

AS Level Mathematics A

H230/02 Pure Mathematics and Mechanics

Question Set 1

1 In triangle ABC , $AB = 20$ cm and angle $B = 45^\circ$.

(a) Given that $AC = 16$ cm, find the two possible values for angle C , correct to 1 decimal place. [4]

(b) Given instead that the area of the triangle is $75\sqrt{2}$ cm², find BC . [2]

2 (a) The curve $y = \frac{2}{3+x}$ is translated by four units in the positive x -direction. State the equation of the curve after it has been translated. [2]

(b) Describe fully the single transformation that transforms the curve $y = \frac{2}{3+x}$ to $y = \frac{5}{3+x}$. [2]

3 In each of the following cases choose one of the statements

$$P \Rightarrow Q \quad P \Leftarrow Q \quad P \Leftrightarrow Q$$

to describe the relationship between P and Q

(a) $P: y = 3x^5 - 4x^2 + 12x$

$Q: \frac{dy}{dx} = 15x^4 - 8x + 12$ [1]

(b) $P: x^5 - 32 = 0$ where x is

real $Q: x = 2$ [1]

(c) $P: \ln y < 0$

$Q: y < 1$ [1]

4 (a) Express $4x^2 - 12x + 11$ in the form $a(x+b)^2 + c$. [3]

(b) State the number of real roots of the equation $4x^2 - 12x + 11 = 0$. [1]

(c) Explain fully how the value of r is related to the number of real roots of the equation $p(x+q)^2 + r = 0$ where p, q and r are real constants and $p > 0$. [2]

5 In this question you must show detailed reasoning.

The line $x + 5y = k$ is a tangent to the curve $x^2 - 4y = 10$. Find the value of the constant k . [5]

- 6 A pan of water is heated until it reaches 100°C . Once the water reaches 100°C , the heat is switched off and the temperature $T^\circ\text{C}$ of the water decreases. The temperature of the water is modelled by the equation

$$T = 25 + ae^{-kt},$$

where t denotes the time, in minutes, after the heat is switched off and a and k are positive constants.

- (a) Write down the value of a . [1]

- (b) Explain what the value of 25 represents in the equation $T = 25 + ae^{-kt}$. [1]

When the heat is switched off, the initial rate of decrease of the temperature of the water is 15°C per minute.

- (c) Calculate the value of k . [3]

- (d) Find the time taken for the temperature of the water to drop from 100°C to 45°C . [3]

- (e) A second pan of water is heated, but the heat is turned off when the water is at a temperature of less than 100°C . Suggest how the equation for the temperature as the water cools would be modified by this. [1]

- 7 (a) Show that the equation

$$2 \sin x \tan x = \cos x + 5$$

can be expressed in the form

$$3 \cos^2 x + 5 \cos x - 2 = 0. \quad [3]$$

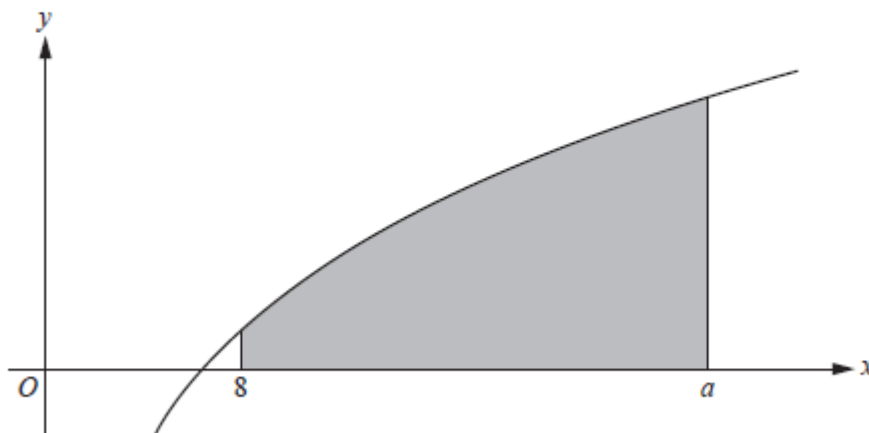
- (b) Hence solve the equation

$$2 \sin 2\theta \tan 2\theta = \cos 2\theta + 5,$$

giving all values of θ between 0° and 180° , correct to 1 decimal place. [5]

- 8 In this question you must show detailed reasoning.

The diagram shows part of the graph of $y = 2x^{\frac{1}{3}} - \frac{7}{x^{\frac{1}{3}}}$. The shaded region is enclosed by the curve, the x -axis and the lines $x = 8$ and $x = a$, where $a > 8$.



Given that the area of the shaded region is 45 square units, find the value of a . [9]

Total Marks for Question Set 1: 50

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