

Mrs Cooper
Mr Feng
Mrs Kerr
Mrs Millar
Mrs Squires

Ms Davis
Mrs Greenberg
Mrs Kydd
Ms Smith
Mrs Ward

Name:

Teacher:.....



Pymble Ladies' College

YEAR 11 MATHEMATICS ADVANCED

ASSESSMENT TASK 2

Term 2

2022

General Instructions

- Working time 60 minutes
- Write using black or blue pen.
- Erasable pens are not to be used.
- Approved calculators may be used.
- Diagrams are not drawn to scale.
- All necessary working should be shown in every question.
- Marks may be deducted for careless or untidy work.
- Reference sheets are provided.

Mark	/45
Rank	/
Highest Mark	/45

Section I

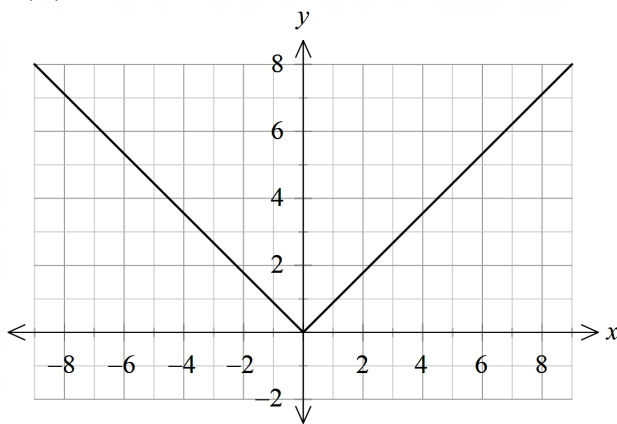
Multiple Choice.

(Each question in this section is worth 1 mark)

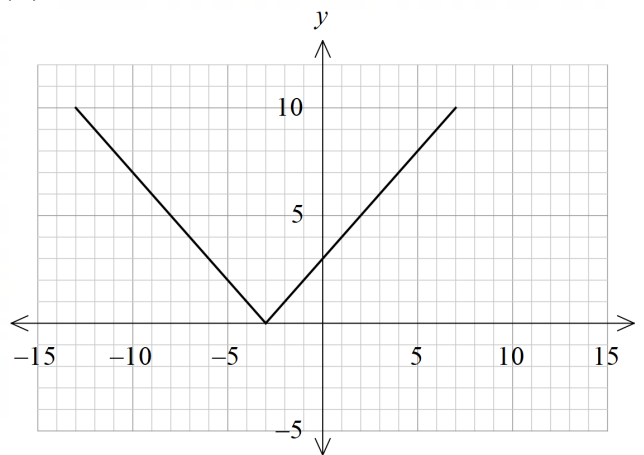
Answer the Multiple Choice questions by placing a circle around your answer.

1 Which of these is the graph of $y = |x + 3|$?

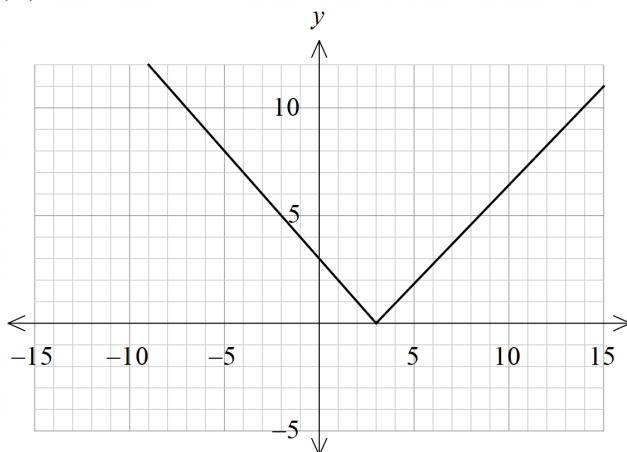
(A)



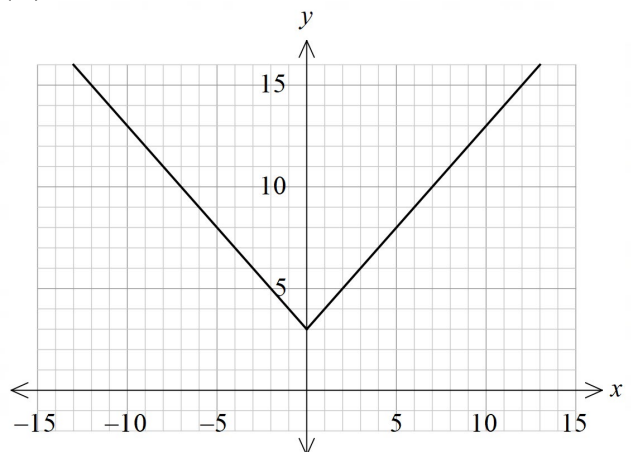
(B)



(C)

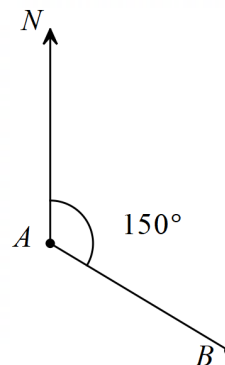


(D)



2 A plane flies on a bearing of 150° from A to B.
What is the bearing from B to A?

- (A) 30°
- (B) 60°
- (C) 300°
- (D) 330°



3 What is the correct simplification of the expression $\frac{1}{\sec 30^\circ - \tan 30^\circ}$?

(A) $\sqrt{3}$

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

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

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

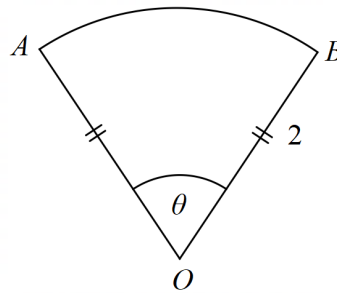
4 The diagram shows a sector OAB of a circle with centre O and radius 2. The angle AOB is θ radians and the perimeter of the sector is 6. What is the correct value for θ ?

(A) 1

(B) 2

(C) $\sqrt{3}$

(D) 3



5 What is the correct derivative of $f(x) = x^2 + 6x + 9$?

(A) $f'(x) = 2x + 6 + 9$

(B) $f'(x) = x^2 + 6$

(C) $f'(x) = 2x + 6$

(D) $f(x) = 2x$

6 What is the correct derivative of $y = (x^2 + 5)^3$?

(A) $6(x^2 + 5)^2$

(B) $6x(x^2 + 5)^2$

(C) $(2x + 5)^3$

(D) $3(2x + 5)^2$

- 7 What is the exact value of $\cos\left(\frac{3\pi}{4}\right)$?
- (A) $-\frac{1}{\sqrt{2}}$
- (B) $\frac{1}{\sqrt{2}}$
- (C) $\frac{1}{2}$
- (D) $-\frac{1}{2}$
- 8 The derivative of $y = 2x^{\frac{1}{2}}$ is which of the following?
- (A) $-\frac{2}{\sqrt{x}}$
- (B) $-\frac{1}{\sqrt{x}}$
- (C) $\frac{1}{\sqrt{x^3}}$
- (D) $\frac{1}{\sqrt{x}}$
- 9 The equation $x^2 + y^2 - 6x + 6 = 0$ represents a circle. What are the coordinates of the centre of the circle?
- (A) $(3, -3)$
- (B) $(-3, -3)$
- (C) $(3, 0)$
- (D) $(-6, 0)$
- 10 What is the exact value of $\tan(-150^\circ)$?
- (A) $\sqrt{3}$
- (B) $\frac{1}{\sqrt{3}}$
- (C) $-\sqrt{3}$
- (D) $-\frac{1}{\sqrt{3}}$

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Section II

Name.....

Attempt all Questions.

Your responses should include relevant mathematical reasoning and/or calculations.

Answer in the spaces provided.

Question 11 (2 marks)

State the domain and range of $y = 2 + |x - 3|$.

2

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Question 12 (3 marks)

(a) Sketch the graph of $y = \sin x$ for $0 < x < 2\pi$.

2



(b) How many solutions are there to $\sin x = -0.4$ for $0 < x < 2\pi$?

1

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Question 13 (1 mark)

Convert $\frac{4\pi}{7}$ to degrees, giving your answer to the nearest minute.

1

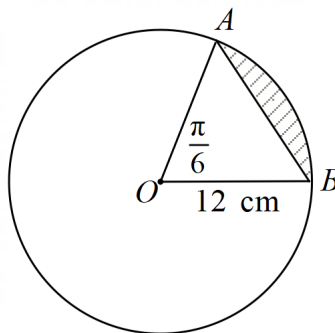
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Question 14 (3 marks)

The diagram shows a circle with radius 12 cm, centre O .



Given $\angle AOB = \frac{\pi}{6}$:

- (a) Find the area of the sector AOB .

1

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- (b) Find the exact area of the shaded segment.

2

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Question 15 (2 marks)

Simplify $\cot \theta \sec \theta$.

2

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Question 16 (3 marks)

Given that $\cos \theta = \frac{\sqrt{5}}{3}$ and $\tan \theta < 0$, find the exact value of $\sin \theta \sec \theta$.

3

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Question 17 (8 marks)

Differentiate the following.

(a) $y = x^2 + x$ **1**

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(b) $y = 7x^4 + \frac{6}{x} - 9$ **2**

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(c) $f(x) = \frac{x^2}{4x+1}$ **2**

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(d) $y = x^2(x-1)^3$ **3**

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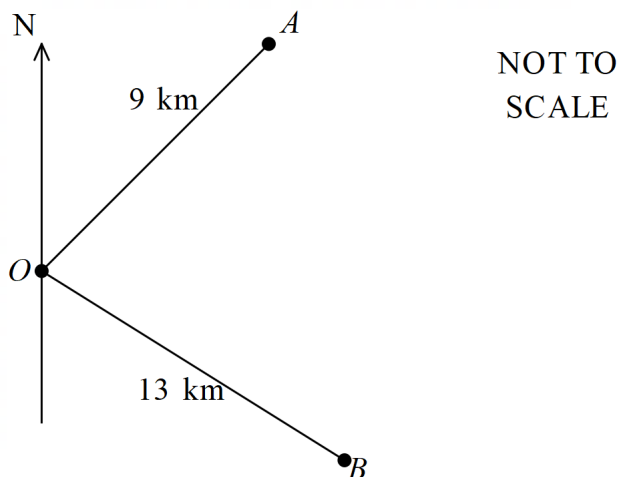
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Question 18 (4 marks)

Alex and Bobby and a group of students were camping at a site. Alex walked with some students on a bearing of 037° for 9 km to location A . Bobby, with the rest of the students, walked on a bearing of 102° for 13 km to location B .



- (a) Show that the angle AOB is 65° . 1

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- (b) Find the distance AB , in km, correct to 2 decimal places. 1

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- (c) Find the bearing of Bobby's group from Alex's group. 2
Give your answer correct to the nearest degree.

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Question 19 (4 marks)

Solve the following equations:

(a) $\cos \theta = -\frac{1}{\sqrt{2}}, \quad 0 < \theta < 360^\circ$

1

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(b) $2 \sin^2 \theta - 3 \sin \theta = -1, \quad 0 < \theta < 2\pi$

3

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Question 20 (2 marks)

Find the values of α and x such that:

2

$$\alpha \sin x = 5 \sin 20^\circ + 3 \cos 70^\circ.$$

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Question 21 (3 marks)

Prove that $\frac{1}{\cos \theta} + \cos \theta = (2 - \sin^2 \theta) \sec^2 \theta$.

3

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End of Assessment

Extra writing space

If you use this space, clearly indicate which question you are answering.

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Mrs Kerr
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Name: Solutions

Teacher:



Pymble Ladies' College

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ASSESSMENT TASK 2**

**Term 2
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Section I

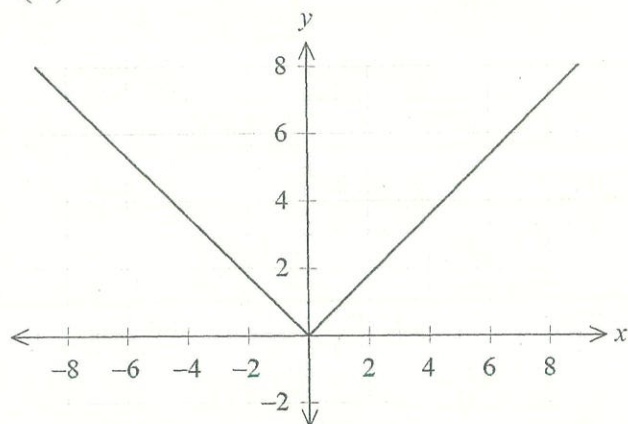
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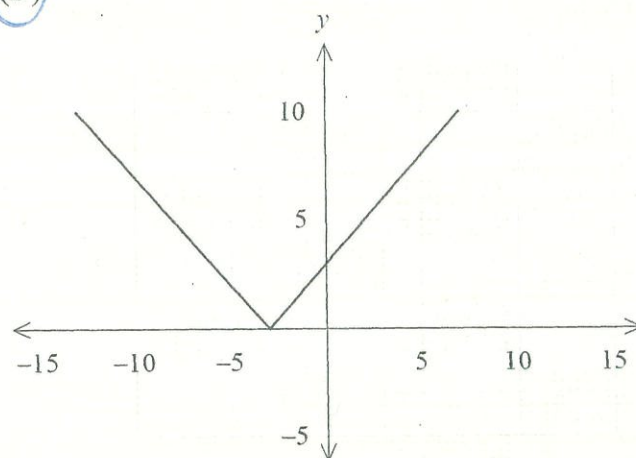
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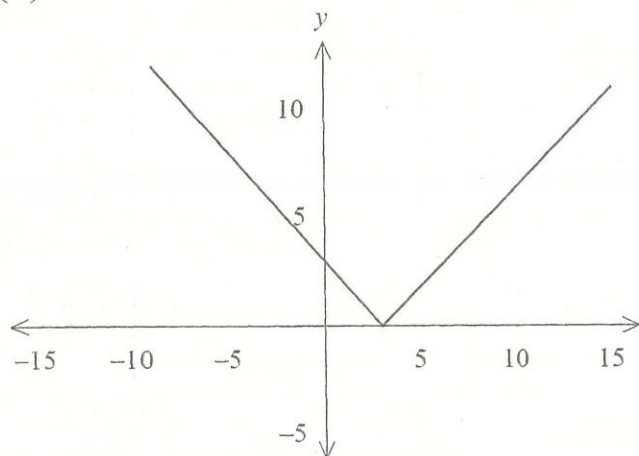
(A)



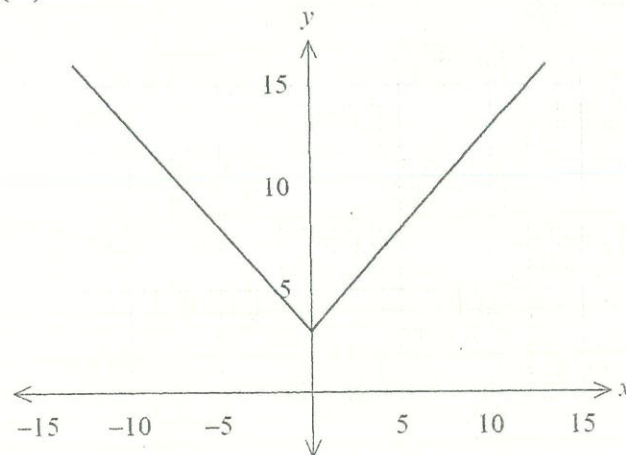
(B)



(C)

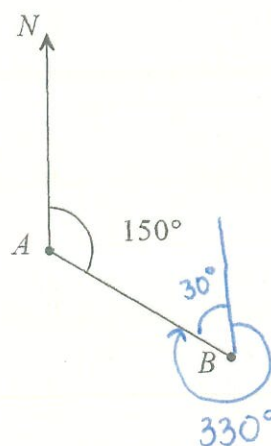


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- 2 A plane flies on a bearing of 150° from A to B.
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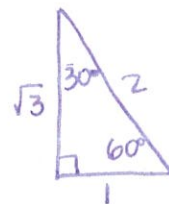
(C) $\frac{1}{2}$

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

$$= \frac{1}{\frac{2}{\sqrt{3}} - \frac{1}{\sqrt{3}}}$$

$$= \frac{1}{\frac{1}{\sqrt{3}}}$$

$$= \sqrt{3}$$



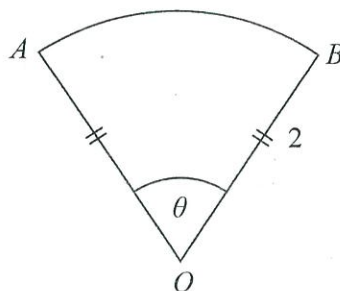
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(A) 1

(B) 2

(C) $\sqrt{3}$

(D) 3



$$P = 6$$

$$6 = 2(2) + 2\theta$$

$$6 = 4 + 2\theta$$

$$2 = 2\theta$$

$$1 = \theta$$

- 5 What is the correct derivative of $f(x) = x^2 + 6x + 9$?

(A) $f'(x) = 2x + 6 + 9$

$$f'(x) = 2x + 6$$

(B) $f'(x) = x^2 + 6$

(C) $f'(x) = 2x + 6$

(D) $f(x) = 2x$

- 6 What is the correct derivative of $y = (x^2 + 5)^3$?

(A) $6(x^2 + 5)^2$

(B) $6x(x^2 + 5)^2$

(C) $(2x + 5)^3$

(D) $3(2x + 5)^2$

$$y' = 3(x^2 + 5)^2 (2x)$$

$$= 6x(x^2 + 5)^2$$

7 What is the exact value of $\cos\left(\frac{3\pi}{4}\right)$?

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

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

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

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

8 The derivative of $y = 2x^{\frac{1}{2}}$ is which of the following?

(A) $-\frac{2}{\sqrt{x}}$

(B) $-\frac{1}{\sqrt{x}}$

(C) $\frac{1}{\sqrt{x^3}}$

(D) $\frac{1}{\sqrt{x}}$

$$y' = x^{-1/2}$$

$$= \frac{1}{\sqrt{x}}$$

9 The equation $x^2 + y^2 - 6x + 6 = 0$ represents a circle. What are the coordinates of the centre of the circle?

(A) $(3, -3)$

(B) $(-3, -3)$

(C) $(3, 0)$

(D) $(-6, 0)$

$$x^2 - 6x + 9 + y^2 = -6 + 9$$

$$(x-3)^2 + y^2 = 3$$

$\therefore$ centre at $(3, 0)$

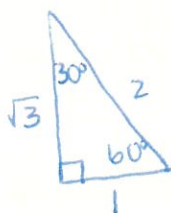
10 What is the exact value of $\tan(-150^\circ)$?

(A) $\sqrt{3}$

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

(C) $-\sqrt{3}$

(D) $-\frac{1}{\sqrt{3}}$



$$\tan 30 = \frac{1}{\sqrt{3}}$$

$$\tan(-150) = \tan 30$$

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Section II

Name.....

Attempt all Questions.

Your responses should include relevant mathematical reasoning and/or calculations.

Answer in the spaces provided.

Question 11 (2 marks)

State the domain and range of $y = 2 + |x - 3|$.

2

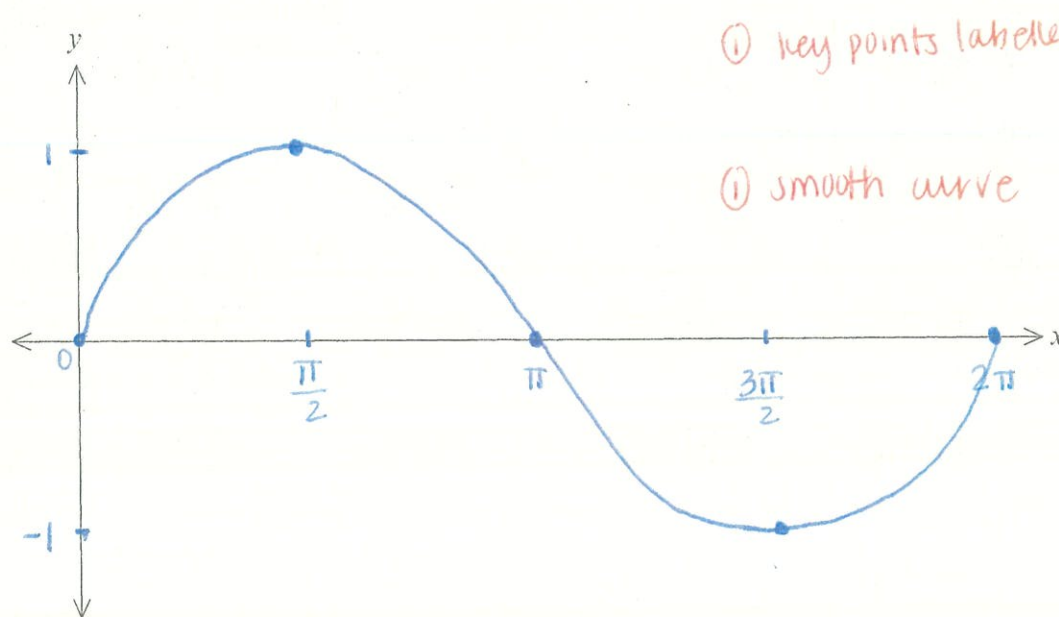
Domain: $x: x \in \mathbb{R}$ ①

Range: $y: y \in [2, \infty]$ ①

Question 12 (3 marks)

(a) Sketch the graph of $y = \sin x$ for $0 < x < 2\pi$.

2



(b) How many solutions are there to $\sin x = -0.4$ for $0 < x < 2\pi$?

1

two solutions ①

Question 13 (1 mark)

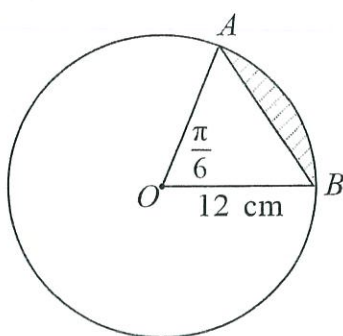
Convert $\frac{4\pi}{7}$ to degrees, giving your answer to the nearest minute.

1

$$\frac{4\pi}{7} \times \frac{180}{\pi} = 102^{\circ}51' \quad (1)$$

Question 14 (3 marks)

The diagram shows a circle with radius 12 cm, centre O .



Given $\angle AOB = \frac{\pi}{6}$:

- (a) Find the area of the sector AOB .

1

$$\begin{aligned} A &= \frac{1}{2} r^2 \theta \\ &= \frac{1}{2} (12)^2 \left(\frac{\pi}{6} \right) \\ &= 12\pi \text{ cm}^2 \quad (1) \end{aligned}$$

- (b) Find the exact area of the shaded segment.

2

$$\begin{aligned} A_{\text{segment}} &= A_{\text{sector}} - A_{\text{triangle}} \\ &= 12\pi - \frac{1}{2} \times 12 \times 12 \times \sin \frac{\pi}{6} \\ &= (12\pi - 36) \text{ cm}^2 \end{aligned}$$

(1) • Sect - Δ
• correct Δ area formula.
• CPFA - Δ

(2) correct soln

Question 15 (2 marks)

Simplify $\cot \theta \sec \theta$.

2

$$\begin{aligned}\cot \theta \sec \theta &= \frac{\cos \theta}{\sin \theta} \times \frac{1}{\cos \theta} \\ &= \frac{1}{\sin \theta} \\ &= \operatorname{cosec} \theta\end{aligned}$$

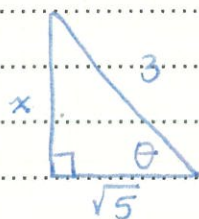
① uses one identity
 $\cot \theta = \frac{\cos \theta}{\sin \theta}$ or $\sec \theta = \frac{1}{\cos \theta}$

② correct solution

Question 16 (3 marks)

Given that $\cos \theta = \frac{\sqrt{5}}{3}$ and $\tan \theta < 0$, find the exact value of $\sin \theta \sec \theta$.

3



$$\begin{aligned}x &= \sqrt{3^2 - (\sqrt{5})^2} \\ &= 2\end{aligned}$$

one is positive & one is negative

$$\sin \theta \sec \theta = -\frac{2}{3} \times \frac{3}{\sqrt{5}}$$

① values of $\sin \theta$ and $\sec \theta$

$$= -\frac{2}{\sqrt{5}}$$

① negative

① • correct Δ
• as $\tan \theta < 0$ Q4

② • $\sin \theta \sec \theta$ using CFPE
• neg sine value.

③ correct soln.

Question 17 (8 marks)

Differentiate the following.

(a) $y = x^2 + x$

1

$y' = 2x + 1$ (1)

(b) $y = 7x^4 + \frac{6}{x} - 9$

2

$= 7x^4 + 6x^{-1} - 9$

$y' = 28x^3 - 6x^{-2}$ (1) (1) OR $y' = 28x^3 - \frac{6}{x^2}$

(c) $f(x) = \frac{x^2}{4x+1} = \frac{u}{v}$ $f'(x) = \frac{vu' - uv'}{v^2}$

2

$f'(x) = \frac{(4x+1)(2x) - (x^2)(4)}{(4x+1)^2}$

(1) correct diff one term

(2) correct solution

$= \frac{8x^2 + 2x - 4x^2}{(4x+1)^2} = \frac{4x^2 + 2x}{(4x+1)^2}$

(d) $y = x^2(x-1)^3 = uv$ $y' = uu' + uv'$

3

$y' = (x-1)^3(2x) + (x^2)(3(x-1)^2)$

(1) correct diff one term.

$= 2x(x-1)^3 + 3x^2(x-1)^2$

OR $= x(x-1)^2(2(x-1) + 3x)$

} not necessary for marking

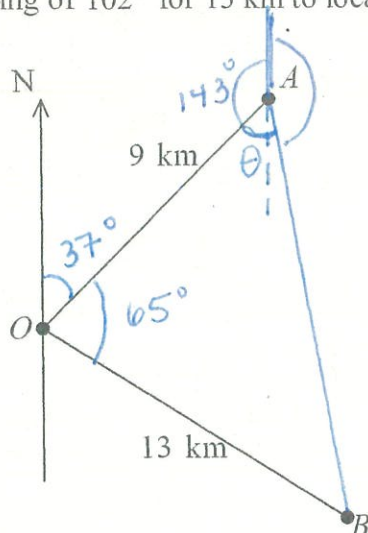
$= x(x-1)^2(5x-2)$

(2) corr diff 2 terms

(3) soln

Question 18 (4 marks)

Alex and Bobby and a group of students were camping at a site. Alex walked with some students on a bearing of 037° for 9 km to location A. Bobby, with the rest of the students, walked on a bearing of 102° for 13 km to location B.



NOT TO
SCALE

- (a) Show that the angle AOB is 65° .

1

$$\begin{aligned}\angle AOB &= \angle NOB - \angle NOA \\ &= 102^\circ - 37^\circ \\ &= 65^\circ \quad (1)\end{aligned}$$

- (b) Find the distance AB in km, correct to 2 decimal places.

1

$$\begin{aligned}AB^2 &= 9^2 + 13^2 - 2 \times 9 \times 13 \times \cos 65 \\ &= 381.6142 \dots \\ AB &= \sqrt{381.6142 \dots} \quad (1) \\ &= 19.52 \dots = 19.52 \text{ km (2 d.p.)}\end{aligned}$$

- (c) Find the bearing of Bobby's group from Alex's group.
Give your answer correct to the nearest degree.

2

$$\begin{aligned}\frac{\sin \theta}{13} &= \frac{\sin 65}{12.29} \\ \theta &= \sin^{-1} \left(\frac{13 \times \sin 65}{12.29} \right) \\ &= 73.42\end{aligned}$$

$$\begin{aligned}\text{Bearing} &= 360 - 143 - 73.42 \\ &= 143.58 \\ &= 144^\circ\end{aligned}$$

Working toward θ using
sine or cosine rule

correct bearing

Question 19 (4 marks)

Solve the following equations:

(a) $\cos \theta = -\frac{1}{\sqrt{2}}, \quad 0 < \theta < 360^\circ$

1

$\theta = 135^\circ, 225^\circ$ (1)

(b) $2\sin^2 \theta - 3\sin \theta = -1, \quad 0 < \theta < 2\pi$

3

$2\sin^2 \theta - 3\sin \theta + 1 = 0$ let $u = \sin \theta$

$2u^2 - 3u + 1 = 0$

$(2u-1)(u-1) = 0$

$\therefore u = \frac{1}{2} \quad u = 1$

$\therefore \sin \theta = \frac{1}{2} \quad \sin \theta = 1$

$\therefore \theta = \frac{\pi}{6}, \frac{5\pi}{6}, \frac{\pi}{2}$

[1] • let $u = \sin \theta$ + attempts to make quadratic
• attempt to factorise

[2] correct fact
 $u = \frac{1}{2} \quad u = 1$ (either
 $\sin \theta = \frac{1}{2} \quad \sin \theta = 1$ (either

Question 20 (2 marks)

Find the values of α and x such that:

$\alpha \sin x = 5 \sin 20^\circ + 3 \cos 70^\circ$

$\sin \theta = \cos(90^\circ - \theta)$

$\alpha \sin x = 5 \sin 20^\circ + 3 \sin 20^\circ$
 $= 8 \sin 20^\circ$

$\therefore \alpha = 8, \quad x = 20^\circ$

[1] • using complementary identity ($\cos 70^\circ = \sin 20^\circ$)
• attempt to add like terms
• either $x = 20^\circ$ or $\alpha = 8$

[2] correct values of α and x .

Question 21 (3 marks)

Prove that $\frac{1}{\cos \theta} + \cos \theta = (2 - \sin^2 \theta) \sec \theta$.

3

$$\begin{aligned} \text{LHS} &= \frac{1}{\cos \theta} + \cos \theta \\ &= \frac{1 + \cos^2 \theta}{\cos \theta} \\ &= \frac{1 + (1 - \sin^2 \theta)}{\cos \theta} \end{aligned} \quad \begin{aligned} &= \frac{2 - \sin^2 \theta}{\cos \theta} \\ &= (2 - \sin^2 \theta) \sec \theta \\ &= \text{RHS} \end{aligned}$$

End of Assessment

$$\begin{aligned} \text{① } \sin^2 \theta &= 1 - \cos^2 \theta \\ \cos^2 \theta &= 1 - \sin^2 \theta \\ \sec \theta &= \frac{1}{\cos \theta} \\ \frac{1}{\cos \theta} &= \sec \theta \end{aligned}$$

② LHS - comm. den
works towards
simplifying LHS

→ RHS

③ correct soln
correct s. out

④ if transposes
any terms.
or doesn't use
LHS/RHS.