Modelling with Trigonometric Functions

Specification: AQA 7357: E9, E6, E7 · Edexcel 9MA0: 5.9, 5.6, 5.7

HOMEWORK Consolidation

1 The height of a seat on a wheel is $h = 18 - 16\cos(10t)°$ m, t minutes after the start. State the maximum height, the minimum height and the time for one revolution.
AQA E9, E6 · Edexcel 5.9, 5.6

2 For the same wheel, find the height after 4 minutes.
AQA E9, E6 · Edexcel 5.9, 5.6

3 For the same wheel, find the first time the seat is 26 m high.
AQA E9, E6 · Edexcel 5.9, 5.6

4 The depth of a harbour is $D = 3.5 + 1.8\cos(\frac{\pi t}{6.2})$ m, t hours after midnight (radians). Find the greatest depth and the times of the first two high tides.
AQA E9, E6 · Edexcel 5.9, 5.6

5 For the same harbour, find the times in the first 12 hours when the depth is 2.6 m.
AQA E9, E6 · Edexcel 5.9, 5.6

6 A model for the mean daily temperature in a city is $T = 12 + 9\sin(\frac{2\pi(t - 105)}{365})$ °C, where t is the day of the year. Find the greatest mean temperature and the day on which it occurs.
AQA E9, E6 · Edexcel 5.9, 5.6

7 A wheel has diameter 34 m and its lowest point is 2 m above the ground. It turns once every 12 minutes, starting with a seat at the bottom. Find a model for the height H m of the seat after t minutes.
AQA E9, E6 · Edexcel 5.9, 5.6

8 For the model $H = 19 - 17\cos(30t)°$, for how long in each revolution is the seat more than 30 m above the ground?
AQA E9, E6 · Edexcel 5.9, 5.6

9 (a) Write $6\sin(20t)° + 8\cos(20t)°$ in the form $R\sin(20t + \alpha)°$.
(b) Find the smallest positive t at which it takes its maximum value.
AQA E9, E6 · Edexcel 5.9, 5.6

10 Give two limitations of the daylight model $L = 12.2 + 4.6\sin(\frac{2\pi(t - 80)}{365})$.
AQA E9, E6 · Edexcel 5.9, 5.6

11 *AQA-style*. The depth of water at a harbour entrance is modelled by $D = 5 + 2\sin(30t)° + 1.5\cos(30t)°$ metres, where t is the time in hours after midnight.
(a) Express $2\sin(30t)° + 1.5\cos(30t)°$ in the form $R\sin(30t + \alpha)°$, where $R > 0$ and $0 < \alpha < 90$. [3 marks]
(b) Find the greatest depth and the time it first occurs. [2 marks]
(c) A boat needs a depth of at least 4 m. Find the times between 00:00 and 12:00 when the boat cannot enter. [4 marks]
AQA E9, E6 · Edexcel 5.9, 5.6 · AQA-style

12 *Edexcel-style*. The height of a passenger on a wheel is $H = 35 - 30\cos(\frac{\pi t}{15})$ metres, where t is the time in minutes and angles are in radians.
(a) State the maximum height, the minimum height and the time for one revolution. [3 marks]
(b) Find the first time the passenger is 50 m above the ground. [3 marks]
(c) For how long in each revolution is the passenger more than 50 m above the ground? [2 marks]
AQA E9, E6 · Edexcel 5.9, 5.6 · Edexcel-style