**7.** The ellipse $E$ has equation

$$\frac{x^2}{45} + \frac{y^2}{20} = 1$$

and eccentricity $e$

(a) Determine

(i) the exact value of $e$

(ii) the equations of the directrices of $E$

**(4)**

The curve $C$ has parametric equations

$$x = 2\cosh 2t \qquad y = 8\sinh t \qquad t > 0$$

(b) Show that a Cartesian equation for $C$ is

$$y^2 = 16x - 32 \qquad y > 0$$

**(3)**

The curve $C$

- intersects $E$ at the point $A$
- intersects a directrix of $E$ at the point $B$

The arc $AB$ of $C$ is rotated through $2\pi$ radians about the $x$-axis.

(c) Use the result in part (b) and algebraic integration to determine the area of the surface generated, giving the answer in the form

$$\frac{p\pi}{3}\left(q\sqrt{q} - r\sqrt{r}\right)$$

where $p$, $q$ and $r$ are integers.

(*Solutions relying entirely on calculator technology are not acceptable.*)

**(7)**

**(Total for Question 7 is 14 marks)**