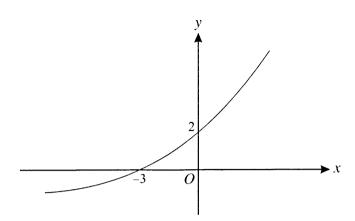
1 Find the exact solutions of the equation |4x - 5| = |3x - 5|. [4]

2



The diagram shows the graph of y = f(x). It is given that f(-3) = 0 and f(0) = 2. Sketch, on separate diagrams, the following graphs, indicating in each case the coordinates of the points where the graph crosses the axes:

(i)
$$y = f^{-1}(x)$$
, [2]

(ii)
$$y = -2f(x)$$
. [3]

3 Find, in the form y = mx + c, the equation of the tangent to the curve

$$y = x^2 \ln x$$

at the point with x-coordinate e.

4 The gradient of the curve $y = (2x^2 + 9)^{\frac{5}{2}}$ at the point P is 100.

- (i) Show that the x-coordinate of P satisfies the equation $x = 10(2x^2 + 9)^{-\frac{3}{2}}$. [3]
- (ii) Show by calculation that the x-coordinate of P lies between 0.3 and 0.4. [3]
- (iii) Use an iterative formula, based on the equation in part (i), to find the *x*-coordinate of *P* correct to 4 decimal places. You should show the result of each iteration. [3]
- 5 (a) Express $\tan 2\alpha$ in terms of $\tan \alpha$ and hence solve, for $0^{\circ} < \alpha < 180^{\circ}$, the equation

$$\tan 2\alpha \tan \alpha = 8. ag{6}$$

[6]

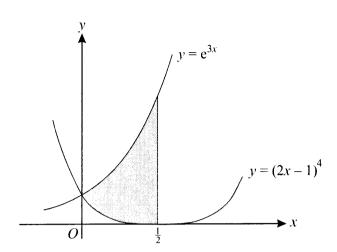
(b) Given that β is the acute angle such that $\sin \beta = \frac{6}{7}$, find the exact value of

(i)
$$\csc \beta$$
, [1]

(ii)
$$\cot^2 \beta$$
. [2]

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6



The diagram shows the curves $y = e^{3x}$ and $y = (2x - 1)^4$. The shaded region is bounded by the two curves and the line $x = \frac{1}{2}$. The shaded region is rotated completely about the x-axis. Find the exact volume of the solid produced.

7 It is claimed that the number of plants of a certain species in a particular locality is doubling every 9 years. The number of plants now is 42. The number of plants is treated as a continuous variable and is denoted by *N*. The number of years from now is denoted by *t*.

(i) Two equivalent expressions giving N in terms of t are

$$N = A \times 2^{kt}$$
 and $N = Ae^{mt}$.

Determine the value of each of the constants A, k and m.

(ii) Find the value of t for which N = 100, giving your answer correct to 3 significant figures. [2]

[4]

(iii) Find the rate at which the number of plants will be increasing at a time 35 years from now. [3]

8 The expression $T(\theta)$ is defined for θ in degrees by

$$T(\theta) = 3\cos(\theta - 60^{\circ}) + 2\cos(\theta + 60^{\circ}).$$

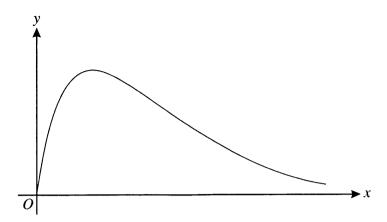
(i) Express $T(\theta)$ in the form $A \sin \theta + B \cos \theta$, giving the exact values of the constants A and B. [3]

(ii) Hence express $T(\theta)$ in the form $R \sin(\theta + \alpha)$, where R > 0 and $0^{\circ} < \alpha < 90^{\circ}$. [3]

(iii) Find the smallest positive value of θ such that $T(\theta) + 1 = 0$. [4]

[Question 9 is printed overleaf.]

9



The function f is defined for the domain $x \ge 0$ by

$$f(x) = \frac{15x}{x^2 + 5}.$$

The diagram shows the curve with equation y = f(x).

- (i) Find the range of f. [6]
- (ii) The function g is defined for the domain $x \ge k$ by

$$g(x) = \frac{15x}{x^2 + 5}.$$

Given that g is a one-one function, state the least possible value of k.

(iii) Show that there is no point on the curve y = g(x) at which the gradient is -1. [4]

[1]

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