## Question 9

The approximate length of the day in Galway, measured in hours from sunrise to sunset, may be calculated using the function

$$
f(t)=12 \cdot 25+4 \cdot 75 \sin \left(\frac{2 \pi}{365} t\right)
$$

where $t$ is the number of days after March $21^{\text {st }}$ and $\left(\frac{2 \pi}{365} t\right)$ is expressed in radians.
(a) Find the length of the day in Galway on June $5^{\text {th }}$ (76 days after March $21^{\text {st }}$ ). Give your answer in hours and minutes, correct to the nearest minute.

(b) Find a date on which the length of the day in Galway is approximately 15 hours.

(c) Find $f^{\prime}(t)$, the derivative of $f(t)$.

(d) Hence, or otherwise, find the length of the longest day in Galway.

(e) Use integration to find the average length of the day in Galway over the six months from March $21^{\text {st }}$ to September $21^{\text {st }}$ (184 days). Give your answer in hours and minutes, correct to the nearest minute.


