

Chapter 5

Practise, Apply, Solve 5.1, page 413

1. (a) iv.; quadratic model
- (b) i.; periodic function
- (c) v.; periodic function
- (d) iii.; linear model
- (e) ii.; exponential model

2. (a) The average temperature for each month stays relatively the same from year to year, forming a self-replicating function. For example, the average temperature in July should be about the same regardless of the year.

(b) Rabbit and coyote population depend on each other. As the rabbit population increases, the coyote population which eats rabbits also increases to the point where the rabbit population starts to decrease. This in turn causes the coyote population to decrease which then causes the rabbit population to increase. This forms a self-replicating function.

(c) The melting of winter snow and the run off of spring rain causes the lake level to rise. The heat of the summer sun increases evaporation and causes the lake level to decrease. This cycle generally repeats itself over a twelve month period, forming a self-replicating function.

(d) The sun rises in the same spot as the earth rotates, forming a self-replicating function.

(e) As a tuning fork vibrates it moves back and forth from its rest position. The throngs of the fork move a fixed distance in one direction, back to rest and a fixed distance in the other direction and back to rest, a certain number of times per second. The motion repeats itself in a predictable pattern (periodic).

3. (a) This is periodic because it is self-replicating.

(b) This is periodic because it has the same maximum and minimum value and it is self-replicating

(c) This is periodic because it is self-replicating

4. (a) It takes Nolan 3 s before his jumping becomes periodic; Nolan needs time to create a rhythm.

(b) The length of the period is 2 s. For example, $5\text{ s} - 3\text{ s} = 2\text{ s}$. The period is the time needed for Nolan to complete one jump (to move from the lowest position to the highest position and back to the lowest position).

(c) The maximum height is 4 m. The minimum height is 0.5 m. The axis of the periodic portion of the curve is:

$$H = \frac{4 + 0.5}{2} = 2.25, \text{ where } H \text{ is the height in metres}$$

(d) The amplitude is the distance from the axis of the curve to either the maximum or minimum value. The formula is:

$$\begin{aligned} a &= \left| \frac{\text{max} - \text{min}}{2} \right| \\ &= \left| \frac{4 - 0.5}{2} \right| \\ &= 1.75 \text{ m} \end{aligned}$$

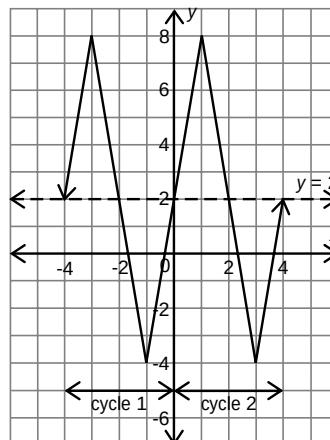
or

$$4 - 2.25 = 1.75 \text{ m}$$

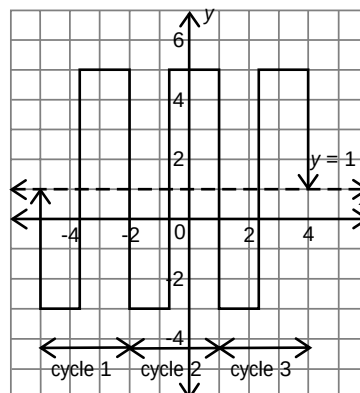
$$2.25 - 0.5 = 1.75 \text{ m}$$

Twice the amplitude of the curve added to the minimum height is Nolan's maximum height off of the ground.

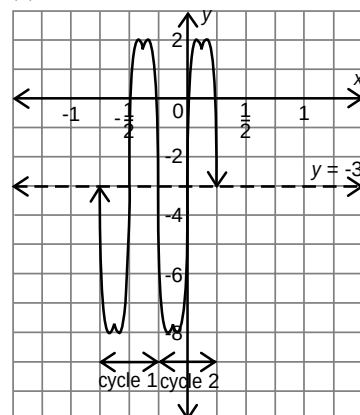
5. (a)



(b)



(c)



6. (a) period: 2;

$$\text{amplitude: } a = \left| \frac{\text{max} - \text{min}}{2} \right| = \left| \frac{3 - (-8)}{2} \right| = 5.5$$

$$\text{axis of the curve: } y = \frac{\text{max} + \text{min}}{2} = \frac{3 + (-8)}{2} = -2.5$$

(b) period: 4

$$\text{amplitude: } a = \left| \frac{\text{max} - \text{min}}{2} \right| = \left| \frac{4 - 2}{2} \right| = 1$$

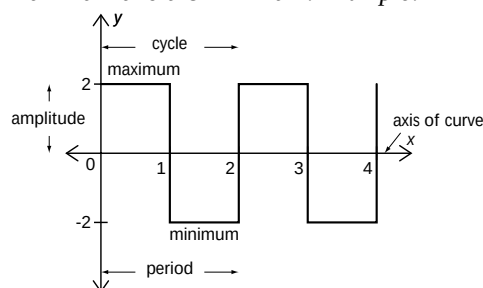
$$\text{axis of the curve: } y = \frac{\text{max} + \text{min}}{2} = \frac{4 + 2}{2} = 3$$

(c) period: 180°

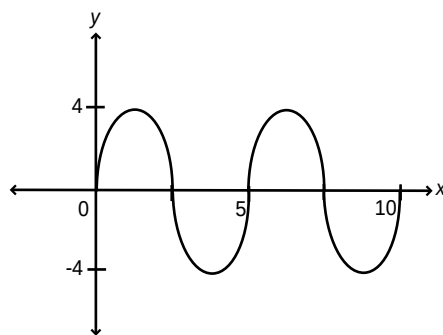
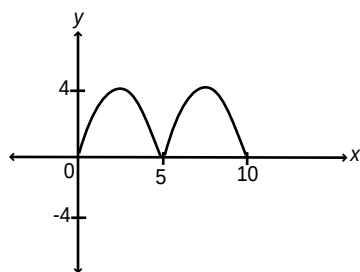
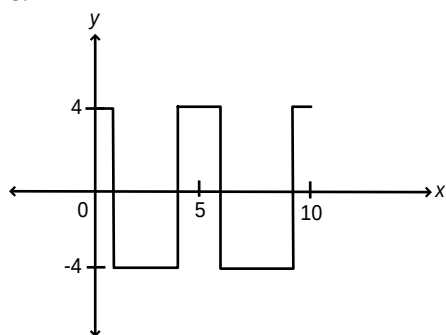
$$\text{amplitude: } a = \left| \frac{\text{max} - \text{min}}{2} \right| = \left| \frac{12 - 6}{2} \right| = 3$$

$$\text{axis of the curve: } y = \frac{\text{max} + \text{min}}{2} = \frac{12 + 6}{2} = 9$$

7. Answers will vary. The shape of the graph is the congruent part that repeats. The shape is dependent on what point is considered as the start of the shape. The period is the length of the shape. The amplitude is the distance from the axis of the shape to the maximum or minimum values. The axis of the shape is the horizontal line, half-way between the maximum and the minimum. *Example:*



8.



9. (a) The first block is the wash cycle, followed by the spray cycle and then the rinse and spin cycles.

(b) The washing process takes 28 min. Therefore, the period of one complete cycle is 28 min.

(c) Find the maximum levels for each part of the graph:
Wash cycle: 50 L; Spray cycle: 10 L; Rinse/Spin cycle: 50 L

(d) One complete cycle uses 110 L.

(e) The axis is halfway between the maximum and minimum values. Thus, $V = 25$ L.

(f) amplitude:

$$a = \left| \frac{50 - 0}{2} \right| = 25$$

10. (a) maximum: 30 m, minimum: 10 m

(b) It takes 4 min to complete one cycle. Thus, one revolution of the Ferris wheel takes 4 min.

(c) amplitude: $a = \left| \frac{30 - 10}{2} \right| = 10$

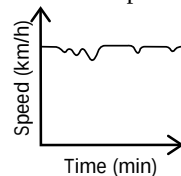
The radius of the Ferris wheel is 10 m.

(d) axis of the curve: $H = \frac{30 + 10}{2} = 20$

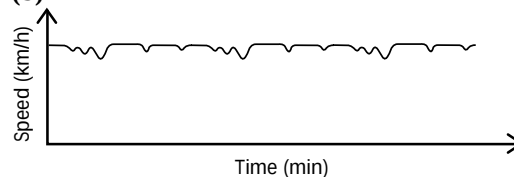
where H is the height in metres

11. Swallows are an example of periodic phenomena because they follow the cycle of migration every year. Around February 18 they leave Goya. About March 19 they arrive in Capistrano. About October 23 they leave Capistrano and arrive back in Goya about one month later. The repeated pattern is periodic.

12. (a) The sketch for her first qualifying lap begins at time zero, after several preliminary laps. He is not starting at zero kilometres per hour.



(b)



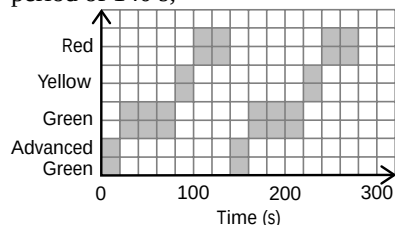
(c) The period represents one lap around the track. No speed was given, therefore the length of the period cannot be found.

13. (a) The graph is self-replicating so it represents a periodic relation: the traffic light goes from one colour to the next following the same pattern of colour and the same time interval for each colour.

(b) One cycle: long green light(60 s) changes to yellow for a short time(20 s) and then turns red(40 s)

(c) period = $60 + 20 + 40 = 120$ s or 2 min

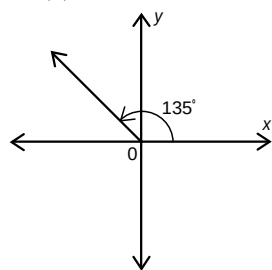
(d) An advanced green adds 20 s to the period, to give a period of 140 s;



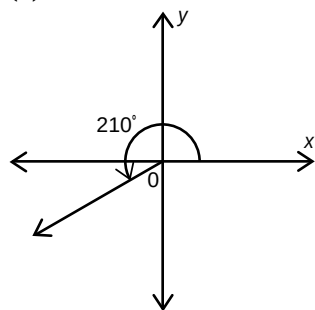
14. Answers will vary. *Example:* A function such that the range of the independent variable can be separated into equal subintervals so that the graph of the function is the same in each subinterval. (The length of the smallest equal subinterval is the period of the function). The rising and setting of the sun is a example of a periodic function. Since the sun rises and sets at approximately the same time everyday (i.e the cycle repeats every day), this is a self-replicating function.

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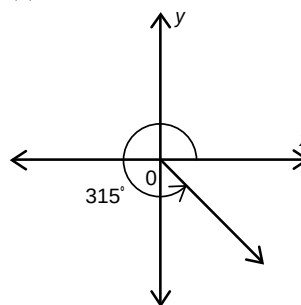
1. (a)



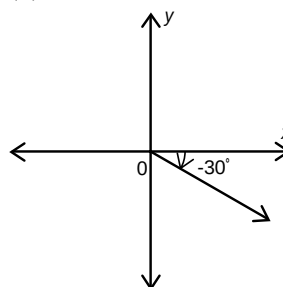
(b)



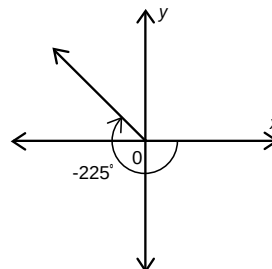
(c)



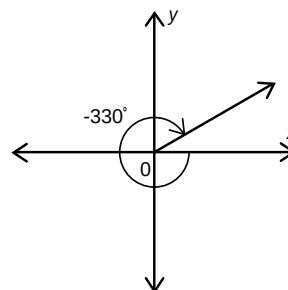
(d)



(e)



(f)



(g)

