

**All questions should be attempted**

*Marks*

1. Find the equation of the line through the point  $(3, -5)$  which is parallel to the line with equation  $3x + 2y - 5 = 0$ . (2)
  
2. The points A and B have coordinates  $(a, a^2)$  and  $(2b, 4b^2)$  respectively. Determine the gradient of AB in its simplest form. (2)
  
3. Show that the vectors  $\mathbf{a} = 2\mathbf{i} + 3\mathbf{j} - \mathbf{k}$  and  $\mathbf{b} = 3\mathbf{i} - \mathbf{j} + 3\mathbf{k}$  are perpendicular. (3)
  
4. Diagram 1 shows part of the graph of  $y = ke^{0.5x}$ .
 

(a) Find the value of  $k$ .

(b) The line with equation  $x = 1$  intersects the graph at P.

Find the coordinates of the point P.

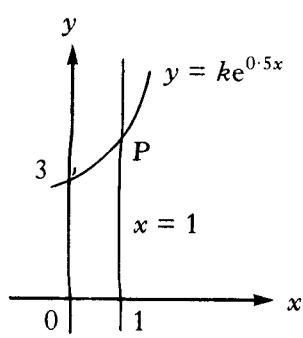


Diagram 1

1

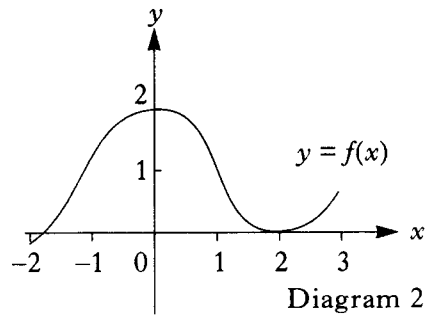
2

(3)
  
5. Find the equation of the tangent to the curve  $y = 3x^2 + 2$  at the point where  $x = 1$ . (4)
  
6. When  $f(x) = 2x^4 - x^3 + px^2 + qx + 12$  is divided by  $(x - 2)$ , the remainder is 114. One factor of  $f(x)$  is  $(x + 1)$ .  
Find the values of  $p$  and  $q$ . (5)
  
7. (a) Show that the points  $L(-5, 6, -5)$ ,  $M(7, -2, -1)$  and  $N(10, -4, 0)$  are collinear. 4  
 (b) Find the ratio in which M divides LN. 1  
(5)
  
8. Find the equation of the tangent at the point  $(3, 1)$  on the circle  $x^2 + y^2 - 4x + 6y - 4 = 0$ . (5)

9. Diagram 2 shows the graph of  $y = f(x)$ , where  $-2 \leq x \leq 3$ .

On separate diagrams, sketch the graphs of:

- (a)  $y = -f(x)$ ;  
(b)  $y = f'(x)$ .



2  
3  
(5)

10. A curve with equation  $y = f(x)$  passes through the point  $(2, -1)$  and is such that  $f'(x) = 4x^3 - 1$ .

Express  $f(x)$  in terms of  $x$ .

(5)

11. On the day of his thirteenth birthday, a boy is given a sum of money to invest and instructions not to withdraw any money until after his eighteenth birthday. The money is invested and compound interest of 9% per annum is added each following birthday. By what percentage will the investment have increased when he withdraws his money just after his eighteenth birthday?

(4)

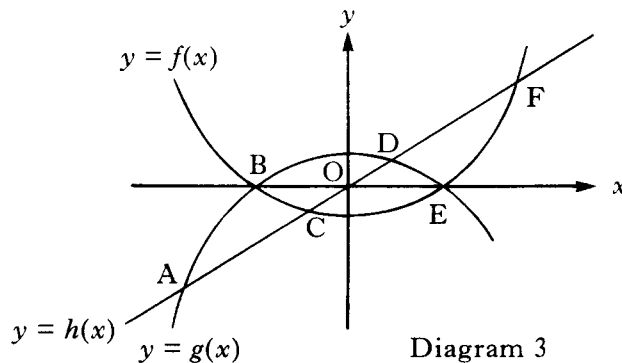
12. Given that  $\sin A = \frac{3}{4}$ , where  $0 < A < \frac{\pi}{2}$ , find the **exact** value of  $\sin 2A$ .

(3)

13. Given that  $f(x) = 5(7 - 2x)^3$ , find the value of  $f'(4)$ .

(4)

14. Diagram 3 is a rough sketch of the curves  $y = f(x)$ ,  $y = g(x)$  and  $y = h(x)$ . A is  $(-4, -12)$ , B is  $(-2, 0)$ , C is  $(-1, -3)$ , D is  $(1, 3)$ , E is  $(2, 0)$  and F is  $(4, 12)$ .



State the range of values of  $x$  for which:

- (a)  $f(x) \leq g(x)$ ;  
(b)  $h(x) < g(x) < f(x)$ .

1  
2  
(3)

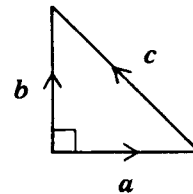
15. (a) Express  $7 - 2x - x^2$  in the form  $a - (x + b)^2$  and write down the values of  $a$  and  $b$ . Marks  
2

- (b) State the maximum value of  $7 - 2x - x^2$  and justify your answer. 2  
(4)

16. (a) Find the value of  $\int_1^2 (4 - x^2) dx$ . 3

- (b) Sketch a graph and shade the area represented by the integral in part (a). 2  
(5)

17. Diagram 4 shows a right-angled isosceles triangle whose sides represent the vectors  $\mathbf{a}$ ,  $\mathbf{b}$  and  $\mathbf{c}$ . The two equal sides have length 2 units.



Find the value of  $\mathbf{b} \cdot (\mathbf{a} + \mathbf{b} + \mathbf{c})$ .

Diagram 4

18. Given that  $k$  is a real number, show that the roots of the equation  $kx^2 + 3x + 3 = k$  are always real numbers. (5)

19. Diagram 5 illustrates three functions  $f$ ,  $g$  and  $h$ . The functions  $f$  and  $g$  are defined by

$$f(x) = 2x + 5$$

$$g(x) = x^2 - 3.$$

The function  $h$  is such that whenever  $f(p) = q$  and  $g(q) = r$ , then  $h(p) = r$ .

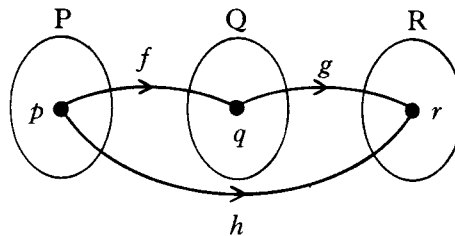


Diagram 5

- (a) If  $q = 7$ , find the values of  $p$  and  $r$ . 2  
 (b) Find a formula for  $h(x)$ , in terms of  $x$ . 2  
(4)

20. Diagram 6 shows two curves

$$y = \cos 2x^\circ \text{ and } y = 1 + \sin x^\circ,$$

where  $0 \leq x \leq 360$ .

Find the  $x$ -coordinate of the point of intersection at A.

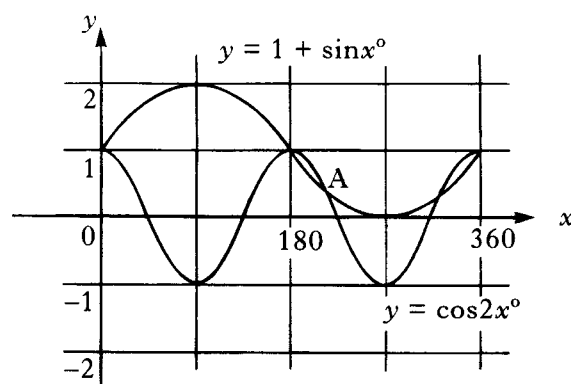


Diagram 6

[END OF QUESTION PAPER]