

4. (i) A sequence U_1, U_2, U_3, \dots is defined by

$$U_{n+2} = 2U_{n+1} - U_n, \quad n \geq 1$$

$$U_1 = 4 \text{ and } U_2 = 4$$

Find the value of

(a) U_3 (1)

(b) $\sum_{n=1}^{20} U_n$ (2)

(ii) Another sequence V_1, V_2, V_3, \dots is defined by

$$V_{n+2} = 2V_{n+1} - V_n, \quad n \geq 1$$

$$V_1 = k \text{ and } V_2 = 2k, \text{ where } k \text{ is a constant}$$

(a) Find V_3 and V_4 in terms of k . (2)

Given that $\sum_{n=1}^5 V_n = 165$,

(b) find the value of k . (3)

5. The equation

$$(p - 1)x^2 + 4x + (p - 5) = 0, \text{ where } p \text{ is a constant}$$

has no real roots.

(a) Show that p satisfies $p^2 - 6p + 1 > 0$

(3)

(b) Hence find the set of possible values of p .

(4)



Question 5 continued

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Question 5 continued

Lined area for writing the answer to Question 5.

Q5

(Total 7 marks)



6. The curve C has equation

$$y = \frac{(x^2 + 4)(x - 3)}{2x}, \quad x \neq 0$$

(a) Find $\frac{dy}{dx}$ in its simplest form. **(5)**

(b) Find an equation of the tangent to C at the point where $x = -1$

Give your answer in the form $ax + by + c = 0$, where a , b and c are integers. **(5)**



Question 6 continued

Lined writing area consisting of 30 horizontal lines.

(Total 10 marks)

Q6

Two small empty boxes, likely for marking.



8. (a) Factorise completely $9x - 4x^3$ **(3)**

(b) Sketch the curve C with equation

$$y = 9x - 4x^3$$

Show on your sketch the coordinates at which the curve meets the x -axis. **(3)**

The points A and B lie on C and have x coordinates of -2 and 1 respectively.

(c) Show that the length of AB is $k\sqrt{10}$ where k is a constant to be found. **(4)**



Question 8 continued



9. Jess started work 20 years ago. In year 1 her annual salary was £17000. Her annual salary increased by £1500 each year, so that her annual salary in year 2 was £18500, in year 3 it was £20000 and so on, forming an arithmetic sequence. This continued until she reached her maximum annual salary of £32000 in year k . Her annual salary then remained at £32000.

(a) Find the value of the constant k . (2)

(b) Calculate the total amount that Jess has earned in the 20 years. (5)



10. A curve with equation $y = f(x)$ passes through the point (4, 9).

Given that

$$f'(x) = \frac{3\sqrt{x}}{2} - \frac{9}{4\sqrt{x}} + 2, \quad x > 0$$

(a) find $f(x)$, giving each term in its simplest form. (5)

Point P lies on the curve.

The normal to the curve at P is parallel to the line $2y + x = 0$

(b) Find the x coordinate of P . (5)



