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VCE Mathematical Methods ¾
Circular Functions II [3.3]
Test

30 Marks. 1 Minute Reading. 24 Minutes Writing.

Results:

Test Questions	_____ / 22
Extension Questions	_____ / 8

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Section A: Test Questions (22 Marks)

Question 1 (3 marks)

Tick whether the following statements are **true** or **false**.

Statement	True	False
a. For sin and cos functions, the amplitude is always the *coefficient* of sin and cos.		
b. We should start sketching the function when the angle is equal to 0.		
c. The y-value of the inflection of the tangent graph is always given by the vertical translation of the function.		
d. To find the vertical asymptote of any tangent function, we simply let the angle equal to $\frac{\pi}{2}$.		
e. For the sum of two trigonometric functions, the period of the overall sum is equal to the larger period.		
f. $\sin(x) \geq \frac{1}{2}$ for $\frac{1}{3}$ of its period.		

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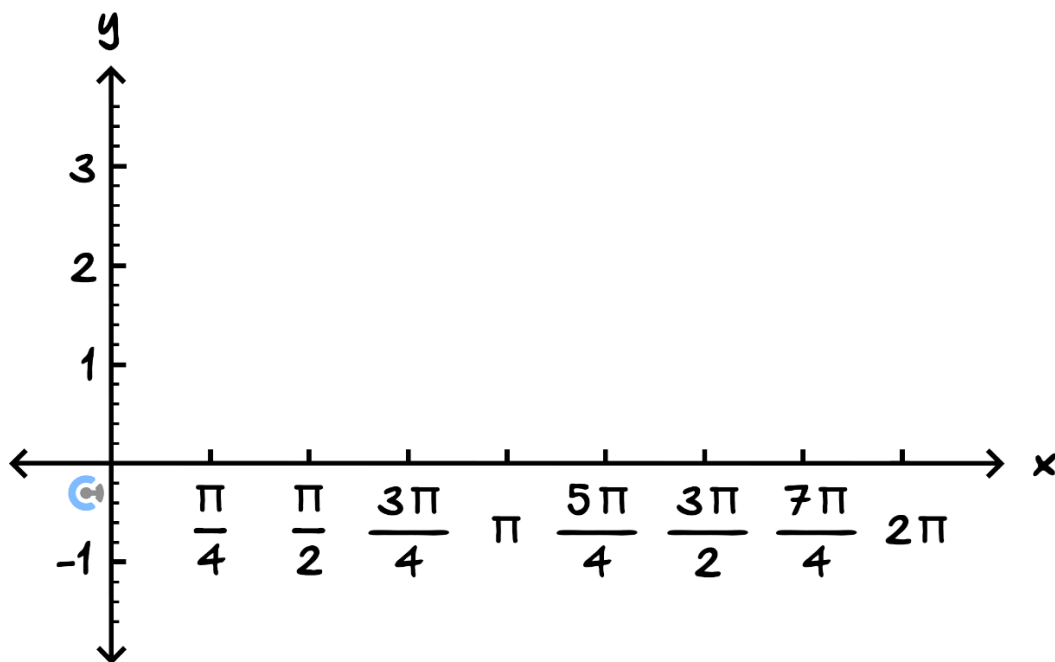VCE Methods ¾ Questions? Message +61 440 138 726

Question 2 (3 marks)

Sketch the graph of $f(x) = 2\tan\left(x + \frac{\pi}{6}\right) + 2$ for $x \in [0, 2\pi]$ on the axes below, labelling all asymptotes, intercepts and endpoints with their coordinates.

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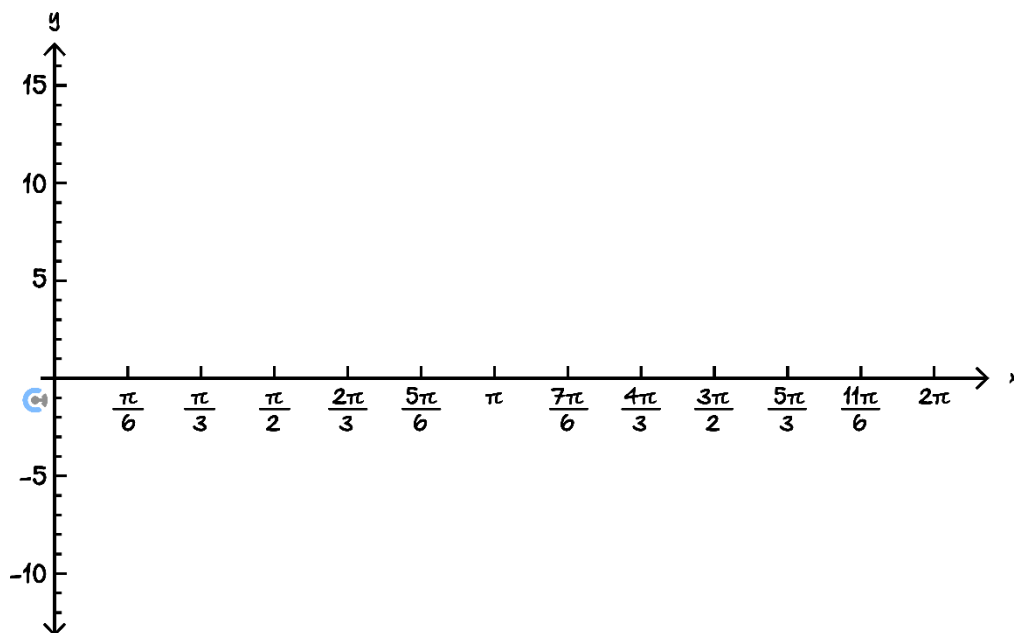
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Question 3 (7 marks)

a. Sketch the graph of $f(x) = -2\cos(2x) + 1$ for $x \in [0, 2\pi]$ on the axes below, labelling all intercepts and endpoints with their coordinates. (3 marks)

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b. Solve $f(x) \geq 1$ for $x \in [0, 2\pi]$. (2 marks)

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Consider a function $h(x) = f(x) + k$.

c. Solve for the value(s) of k such that the solutions of $h(x) = 0$ have a constant interval between them. (2 marks)

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Question 4 (9 marks)

The population of foxes in a certain forest varies according to the rule:

$$P(t) = 50 - 30\cos\left(\frac{\pi}{2}(t-2)\right)$$

Where $P(t)$ is the number of foxes t years after 2024.

a. Find the period and amplitude of this function. (2 marks)

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b. Find the maximum and minimum number of foxes in the forest. (2 marks)

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c. After how many years is the population of foxes a minimum in the first 5 years? (2 marks)

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Foxes are declared a vulnerable species if their population drops below 35.

d. Find the percentage of time when the foxes are declared as vulnerable species. (3 marks)

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Section B: Extension Questions (8 Marks)

Question 5 (8 marks) **Tech-Active.**

The side view of a roller coaster is shown below, where h is the vertical height in m and x is the horizontal distance in m. The start of the roller coaster is at $(0,30)$ and its maximum height reaches $60\ m$.
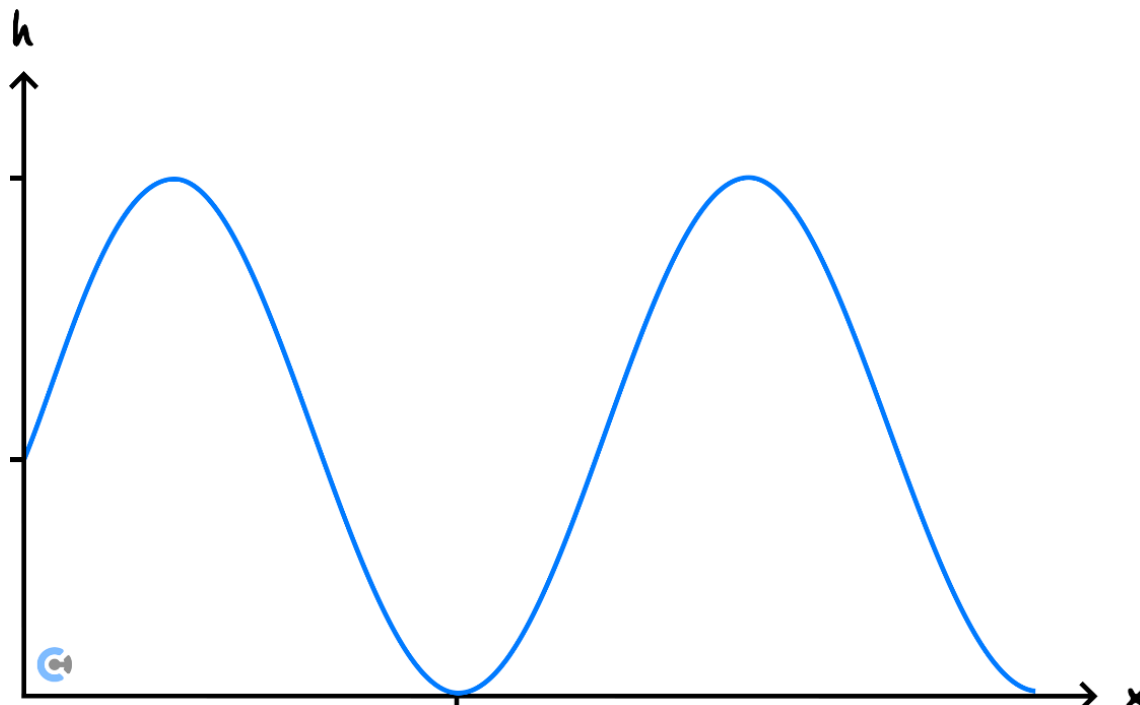
The roller coaster can be modelled by the equation $h(x) = a\sin(nx) + b$ where $a, b, n \in \mathbb{R}$.

a. Find the values of A, B. (2 marks)

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The average rate of change formula is given by $\frac{y_2 - y_1}{x_2 - x_1}$.

b.

   **i.** Find the average rate of change between the first highest point and the first lowest point of the rollercoaster. (2 marks)

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   ii. Find the largest possible value of n if, due to safety regulations, the average rate of change between the peaks is not to exceed a magnitude of 2. (2 marks)

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Use the largest value of n obtained from part **b. ii.** for the questions below.

It is found that the roller coaster needs support with a width of $10\ m$.
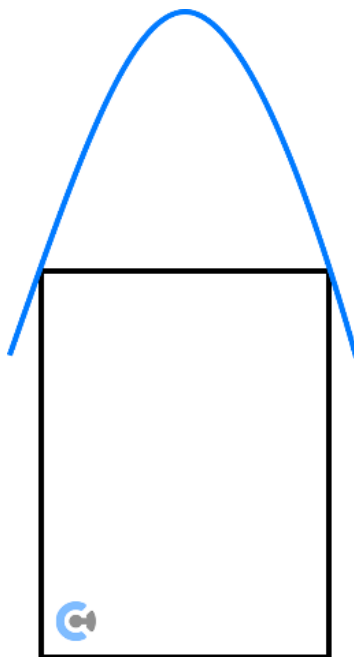
c. What is the maximum height of the support? Give your answer correct to 2 decimal places. (2 marks)

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