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

(a) Show that the substitution $u = e^x - \frac{1}{2}$ transforms

$$\int_{\ln 3}^{\ln 8} \frac{24e^x - 2}{(2e^x - 1)^2}\,dx$$

to

$$\int_a^b \frac{12u + 5}{u^2(2u + 1)}\,du$$

where a and b are constants to be found.

(4)

(b) Find an expression for $\frac{12u + 5}{u^2(2u + 1)}$ in the form

$$\frac{A}{u^2} + \frac{B}{u} + \frac{C}{(2u + 1)}$$

where A, B and C are integers.

(3)

(c) Hence show that

$$\int_{\ln 3}^{\ln 8} \frac{24e^x - 2}{(2e^x - 1)^2}\,dx = p + \ln q$$

where p and q are constants to be found.

(4)

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Question 7 continued

(Total for Question 7 is 11 marks)

8: Relative to a fixed origin O,

- the point A has position vector $2\mathbf{i} - \mathbf{j} + 5\mathbf{k}$
- the point B has position vector $3\mathbf{i} + 4\mathbf{j} - 6\mathbf{k}$

Given that the line l passes through A and B,

(a) (i) find $\overrightarrow{AB}$

(ii) find a vector equation for l.

(3)

The point C has position vector $p\mathbf{i} + 4\mathbf{j} - \mathbf{k}$, where p is a constant.

Given that $\overrightarrow{CA}$ is perpendicular to $\overrightarrow{CB}$,

(b) find the possible values of p.

(4)

The points A, B and C form a triangle ABC.

Given also that $p > 0$

(c) find the area of triangle ABC, giving your answer to 3 significant figures.

(4)

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