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

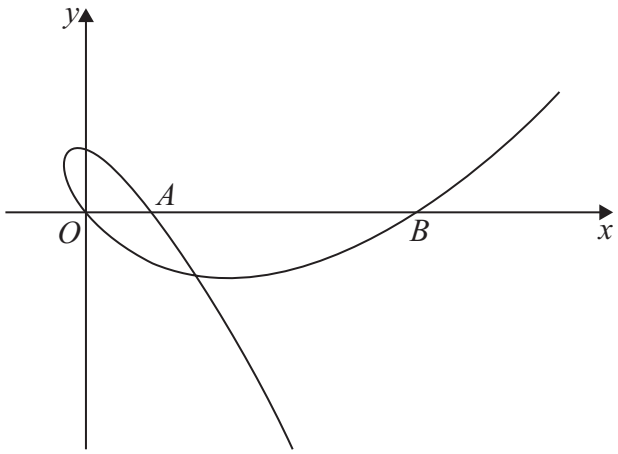


Figure 3

Figure 3 shows a sketch of part of the curve with parametric equations

$$x = t^2 + 2t \qquad y = t^3 - 9t \qquad t \in \mathbb{R}$$

The curve cuts the x-axis at the origin and at the points A and B as shown in Figure 3.

(a) Find the coordinates of point A and show that point B has coordinates (15, 0).

(3)

(b) Find the equation of the tangent to the curve at B, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers.

(4)

The tangent to the curve at B cuts the curve again at point X.

(c) Use algebra to find the coordinates of X, showing each stage of your working.

(5)

(Total for Question 8 is 12 marks)

9. Relative to a fixed origin O, the line l has vector equation

$$\mathbf{r} = \begin{pmatrix} -1 \\ -4 \\ 6 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ 1 \\ -1 \end{pmatrix}$$

where λ is a scalar parameter.

Points A and B lie on the line l, where A has coordinates $(1, a, 5)$ and B has coordinates $(b, -1, 3)$.

(a) Find the value of the constant a and the value of the constant b.

(3)

(b) Find the vector $\overrightarrow{AB}$

(2)

The point C has coordinates $(4, -3, 2)$

(c) Find the size of angle CAB.

(3)

(d) Find the exact area of the triangle CAB.

(2)

The point D lies on the line l so that the area of the triangle CAD is twice the area of the triangle CAB.

(e) Find the coordinates of the two possible positions of D.

(4)

(Total for Question 9 is 14 marks)

TOTAL FOR PAPER IS 75 MARKS