50 multiple-choice questions

Question 1 (Level 1) — *Identifying the hypotenuse*
In a right-angled triangle, which side is always the longest?

(A) The hypotenuse

(B) The opposite side

(C) The adjacent side

(D) It depends on the triangle

Question 2 (Level 1) — *SOH CAH TOA — sine definition*
In a right-angled triangle, $\sin\theta$ equals:

(A) $\dfrac{\text{opposite}}{\text{hypotenuse}}$

(B) $\dfrac{\text{adjacent}}{\text{hypotenuse}}$

(C) $\dfrac{\text{opposite}}{\text{adjacent}}$

(D) $\dfrac{\text{hypotenuse}}{\text{opposite}}$

Question 3 (Level 1) — *Finding a side using sine*
In a right-angled triangle, the hypotenuse is 10 and $\sin\theta = 0.6$. Find the length of the opposite side.

(A) 6

(B) 8

(C) 4

(D) 16

Question 4 (Level 1) — *Tangent definition*
In a right-angled triangle, $\tan\theta$ equals:

(A) $\dfrac{\text{opposite}}{\text{adjacent}}$

(B) $\dfrac{\text{adjacent}}{\text{opposite}}$

(C) $\dfrac{\text{opposite}}{\text{hypotenuse}}$

(D) $\dfrac{\text{hypotenuse}}{\text{adjacent}}$

Question 5 (Level 1) — *Finding an angle*
If $\cos\theta = 0.5$, find θ (for $0ř \leq \theta \leq 90ř$).

(A) $60ř$

(B) $30ř$

(C) $45ř$

(D) $90ř$

Question 6 (Level 1) — *Pythagorean check*
A right-angled triangle has sides 3, 4 and 5. What is $\sin\theta$ if θ is opposite the side of length 3?

(A) $\frac{3}{5}$

(B) $\frac{4}{5}$

(C) $\frac{3}{4}$

(D) $\frac{5}{3}$

Question 7 (Level 1) — *Cosine definition*
$\cos\theta$ in a right-angled triangle equals:

(A) $\frac{\text{adjacent}}{\text{hypotenuse}}$

(B) $\frac{\text{opposite}}{\text{hypotenuse}}$

(C) $\frac{\text{hypotenuse}}{\text{adjacent}}$

(D) $\frac{\text{opposite}}{\text{adjacent}}$

Question 8 (Level 1) — *Using tan to find a side*
In a right-angled triangle, the side adjacent to θ is 8 and $\tan\theta = \frac{3}{4}$. Find the opposite side.

(A) 6

(B) 10

(C) $\frac{32}{3}$

(D) 24

Question 9 (Level 1) — *Complementary angles*
If $\theta = 40$ř in a right-angled triangle, what is the other acute angle?

(A) 50ř

(B) 40ř

(C) 60ř

(D) 140ř

Question 10 (Level 1) — *Choosing the right ratio*
You know the opposite and adjacent sides. Which ratio should you use to find θ?

(A) Tangent

(B) Sine

(C) Cosine

(D) Pythagoras

Question 11 (Level 2) — *Exact value — sin 30ř*
What is the exact value of $\sin 30$ř?

(A) $\dfrac{1}{2}$

(B) $\dfrac{\sqrt{3}}{2}$

(C) $\dfrac{\sqrt{2}}{2}$

(D) 1

Question 12 (Level 2) — *Exact value — cos 45ř*
What is the exact value of $\cos 45$ř?

(A) $\dfrac{\sqrt{2}}{2}$

(B) $\dfrac{1}{2}$

(C) $\dfrac{\sqrt{3}}{2}$

(D) 1

Question 13 (Level 2) — *Exact value — tan 60ř*
What is the exact value of $\tan 60$ř?

(A) $\sqrt{3}$

(B) $\dfrac{1}{\sqrt{3}}$

(C) 1

(D) $\dfrac{\sqrt{3}}{2}$

Question 14 (Level 2) — *Finding a side using cosine*
A right-angled triangle has hypotenuse 12 cm and an angle of 60ř adjacent to side x. Find x.

(A) 6 cm

(B) $6\sqrt{3}$ cm

(C) $12\sqrt{3}$ cm

(D) 24 cm

Question 15 (Level 2) — *Angle of elevation*
A tree casts a shadow 10 m long. The angle of elevation to the top of the tree is 45ř. How tall is the tree?

(A) 10 m

(B) $5\sqrt{2}$ m

(C) $10\sqrt{2}$ m

(D) 20 m

Question 16 (Level 2) — *Finding the hypotenuse*
In a right-angled triangle, the side opposite 30ř is 7 cm. Find the hypotenuse.

(A) 14 cm

(B) $7\sqrt{3}$ cm

(C) 3.5 cm

(D) $7\sqrt{2}$ cm

Question 17 (Level 2) — *Finding an angle using inverse tan*
In a right-angled triangle, the opposite side is 5 and the adjacent side is 5. Find θ.

(A) 45ř

(B) 30ř

(C) 60ř

(D) 90ř

Question 18 (Level 2) — *Exact value — sin 45ř*
What is $\sin 45ř$ as an exact value?

(A) $\dfrac{\sqrt{2}}{2}$

(B) $\dfrac{1}{2}$

(C) $\dfrac{\sqrt{3}}{2}$

(D) $\sqrt{2}$

Question 19 (Level 2) — *Using Pythagoras with trig*
If $\sin\theta = \dfrac{5}{13}$ and θ is acute, find $\cos\theta$.

(A) $\dfrac{12}{13}$

(B) $\dfrac{8}{13}$

(C) $\dfrac{5}{12}$

(D) $\dfrac{13}{12}$

Question 20 (Level 2) — *Exact value — cos 60ř*
What is the exact value of $\cos 60ř$?

(A) $\dfrac{1}{2}$

(B) $\dfrac{\sqrt{3}}{2}$

(C) $\dfrac{\sqrt{2}}{2}$

(D) 0

Question 21 (Level 3) — *Converting degrees to radians*
Convert $180ř$ to radians.

(A) π

(B) 2π

(C) $\dfrac{\pi}{2}$

(D) $\dfrac{\pi}{180}$

Question 22 (Level 3) — *Unit circle — sin 90ř*
Using the unit circle, what is $\sin 90ř$?

(A) 1

(B) 0

(C) -1

(D) Undefined

Question 23 (Level 3) — *Angle in second quadrant*
Find $\sin 150ř$.

(A) $\frac{1}{2}$

(B) $-\frac{1}{2}$

(C) $\frac{\sqrt{3}}{2}$

(D) $-\frac{\sqrt{3}}{2}$

Question 24 (Level 3) — *Cosine in the second quadrant*
Find $\cos 120ř$.

(A) $-\frac{1}{2}$

(B) $\frac{1}{2}$

(C) $-\frac{\sqrt{3}}{2}$

(D) $\frac{\sqrt{3}}{2}$

Question 25 (Level 3) — *Converting radians to degrees*
Convert $\frac{\pi}{4}$ radians to degrees.

(A) 45ř

(B) 90ř

(C) 60ř

(D) 30ř

Question 26 (Level 3) — *Pythagorean identity*
If $\cos\theta = \frac{3}{5}$ and θ is in the first quadrant, find $\sin\theta$.

(A) $\frac{4}{5}$

(B) $\frac{3}{4}$

(C) $\frac{2}{5}$

(D) $-\frac{4}{5}$

Question 27 (Level 3) — *Tangent in the third quadrant*
Find $\tan 225^\circ$.

(A) 1

(B) -1

(C) $\sqrt{2}$

(D) 0

Question 28 (Level 3) — *Simple trig equation*
Solve $\sin\theta = \frac{1}{2}$ for $0^\circ \le \theta \le 360^\circ$.

(A) 30° and 150°

(B) 30° only

(C) 30° and 330°

(D) 150° and 210°

Question 29 (Level 3) — *Bearing problem*
A boat sails 5 km on a bearing of 090°. How far east has it travelled?

(A) 5 km

(B) 0 km

(C) $5\sqrt{2}$ km

(D) 2.5 km

Question 30 (Level 3) — *Exact value of sin in radians*
Find the exact value of $\sin\frac{\pi}{3}$.

(A) $\frac{\sqrt{3}}{2}$

(B) $\frac{1}{2}$

(C) $\dfrac{\sqrt{2}}{2}$

(D) $\sqrt{3}$

Question 31 (Level 4) — *Solving cos equation in radians*
Solve $\cos\theta = -\dfrac{\sqrt{3}}{2}$ for $0 \leq \theta \leq 2\pi$.

(A) $\dfrac{5\pi}{6}$ and $\dfrac{7\pi}{6}$

(B) $\dfrac{\pi}{6}$ and $\dfrac{11\pi}{6}$

(C) $\dfrac{2\pi}{3}$ and $\dfrac{4\pi}{3}$

(D) $\dfrac{5\pi}{6}$ only

Question 32 (Level 4) — *Solving tan equation*
Solve $\tan\theta = -1$ for $0 \leq \theta \leq 2\pi$.

(A) $\dfrac{3\pi}{4}$ and $\dfrac{7\pi}{4}$

(B) $\dfrac{\pi}{4}$ and $\dfrac{5\pi}{4}$

(C) $\dfrac{3\pi}{4}$ and $\dfrac{5\pi}{4}$

(D) $\dfrac{3\pi}{4}$ only

Question 33 (Level 4) — *Complementary angle identity*
Simplify $\sin(90\check{r} - \theta)$.

(A) $\cos\theta$

(B) $\sin\theta$

(C) $-\cos\theta$

(D) $\tan\theta$

Question 34 (Level 4) — *Using the Pythagorean identity*
If $\tan\theta = \dfrac{5}{12}$ and θ is acute, find $\sec\theta$.

(A) $\dfrac{13}{12}$

(B) $\dfrac{12}{13}$

(C) $\dfrac{5}{13}$

(D) $\dfrac{13}{5}$

Question 35 (Level 4) — *Trig equation with a coefficient*
Solve $2\sin\theta - 1 = 0$ for $0 \le \theta \le 2\pi$.

(A) $\dfrac{\pi}{6}$ and $\dfrac{5\pi}{6}$

(B) $\dfrac{\pi}{3}$ and $\dfrac{2\pi}{3}$

(C) $\dfrac{\pi}{6}$ only

(D) $\dfrac{\pi}{6}$ and $\dfrac{7\pi}{6}$

Question 36 (Level 4) — *Negative angle*
Find $\cos(-60\check{r})$.

(A) $\dfrac{1}{2}$

(B) $-\dfrac{1}{2}$

(C) $\dfrac{\sqrt{3}}{2}$

(D) $-\dfrac{\sqrt{3}}{2}$

Question 37 (Level 4) — *Simplifying a trig expression*
Simplify $\sin^2\theta + \cos^2\theta + \tan^2\theta$.

(A) $\sec^2\theta$

(B) $1 + \tan^2\theta$

(C) 2

(D) 1

Question 38 (Level 4) — *Exact value at 5/4*
Find the exact value of $\sin\dfrac{5\pi}{4}$.

(A) $-\dfrac{\sqrt{2}}{2}$

(B) $\dfrac{\sqrt{2}}{2}$

(C) $-\dfrac{1}{2}$

(D) $\dfrac{1}{2}$

Question 39 (Level 4) — *Area of a triangle using trig*
Find the area of a triangle with sides $a = 7$, $b = 10$ and included angle $C = 30$ř.

(A) 17.5

(B) 35

(C) $35\sqrt{3}$

(D) $\dfrac{35\sqrt{3}}{2}$

Question 40 (Level 4) — *Period of sine*
What is the period of $y = \sin(2x)$?

(A) π

(B) 2π

(C) 4π

(D) $\dfrac{\pi}{2}$

Question 41 (Level 5) — *Quadratic trig equation*
Solve $2\cos^2\theta - \cos\theta - 1 = 0$ for $0 \le \theta \le 2\pi$.

(A) $\theta = 0, \dfrac{2\pi}{3}, \dfrac{4\pi}{3}$

(B) $\theta = \dfrac{\pi}{3}, \pi, \dfrac{5\pi}{3}$

(C) $\theta = 0, \dfrac{\pi}{3}, \dfrac{5\pi}{3}$

(D) $\theta = \dfrac{2\pi}{3}, \dfrac{4\pi}{3}$ only

Question 42 (Level 5) — *General solution*
Find the general solution of $\sin\theta = \dfrac{\sqrt{3}}{2}$.

(A) $\theta = \dfrac{\pi}{3} + 2n\pi$ or $\theta = \dfrac{2\pi}{3} + 2n\pi$

(B) $\theta = \dfrac{\pi}{3} + n\pi$

(C) $\theta = \dfrac{\pi}{6} + 2n\pi$ or $\theta = \dfrac{5\pi}{6} + 2n\pi$

(D) $\theta = (-1)^n \dfrac{\pi}{3} + n\pi$

Question 43 (Level 5) — *Double angle — finding sin 2*
If $\sin\theta = \dfrac{3}{5}$ and θ is acute, find $\sin 2\theta$.

(A) $\dfrac{24}{25}$

(B) $\dfrac{6}{5}$

(C) $\dfrac{12}{25}$

(D) $\dfrac{7}{25}$

Question 44 (Level 5) — *Trig equation with transformation*
Solve $\sin(2\theta + \dfrac{\pi}{6}) = \dfrac{1}{2}$ for $0 \le \theta \le \pi$.

(A) $\theta = 0, \dfrac{\pi}{3}, \pi$

(B) $\theta = \dfrac{\pi}{12}, \dfrac{\pi}{3}$

(C) $\theta = \dfrac{\pi}{6}, \dfrac{5\pi}{6}$

(D) $\theta = 0, \dfrac{\pi}{3}$ only

Question 45 (Level 5) — *Proving an identity*
Which expression is equivalent to $\dfrac{\sin\theta}{1+\cos\theta} + \dfrac{1+\cos\theta}{\sin\theta}$?

(A) $2\csc\theta$

(B) $2\sec\theta$

(C) $\csc\theta$

(D) $2\sin\theta$

Question 46 (Level 5) — *Auxiliary angle method*
Express $\sin\theta + \cos\theta$ in the form $R\sin(\theta + \alpha)$. Find R.

(A) $R = \sqrt{2}$

(B) $R = 2$

(C) $R = 1$

(D) $R = \dfrac{\sqrt{2}}{2}$

Question 47 (Level 5) — *Number of solutions*
How many solutions does $\sin(3x) = \dfrac{1}{2}$ have for $0 \le x \le 2\pi$?

(A) 6

(B) 3

(C) 4

(D) 2

Question 48 (Level 5) — *Double angle — cos 2*
If $\cos\theta = -\dfrac{1}{3}$, find $\cos 2\theta$.

(A) $-\dfrac{7}{9}$

(B) $\dfrac{7}{9}$

(C) $-\dfrac{2}{3}$

(D) $\dfrac{1}{9}$

Question 49 (Level 5) — *Maximum value of a trig function*
What is the maximum value of $3\sin\theta - 4\cos\theta$?

(A) 5

(B) 7

(C) 3

(D) $\sqrt{7}$

Question 50 (Level 5) — *Solving with tan substitution*
Solve $\sin\theta + \cos\theta = 1$ for $0 \le \theta \le 2\pi$.

(A) $\theta = 0$ and $\theta = \dfrac{\pi}{2}$

(B) $\theta = \dfrac{\pi}{4}$ only

(C) $\theta = 0, \dfrac{\pi}{2}, \pi, \dfrac{3\pi}{2}$

(D) $\theta = \dfrac{\pi}{2}$ only

Solutions

Q1: (A)
The hypotenuse is the side opposite the right angle and is always the longest side.
Q2: (A)
$\sin\theta = \dfrac{\text{opposite}}{\text{hypotenuse}}$.
Q3: (A)
opposite $= 10 \times 0.6 = 6$.
Q4: (A)
$\tan\theta = \dfrac{\text{opposite}}{\text{adjacent}}$.
Q5: (A)
$\theta = \cos^{-1}(0.5) = 60$ř.
Q6: (A)
$\sin\theta = \dfrac{3}{5} = 0.6$.
Q7: (A)
$\cos\theta = \dfrac{\text{adjacent}}{\text{hypotenuse}}$.
Q8: (A)
$\text{opposite} = 8 \times \dfrac{3}{4} = 6$.
Q9: (A)
Other angle $= 180$ř $- 90$ř $- 40$ř $= 50$ř.
Q10: (A)
$\tan\theta = \dfrac{\text{opposite}}{\text{adjacent}}$, so use tangent.
Q11: (A)
$\sin 30$ř $= \dfrac{1}{2}$.
Q12: (A)
$\cos 45$ř $= \dfrac{\sqrt{2}}{2} = \dfrac{1}{\sqrt{2}}$.
Q13: (A)
$\tan 60$ř $= \dfrac{\sqrt{3}/2}{1/2} = \sqrt{3}$.
Q14: (A)
$x = 12\cos 60$ř $= 12 \times \dfrac{1}{2} = 6$ cm.
Q15: (A)
$\tan 45$ř $= 1 \Rightarrow$ height $= 10 \times 1 = 10$ m.
Q16: (A)
$h = \dfrac{7}{\sin 30\text{ř}} = \dfrac{7}{0.5} = 14$ cm.
Q17: (A)
$\theta = \tan^{-1}(1) = 45$ř.
Q18: (A)
$\sin 45$ř $= \dfrac{1}{\sqrt{2}} = \dfrac{\sqrt{2}}{2}$.
Q19: (A)
Adjacent $= \sqrt{13^2 - 5^2} = \sqrt{144} = 12$. So $\cos\theta = \dfrac{12}{13}$.

Q20: (A)
$\cos 60\check{r} = \frac{1}{2}$.
Q21: (A)
$180\check{r} = \pi$ radians.
Q22: (A)
$\sin 90\check{r} = 1$.
Q23: (A)
$\sin 150\check{r} = \sin 30\check{r} = \frac{1}{2}$.
Q24: (A)
$\cos 120\check{r} = -\cos 60\check{r} = -\frac{1}{2}$.
Q25: (A)
$\frac{\pi}{4} \times \frac{180\check{r}}{\pi} = 45\check{r}$.
Q26: (A)
$\sin^2\theta = 1 - \frac{9}{25} = \frac{16}{25}$. Since Q1, $\sin\theta = \frac{4}{5}$.
Q27: (A)
$\tan 225\check{r} = \tan 45\check{r} = 1$.
Q28: (A)
$\theta = 30\check{r}$ or $\theta = 180\check{r} - 30\check{r} = 150\check{r}$.
Q29: (A)
Due east, so the eastward distance is 5 km.
Q30: (A)
$\sin\frac{\pi}{3} = \sin 60\check{r} = \frac{\sqrt{3}}{2}$.
Q31: (A)
$\theta = \pi - \frac{\pi}{6} = \frac{5\pi}{6}$ or $\theta = \pi + \frac{\pi}{6} = \frac{7\pi}{6}$.
Q32: (A)
$\theta = \pi - \frac{\pi}{4} = \frac{3\pi}{4}$ or $\theta = 2\pi - \frac{\pi}{4} = \frac{7\pi}{4}$.
Q33: (A)
$\sin(90\check{r} - \theta) = \cos\theta$.
Q34: (A)
$\sec^2\theta = 1 + \frac{25}{144} = \frac{169}{144}$. So $\sec\theta = \frac{13}{12}$ (positive, Q1).
Q35: (A)
$\sin\theta = \frac{1}{2} \Rightarrow \theta = \frac{\pi}{6}$ or $\theta = \frac{5\pi}{6}$.
Q36: (A)
$\cos(-60\check{r}) = \cos 60\check{r} = \frac{1}{2}$.
Q37: (A)
$1 + \tan^2\theta = \sec^2\theta$.
Q38: (A)
$\sin\frac{5\pi}{4} = -\sin\frac{\pi}{4} = -\frac{\sqrt{2}}{2}$.
Q39: (A)
Area $= \frac{1}{2}(7)(10)\sin 30\check{r} = \frac{1}{2}(70)(\frac{1}{2}) = \frac{35}{2} = 17.5$ square units.
Q40: (A)

Period $= \dfrac{2\pi}{2} = \pi$.

Q41: (A)

$\cos\theta = 1 \Rightarrow \theta = 0$ (or 2π). $\cos\theta = -\dfrac{1}{2} \Rightarrow \theta = \dfrac{2\pi}{3}$ or $\dfrac{4\pi}{3}$. Solutions: $\theta = 0, \dfrac{2\pi}{3}, \dfrac{4\pi}{3}$.

Q42: (A)

$\theta = \dfrac{\pi}{3} + 2n\pi$ or $\theta = \pi - \dfrac{\pi}{3} + 2n\pi = \dfrac{2\pi}{3} + 2n\pi$, where $n \in \mathbb{Z}$.

Q43: (A)

$\cos\theta = \dfrac{4}{5}$. $\sin 2\theta = 2 \cdot \dfrac{3}{5} \cdot \dfrac{4}{5} = \dfrac{24}{25}$.

Q44: (A)

$u \in [\dfrac{\pi}{6}, \dfrac{13\pi}{6}]$. $\sin u = \dfrac{1}{2} \Rightarrow u = \dfrac{\pi}{6}, \dfrac{5\pi}{6}, \dfrac{13\pi}{6}$. So $2\theta = 0, \dfrac{2\pi}{3}, 2\pi$, giving $\theta = 0, \dfrac{\pi}{3}, \pi$.

Q45: (A)

$$\frac{\sin^2\theta + (1+\cos\theta)^2}{\sin\theta(1+\cos\theta)} = \frac{\sin^2\theta + 1 + 2\cos\theta + \cos^2\theta}{\sin\theta(1+\cos\theta)} = \frac{2 + 2\cos\theta}{\sin\theta(1+\cos\theta)} = \frac{2}{\sin\theta} = 2\csc\theta.$$

Q46: (A)

$R = \sqrt{2}$ and $\alpha = \dfrac{\pi}{4}$, so $\sin\theta + \cos\theta = \sqrt{2}\sin(\theta + \dfrac{\pi}{4})$.

Q47: (A)

Over $[0, 6\pi]$ there are 3 full periods, each contributing 2 solutions = 6 solutions.

Q48: (A)

$$\cos 2\theta = 2\left(\frac{1}{9}\right) - 1 = \frac{2}{9} - 1 = -\frac{7}{9}.$$

Q49: (A)

The expression can be written as $R\sin(\theta - \alpha)$ where $R = \sqrt{9+16} = 5$. Maximum value is 5.

Q50: (A)

$\sqrt{2}\sin(\theta + \dfrac{\pi}{4}) = 1 \Rightarrow \sin(\theta + \dfrac{\pi}{4}) = \dfrac{1}{\sqrt{2}}$. So $\theta + \dfrac{\pi}{4} = \dfrac{\pi}{4}$ or $\dfrac{3\pi}{4}$, giving $\theta = 0$ or $\theta = \dfrac{\pi}{2}$.