adamjee maths

A-LEVEL MATHS / EDEXCEL / FREE RESOURCES

Small angle approximations

Question paper

5 questions

Exam questions and marking instructions remain credited to their board.

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1 June 2025 - Paper 2 - Q6

2 June 2024 - Paper 2 - Q5

3 October 2021 - Paper 2 - Q4

4 June 2019 - Paper 1 - Q2

5 June 2018 - Paper 1 - Q1

6. **In this question you must show detailed reasoning.**

(a) Given that x is small and in radians, use the small angle approximation for $\cos\theta$ to show that

$$1 - \cos^2(2x) \approx 4x^2 - 4x^4$$

(2)

(b) Given that x is small and in radians, use

- the answer to part (a)
- the small angle approximations for $\sin\theta$ and $\tan\theta$

to show that

$$\frac{1 - \cos^2(2x)}{\sin\left(\frac{x}{3}\right)\tan\left(\frac{x}{2}\right)} \approx a + bx^2$$

where a and b are constants to be found.

(2)

(c) Hence, given that x is **very** small, deduce an approximate value for

$$\frac{1 - \cos^2(2x)}{\sin\left(\frac{x}{3}\right)\tan\left(\frac{x}{2}\right)}$$

giving a reason for your answer.

(2)

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Question 6 continued

(Total for Question 6 is 6 marks)

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5. Given that θ is small and in radians, use the small angle approximations to find an approximate numerical value of

$$\frac{\theta \tan 2\theta}{1 - \cos 3\theta}$$

(3)

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Question 5 continued

(Total for Question 5 is 3 marks)

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4. Given that θ is small and measured in radians, use the small angle approximations to show that

$$4 \sin \frac{\theta}{2} + 3 \cos^2 \theta \approx a + b\theta + c\theta^2$$

where a, b and c are integers to be found.

(3)

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Question 4 continued

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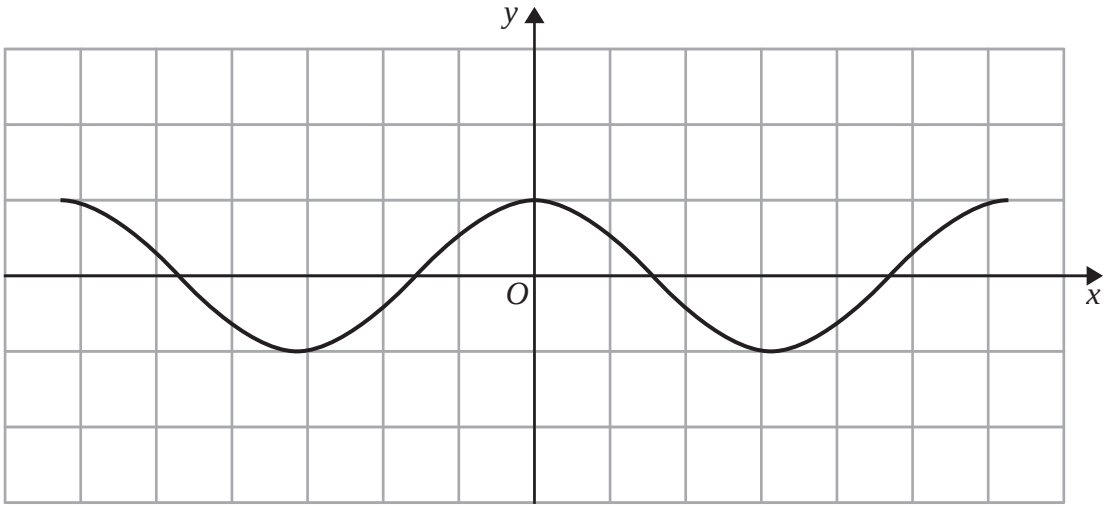


Figure 1

Figure 1 shows a plot of part of the curve with equation $y = \cos x$ where x is measured in radians. Diagram 1, on the opposite page, is a copy of Figure 1.

(a) Use Diagram 1 to show why the equation

$$\cos x - 2x - \frac{1}{2} = 0$$

has only one real root, giving a reason for your answer.

(2)

Given that the root of the equation is α, and that α is small,

(b) use the small angle approximation for $\cos x$ to estimate the value of α to 3 decimal places.

(3)

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Question 2 continued

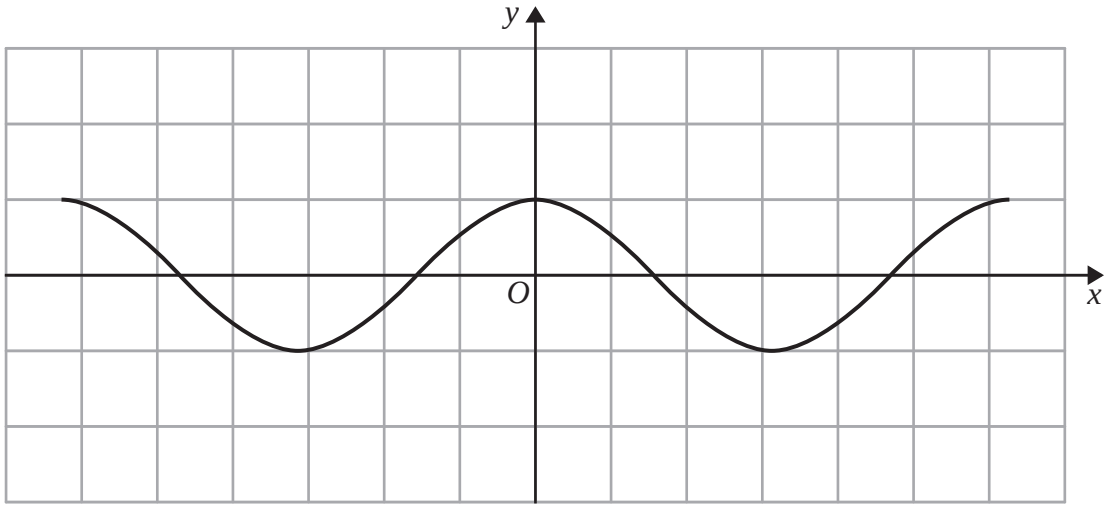


Diagram 1

(Total for Question 2 is 5 marks)

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$5x^2 + 10x$

Answer ALL questions. Write your answers in the spaces provided.

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

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

(3)

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Question 1 continued

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