

back cover

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QUESTIONS

page 21 **Exercise 1B.4**

4 b the difference between two odd functions is odd

page 28 **Exercise 1C.5**

5 in the diagram, θ should be the angle between BC and the horizontal

page 31 **Exercise 1D**

11 should start "Recall that if $f(x)$..."

page 32 **Exercise 1D**

15 e bottom line should be "... and $\tan a = \frac{B}{A}$."

page 33 **Exercise 1D**

16 second line should end with "... and $\tan a = \frac{B}{A}$."

page 37 **Review Set 1B**

3 should begin with "If $\cos \theta = -\frac{2}{3}$ and"

page 46 **Exercise 2A.3**

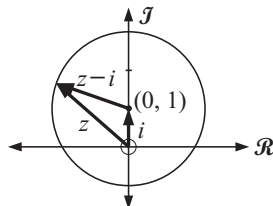
2 first line should be: "Find real numbers x and y if:"

page 50 **Exercise 2B.1**

first line of page should be:
"Notice that $\overline{z_1 + z_2 + z_3} = \overline{z_1 + z_2 + z_3}$..."

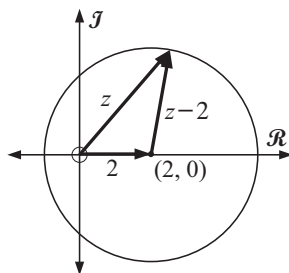
page 65 **Complex sets and their graphs**

first diagram should be:



page 66 **Example 30**

diagram should be:



page 66 **Example 31**

on the diagram, the equation of the line should be labelled as $y = -x$

page 67 **Exercise 2E**

8 b End of question should be " $x > 2$ ", not " $x \geq 2$ "

9 θ is any angle in $0 \leq \theta \leq 2\pi$.

page 74 **Exercise 2G.2**

5 a the n roots of $z^n = 1$ are $1, w, w^2, w^3, \dots, w^{n-1}$

page 84 **Exercise 3B.1**

the blue box at the bottom of the page should read:

$$\frac{P(x)}{ax^2+bx+c} = Q(x) + \frac{ex+f}{ax^2+bx+c}$$

page 95 **Example 20**

the last line of the solution should read:
 $= (x - 2)(x + \sqrt{3})(x - \sqrt{3})$

page 96 **Example 20**

the last line of the solution should read:
 $= (x - 2)(x + \sqrt{3})(x - \sqrt{3})$

page 99

on the first diagram on the page the x -intercept should be at -1

page 103 **Example 25**

question should start "Find the quartic which..."

page 107 **Exercise 3G.2**

3 the last line of the question should be: "using $P(2 - 3i) = 0$ "

page 109 **Exercise 3H**

3 b question should start:
"Explain why $(3 - 2w)(3 - 2w^2) = 19$..."

page 112 **Example 32**

a last line should read " $|z_4| = 0.4072$ "

page 113 **Example 32**

b last line should read " $|z_4| = 9.866$ "
c last line should read " $|z_4| = 25.9044$ "

page 115 **Example 33**

b second line should read " $[2 \operatorname{cis}(-\frac{\pi}{6})]^2 = 4 \operatorname{cis}(-\frac{\pi}{3})$ "

page 116 **Exercise 3J.2**

5 d last line of question should be " $n = 0, 1, 2, 3, 4, 5$ or 6 "

page 120 **Example 36**

a last line should be:
" $\therefore c = \frac{1}{2} + \frac{1}{2}i$ is not a member of the Mandelbrot set."
b last line should be:
" $\therefore c = -1.940799807$ is a member of the Mandelbrot set..."

page 136 **Example 10**

the end of the first line of the question should be "Find x if:"

page 143

text in blue highlight box at bottom of page should be:

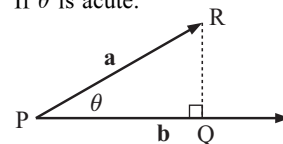
projection vector of \mathbf{a} on \mathbf{b} is $\left(\frac{\mathbf{a} \cdot \mathbf{b}}{|\mathbf{b}|}\right) \frac{\mathbf{b}}{|\mathbf{b}|}$

where $\frac{|\mathbf{a} \cdot \mathbf{b}|}{|\mathbf{b}|}$ is the length of the projection vector
and $\frac{\mathbf{b}}{|\mathbf{b}|}$ is the unit vector in the direction of \mathbf{b}

page 144

the proof at the top of the page should be as follows:

If θ is acute:



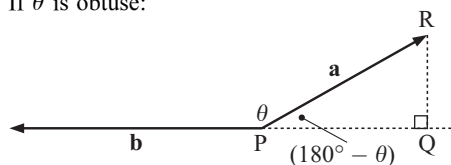
$$\begin{aligned} \text{In triangle PQR, } \cos \theta &= \frac{PQ}{PR} = \frac{PQ}{|\mathbf{a}|} \\ \therefore PQ &= |\mathbf{a}| \cos \theta \\ \therefore PQ &= \frac{|\mathbf{a}| |\mathbf{b}| \cos \theta}{|\mathbf{b}|} \\ \therefore PQ &= \frac{\mathbf{a} \cdot \mathbf{b}}{|\mathbf{b}|} \end{aligned}$$

Now, the projection vector is in the same direction as \mathbf{b} , so its unit vector is $\frac{\mathbf{b}}{|\mathbf{b}|}$.

$$\therefore \text{ the projection vector of } \mathbf{a} \text{ on } \mathbf{b} \text{ is } PQ \times \frac{\mathbf{b}}{|\mathbf{b}|} = \left(\frac{\mathbf{a} \cdot \mathbf{b}}{|\mathbf{b}|}\right) \frac{\mathbf{b}}{|\mathbf{b}|}$$

(continued next page)

If θ is obtuse:



$$\begin{aligned} \text{In triangle PQR, } \cos(180^\circ - \theta) &= \frac{PQ}{PR} = \frac{PQ}{|a|} \\ \therefore PQ &= |a| \cos(180^\circ - \theta) \\ \therefore PQ &= -|a| \cos \theta \\ \therefore PQ &= -\frac{|a||b| \cos \theta}{|b|} \\ \therefore PQ &= -\frac{\mathbf{a} \cdot \mathbf{b}}{|b|} \end{aligned}$$

Now, the projection vector is in the opposite direction to \mathbf{b} , so its unit vector is $-\frac{\mathbf{b}}{|b|}$.

$$\therefore \text{ the projection vector of } \mathbf{a} \text{ on } \mathbf{b} \text{ is } PQ \times -\frac{\mathbf{b}}{|b|} = \left(-\frac{\mathbf{a} \cdot \mathbf{b}}{|b|} \right) \left(-\frac{\mathbf{b}}{|b|} \right) = \left(\frac{\mathbf{a} \cdot \mathbf{b}}{|b|} \right) \frac{\mathbf{b}}{|b|}.$$

Note that in both cases $PQ = \frac{|\mathbf{a} \cdot \mathbf{b}|}{|b|}$.

page 144 **Example 17**

c the projection vector of \mathbf{b} on $\mathbf{a} = \left(\frac{\mathbf{b} \cdot \mathbf{a}}{|\mathbf{a}|} \right) \frac{\mathbf{a}}{|\mathbf{a}|}$

page 153 **Exercise 4G.2**

5 c question should read: "prove that $\mathbf{a} + \mathbf{b} = k\mathbf{c}$ for some scalar k "

page 167 **Exercise 4J**

14 Equation of plane in diagram and question should be: " $Ax + By + Cz + D = 0$ "

page 176

under the section dealing with midpoints the third line of the proof should be " $= \mathbf{a} + \frac{1}{2}(-\overrightarrow{OA} + \overrightarrow{OB})$ "

page 182 **Exercise 5A.3**

1 In the diagram, vector \mathbf{a} should go from O to A.

page 192 **Exercise 5B.1**

1 e XY is parallel to TZ

page 194 **Exercise 5B.1**

11 Last line of the question should read: "that triangle XYZ has constant perimeter."

page 203 **Review Set 5B**

4 On the diagram the point O should be labelled D.

page 214 **Example 3**

c second line of solution is missing. it should be: $\therefore \text{ range} = x(5.954) - x(0) = 150.85 - 2 = 148.85 \text{ m}$

page 215 **Exercise 6C.1**

1 c question should be: "How far from the line at $x = 0$ is the tip of the javelin when it is released?"

page 217

First paragraph after *step 3* should be: "As t takes all values..."

The Bézier curves demo on the student CD produces incorrect results. A corrected version of this demo can be downloaded from our website (www.haeseandharris.com.au).

page 223 **Exercise 6D**

5 a should be "Find the initial position of P."
c should start "Explain why $|\mathbf{v}| = R\omega$..."

page 227

first line of indented section of text should read: "Likewise, $\frac{dy}{dt}$ is the rate at which B moves upwards."

page 232 **Exercise 6F**

10 third line of the problem should state: "Michael starts walking westwards from B at 3 ms^{-1} ."

page 232 **Review Set 6A**

1 b question should be: "The speed of P is constant at $\sqrt{13} \text{ cm/s}$. Find a ."

page 234 **Review Set 6C**

6 third line of problem should end: "3 seconds after A passes through X."

page 237

third line from bottom of page should be: " $= \sin x(0) + \cos x(1) \{ \text{as } h \rightarrow 0, \cos h \rightarrow 1, \frac{\sin h}{h} \rightarrow 1 \}$ "

page 238

Top of page, *Method 1*., third line should be: " $\therefore y = \sin u$ where $u = \frac{\pi}{2} - x$ "

page 250 **Exercise 7C**

8 the flywheel rotates in a clockwise direction

page 258

the integral in both highlighted boxes should be \int_a^b

page 264 **Review Set 7A**

7 AM and BM are 1 km, not AP and BP.

page 267 **Review Set 7D**

7 a Equation should be: $E(\theta) = \frac{dj_1}{\cos \theta} + (l - d \tan \theta)j_2, j_1 > j_2$

page 281

highlighted box should be: "if $\frac{dy}{dx} = f(x)$ then $y = \int f(x)dx$ "

page 293 **Exercise 8E.1**

7 the question should begin: "A body moves to the right..."

page 294 **Example 18**

the worked solution should begin:

$$\begin{aligned} q &= -2\pi kr \frac{dT}{dr} \\ \therefore 680 &= -2\pi(0.2)r \frac{dT}{dr} \\ \therefore \frac{1}{r} &= \frac{-0.4\pi}{680} \frac{dT}{dr} \\ \therefore \int \frac{1}{r} dr &= \int \frac{-0.4}{680} \frac{dT}{dr} dr \\ \therefore \int \frac{1}{r} dr &= \int \frac{-0.4\pi}{680} dT \\ \therefore \int \frac{1}{r} dr &= -0.001848 \int 1 dT \end{aligned}$$

page 297 **Example 20**

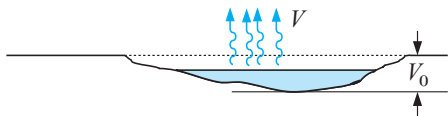
the second line onwards, from the top of the page should read:

$$\begin{aligned} \therefore \frac{v-29.4}{29.4} &= -e^{-\frac{t}{3}} \quad (\text{since } v(0) = 0) \\ \therefore v - 29.4 &= -29.4e^{-\frac{t}{3}} \end{aligned}$$

page 297 **Exercise 8E.2**

6 the third line of the question should be: "The equation for the motion is $\frac{dv}{dt} = g - 4v$..."

7 a question should read: "Explaining the symbols used, why is the differential equation $\frac{dV}{dt} = k(V_0 - V)$ appropriate?"



page 309 **Review Set 8A**

1 a question should end:

"... the differential equation $\frac{d^2y}{dt^2} = -4(y - 3)$."

page 312 **Review Set 8D**

3 last line should end:

"...(y - 2)² = e^x(y - 3)."

page 316 **Opening Problem**

in the diagram, the + and - signs are the wrong way round and the second paragraph should begin: "The extension s , will be positive if the spring is compressed."

page 317 **Investigation 1**

1 equation should be: " $y = \cos(4\pi x)$ "

3 equation should be: " $y = \cos(4\pi x) e^{-x}$ "

page 317 **Investigation 2**

in the diagram, the + and - signs are the wrong way round

page 333 **Investigation 6**

the first equation should be:

" $s(t) = s_0 e^{-\alpha t} \cos(\beta t)$ "

page 337-338 **Investigation 7**

equation for S' should be: $S' = -\alpha S + D + 320$

What to do:

1 By differentiating (2) and using (1), show that a second order DE for the supply function is

$$S'' + \alpha S' + S = 320 \quad \dots (3)$$

2 Write down and solve the characteristic equation corresponding to the second order DE

$$S'' + \alpha S' + S = 0 \quad \dots (4)$$

3 Hence write down the general solution to (4) if:

i $\alpha = 1.8$ ii $\alpha = 2.0$ iii $\alpha = 2.2$

4 Show that if $y_0(t)$ satisfies $y'' + ay' + by = 0$ then $y_1(t) = y_0(t) + c$ satisfies $y'' + ay' + by = bc$.

Hence write down a general solution to (3) for each case:

i $\alpha = 1.8$ ii $\alpha = 2.0$ iii $\alpha = 2.2$

By considering the forms of the solutions obtained, predict which value of α is desired by Muhlack and Dangerfield.

5 Show that as $t \rightarrow \infty$, $S(t) \rightarrow 320$ for each of the general solutions obtained in 4. Explain why this is not surprising.

6 For your chosen value of α :

a Use $S(0) = 0$ to evaluate one of the unknown constants.

b Use (2) evaluated at $t = 0$ to deduce the remaining coefficient.

c Write down a particular solution for $S(t)$.

d Use (2) to obtain a particular solution for $D(t)$.

e Graph $S(t)$ and $D(t)$ on the same set of axes, and hence check your prediction in 4.

7 If the rate of change of gnome supply was

$S' = -\alpha S + \beta D + k$, where $\beta > 0$, k a constant, what would the desired coefficient α be?

Show that β must equal $\alpha - 1$ for supply to match demand at equilibrium. **Hint:** When does $S' = D' = 0$?

page 341 **Investigation 9**

4 second equation should be:

$$"y' = -\frac{1}{10}y \left(1 - \frac{3y}{10000} - \frac{x}{50000}\right)"$$

page 343 **Review Set 9A**

7 spring constant should be: $k = 2.16$

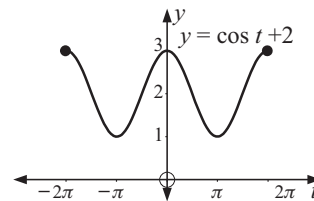
ANSWERS

page 346 **Exercise 1C.1**

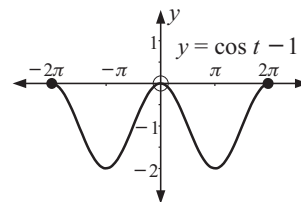
1 Graphs should have solid circles on their end points at $x = 0$ and $x = 4\pi$.

page 347 **Exercise 1C.3**

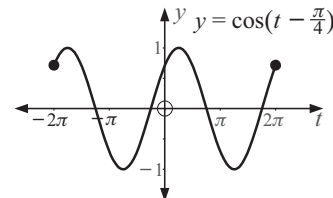
1 a



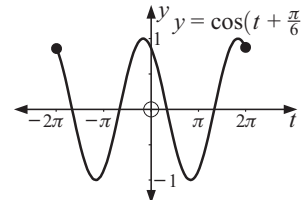
b



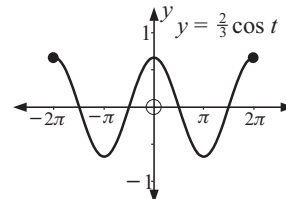
c



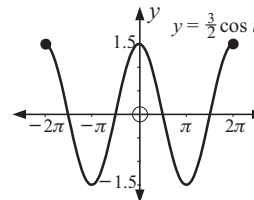
d



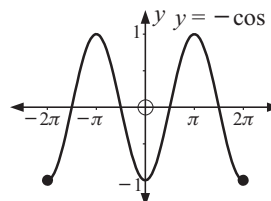
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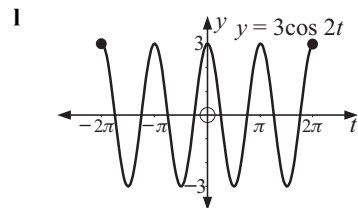
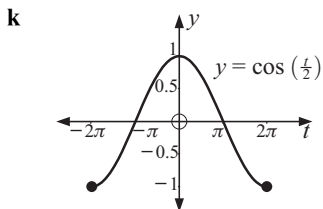
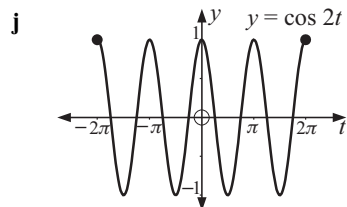
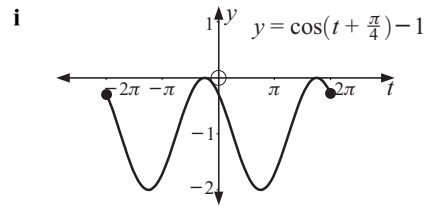
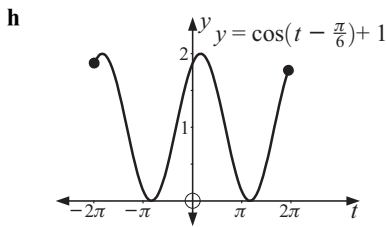


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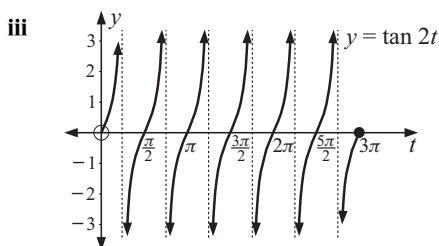
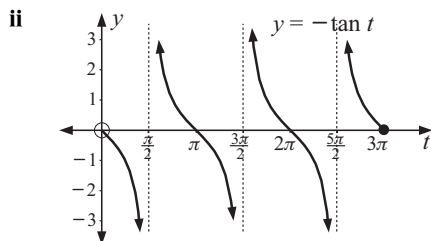
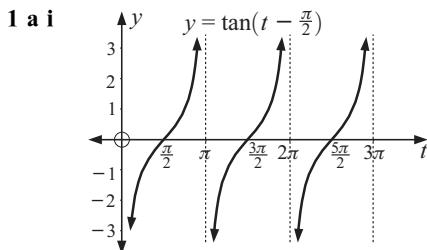


g





page 348 **Exercise 1C.4**



page 348 **Exercise 1E.1**

- 1 d** 5th number should be 6.3648.
h 0.2607, 1.8337, 6.5438

page 349 **Exercise 1E.2**

- 2 c** $0, \frac{2\pi}{3}, \frac{4\pi}{3} \pm k2\pi$
d $\frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6} \pm k2\pi$
3 e 11:15 am

page 349 **Review Set 1A**

- 8 a** all except $x = 0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}, 2\pi$

page 352 **Exercise 2C.3**

- 11 b** 0 if $a \neq 1$, undefined if $a = 1$

page 352 **Exercise 2D.3**

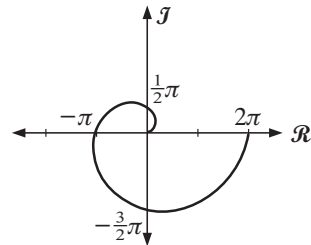
- 3 a** $|z - 1| = 2 \sin \frac{\phi}{2}, \arg(z - 1) = \frac{\phi}{2} + \frac{\pi}{2}$
b $z - 1 = (2 \sin \frac{\phi}{2}) \text{cis}(\frac{\phi}{2} + \frac{\pi}{2})$
c $\overline{z - 1} = (2 \sin \frac{\phi}{2}) \text{cis}(-\frac{\phi}{2} - \frac{\pi}{2})$

page 352 **Exercise 2D.4**

- 4 a** $a(x^2 + 2x + 4) = 0, a \neq 0$
b $a(x^2 - 2x + 2) = 0, a \neq 0$

page 354 **Exercise 2E**

- 9** $r = \theta, 0 \leq \theta \leq 2\pi$



page 355 **Exercise 2G.2**

- 1 a iii** $z = \frac{1-w^n}{2}$, where $n = 0, 1, 2$ and $w = \text{cis} \frac{2\pi}{3}$
4 c $1 - w^5$

page 357 **Exercise 3C**

- 5 b** $P(z) = a(z + 2)(z^2 + 1) \quad a \neq 0$

page 359 **Exercise 3J.2**

- 5 b** 3 cycle
c 3 cycle

page 359 **Exercise 3J.3**

- 1 a ii** $0 \leftrightarrow -1$ is the 2-cycle
b i $\frac{1}{2} \pm \frac{\sqrt{33}}{6}$

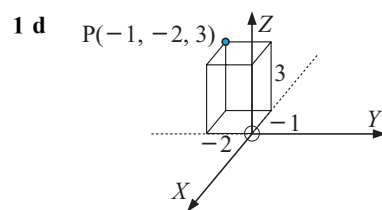
page 359 **Exercise 3J.4**

- 1** $(-1, 0)$

page 359 **Review Set 3A**

- 4** $a = 7, b = 0$ or $a = 4, b = \pm\sqrt{3}$

page 361 **Exercise 4A**



page 362 **Exercise 4B**

- 2 a** $\overrightarrow{AB} = [4, -1, -3] \quad \overrightarrow{BA} = [-4, 1, 3]$

page 363 **Exercise 4F**

- 9 a** -1
20 -7

page 363 Exercise 4H

4 a 4 units^3

page 364 Exercise 4H

5 c 9 units^3

page 364 Exercise 4I

9 a $\mathbf{a} = [2, 3, 6], \mathbf{b} = [1, 1, 1]$

page 364 Exercise 4K

1 b i $a_1 = a_2, b_1 = b_2, c_1 = c_2$

page 365 Review Set 4A

1 c $-\frac{5}{14}[-1, 2, 3]$

page 365 Review Set 4C

2 a 3 units

page 366 Exercise 5A.3

5 $\overrightarrow{ON} = \frac{4}{5}\mathbf{a} - \frac{3}{5}\mathbf{b}$

page 366 Exercise 5B.2

- 1 a yes {opposite angles are supplementary}
- b yes {one side subtends equal angles at the other two vertices}
- c no {opposite angles are not supplementary}
- d yes {opposite angles are supplementary}
- e yes {one side subtends equal angles at the other two vertices}
- f yes {opposite angles are supplementary}

page 367 Exercise 6A.1

1 c $v'(t) \doteq 5.6952t^{0.0865}$

page 367 Exercise 6B

2 d $t = 4.2$ hours

page 367 Exercise 6C.1

- 4 b $[3, 3], 3\sqrt{2} \text{ cms}^{-1}$
- e $\sqrt{26} \text{ cms}^{-1}$
- f maximum speed $9\sqrt{2} \text{ cms}^{-1}$, minimum speed 4.025 cms^{-1}

page 368 Exercise 6C.2

3 c left-most $(-2.552, 1.709)$, right-most $(1, 2)$

page 368 Exercise 6C.3

2 a $X(s) = (1 - 3s)x_0 + 3x_1s, Y(s) = (1 - 3s)y_0 + 3y_1s$

page 368 Exercise 6D

- 3 c arc length l from $(R, 0) = R(\phi + t) \dots$
- 5 b $\mathbf{v} = k[-R\sin(\omega t + \phi), R\cos(\omega t + \phi)]$

page 368 Exercise 6E.1

1 g $(x - 1)(2 - y) = 6$

page 368 Exercise 6E.2

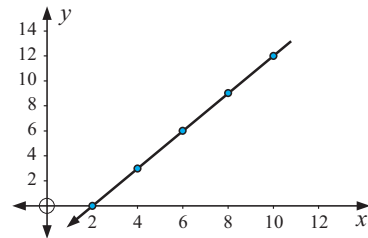
2 b $7x - 2y = 78$

page 368 Exercise 6F

- 2 a moving to the right at 1 unit per second
- 2 b moving to the right at 10000 units per second

page 369 Review Set 6A

1 c



- 2 a $y = \frac{1}{9}(x^2 - 9x + 18)$ for $x \geq 3$
- b $(3, 0)$

page 369 Review Set 6B

- 2 b $(-15, 7)$ and $(-3, 1)$
- 6 a $V(r) = \frac{1}{3}\pi r^2 \left(\frac{8r}{3}\right) = \frac{8\pi}{9}r^3$
- b $\frac{dr}{dt} = -\frac{8}{375\pi}$ m per minute

page 369 Review Set 6C

- 1 a X23 $x_1 = 2 + t, y_1 = 4 - 3t, t \geq 0$
- b Y18 $x_2 = 11 - (t - 2), y_2 = 3 + a(t - 2), t \geq 2$
- c intercept occurred at 2:22:30 pm
- d true bearing of 192.7° , 4.540 units per minute
- 4 a $X(t) = -1.125 - 1.25t, Y(t) = -2 + 5t$
- b ii $k = -22.5$
- 6 3.601 ms^{-1}

page 369 Exercise 7A.1

- 7 a rising
- b rising at 2.731 m per hour
- 8 a -34000π units per second

page 371 Exercise 7C

8 b 100π radians per second

page 371 Exercise 7D.2

7 c $-\ln|\cos x| + c$

page 372 Exercise 7D.5

2 6.283 units^2

page 372 Review Set 7C

7 c increasing at 0.05 units per second

page 372 Review Set 7D

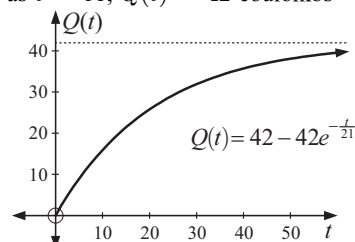
1 b $\frac{dy}{dx} = \frac{-y \cos x}{\sin x + 2y}$

page 373 Exercise 8A.1

- 1 a $P_0 = 10^6$
- b i $2P_0 = 2 \times 10^6$
- b ii $4P_0 = 4 \times 10^6$
- b iii $64P_0 = 6.4 \times 10^7$

page 373 Exercise 8A.2

- 1 c as $t \rightarrow \infty, S \rightarrow 36.31$ gms
- 3 a $3\frac{dQ}{dt} + \frac{Q}{7} = 6$
- b $k = -\frac{1}{21}, c = 42$
- c $a = -42$
- d as $t \rightarrow \infty, Q(t) \rightarrow 42$ coulombs



f 21.62 seconds

page 374 Exercise 8D.1

2 c $t = 6y^{\frac{1}{2}} + 26$

4 a $p = \frac{10}{e}$

page 374 Exercise 8D.2

3 $y = e^{-x^2}$

5 $y^2 = x^2 - 9, a = \pm 3\sqrt{2}$

page 374 Exercise 8E.1

3 \$1537.41, < 847 plates

page 374 Exercise 8E.2

1 a 399.8°C

b 0.3867 m

c 0.1867 m

10 a $I = 2 + Ae^{-\frac{100}{3}t}$

b $I = 2 \left(1 - e^{-\frac{100}{3}t} \right)$

page 374 Exercise 8F

1 d i 41 years

3 c $t \doteq 6.089 \times 10^{-5}$

page 375 Review Set 8A

5 $y^2 = 20 - 4e^x$

7 c $t \doteq 2.057$ years

page 375 Review Set 8B

3 b 0.02479 m

4 a $\frac{dN}{dt} = kN$

6 a $y = 1 - \frac{2}{x^2 + 4x + 1}$

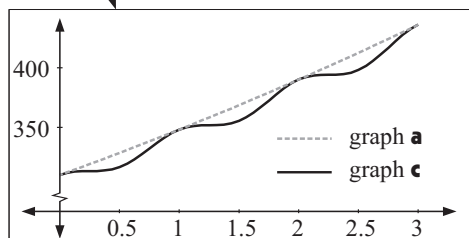
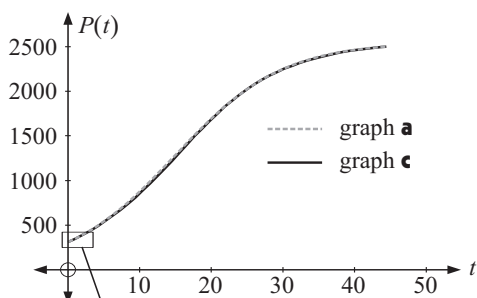
b vertical asymptotes $x = -2 \pm \sqrt{3}$

page 375 Review Set 8D

5 a $P(t) = \frac{2550}{1 + 7.226e^{-0.1330t}}$

b $t = 14.87$ years

c $P = \frac{2550}{1 + 7.380e^{-0.1330t - 0.02116 \cos 2\pi t}}$



d The student's initial model predicts the long-term population behaviour just as well as the modified model (seen from the graph with $0 \leq t \leq 50$). However, (as seen from the graph with $0 \leq t \leq 3$) the modified model accounts for the small-scale detail of seasonal fluctuations that the initial model lacks.

page 375 Exercise 9A.3

5 $I(t) = I_p \cos(t + \frac{3\pi}{2})$

$V(t) = 2I_p \sin(t + \frac{3\pi}{2})$

page 375 Exercise 9B.1

2 a line 2 should be "if $w \neq 0, y = Ae^{wt} + Be^{-wt}$ "

page 375 Exercise 9B.2

1 a $y(t) = 3e^{2t} + 4e^{-t}$

2 b $y(t) = 4 - 3e^{3t}$

page 376 Exercise 9C.2

4 b i $\alpha = \beta = 0 : x(t) = A + Bt$

$\alpha = \beta \neq 0 : x(t) = A \cos \alpha t + B \sin \alpha t$

4 b ii $\alpha = 0$ or $\beta = 0 : x(t) = A + Bt$

$\alpha \neq 0$ and $\beta \neq 0 : x(t) = A \cos t\sqrt{\alpha\beta} + B \sin t\sqrt{\alpha\beta}$

page 376 Exercise 9C.3

6 second line should be:

$y(t) = e^{-t}(2 \cos 3t - 2 \sin 3t)$

page 376 Review Set 9B

4 b i when $\alpha\delta - \gamma\beta < 0$

ii when $\alpha\delta - \gamma\beta > 0$

7 second line of solution should be:

$v(t) = 4 \cos 0.9t - 2.7 \sin 0.9t$

8 a $A(t) = \frac{720}{17} - \frac{380}{17}e^{-1.7t}$

$B(t) = \frac{380}{17}e^{-1.7t} + \frac{640}{17}$