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

The number of electric cars and the number of petrol cars being registered in a country were monitored over the same period of time.

The number of electric cars, E thousands, registered in the country t years after monitoring began, is modelled by the equation

$$E = A + 40e^{0.2t} \qquad t \geqslant 0$$

where A is a constant.

Given that $E = 5$ when $t = 0$

(a) state the value of A.

(1)

Use the equation for this model to answer parts (b) and (c).

(b) Find the number of electric cars registered in the country when $t = 3$, giving the answer to 3 significant figures.

(2)

(c) Find the **rate of increase** in the number of electric cars registered in the country when $t = 5$, giving the answer to 3 significant figures.

(2)

The number of petrol cars, P thousands, registered in the country t years after monitoring began, is modelled by the equation

$$P = 150 + 450e^{-0.2t} \qquad t \geqslant 0$$

When $t = X$, the number of electric cars registered in the country was equal to the number of petrol cars registered in the country.

Using the equations of both models,

(d) find the value of X, giving the answer to one decimal place.

(*You must show sufficient algebraic working to make your method clear.*)

(4)

(Total for Question 8 is 9 marks)

9.

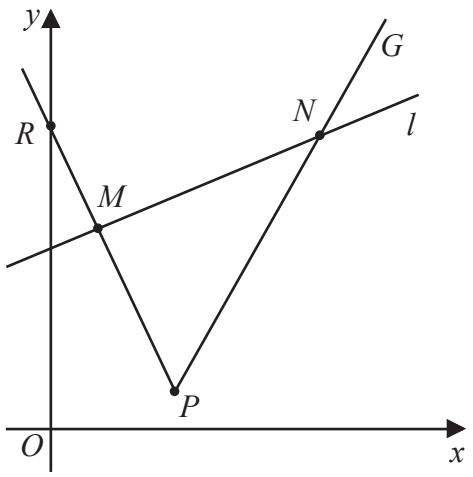


Figure 4

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

Figure 4 shows

- the graph G with equation $y = |2x - k| + 3$
- the line l with equation $y = \frac{1}{2}x + \frac{k+7}{2}$

where k is a constant, $k > 1$

Given that G has a minimum point at P,

(a) find, in terms of k, the coordinates of P.

(2)

Given that l meets G at the points M and N, as shown in Figure 4,

(b) find, in terms of k, the x coordinate of M and the x coordinate of N.

(4)

Given also that

- graph G meets the y-axis at point R
- the area of triangle ORM is $\frac{33}{40}$ square units

(c) find the exact value of the area of triangle ORN.

(4)

(Total for Question 9 is 10 marks)