7.

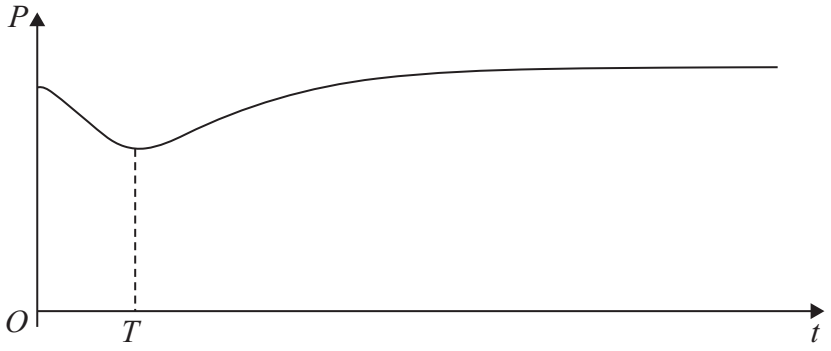


Figure 3

A colony of bees is being studied. The number of bees in the colony is modelled by the equation

$$P = 200 - \frac{160e^{0.6t}}{15 + e^{0.8t}} \qquad t \in \mathbb{R} \qquad t \geqslant 0$$

where P is the number of bees, measured in thousands, t years after the study started.
A sketch of the graph of P against t is shown in Figure 3

(a) Calculate the number of bees in the colony at the start of the study.

(2)

(b) Find $\frac{dP}{dt}$

(3)

The population of bees initially decreases, reaching a minimum value after T years, as shown in Figure 3

(c) Using your answer to part (b), calculate the value of T to 2 decimal places.

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

(4)

(Total for Question 7 is 9 marks)

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

(a) Express $10\cos\theta - 3\sin\theta$ in the form $R\cos(\theta + \alpha)$, where $R > 0$ and $0 < \alpha < 90°$

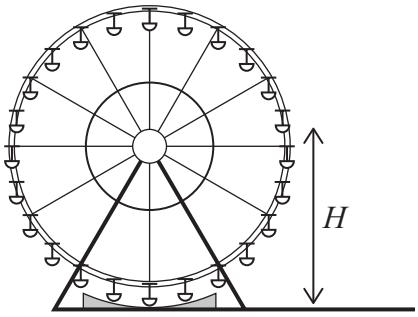
Give the exact value of R and the value of α to 2 decimal places.

(3)

Alana models the height above the ground of a passenger on a Ferris wheel by the equation

$$H = 12 - 10\cos(30t)° + 3\sin(30t)°$$

where the height of the passenger above the ground is H metres at time t minutes after the wheel starts turning.



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

(b) Calculate

(i) the maximum value of H

(ii) the value of t when this maximum first occurs.

Give each answer to 2 decimal places.

(3)

(c) Calculate the value of t when the passenger is 18 m above the ground for the first time.

Give your answer to 2 decimal places.

(4)

(d) Determine the time taken for the Ferris wheel to complete two revolutions.

(2)

(Total for Question 8 is 12 marks)

TOTAL FOR PAPER IS 75 MARKS