

Chapter 12 Solution

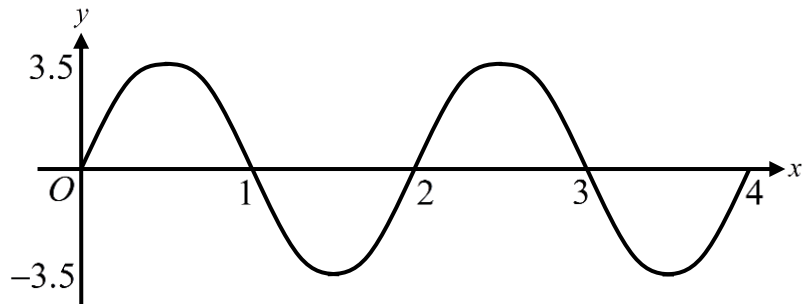
Exercise 37

1. (a) $p = \frac{2 - (-6)}{2}$ (M1) for valid approach
 $p = 4$ A1 N2 [2]
- (b) The period of the graph is 180° .
 $q = \frac{360^\circ}{180^\circ}$ (M1) for valid approach
 $q = 2$ A1 N2 [2]
- (c) $r = \frac{2 + (-6)}{2}$ (M1) for valid approach
 $r = -2$ A1 N2 [2]
2. (a) $p = \frac{60 - 28}{2}$ (M1) for valid approach
 $p = 16$ A1 N2 [2]
- (b) The period of the graph is 1440° .
 $q = \frac{360^\circ}{1440^\circ}$ (M1) for valid approach
 $q = \frac{1}{4}$ A1 N2 [2]
- (c) $r = \frac{28 + 60}{2}$ (M1) for valid approach
 $r = 44$ A1 N2 [2]

3. (a) $p = \frac{2\pi - (-2\pi)}{2}$ (M1) for valid approach
 $p = 2\pi$ A1 N2 [2]
- (b) The period of the graph is 60° .
 $q = \frac{360^\circ}{60^\circ}$ (M1) for valid approach
 $q = 6$ A1 N2 [2]
- (c) $2\pi = 2\pi \cos(6(15^\circ - r))$ (M1) for setting equation
 $1 = \cos(90^\circ - 6r)$
 $90^\circ - 6r = 0^\circ$ or $90^\circ - 6r = 360^\circ$
 $r = 15^\circ$ or $r = -45^\circ$ (*Rejected*) A1 N2 [2]
4. (a) $p = \frac{20 - 0}{2}$ (M1) for valid approach
 $p = 10$ A1 N2 [2]
- (b) The period of the graph is 1080° .
 $q = \frac{360^\circ}{1080^\circ}$ (M1) for valid approach
 $q = \frac{1}{3}$ A1 N2 [2]
- (c) $20 = 10 \cos\left(\frac{1}{3}(1080^\circ + r)\right) + 10$ (M1) for setting equation
 $10 = 10 \cos\left(360^\circ + \frac{1}{3}r\right)$
 $\cos\left(360^\circ + \frac{1}{3}r\right) = 1$
 $360^\circ + \frac{1}{3}r = 0^\circ$ or $360^\circ + \frac{1}{3}r = 360^\circ$
 $r = -1080^\circ$ or $r = 0^\circ$ (*Rejected*) A1 N2 [2]

Exercise 38

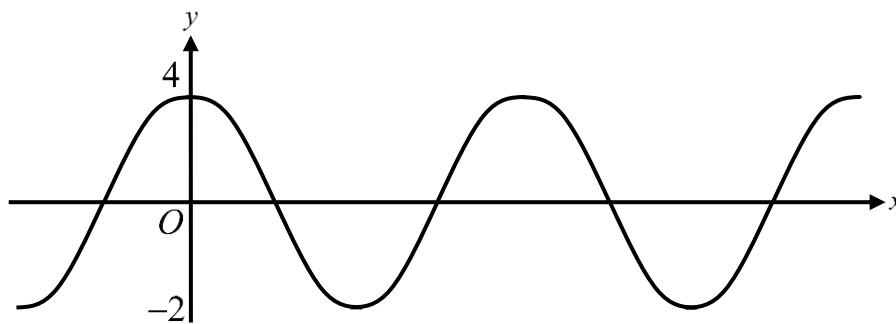
1. (a) (i) The amplitude of f is 3.5. A1 N1
- (ii) The period of f
 $= 360^\circ \div 180^\circ$ (M1) for valid approach
 $= 2$ A1 N2
- (b) For correct x -intercepts A1 [3]
 For correct maximum and minimum points A1
 For correct domain A1
 For sinusoidal curve starting at the origin with
 correct period A1 N4 [4]



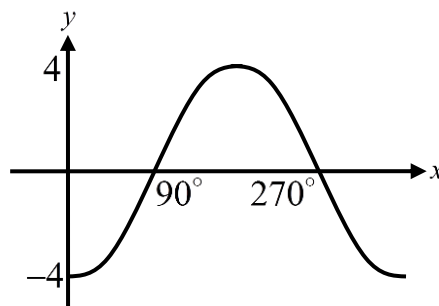
2. (a) (i) The amplitude of f is 3. A1 N1
- (ii) The period of f
 $= 360^\circ \div 180^\circ$ (M1) for valid approach
 $= 2$ A1 N2
- (b) For correct x -intercepts A1
 For correct maximum and minimum points A1
 For correct domain A1
 For sinusoidal curve starting at $(0, 4)$ with
 correct period A1 N4

[3]

[4]

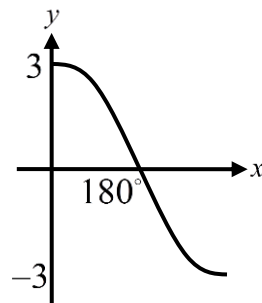


3. (a) (i) The amplitude of f is 4. A1 N1
- (ii) The period of f
 $= 360^\circ \div 1$ (M1) for valid approach
 $= 360^\circ$ A1 N2 [3]
- (b) For correct x -intercepts A1
 For correct maximum and minimum points A1
 For correct domain A1
 For sinusoidal curve starting at the $(0, -4)$ with
 correct period A1 N4 [4]



4. (a) (i) The amplitude of f is 3. A1 N1
- (ii) The period of f
 $= 360^\circ \div \frac{1}{2}$ (M1) for valid approach
 $= 720^\circ$ A1 N2
- (b) For correct x -intercept A1 [3]
 For correct maximum and minimum points A1
 For correct domain A1
 For sinusoidal curve starting at $(0, 3)$ with
 correct period A1 N4

[4]



Exercise 39

1. (a) The period

$$= \frac{360^\circ}{2}$$

$$= 180^\circ$$
(M1) for valid approach
A1 N2
[2]
- (b) The minimum value

$$= -1 - 1$$

$$= -2$$
(M1) for valid approach
A1 N2
[2]
- (c) $f(x) = 0$
 $\sin 2x - 1 = 0$
 $x = 45^\circ$ or $x = 225^\circ$
A2 N2
[2]
2. (a) 3
A1 N1
[1]
- (b) The maximum value

$$= 1 - 3(-1)$$

$$= 4$$
(M1) for valid approach
A1 N2
[2]
- (c) $f(x) = -2$
 $1 - 3\cos x = -2$
 $3 - 3\cos x = 0$
 $x = 0^\circ, x = 360^\circ$ or $x = 720^\circ$
(M1) for setting equation
A2 N3
[3]
3. (a) The period

$$= \frac{360^\circ}{4}$$

$$= 90^\circ$$
(M1) for valid approach
A1 N2
[2]
- (b) $\{y : 1 \leq y \leq 5\}$
A2 N2
[2]
- (c) $f(x) - 4 = 0$
 $2\sin 4x + 3 - 4 = 0$
 $2\sin 4x - 1 = 0$
 $x = -82.5^\circ, x = -52.5^\circ, x = 7.5^\circ$ or $x = 37.5^\circ$
(M1) for setting equation
A2 N3
[3]

4. (a) $\frac{1}{2}$ A1 N1 [1]
- (b) $\left\{y: -\frac{3}{4} \leq y \leq \frac{1}{4}\right\}$ A2 N2 [2]
- (c) $2f(x)+1=0$
 $2\left(-\frac{1}{2}\cos\frac{1}{3}x-\frac{1}{4}\right)+1=0$ (M1) for setting equation
 $-\cos\frac{1}{3}x+\frac{1}{2}=0$
 $x=180^\circ$ or $x=900^\circ$ A2 N3 [3]

Exercise 40

1. (a) (i) The time required
 $= 13.75 - 8.25$ (M1) for valid approach
 $= 5.5$ hours A1 N2
- (ii) The difference in height
 $= 1.8 - 0.4$ (M1) for valid approach
 $= 1.4$ m A1 N2 [4]
- (b) (i) $p = \frac{1.8 - 0.4}{2}$ (M1) for valid approach
 $p = 0.7$ A1 N2
- (ii) The period
 $= 2(5.5)$ (M1) for valid approach
 $= 11$ hours (A1) for correct value
 $\therefore q = \frac{360^\circ}{11}$
 $\therefore q = \left(\frac{360}{11}\right)^\circ$ A1 N3
- (iii) $r = \frac{1.8 + 0.4}{2}$ (M1) for valid approach
 $r = 1.1$ A1 N2 [7]
- (c) Recognizing that 9 April 2018 implies $25 \leq t < 49$ (M1) for valid approach
 $t = 8.25 + 3(11)$
 $t = 41.25$ (A1) for correct value
 Thus, the time is 16:15. A1 N3 [3]

2. (a) (i) The time required
 $= 2(13 - 6.5)$
 $= 13$ hours (M1) for valid approach
A1 N2
- (ii) The difference in height
 $= 4.2 - 1.8$
 $= 2.4$ m (M1) for valid approach
A1 N2 [4]
- (b) (i) $p = \frac{4.2 - 1.8}{2}$
 $p = 1.2$ (M1) for valid approach
A1 N2
- (ii) The period is 13 hours. (A1) for correct value
 $\therefore q = \frac{360^\circ}{13}$
 $\therefore q = \left(\frac{360}{13}\right)^\circ$ A1 N2
- (iii) $r = \frac{4.2 + 1.8}{2}$
 $r = 3$ (M1) for valid approach
A1 N2 [6]
- (c) Recognizing that 25 August 2018 implies
 $36 \leq t < 60$
 $t = 13 + 3(13)$
 $t = 52$
Thus, the time is 16:00. (M1) for valid approach
(A1) for correct value
A1 N3 [3]

3. (a) The time required
 $= 2 \times 9$ (M1) for valid approach
 $= 18$ minutes
Hence, the Ferris wheel will first reach a height of
91 m at 9:18. A1 N2 [2]
- (b) (i) $p = \frac{91-1}{2}$ (M1) for valid approach
 $p = 45$ A1 N2
- (ii) The period is 36 minutes. (A1) for correct value
 $\therefore q = \frac{360^\circ}{36}$
 $q = 10^\circ$ A1 N2
- (iii) $r = \frac{1+91}{2}$ (M1) for valid approach
 $r = 46$ A1 N2 [6]
- (c) $-45 \cos(10^\circ t) + 46 = 60$ (M1) for setting equation
 $-45 \cos(10^\circ t) - 14 = 0$ (A1) for correct equation
By considering the graph of the function
 $y = -45 \cos(10^\circ t) - 14$, $t = 82.81262$. (M1) for valid approach
Thus, the time is 10:22. A1 N4 [4]

4. (a) (i) $p = \frac{73-3}{2}$ (M1) for valid approach
 $p = 35$ A1 N2
- (ii) $q = \frac{360^\circ}{26}$ (M1)(A1) for correct value
 $q = \left(\frac{180}{13}\right)^\circ$ A1 N3
- (iii) $r = \frac{73+3}{2}$ (M1) for valid approach
 $r = 38$ A1 N2
- (b) The height [7]
 $= h(56)$
 $= -35 \cos\left(\left(\frac{180}{13}\right)^\circ \cdot 56\right) + 38$ (M1) for substitution
 $= 18.11773386$
 $= 18.1 \text{ m}$ A1 N2
- (c) $h(t) = 10$ [2]
 $-35 \cos\left(\left(\frac{180}{13}\right)^\circ \cdot t\right) + 38 = 10$ (M1) for setting equation
 $-35 \cos\left(\left(\frac{180}{13}\right)^\circ \cdot t\right) + 28 = 0$ (A1) for correct equation
- By considering the graph of the function
 $y = -35 \cos\left(\left(\frac{180}{13}\right)^\circ \cdot t\right) + 28, t = 75.337174.$ (M1) for valid approach
- Thus, the time is 14:00. A1 N4
- [4]