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VCE Specialist Mathematics ½
Trigonometric Exam Skills [3.3]
Homework

Admin Info & Homework Outline:

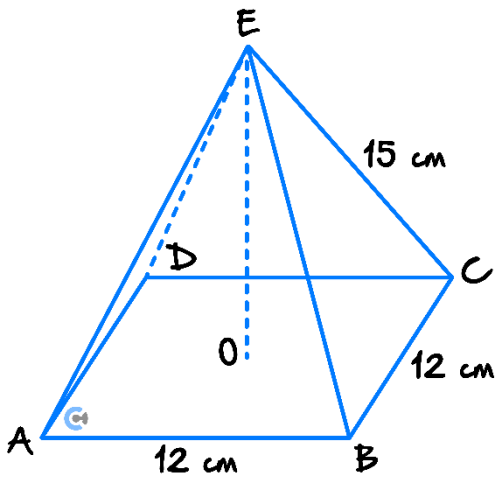
Student Name	
Questions You Need Help For	
Compulsory Questions	Pg 2- Pg 21

Section A: Compulsory Questions

Sub-Section [3.3.1] and [3.3.2]: Apply Trigonometry to Solve Problems in 3D and Find the Angle between Planes

Question 1

A square pyramid $ABCDE$ stands on level horizontal ground. The vertex of the pyramid is at E. The points A, B, C, D are the corners of a square of side 12 cm, whose diagonals intersect at the point O. Each of the sloping edges of the pyramid has a length of 15 cm.



a. Calculate the length OC.

b. Calculate the volume of the pyramid. (Recall $V = \frac{1}{3} \times \text{base} \times \text{height}$)

c. Calculate the total surface area of the pyramid.

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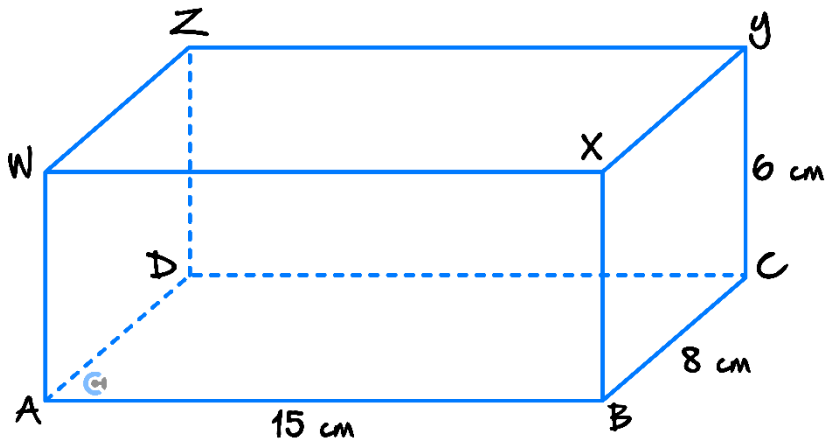
Question 2

The figure shows a cuboid $ABCDWXYZ$ standing on level horizontal ground. The lengths of AB, BC and CY are 15 cm, 8 cm and 6 cm, respectively.



a. Find the length of AY.

b. Calculate the angle AY makes with the ground, correct to two decimal places.

c. Determine the area of the triangle ABY.

The point M is the midpoint of AB and the point N lies on AY.

d. The point M is the midpoint of AB and the point N lies on AY. Calculate the length of MN, given that MN is perpendicular to AY . Give your answer correct to two decimal places.

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Question 3

A pyramid $PQRS$ has a triangular horizontal base PQR, where $PQ = PR = 8\ m$ and $RQ = 12\ m$. The vertex of the pyramid S lies directly above the level of PQR so that $SQ = SR = 10\ m$ and $SP = 8\ m$.

a. Show that the shortest distance of S from the base PQR is $\sqrt{57}\ m$.

b. Calculate, in degrees correct to two decimal places, the acute angle between:

i. The plane SQR and the plane PQR.

ii. The edge SQ and the plane PQR.

c. Determine, as an exact surd, the shortest distance of P from the plane SQR.

HINT: Compute the volume of the pyramid in two different ways.

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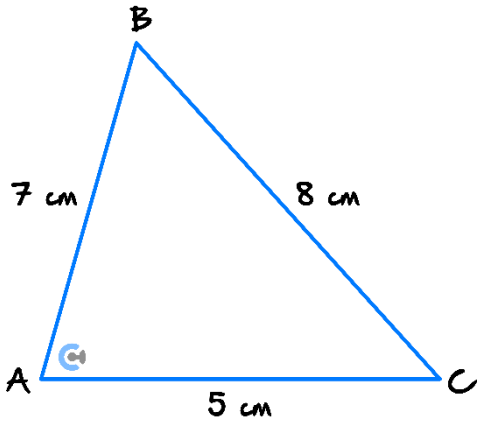
Sub-Section: Exam 1 Questions

Question 4

The figure below shows a triangle ABC where the following information is given.

$$|AB| = 7\ cm, |BC| = 8\ cm, |AC| = 5\ cm.$$

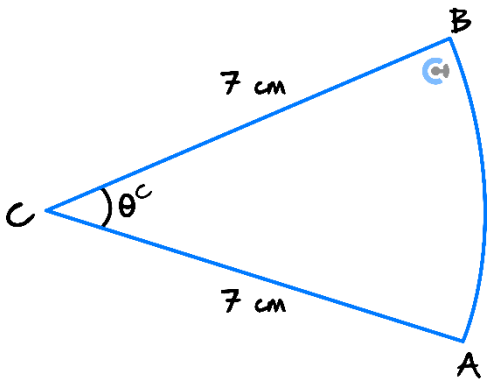


a. Find the size of the angle $\angle ACB$ in degrees.

b. Hence, determine as an exact surd the area of the triangle ABC.

Question 5

The figure below shows a circular sector ABC of radius 7 cm subtending an angle θ radius at C. Given that the perimeter of the sector is equal to the area of the sector, find the value of θ in radians.



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Question 6

Prove the identity $\frac{\cos\theta}{1-\sin\theta} = \frac{1+\sin\theta}{\cos\theta}$.

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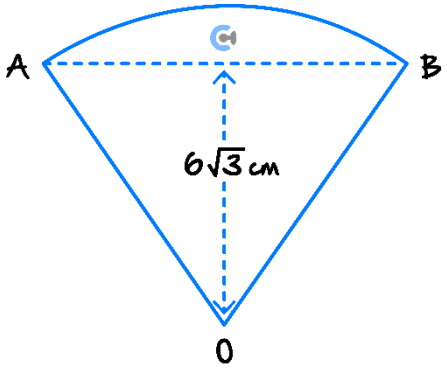
Question 7

The figure above shows a badge in the shape of a circular sector OAB, centred at O. The triangle OAB is equilateral and its perpendicular height is $6\sqrt{3}\ cm$.



a. Find the length of OA.

b. Determine in terms of π:

i. The area of the badge.

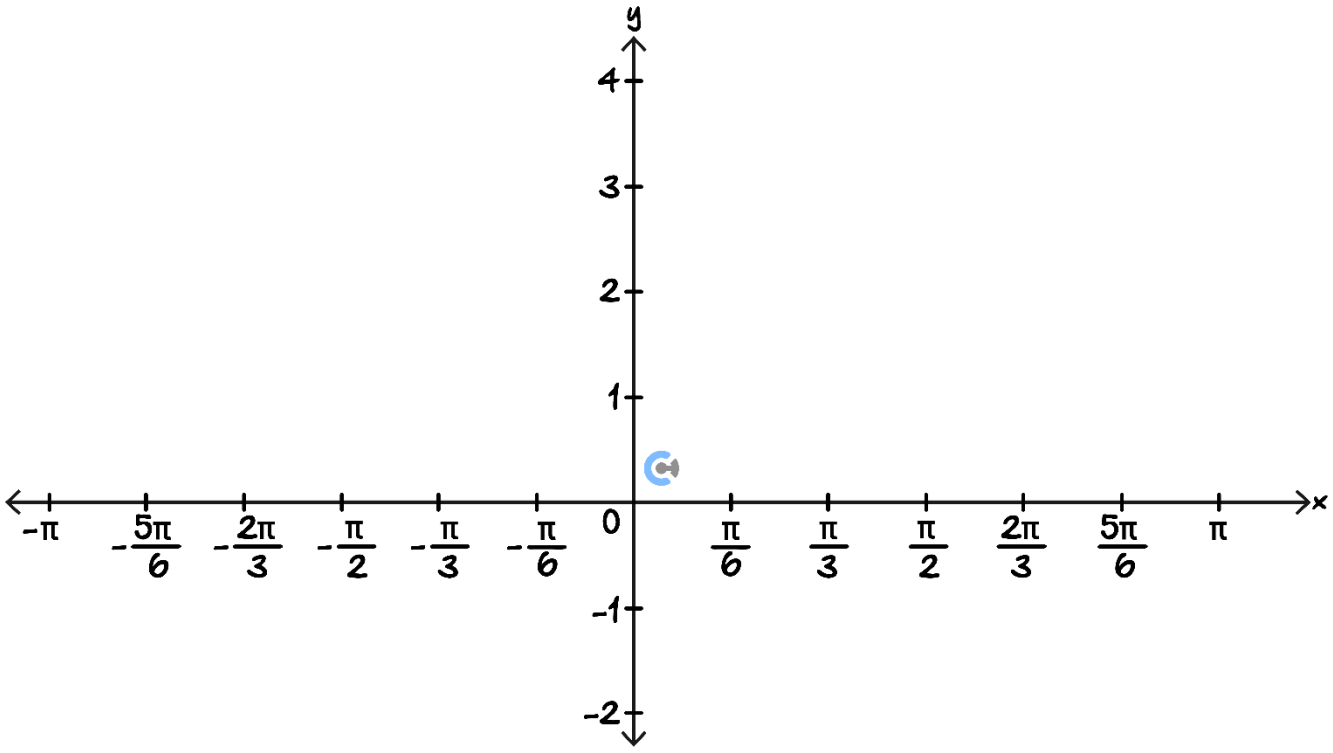
ii. The perimeter of the badge.

Question 8

Consider the function $f(x) = 2\sin\left(2x - \frac{\pi}{3}\right) + 1$.

a. Find the general solution to $f(x) = 0$.

b. Sketch the graph of $y = f(x)$ for $x \in [-\pi, \pi]$ on the axes below. Label all axes intercepts, turning points and endpoints with coordinates.



c. Find the values of x for which $f(x) > 2$.

d. The function $f(x)$ has an equivalent expression $f(x) = 2\cos\left(2x + \frac{a\pi}{6}\right) + 1$, where $0 < a < 12$.
State the value of a.

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Sub-Section: Exam 2 Questions

Question 9

A building is 60 metres tall. From a certain point, the angle of elevation to the top of the building is 30°. How far is the point from the building?

A. $60\sqrt{3}$ metres.

B. $45\sqrt{3}$ metres.

C. $30\sqrt{3}$ metres.

D. $40\sqrt{3}$ metres.

Question 10

If $\tan(\theta) = -\frac{3}{4}$ and $\theta \in [0,2\pi]$, then $\cos(\theta)$ is equal to:

A. $\frac{3}{5}$ or $-\frac{3}{5}$.

B. $\frac{4}{3}$ or $-\frac{4}{3}$.

C. $-\frac{3}{5}$ or $-\frac{4}{5}$.

D. $\frac{4}{5}$ or $-\frac{4}{5}$.

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Question 11

The solutions of the equation

$$2\cos\left(2x-\frac{\pi}{3}\right)+1=0$$

are:

A. $x=\frac{\pi(6k-2)}{6}$ or $x=\frac{\pi(6k-3)}{6}$, for $k\in\mathbb{Z}$.

B. $x=\frac{\pi(6k-2)}{6}$ or $x=\frac{\pi(6k+5)}{6}$, for $k\in\mathbb{Z}$.

C. $x=\frac{\pi(6k-1)}{6}$ or $x=\frac{\pi(6k+2)}{6}$, for $k\in\mathbb{Z}$.

D. $x=\frac{\pi(6k-1)}{6}$ or $x=\frac{\pi(6k+3)}{6}$, for $k\in\mathbb{Z}$.

Question 12

Let $\cos(x)=-\frac{3}{5}$ and $\sin^2(y)=\frac{25}{169}$, where $x\in\left[\frac{\pi}{2},\pi\right]$ and $y\in\left[\frac{3\pi}{2},2\pi\right]$.

The value of $\sin(x)+\cos(y)$ is:

A. $\frac{8}{65}$

B. $-\frac{112}{65}$

C. $\frac{112}{65}$

D. $-\frac{8}{65}$

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Question 13

Ryan's line of sight, while looking at a bird on a tree top, makes a 45° angle of elevation. He walks 240 metres towards the tree to observe the bird closely, thus causing his line of sight to make a 60° angle of elevation.
How far was Ryan from the tree initially?

A. $\frac{240\sqrt{3}}{\sqrt{3}-1}$ metres.

B. $\frac{240}{\sqrt{3}-1}$ metres.

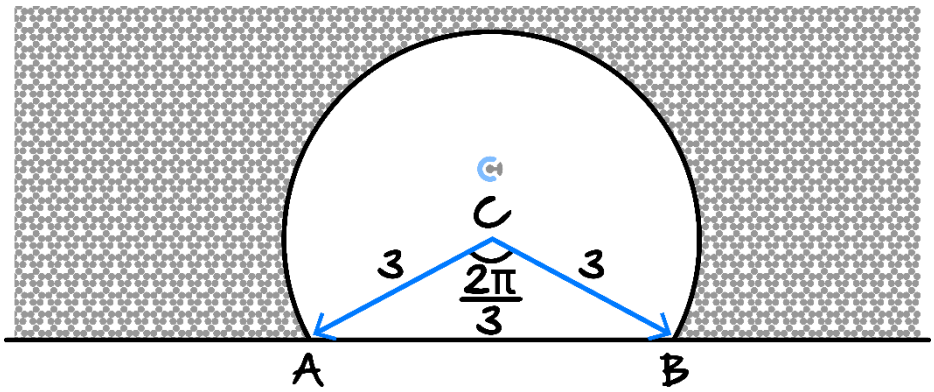
C. $\frac{240}{\sqrt{3}}$ metres.

D. $240\sqrt{3}$ metres.

Question 14

The figure below shows the cross-section of a railway tunnel, modelled as the major segment of a circle, centre at C and radius of 3 m.

The angle $\angle ACB$ is $\frac{2\pi}{3}$ radians.



a. Find the exact length of AB.

b. Determine the area of the triangle ACB.

c. Find the cross-sectional area of the tunnel.

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Question 15

The distance between the town of Alphaville (A) and the town of Betaville (B) is 60 km. Betaville is on a bearing of 75° from Alphaville.

The village of Cappal (C) is on a bearing of 120° from Alphaville and on a bearing of 195° from Betaville. The village of Deltan (D) is on a bearing of 135° from Alphaville and on a bearing of 210° from Betaville.

a. Find, correct to one decimal place where appropriate, the distance between:

i. Betaville and Cappal.

ii. Betaville and Deltan.

iii. Cappal and Deltan.

b. Find the bearing of Deltan from Cappal.

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Question 16

The population of koalas in a particular location varies according to the rule:

$$n(t) = 1500 + 500\cos\left(\frac{\pi t}{4}\right)$$

where n is the number of koalas and t is the number of months after 1 March 2015.

a. Find the period and amplitude of the function n.

b. Find the maximum and minimum populations of koalas in this location.

c. Find $n(2)$.

d. Over the 10 months from 1 March 2015, find the fraction of time when the population of koalas in this location was less than $n(2)$.

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