 + 2\sqrt{2} + 2 + 3 + 2 + 2\sqrt{2}$
$= 10 + 4\sqrt{2} = 10 + 4 \times 1.41 = 10 + 5.64$
$= 15.64$ units // (c)

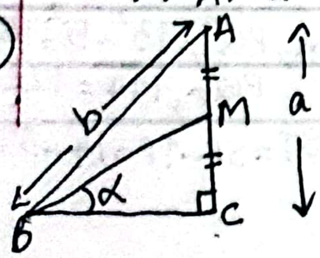
34) 


A pendulum of length $\sqrt{3}$ m is attached to a point 2.3 m from the ground. It swings through an angle of 30° on each side of the vertical. The height above the ground at ends of its path is
(a) 0.9m (b) 0.6m (c) 0.7m (d) 0.8m

Ans:- In rt. $\triangle OMA$, $\cos 30° = \frac{OM}{OA}$

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{OM}{\sqrt{3}} \Rightarrow OM = \frac{3}{2} = 1.5m$$

$\therefore AP = 2.3 - 1.5 = 0.8m$ (d)

35) 


AM = MC and ∠C is a right angle then $\sin^2\alpha - \cos^2\alpha =$ ___

(a) $\frac{4b^2-3a^2}{5a^2-4b^2}$ (b) $\frac{5a^2-4b^2}{4b^2-3a^2}$ (c) $\frac{4a^2-5b^2}{3b^2-4a^2}$ (d) $\frac{3b^2-4a^2}{4a^2-5b^2}$

ans:- $AM = MC = \frac{a}{2}$

In rt. $\triangle ABC$, $BC^2 = AB^2 - AC^2 = b^2 - a^2 \rightarrow (1)$

In rt. $\triangle MCB$, $BM^2 = MC^2 + BC^2 = \left(\frac{a}{2}\right)^2 + b^2 - a^2 = \frac{a^2}{4} + b^2 - a^2$

$$BM^2 = \frac{a^2+4b^2-4a^2}{4} = \frac{4b^2-3a^2}{4} \rightarrow (2)$$

$\sin\alpha = \frac{MC}{BM}$ ; $\cos\alpha = \frac{BC}{BM}$

$$\therefore \sin^2\alpha - \cos^2\alpha = \frac{MC^2}{BM^2} - \frac{BC^2}{BM^2} = \frac{MC^2 - BC^2}{BM^2}$$

$$= \frac{\left(\frac{a}{2}\right)^2 - b^2 + a^2}{\frac{4b^2-3a^2}{4}} = \frac{\frac{a^2}{4} - b^2 + a^2}{\frac{4b^2-3a^2}{4}}$$

$$= \frac{\frac{a^2-4b^2+4a^2}{\cancel{4}}}{\frac{4b^2-3a^2}{\cancel{4}}} = \frac{5a^2-4b^2}{4b^2-3a^2} \text{ (b)}$$

36) In $\triangle ABC$ right-angled at C, if $\tan A = 1$, then the value of $2\sin A\cos A$ is

(a) 1 (b) $1/2$ (c) 2 (d) $\sqrt{3}/2$

ans:- $\tan A = 1 \Rightarrow A = 45^\circ$

$$2\sin A\cos A = 2\sin 45^\circ \cdot \cos 45^\circ = 2 \times \frac{1}{\sqrt{2}} \times \frac{1}{\sqrt{2}} = \frac{2}{2} = 1 \text{ (a)}$$

37) If $\tan\theta = \frac{4}{5}$, then the value of $\frac{5\sin\theta - 2\cos\theta}{5\sin\theta + 2\cos\theta}$ is

(a) $\frac{1}{3}$ (b) $\frac{2}{5}$ (c) $\frac{3}{5}$ (d) 6

ans:- $\tan\theta = \frac{4}{5} \Rightarrow 5\tan\theta = 4 \rightarrow (1)$

$(\div \cos\theta)$, $\frac{5\tan\theta - 2}{5\tan\theta + 2} = \frac{4-2}{4+2} = \frac{2}{6} = \frac{1}{3}$ (a)

38) If $\sin\theta = 1/5$, then the value of $\frac{1}{5}\cot^2\theta + \frac{1}{5}$ is (a) $\frac{1}{125}$ (b) $\frac{1}{5}$ (c) 25 (d) 5

ans:- $\sin\theta = 1/5 \Rightarrow \operatorname{cosec}\theta = 5$

$$\therefore \frac{1}{5}(\cot^2\theta + 1) = \frac{1}{5}\operatorname{cosec}^2\theta = \frac{1}{\cancel{5}_1} \times \cancel{25}^{5} = 5 \text{ (d)}$$

39) If $\cos\theta = \frac{2}{3}$, then $2\sec^2\theta + 2\tan^2\theta - 7$ is equal to

(a) 1 (b) 0 (c) 3 (d) 4

ans:- $\cos\theta = \frac{2}{3} \Rightarrow \sec\theta = \frac{3}{2}$

$$2\sec^2\theta + 2\tan^2\theta - 7 = 2\sec^2\theta + 2(\sec^2\theta - 1) - 7$$
$$= 2\sec^2\theta + 2\sec^2\theta - 2 - 7$$
$$= 4\sec^2\theta - 9$$
$$= 4 \times \frac{9}{4} - 9$$
$$= 9 - 9 = 0 \text{ (b)}$$

40) $(\sin 90° - \cos 45° + \cos 60°)(\cos 0° + \sin 45° + \sin 30°) =$

(a) $\frac{5}{8}$ (b) $\frac{7}{4}$ (c) $\frac{4}{7}$ (d) $\frac{3}{5}$

ans:- $\left(1 - \frac{1}{\sqrt{2}} + \frac{1}{2}\right)\left(1 + \frac{1}{\sqrt{2}} + \frac{1}{2}\right)$

$$= \left[\left(1 + \frac{1}{2}\right) - \frac{1}{\sqrt{2}}\right]\left[\left(1 + \frac{1}{2}\right) + \frac{1}{\sqrt{2}}\right]$$
$$= \left(\frac{3}{2} - \frac{1}{\sqrt{2}}\right)\left(\frac{3}{2} + \frac{1}{\sqrt{2}}\right) = \left(\frac{3}{2}\right)^2 - \left(\frac{1}{\sqrt{2}}\right)^2$$
$$= \frac{9}{4} - \frac{1 \times 2}{2 \times 2}$$
$$= \frac{9}{4} - \frac{2}{4} = \frac{7}{4} \text{ (b)}$$