1 When θ is small,

(a) show that $\frac{\cos\theta}{\sin\theta}$ can be approximated by $\frac{2-\theta^2}{2\theta}$

(3)

(b) Hence, approximate the value of $\frac{\cos\frac{\pi}{24}}{\sin\frac{\pi}{24}}$

(2)

(c) Calculate the percentage error in your approximation

(1)

(Total for question 1 is 6 marks)

2 When x is small,

(a) show that $\tan(3x)\cos(2x)$ can be approximated by $3x - 6x^3$

(3)

(b) Hence, approximate the value of $\tan(0.3)\cos(0.2)$

(2)

(c) Calculate the percentage error in your approximation

(1)

(Total for question 2 is 6 marks)

3 Given that θ is small,

(a) use the small angle approximation of $\cos\theta$ to show that

$$4\cos(\theta) + \cos^2(2\theta) \approx 5 - 6\theta^2 + 4\theta^4$$

(3)

(b) Hence find an approximation of $4\cos(\theta) + \cos^2(2\theta)$ when $\theta = 3^\circ$

(2)

(c) Calculate the percentage error in your approximation

(1)

(Total for question 3 is 6 marks)

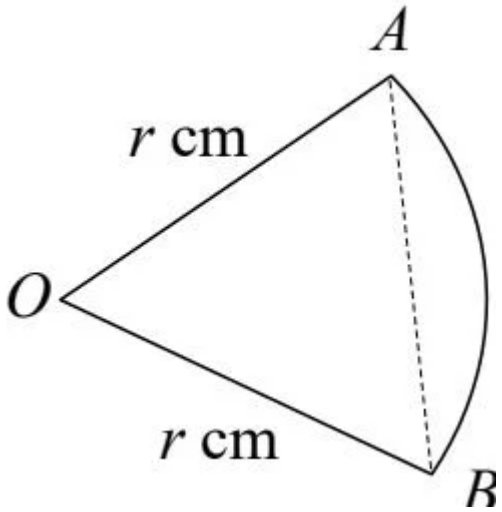
4 Given that θ is small and is measured in radians, use the small angle approximations to find an approximate value of

$$\frac{4\theta \sin 3\theta}{1 - \cos 2\theta}$$

Find an approximate value of the expression.

(Total for question 4 is 3 marks)

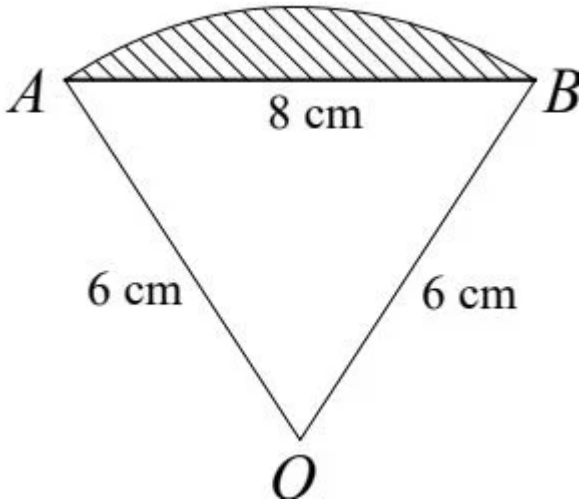
5 Sector AOB is a sector of a circle, radius r cm.



Triangle AOB is equilateral. The area of sector AOB is 24π cm^2
Find, in terms of π, the perimeter of the sector.

(Total for question 5 is 4 marks)

6 Sector AOB is a sector of a circle, radius 6cm. The chord AB is 8cm long.



(a) Find the angle AOB in radians, giving your answer to 3 decimal places

(3)

(b) Calculate the area of the sector AOB

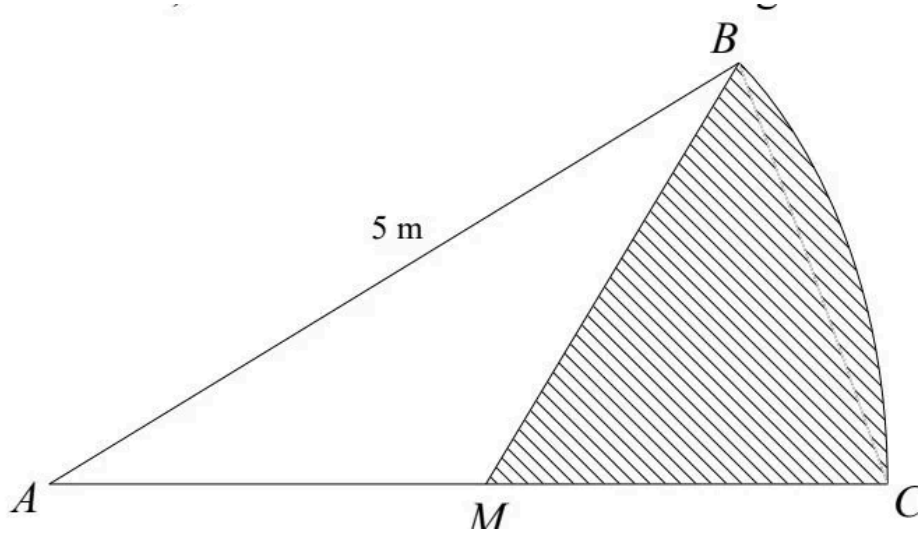
(2)

(c) Calculate the shaded area.

(3)

(Total for question 6 is 8 marks)

7 Sector ABC is a sector of a circle, centre A and and radius 5m. Angle BAC = 0.5 radians



(a) Find the length of the arc BC

(2)

(b) Calculate the area of the sector ABC

(2)

(c) Given that M is the midpoint of AC, find the perimeter of the shaded region

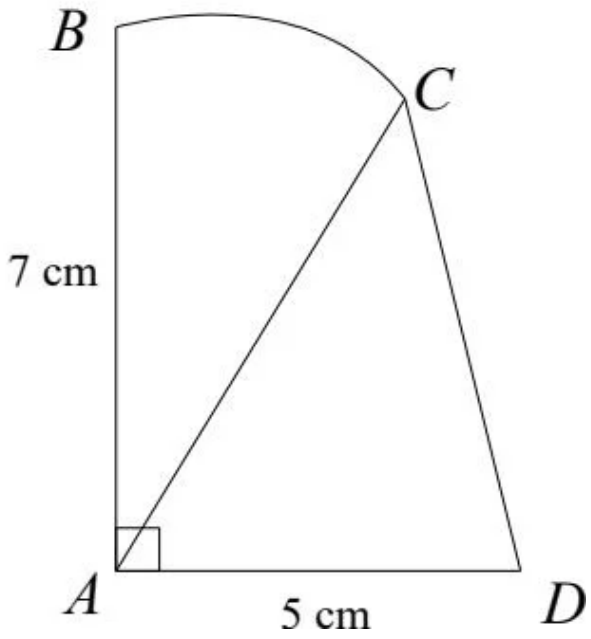
(4)

(d) Find the area of the shaded region

(4)

(Total for question 7 is 12 marks)

8 Sector ABC is a sector of a circle, centre A and and radius 7 cm. Angle BAC = 0.6 radians



(a) Find the length of the arc BC

(2)

(b) Calculate the area of the sector ABC

(2)

(c) Find the size of angle CAD, in radians

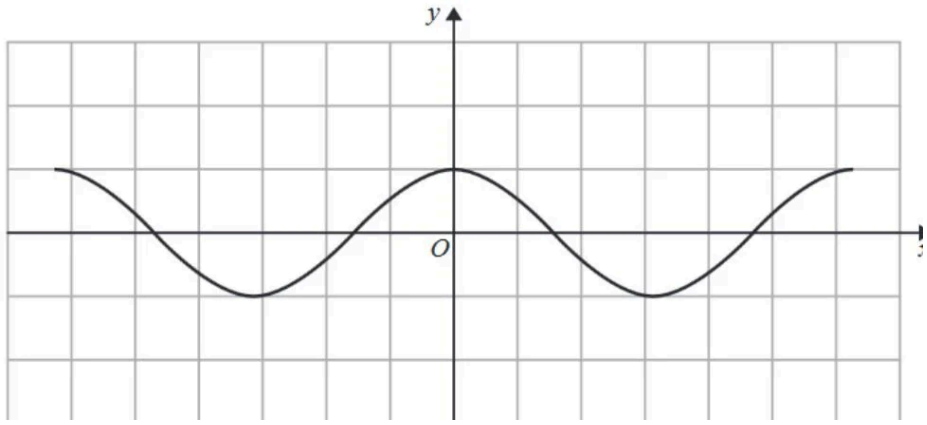
(1)

(d) Find the total area of the shape ABCD

(3)

(Total for question 8 is 8 marks)

9 The diagram shows the graph of $y = \cos x$ where x is measured in radians.



(a) Explain why the equation $\cos x - 3x - 0.5 = 0$ only has one real root.

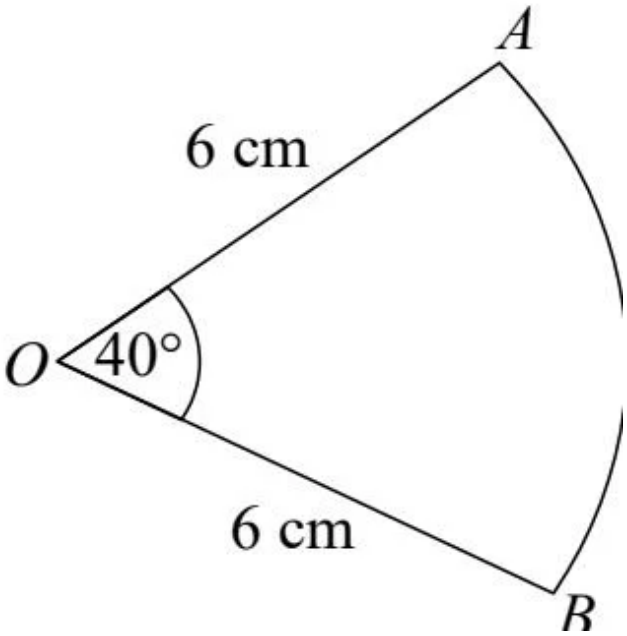
(2)

(b) Given the root of the equation is α, and α is small, use small angle approximations to find the value of α to 3 decimal places.

(3)

(Total for question 9 is 5 marks)

10 Sector AOB is a sector of a circle. A student's attempt to find the area of sector AOB is shown below.



$$\begin{aligned}\text{Area} &= \frac{1}{2}r^2\theta \\ &= \frac{1}{2} \times 6^2 \times 40 \\ &= 58 \text{ cm}^2\end{aligned}$$

(a) Identify the mistake made by the student.

(1)

(b) Write out a correct solution.

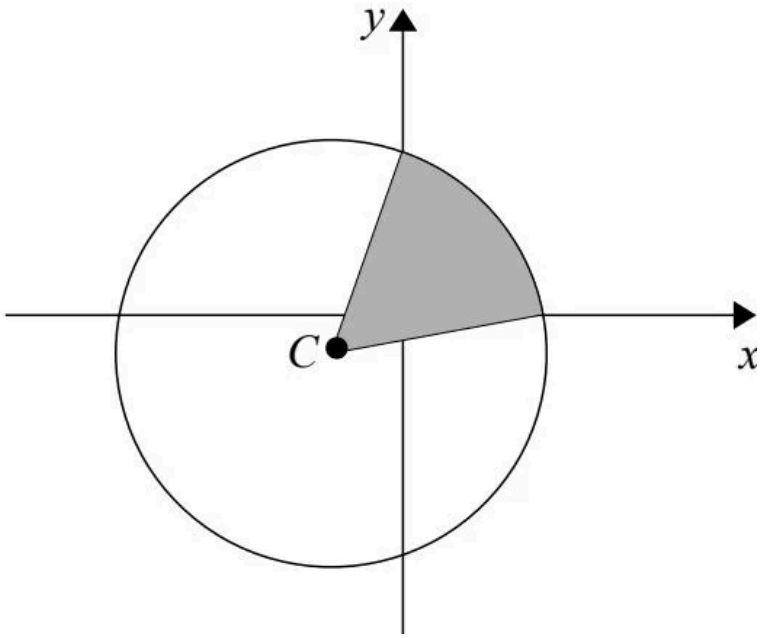
(2)

(Total for question 10 is 3 marks)

11 Show that, for small values of x, the graph of $y = 3 + 6\sin\frac{x}{3} - 8\tan\frac{x}{2}$ can be approximated by a straight line.

(Total for question 11 is 3 marks)

12 The diagram shows a circle, with centre C, with equation $(x+2)^2+(y+1)^2=25$. The circle intersects the x-axis at A and intersects the y-axis at B. The sector ABC is shown on the diagram.



(a) Shown that angle $ACB = 0.958$ radians to 3 significant figures.

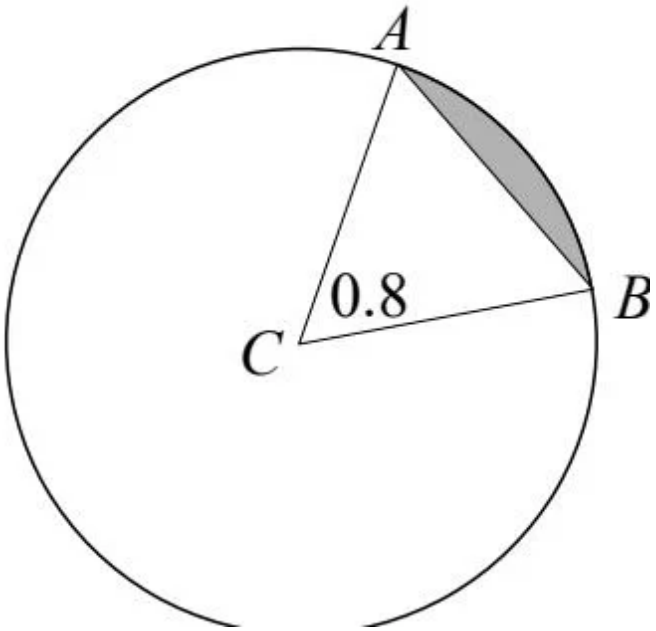
(5)

(b) Find the perimeter of sector ABC.

(3)

(Total for question 12 is 8 marks)

13 The diagram shows a circle, with centre C, with equation $x^2 + y^2 - 6x + 10y = 222$. AB is a chord of the circle. Angle $ACB = 0.8$ radians.



Find the area of the minor segment shaded on the diagram. Give your answer to three significant figures.

(Total for question 13 is 5 marks)

14 Given that θ is small and is measured in radians, use the small angle approximations to find an approximate value of

$$\frac{5\theta \tan 2\theta}{\cos 4\theta - 1}$$

Find an approximate value of the expression.

(Total for question 14 is 3 marks)

15 (a) For a small angle θ, where θ is in radians, show that $2\cos\theta + (\sin\theta + 1)^2 \approx 2\theta + 3$

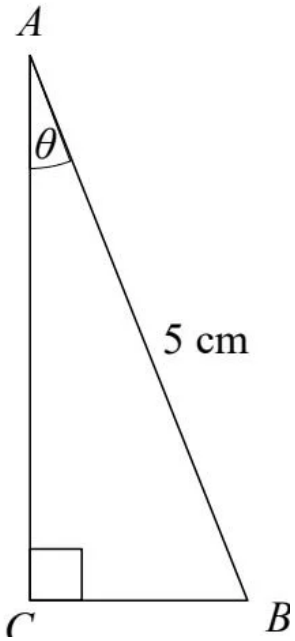
(3)

(b) Hence determine an approximate solution to $2\cos\theta + (\sin\theta + 1)^2 \approx 20\tan\theta$

(2)

(Total for question 15 is 5 marks)

16 ABC is a right angled triangle. Angle $BAC = \theta$, where θ is in radians. $AB = 5$ cm.



Given that θ is small, find the length of AC.

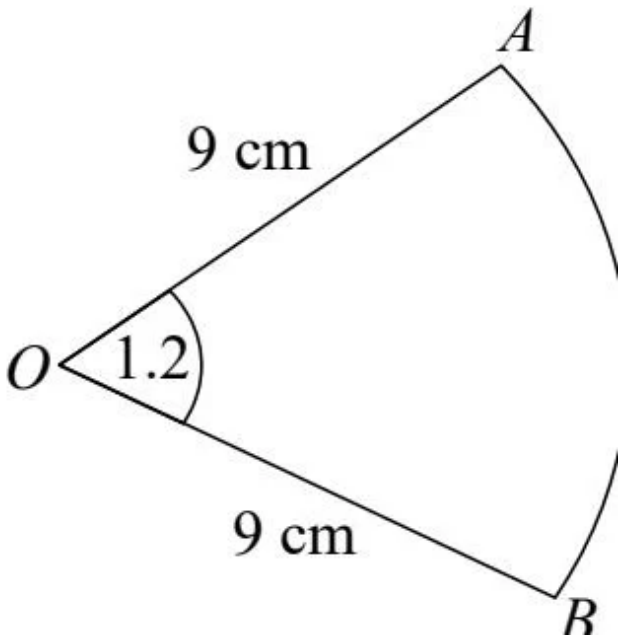
(Total for question 16 is 3 marks)

17 The area of a sector of a circle is 1.872 cm^2. The arc length of the sector is 1.56 cm. The angle of the sector is θ radians and the radius of the circle is r cm.

Find the value of θ and the value of r.

(Total for question 17 is 3 marks)

18 Sector AOB is a sector of a circle with radius 9 cm. The angle of the sector is 1.2 radians.



(a) Calculate the length of the arc AB

(1)

(b) Calculate the area of the sector.

(2)

(Total for question 18 is 3 marks)