

6:

In this question you must show all stages of your working.
Solutions relying entirely on calculator technology are not acceptable.

The temperature, $\theta^{\circ}\text{C}$, of a computer processor, t minutes after the computer is switched off, is modelled by the equation

$$\theta = 21 + Ae^{-kt}$$

where A and k are positive constants.

Given that the temperature of the processor was 75°C when the computer was switched off,

(a) find the value of A .

(2)

Given also that it takes 5 minutes for the temperature of the processor to decrease from 75°C to 25°C ,

(b) find the value of k , giving your answer to 3 significant figures.

(3)

At time T minutes, the temperature of the processor is decreasing at a rate of 9°C per minute.

(c) Find the value of T according to the model, giving your answer to 2 decimal places.

(3)

9.

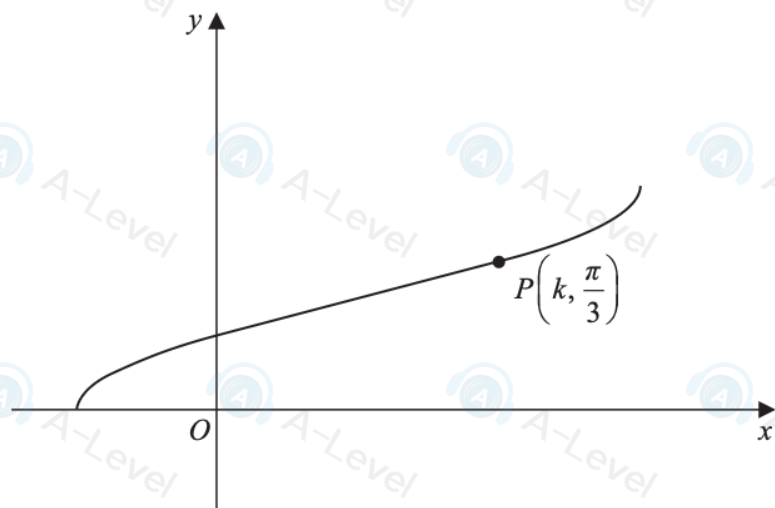


Figure 5

The curve shown in Figure 5 has equation

$$x = 4\sin^2 y - 1 \quad 0 \leq y \leq \frac{\pi}{2}$$

The point $P\left(k, \frac{\pi}{3}\right)$ lies on the curve.

(a) Verify that $k = 2$ (1)

(b) (i) Find $\frac{dx}{dy}$ in terms of y

(ii) Hence show that $\frac{dy}{dx} = \frac{1}{2\sqrt{x+1}\sqrt{3-x}}$ (6)

The normal to the curve at P cuts the x -axis at the point N .

(c) Find the exact area of triangle OPN , where O is the origin.

Give your answer in the form $a\pi + b\pi^2$ where a and b are constants. (3)

2.

$$g(x) = \frac{2x^2 - 5x + 8}{x - 2}$$

(a) Write $g(x)$ in the form

$$Ax + B + \frac{C}{x - 2}$$

where A , B and C are integers to be found.

(3)

(b) Hence use algebraic integration to show that

$$\int_4^8 g(x) dx = \alpha + \beta \ln 3$$

where α and β are integers to be found.

(4)

5.

**In this question you must show all stages of your working.
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The number of squirrels in a forest is being studied.

The number of squirrels, N , in the forest, t years after the start of the study, is modelled by the equation

$$N = \frac{4000e^{0.1t}}{19 + e^{0.2t}} \quad t \geq 0$$

Use the equation of the model to answer parts (a), (b), (c) and (d).

(a) Find the number of squirrels in the forest at the start of the study.

(1)

(b) Find $\frac{dN}{dt}$

(2)

The number of squirrels in the forest is at a maximum when $t = T$

Using the answer to part (b),

(c) show that $e^{0.2T} = A$, where A is a constant to be found.

(2)

(d) Hence find the maximum number of squirrels in the forest.

Show your working and give your answer to the nearest whole number.

(3)

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7.

In this question you must show all stages of your working.**Solutions relying entirely on calculator technology are not acceptable.**The curve C has equation

$$y = \frac{16}{9(3x - k)} \quad x \neq \frac{k}{3}$$

where k is a positive constant not equal to 3

- (a) Find $\frac{dy}{dx}$ giving your answer in simplest form in terms of k .

(2)

The point P with x coordinate 1 lies on C .Given that the gradient of the curve at P is -12

- (b) find the two possible values of k

(3)

Given also that $k < 3$

- (c) find the equation of the normal to C at P , writing your answer in the form $ax + by + c = 0$, where a , b and c are integers to be found.

(3)

- (d) show, using algebraic integration that,

$$\int_1^3 \frac{16}{9(3x - k)} dx = \lambda \ln 10$$

where λ is a constant to be found.

(4)

3.

In this question you must show all stages of your working.**Solutions relying on calculator technology are not acceptable.**

A curve has equation

$$y = \frac{4x + 1}{(x + 3)^2} \quad x \neq -3 \quad x \in \mathbb{R}$$

Use calculus to find the range of values of x for which y is increasing.

(6)