

11.

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

- (a) Express $4\cos x - 13\sin x$ in the form $R\cos(x + \alpha)$, where $R > 0$ and $0 < \alpha < \frac{\pi}{2}$

Give the exact value of R and give the value of α , in radians, to 3 decimal places.

(3)

The demand for electricity, D gigawatts (GW), in the UK on a particular day, is modelled by the equation

$$D = 30 + 4\cos\left(\frac{\pi t}{12} + 0.2\right) - 13\sin\left(\frac{\pi t}{12} + 0.2\right) \quad 0 < t < 24$$

where t is the number of hours after midnight.

Use the equation of the model and the answer to part (a), to answer parts (b) and (c).

- (b) (i) Deduce the minimum demand for electricity during this day.

- (ii) Find the time of the day when this minimum demand occurs.

(4)

At 3pm on this day, the demand for electricity is increasing at a rate of k GW per hour.

- (c) Find the value of the constant k , giving the answer to 3 significant figures.

(3)

- (d) Give a reason why it would not be sensible to use the same equation to model the demand for electricity in the UK on every day of the year.

(1)