Question	Scheme	Marks	AOs
11(a)	$(R=)\sqrt{185}$	B1	1.1b
	$\tan\alpha=\frac{13}{4}\Rightarrow\alpha=...$	M1	1.1b
	$\alpha=$ awrt 1.272 or $\sqrt{185}\cos(x+1.272)$	A1	1.1b
		(3)	
(b)(i)	$30-\sqrt{185}$ or awrt 16.4	B1ft	2.2a
(b)(ii)	$\cos\left(\frac{\pi t}{12}+1.272+0.2\right)=-1\Rightarrow\frac{\pi t}{12}+1.272+0.2=\pi\Rightarrow t=..$	M1	3.1b
	$(t=)$ awrt 6.4	A1	1.1b
	6:22 or 6:23 oe (see notes)	B1ft	3.2a
		(4)	
(c)	$D=30+\sqrt{185}\cos\left(\frac{\pi t}{12}+1.272+0.2\right)$ $\Rightarrow\left(\frac{\mathrm{d}D}{\mathrm{d}t}=\right)-\frac{\pi\sqrt{185}}{12}\sin\left(\frac{\pi t}{12}+1.272+0.2\right)$	M1	3.4
	3pm $\rightarrow t=15$ $\Rightarrow\left(\frac{\mathrm{d}D}{\mathrm{d}t}=\right)-\frac{\pi\sqrt{185}}{12}\sin\left(\frac{15\pi}{12}+1.272+0.2\right)$	dM1	3.1b
	$\Rightarrow(k=)$ awrt 2.75	A1	1.1b
		(3)	
(d)	Examples: • the demand for electricity is not the same every day • during cold weather the demand will be greater • in the summer, demand will be less	B1	3.5b
		(1)	
			(11 marks)

Notes

(a) **Note that B0M1A1 is possible**

B1: $\sqrt{185}$

M1: Award for $\tan\alpha=\pm\frac{13}{4}\Rightarrow\alpha=...$, $\tan\alpha=\pm\frac{4}{13}\Rightarrow\alpha=...$,

$\sin\alpha=\pm\frac{13}{"\sqrt{185}"}\Rightarrow\alpha=...$ or $\cos\alpha=\pm\frac{4}{"\sqrt{185}"}\Rightarrow\alpha=...$

May be implied by (±) any of awrt 1.27 or awrt 72.9° or awrt 0.298 or awrt 17.1° or awrt 1.87 or awrt 107°

A1: $\alpha=$ awrt 1.272 or $\sqrt{185}\cos(x+1.272)$

Note that $\sqrt{185}\cos(x+1.272)$ scores B1M1A1

Mark (b)(i) and(ii) together

(b)(i)

B1ft: $\left(30-\sqrt{185}\right)$ (GW) **or** awrt 16. 4 (GW) Condone lack of / ignore units and follow through on their *R* to 3sf

(ii)

M1: Sets $\frac{\pi t}{12}+"1.272"+0.2=\pi \Rightarrow t=..$ May be implied by a correct value for *t* for their "1.272". If just a value is stated you may need to check this on your calculator.

May set $"30+\sqrt{185}\cos\left(\frac{\pi t}{12}+1.272+0.2\right)"=\underline{30-"\sqrt{185}"} \Rightarrow t=...$ but condone if they have rounded $\underline{30-"\sqrt{185}"}$ to 3sf or better.

A1: awrt 6.4 and no others in the range $0<t<24$ unless rejected. This can be implied by 6:22 or 6:23 oe and no additional times given.
If no value for *t* is given then allow to be implied by 6:22 or 6:23 oe

B1ft 6:22 or 6:23 oe or ft on their final *t* to nearest min or truncated **provided** $0<"t"<24$ e.g. 0622 or 6 hours 23 minutes after midnight. Condone various notation or forms provided there is evidence of the correct time. E.g. 6:23am 6.22 or 6,23 or 6;23 or 6/22. If using e.g. am or pm it must be consistent with their value of *t*.

(c) Note that no differentiation seen scores M0dM0A0.

M1: Attempts to differentiate their $D=30+"\sqrt{185}"\cos\left(\frac{\pi t}{12}+q\right)$ to obtain $...\sin\left(\frac{\pi t}{12}+q\right)$ where $q="1.272"+0.2$ oe or condone if 0.2 is missing

Condone also differentiating $D=30+4\cos\left(\frac{\pi t}{12}+0.2\right)-13\sin\left(\frac{\pi t}{12}+0.2\right)$ to obtain $...\sin\left(\frac{\pi t}{12}+0.2\right)+...\cos\left(\frac{\pi t}{12}+0.2\right)$

NB correct derivative is $-\frac{4\pi}{12}\sin\left(\frac{\pi t}{12}+0.2\right)-\frac{13\pi}{12}\cos\left(\frac{\pi t}{12}+0.2\right)$

dM1: Substitutes *t* = 15 into their derivative and obtains a value. It is dependent on the previous method mark. 15 embedded in their derivative followed by a value or stating when *t* = 15, $\frac{\mathrm{d}D}{\mathrm{d}t}=...$ is sufficient but if just a value is stated with no working then you may need to check this value is correct for their $\frac{\mathrm{d}D}{\mathrm{d}t}$ (condone mislabelling)

A1: awrt 2.75

(d)

B1: for a valid 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.** Mark positively.

Look for any reason that suggests the demand is not the same **every day** or it is **different to this particular day.** They either need to:

- suggest the demand is not the same every day such as
  - it varies at different times of the year / the length of day(light) varies
  - this was only for a particular day
- suggest a possible scenario where the demand might be different such as
  - it is different at weekends
  - may have dinner at a different time of day on a Sunday
  - might introduce an incentive scheme
  - the price cap might affect how much people use
  - people might go abroad in school holidays

Do not allow "we do not have enough data" (too vague)