6.1 Entertainment:
pp. 320-322 #1aceg, 2aceg, 3bc, 4bc, 5, 7ab, 8ab, 9ac, 11, 12, 13.
Challenge Yourself! #10, 16* the answer for 16 should be about 86.81 radians per second.

6.2 Entertainment: pp.330-332 #2ab, 3, 5acdf, 6cdef, 7ad, 11, 13, 15, 16, 19

6.3 Entertainment: p. 336 #2c, 3, 5

6.4 Entertainment: pp.343-346 #**1ad, 4bc, 5ac, 6c, 7bc, 8c*d*** graph (do not sketch), **9, 10*** graph (do not sketch), **11, 12, 14a**

6.1 Entertainment:
pp. 320-322 #1aceg, 2aceg, 3bc, 4bc, 5, 7ab, 8ab, 9ac, 11, 12, 13.
Challenge Yourself! #10, 16* the answer for 16 should be about 86.81 radians per second.

p.322 **11.** A wind turbine has three blades, each measuring 3 m from centre to tip. At a particular time, the turbine is rotating four times a minute.
a) Determine the angular velocity of the turbine in radians/second.
b) How far has the tip of a blade travelled after 5 min?

11. $r = 3m$ 4 rev/min.

a) ang. vel. $= \frac{\theta}{t}$

$\theta = 2\pi \times 4$
$= 8\pi$ rad.

$= \frac{8\pi \text{ rad}}{1 \text{ min}}$

$= \frac{8\pi}{1\text{ min}} \times \frac{1 \text{ min}}{60 \text{ sec}}$

$= \frac{4\pi}{30} \frac{\text{rad}}{\text{sec}}$

$= \frac{2\pi}{15}$ rad/sec

$\doteq 0.418$ rad/sec

b) 1 rev. $= 2\pi r$
$= 2\pi(3)$
$= 6\pi$

4rev/min $= 24\pi$ /min

$\therefore$ after 5min $= 120\pi$ m
$\doteq 376.99$
$\doteq 377$ m

6.1 Entertainment:
pp. 320-322 #1aceg, 2aceg, 3bc, 4bc, 5, 7ab, 8ab, 9ac, 11, 12, 13.
Challenge Yourself! #10, 16* the answer for 16 should be about 86.81 radians per second.

p.322 **12.** A wheel is rotating at an angular velocity of 1.2π radians/s, while a point on the circumference of the wheel travels 9.6π m in 10 s.
a) How many revolutions does the wheel make in 1 min?
b) What is the radius of the wheel?

12. ang. vel. $(\omega) = 1.2\pi$ rad/sec
$\theta = 9.6\pi$ m / 10 sec

a) $\omega = \frac{1.2\pi \text{ rad}}{\text{sec}} \times \frac{60 \text{ sec}}{1 \text{ min}}$

$= \frac{72\pi \text{ rad}}{\text{min}} \times \frac{1 \text{ rev}}{2\pi \text{ rad}}$

$= 36$ rev./min

b) $\theta = \frac{9.6\pi \text{ m}}{10 \text{ sec}} \times \frac{60 \text{ sec}}{1 \text{ min}}$

$= 57.6\pi$ m/min

$\therefore \frac{57.6\pi \text{ m}}{\text{min}} \times \frac{1 \text{ min}}{36 \text{ rev}}$

$= 1.6\pi$ m/rev.

$C = 2\pi r$
$1.6\pi \text{ m} = 2\pi r$
$\therefore r = \frac{1.6\pi \text{ m}}{2\pi}$
$= 0.8$ m

6.1 Entertainment:
pp. 320-322 #1aceg, 2aceg, 3bc, 4bc, 5, 7ab, 8ab, 9ac, 11, 12, 13.
Challenge Yourself! #10, 16* the answer for 16 should be about 86.81 radians per second.

p.322

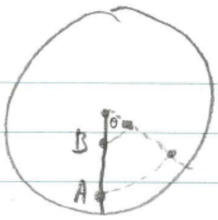
13. Two pieces of mud are stuck to the spoke of a bicycle wheel. Piece A is closer to the circumference of the tire, while piece B is closer to the centre of the wheel.

a) Is the angular velocity at which piece A is travelling greater than, less than, or equal to the angular velocity at which piece B is travelling?

b) Is the velocity at which piece A is travelling greater than, less than, or equal to the velocity at which piece B is travelling?

c) If the angular velocity of the bicycle wheel increased, would the velocity at which piece A is travelling as a percent of the velocity at which piece B is travelling increase, decrease, or stay the same?

13.



a) $\omega = \frac{\theta}{t}$

in both cases, $\theta = 1$ radian,

∴ the angular velocity of each piece of mud is equal.

b) $v = \frac{d}{t}$, in this case, the distance piece A travels is greater than piece B, so velocity A > velocity B

c) $v_A = \frac{2\pi r_A}{t}$ $\quad v_B = \frac{2\pi r_B}{t}$ $\quad \% \frac{v_A}{v_B} = \frac{2\pi r_A}{t} \div \frac{2\pi r_B}{t}$

$= \frac{2\pi r_A}{t} \times \frac{t}{2\pi r_B}$

$= \frac{r_A}{r_B}$ ∴ constant (ie) independent of ang. velocity

6.2 Entertainment: pp.330-332 #2ab, 3, 5acdf, 6cdef, 7ad, 11, 13, 15, 16, 19

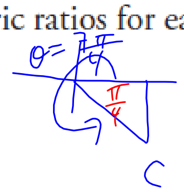
cd

p.330

3. Determine the primary trigonometric ratios for each angle.

a) $-\frac{\pi}{2}$ c) $\frac{7\pi}{4}$

b) $-\pi$ d) $-\frac{\pi}{6}$



$\theta = \frac{7\pi}{4}$ $2\pi = \frac{8\pi}{4}$

$\beta = 2\pi - \frac{7\pi}{4}$

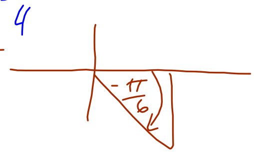
$= \frac{\pi}{4}$

3c) $\sin\frac{7\pi}{4}$ $\cos\frac{7\pi}{4}$ $\tan\frac{7\pi}{4}$

$= -\sin\left(\frac{\pi}{4}\right)$ $= +\cos\left(\frac{\pi}{4}\right)$ $= -\tan\left(\frac{\pi}{4}\right)$

$= \frac{-\sqrt{2}}{2}$ $= \frac{\sqrt{2}}{2}$ $= -1$

d) $-\frac{\pi}{6}$



$\beta = \frac{\pi}{6}$

$\sin\left(-\frac{\pi}{6}\right)$ $\cos\left(-\frac{\pi}{6}\right)$ $\tan\left(-\frac{\pi}{6}\right)$

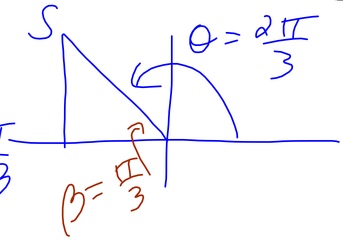
$-\sin\left(\frac{\pi}{6}\right)$ $+\cos\left(\frac{\pi}{6}\right)$ $-\tan\left(\frac{\pi}{6}\right)$

$= -\frac{1}{2}$ $= \frac{\sqrt{3}}{2}$ $= \frac{-\sqrt{3}}{3}$

p.330

5. Determine the exact value of each trigonometric ratio.

a) $\sin\frac{2\pi}{3}$

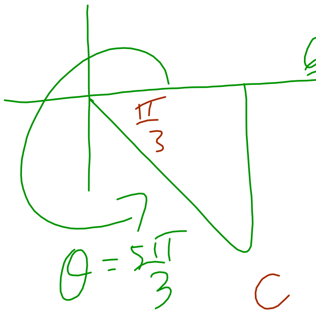


$\theta = \frac{2\pi}{3}$ $\frac{3\pi}{3}$ $\beta = \frac{\pi}{3}$

$= +\sin\left(\frac{\pi}{3}\right)$

$= \frac{\sqrt{3}}{2}$

f) $\sec\frac{5\pi}{3}$ $= +\sec\left(\frac{\pi}{3}\right)$



$\frac{6\pi}{3} = 2\pi$

$\beta = \frac{\pi}{3}$

$\theta = \frac{5\pi}{3}$

$\sec\left(\frac{\pi}{3}\right)$

$= \frac{1}{\cos\left(\frac{\pi}{3}\right)}$

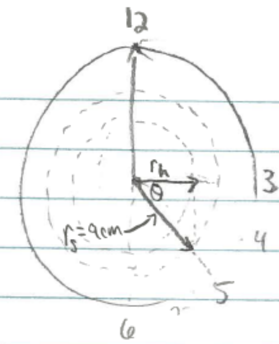
$= \frac{1}{\frac{1}{2}}$

$\therefore \sec\frac{5\pi}{3} = 2$

6.2 Entertainment: pp.330-332 #2ab, 3, 5acdf, 6cdef, 7ad, 11, 13, 15, 16, 19

p.331 **11.** A clock is showing the time as exactly 3:00 p.m. and 25 s. Because a full minute has not passed since 3:00, the hour hand is pointing directly at the 3 and the minute hand is pointing directly at the 12. If the tip of the second hand is directly below the tip of the hour hand, and if the length of the second hand is 9 cm, what is the length of the hour hand?

11.



Length second hand

$= 9$ cm

$= r_s$

b/w the 3 & 5

is 10 sec

$\therefore \theta = \frac{10}{60}$ of the central angle

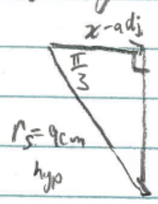
$\therefore \theta = \frac{10}{60}$ of 2π

$= \frac{\pi}{3}$

$\doteq 1.047$

$\doteq 1.05$ rad

length of hour hand



$\cos \frac{\pi}{3} = \frac{x}{9}$

$x = 9 \cos\left(\frac{\pi}{3}\right)$

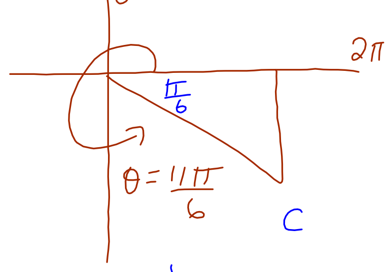
$= 9\left(\frac{1}{2}\right)$

$= 4.5$

(book says $\doteq$, but really $=$)

6.2 Entertainment: pp.330-332 #2ab, 3, 5acdf, 6cdef, 7ad, 11, 13, 15, 16, 19

p.332 **15.** Show that $2\sin^2\theta - 1 = \sin^2\theta - \cos^2\theta$ for $\frac{11\pi}{6}$. $\rightarrow$ raa $= \frac{\pi}{6}$



$LS = 2\sin^2\theta - 1$

$= 2\sin^2\left(\frac{11\pi}{6}\right) - 1$

$= 2\left(-\frac{1}{2}\right)^2 - 1$

$= 2\left(\frac{1}{4}\right) - 1$

$= \frac{1}{2} - 1$

$= -\frac{1}{2}$

$RS = \sin^2\theta - \cos^2\theta$

$= \left(-\frac{1}{2}\right)^2 - \left(\frac{\sqrt{3}}{2}\right)^2$

$= \frac{1}{4} - \frac{3}{4}$

$= -\frac{2}{4}$

$= -\frac{1}{2}$

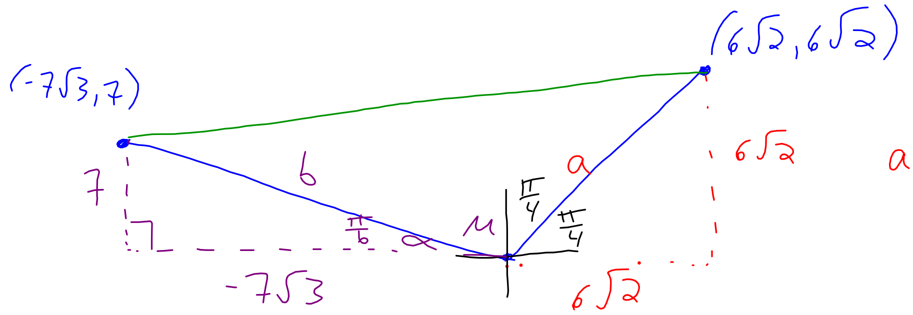
$\sin\frac{11\pi}{6} = -\sin\left(\frac{\pi}{6}\right) = -\frac{1}{2}$

$\cos\frac{11\pi}{6} = +\cos\frac{\pi}{6} = \frac{\sqrt{3}}{2}$

$\therefore LS = RS$

$\therefore$ QED.

p.332 **19.** Find the cosine of the angle formed by two rays that start at the origin of the Cartesian plane if one ray passes through the point $(6\sqrt{2}, 6\sqrt{2})$ and the other ray passes through the point $(-7\sqrt{3}, 7)$. Round your answer to the nearest hundredth, if necessary.



$a^2 = (6\sqrt{2})^2 + (6\sqrt{2})^2$

$= 72 + 72$

$= 144$

$\therefore a = 12$

$b^2 = (-7\sqrt{3})^2 + 7^2$

$= 147 + 49$

$= 196$

$\therefore b = 14$

$\tan\alpha = \frac{7}{-7\sqrt{3}}$

$= \frac{-1}{\sqrt{3}}$

$\therefore \alpha = \frac{\pi}{6}$

$\therefore \mu = \frac{\pi}{3}$

Now $\frac{\pi}{3} + \frac{\pi}{4}$

$= \frac{4\pi}{12} + \frac{3\pi}{12}$

$= \frac{7\pi}{12}$

$\therefore \cos\left(\frac{7\pi}{12}\right)$

$\doteq -0.258$

$\doteq -0.26$

6.3 Entertainment: p. 336 #2c, 3, 5

p.336 **2.** **a)** Use a graphing calculator, in radian mode, to create the graphs of the trigonometric functions $y = \sin\theta$ and $y = \cos\theta$ on the interval $-2\pi \le \theta \le 2\pi$. To do this, enter the functions $Y1 = \sin\theta$ and $Y2 = \cos\theta$ in the equation editor, and use the window settings shown.

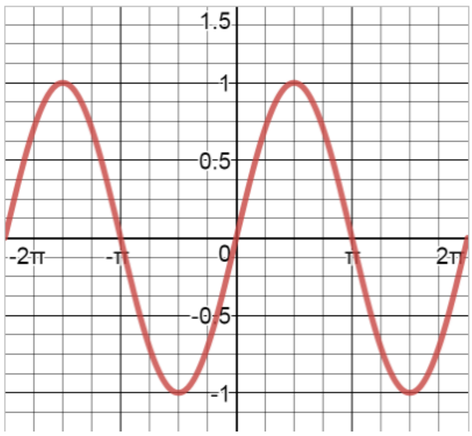
b) Determine the values of θ where the functions intersect.

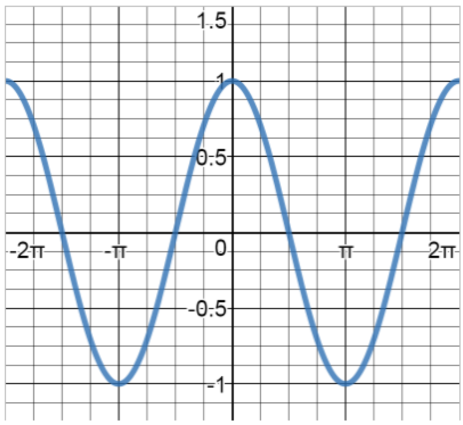
c) The equation $t_n = a + (n - 1)d$ can be used to represent the general term of any arithmetic sequence, where a is the first term and d is the common difference. Use this equation to find an expression that describes the location of each of the following values for $y = \sin\theta$, where $n \in \mathrm{I}$ and θ is in radians.

i) θ-intercepts

ii) maximum values

iii) minimum values





i) $\{x \in \mathbb{R} \mid 0 + k\pi, k \in I\}$

ii) $\{x \in \mathbb{R} \mid \frac{\pi}{2} + 2\pi k, k \in I\}$

iii) $\{x \in \mathbb{R} \mid \frac{3\pi}{2} + 2k\pi, k \in I\}$

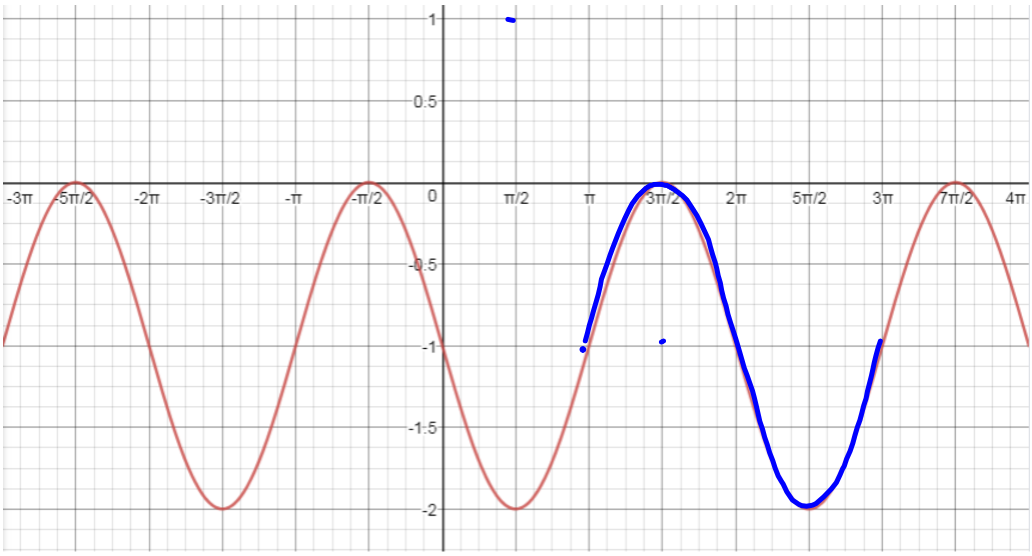
6.4 Entertainment: pp.343-346 #**1ad, 4bc, 5ac, 6c, 7bc, 8c*d*** graph (do not sketch), **9, 10*** graph (do not sketch), **11, 12, 14a**

p.345 **6.** State the transformations that were applied to the parent function $f(x) = \sin x$ to obtain each of the following transformed functions. Then graph the transformed functions.

c) $f(x) = \sin(x - \pi) - 1$

phase shift π radians to the right

V.t. down 1 unit



6.4 Entertainment: pp.343-346 #**1ad, 4bc, 5ac, 6c, 7bc, 8c*d*** graph (do not sketch), **9, 10*** graph (do not sketch), **11, 12, 14a**

p.345

9. Each person's blood pressure is different, but there is a range of blood pressure values that is considered healthy. The function $P(t) = -20\cos\frac{5\pi}{3}t + 100$ models the blood pressure, p, in millimetres of mercury, at time t, in seconds, of a person at rest.

a) What is the period of the function? What does the period represent for an individual?

b) How many times does this person's heart beat each minute?

c) Sketch the graph of $y = P(t)$ for $0 \le t \le 6$.

d) What is the range of the function? Explain the meaning of the range in terms of a person's blood pressure.

a) period $= \dfrac{2\pi}{\left|\frac{5\pi}{3}\right|}$

$= 2\pi \div \dfrac{5\pi}{3}$

$= 2\pi \times \dfrac{3}{5\pi}$

$= \dfrac{6}{5}$

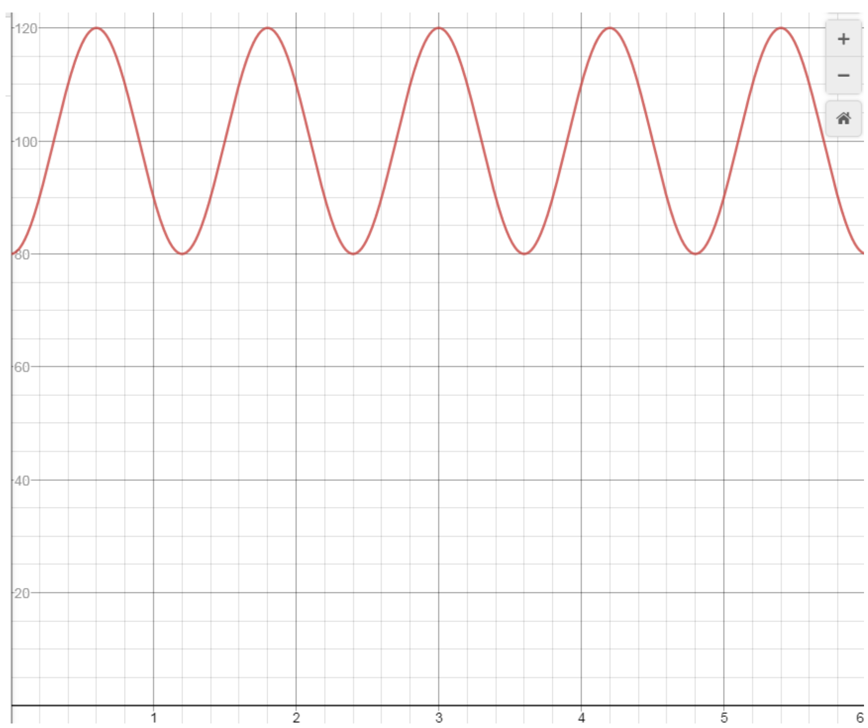
$\therefore$ the time between heartbeats is $1\frac{1}{5}$ seconds (or 1.2 sec).

b) beats per minute

$= \dfrac{60}{1.2}$

$= 50$ bpm

c)



d) Range:

$[80, 120]$

$\therefore$ blood pressure ranges from 80 mm Hg to 120 mm of Hg

6.4 Entertainment: pp.343-346 #**1ad, 4bc, 5ac, 6c, 7bc, 8c*d*** graph (do not sketch), **9, 10*** graph (do not sketch), **11, 12, 14a**

p.345 **10.** A pendulum swings back and forth 10 times in 8 s. It swings through a total horizontal distance of 40 cm.

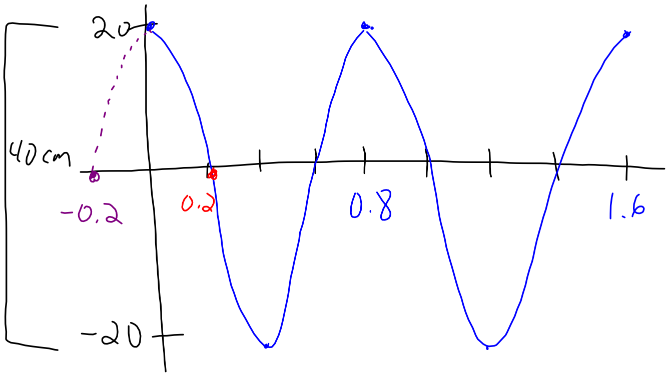
a) Sketch a graph of this motion for two cycles, beginning with the pendulum at the end of its swing.

b) Describe the transformations necessary to transform $y = \sin x$ into the function you graphed in part a).

c) Write the equation that models this situation.

period = $\frac{8 \text{ sec}}{10 \text{ cycles}}$

$= 0.8$ sec/cycle



c) $a = 20$

$k = \frac{\text{original period}}{\text{period}}$

$= \frac{2\pi}{0.8}$

$= 2\pi \div \frac{8}{10}$

$= 2\pi \times \frac{\cancel{10}\,5}{\cancel{8}\,\cancel{4}\,2}$

$= \frac{5\pi}{2}$

$\therefore y = 20\cos\left(\frac{5\pi}{2}(x-0)\right) + 0$

but question asks for sine!

$\therefore y = -20\sin\left(\frac{5\pi}{2}(x-0.2)\right)$

or $y = 20\sin\left(\frac{5\pi}{2}(x+0.2)\right)$

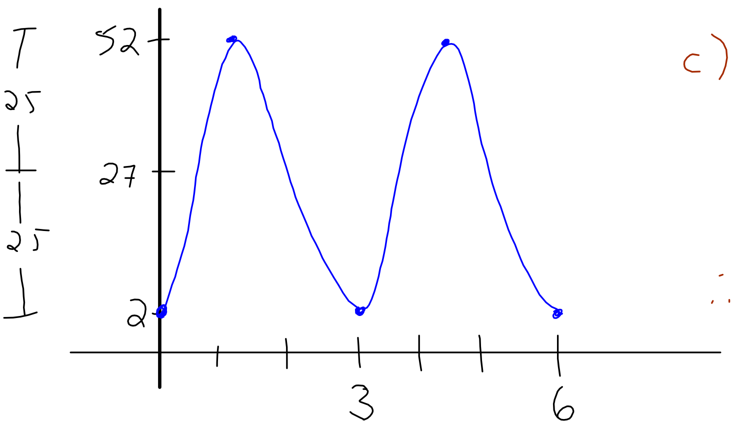
6.4 Entertainment: pp.343-346 #**1ad, 4bc, 5ac, 6c, 7bc, 8c*d*** graph (do not sketch), **9, 10*** graph (do not sketch), **11, 12, 14a**

p.346 **11.** A rung on a hamster wheel, with a radius of 25 cm, is travelling at a constant speed. It makes one complete revolution in 3 s. The axle of the hamster wheel is 27 cm above the ground.

a) Sketch a graph of the height of the rung above the ground during two complete revolutions, beginning when the rung is closest to the ground.

b) Describe the transformations necessary to transform $y = \cos x$ into the function you graphed in part a).

c) Write the equation that models this situation.



c) $a = 25$ $k = \frac{2\pi}{3}$

$d = 0$, $c = 27$

$\therefore y = -25\cos\left(\frac{2\pi}{3}(x-0)\right) + 27$

$= -25\cos\left(\frac{2\pi}{3}x\right) + 27$