

3. (a) (i) 14 (ii) 27
(b) (i) 21 (ii) 17
4. 5005
5. (a) 35 (b) 15
6. 15 380 937
7. 36960
8. 31 500
9. $\binom{140}{12} \binom{128}{10} \binom{118}{10} = 1.62 \times 10^{45}$ (3SF)
10. (a) 43 680
(b) 65 520
11. (a) 35 (b) 35
(c) 31 (d) 33
12. (a) 126
(b) 120
13. 105
14. (a) 120
(b) 210
15. 24
16. $\binom{45}{15} \binom{30}{15} = 5.35 \times 10^{19}$ (3SF)

Exercise 1E

1. 560
2. 600
3. (a) 120
(b) 1320
4. (a) 4920
(b) 4800
5. 19557
6. 270200
7. 65 559
8. (a) 11082
(b) 48387
9. 696

Exercise 1F

1. (a) (i) 6 (ii) 5
(b) (i) 56 (ii) 110
(c) (i) 720 (ii) 1320

2. (i) 5040 (ii) 5040
3. (i) 60 (ii) 210
4. (a) (i) $n=7$ (ii) $n=10$
(b) (i) $n=11$ (ii) $n=14$
5. 7.75×10^{10} (3SF)
6. 255 024
7. 504
8. 336
9. 3 276 000
11. 186
12. 84
13. 4624
14. $n=3$

Exercise 1G

1. $13! \times 2 = 1.25 \times 10^{10}$
2. 2 488 320
3. 30 240
4. 150×10^{14}
5. (a) 32 432 400
(b) 45 360
6. (a) 17280
(b) 5760
(c) 43200
(d) 2880

Mixed examination practice 1

Short questions

1. 210
2. 120
3. 30 240
4. 729
5. 55
6. $n=5$
7. 8640
8. $n=15$
9. 2947
10. 480

11. 672
 12. 921 164 400
 13. 25 200
 14. 112

Long questions

1. (a) 48
 (b) 72
 (c) 42
2. (a) 20
 (b) 22
 (c) 30
3. (a) 121 080 960
 (b) 3 991 680
 (c) 27 941 760
4. (a) We select 2 out of 4 places to put R's in.
 (b) $\binom{2n}{n}$
 (c) 20
 (d) $\binom{n+m-2}{n-1}$
5. (b) 2047
 (c) 5775
6. (a) 4495
 (b) 22
 (c) 26

Chapter 2

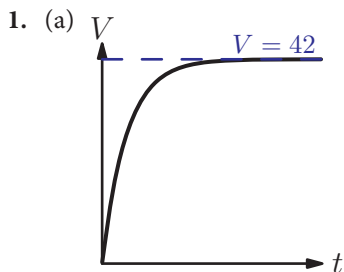
Exercise 2A

1. (a) (i) 6^7 (ii) 5^8
 (b) (i) a^8 (ii) x^9
 (c) (i) 7^{-3} (ii) 5^5
 (d) (i) x^2 (ii) x^5
 (e) (i) g^{-12} (ii) k^{-8}
2. (a) (i) 6^1 (ii) 5^{-2}
 (b) (i) a^{-2} (ii) x^3
 (c) (i) 5^9 (ii) 7^{15}
 (d) (i) x^6 (ii) x^{-11}
- (e) (i) 2^2 (ii) 3^{-14}
 (f) (i) g^6 (ii) k^{-8}
3. (a) (i) 2^{12} (ii) 3^{14}
 (b) (i) 5^{-4} (ii) 7^{-6}
 (c) (i) 11^2 (ii) 13^{15}
 (d) (i) 2^{17} (ii) 3^3
 (e) (i) 6^{12} (ii) 3^6
4. (a) (i) 2^{10} (ii) 3^{14}
 (b) (i) 2^9 (ii) 2^{20}
 (c) (i) 2^{13} (ii) 3^4
 (d) (i) 2^9 (ii) 3^{11}
 (e) (i) 2^{-6} (ii) 3^{-6}
 (f) (i) 2^2 (ii) 3^{10}
5. (a) (i) $8x^6$ (ii) $9x^8$
 (b) (i) $2x^6$ (ii) $3x^8$
 (c) (i) $9a^{10}$ (ii) 16
 (d) (i) $\frac{1}{2x}$ (ii) $\frac{y^2}{9}$
 (e) (i) $\frac{2}{x}$ (ii) $3y^2$
 (f) (i) $\frac{5x^2y^4}{9}$ (ii) $\frac{ab^5}{8}$
 (g) (i) $\frac{p^3}{2q^2}$ (ii) $\frac{2^73^{10}}{x^7}$
6. (a) (i) x^3 (ii) x^{12}
 (b) (i) $2x^5$ (ii) $\frac{1}{2x^4}$
 (c) (i) $\frac{4}{3x^3}$ (ii) $\frac{y^{12}}{x^6}$
7. (a) (i) $\frac{5}{3}$ (ii) $-\frac{3}{2}$
 (b) (i) $-\frac{1}{2}$ (ii) $-\frac{3}{4}$
 (c) (i) 4 (ii) 2
 (d) (i) 4 (ii) 0
 (e) (i) 4 (ii) 11
 (f) (i) 3 (ii) 3
8. 5×10^{-4}
9. 8cm
10. (a) $k = \frac{1}{3}$
 (b) $A = 16 \text{ cm}^2$
11. $2^{350} = (2^7)^{50} = (128)^{50}$
 $5^{150} = (5^3)^{50} = (125)^{50}$
12. $b = 1, a = \frac{3}{2}$

Short questions

- $x = \pm 24$
- (a) $2a + \frac{b}{2} - c$
(b) $\frac{a-1}{2}$
(c) $\frac{b-c}{2}$
- $x = e^{\frac{4}{3}} = 3.79, y = e^{\frac{10}{3}} = 28.0$
- $x = 1 \pm \sqrt{1 - e^y}$
- $x = \frac{\ln 3}{\ln 2}$
- $a = b^{-2}$
- $x = 5^{\frac{5}{3}}$ or $5^{-\frac{5}{3}}$
- $x = e^2$ or e^{-2}

Long questions



- (b) 0 ms^{-1}
(c) 42 ms^{-1}
(d) 3.71 s
- (a) $k = 37000, a = \left(\frac{22}{37}\right)^{0.1} = 0.949$
(b) 2750
(c) 2039
(d) $k = 7778, a = \left(\frac{10000}{7778}\right)^{0.1} = 1.025$
(e) 2.5%
 - (a) $y = 3x^2$
(b) $y = e^6 x^4$
(c) $y = 2e^{3x-3}$
(d) 2

Exercise 3A

- (a) (i) Order 3, lead coefficient 3
(ii) Order 5, lead coefficient -1
(c) No
(d) No
(e) No
(f) No
(g) Order 7, lead coefficient 2
(h) Order 0, lead coefficient 1
- (a) (i) $6x^3 + 8x^2 - 29x + 14$
(ii) $3x^3 + 16x^2 + 23x + 6$
(b) (i) $2x^4 - 15x^3 + 4x^2 + 4x - 1$
(ii) $2x^4 - 7x^3 - 30x^2 + 6x + 15$
(c) (i) $b^4 + b^3 - 3b^2 + 14b - 4$
(ii) $r^4 - 11r^3 + 33r^2 - 62r + 14$
(d) (i) $-x^6 + 2x^5 + 5x^4 - 10x^3 - x^2 + 5$
(ii) $-x^6 + 2x^4 + x^3 - x^2 - x$
- (a) (i) $x^2 + 5x - 1$
(ii) $x^2 + x - 6$
(b) (i) $3x^2 + 2x - 2$
(ii) $5x^2 - 2$
(c) (i) $x^3 - 2x^2 + 3x + 7$
(ii) $x^3 - x^2 + x + 7$
(d) (i) $x^2 + 5$
(ii) $x - 2$
- (a) (i) $x^3 + x^2 + 3$
(ii) $x^3 + x^2 + 2$
(b) (i) $2x^2 + 3$
(ii) $x - 3$
- (a) (i) $a = 4, b = -6$
(ii) $a = 3, b = 1$
(b) (i) $a = b = 2$
(ii) $a = 0, b = -3$
(c) (i) $a = 2, b = -2$
(ii) $a = 2, b = 5$
(d) (i) $a = -4, b = -6$
(ii) $a = 10, b = 3$
(e) (i) $a = \pm 2, b = 2$
(ii) $a = \pm 2, b = \mp 5$
- (a) Yes (b) No

10. $m \leq -8$ or $m \geq 0$

11. $m < -\frac{9}{16}$

12. $k = \pm 9$

Mixed examination practice 3

Short questions

1. $k+2$

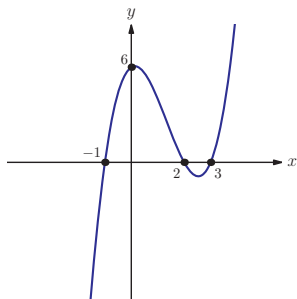
2. a, c negative, b positive, $b^2 - 4ac = 0$

3. $a = 1, b = 2, c = -12, d = -18, e = 27$

4. $a = 1, b = 0$

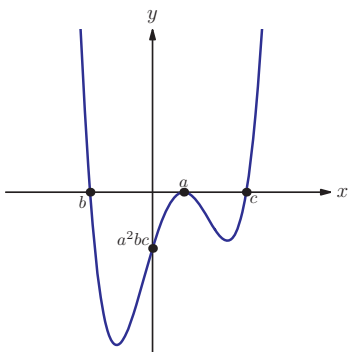
5. (b) $f(x) = (x-2)(x+1)(x-3)$

(c)



6. $(a, b) = \pm\left(\frac{5}{3}, -\frac{4}{3}\right), \pm\left(-\frac{1}{3}, \frac{8}{3}\right)$

7.



8. $3 \pm 2\sqrt{2}$

9. $-4\sqrt{3} < k < 4\sqrt{3}$

10. $k \leq -\sqrt{5} - \frac{1}{2}$ or $k \geq \sqrt{5} - \frac{1}{2}$

11. $a = -10, b = -18$

12. (a) $k-1, 1$

(b) $-3, 5$

14. $-2\sqrt{2} \leq k \leq 2\sqrt{2}$

Long questions

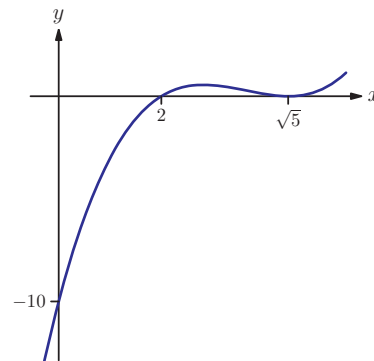
1. (a) $(0, -a)$

(b) $x = -\frac{b}{2}$

(d) $b > 7$ or $b < -5$

2. (b) $p = \pm 2\sqrt{5}$

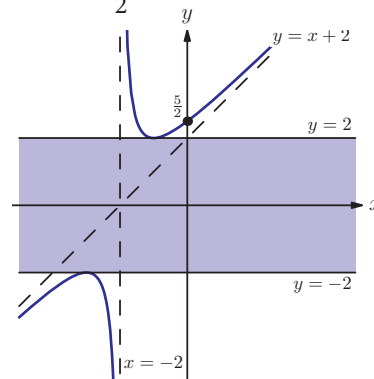
(c)



3. (b) $x = -2, y = x + 2$

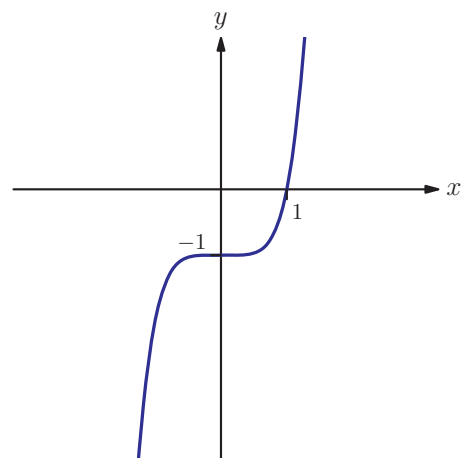
(c) $x = \frac{y \pm \sqrt{y^2 - 4}}{2} - 2$

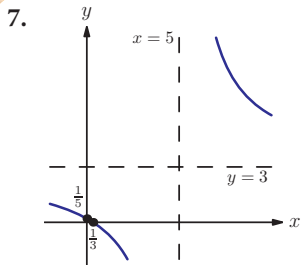
(e)



4. (a) 5

(c)



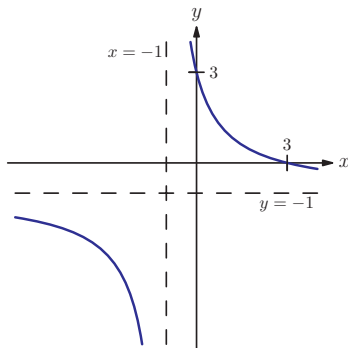


8. (a) $y \neq \frac{a}{2}$
 (b) $f^{-1}(x) = \frac{8x+3}{2x-a}, x \neq \frac{a}{2}$
 (c) 8

Mixed examination practice 5

Short questions

1. (a) $3^x - 3$
 (b) $\sqrt[3]{\ln\left(\frac{x}{3}\right)} + 1$
2. (a) $y = \log_2 x$ (b) (1, 0)
3. (a) $x = 5, y = -4$
 (b) $f^{-1}(x) = \frac{5x+3}{x+4}$
4. (a) $(x-3)^2 + 1$ (b) $\sqrt{x-1} + 3$
 (c) $x \geq 1$
5. (a) $(x-3)^2 - 7$ (b) $y \geq -7$ (c) $\sqrt{x+7} + 3$
6. (a) $y \in \mathbb{R}, y \neq -1$
 (b)



- (c) $f^{-1}(x) = \frac{3-x}{x+1}, x \neq -1, y \neq -1$
7. (a) (i) $]0, 3] \cup]5, \infty[$
 (ii) $f^{-1}(x) = \begin{cases} \ln\left(\frac{3}{x}\right), & 0 < x \leq 3 \\ 5-x, & x > 5 \end{cases}$

Domain: $]0, 3] \cup]5, \infty[$

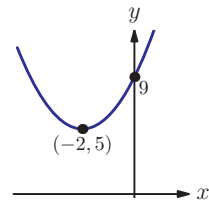
(b) $p = 5$

8. (a) $a = -2, b = 1$ (b) $y \geq 0$

Long questions

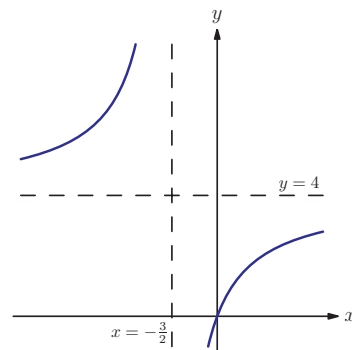
1. (a) 10
 (b) $4 - x^2$
 (c) Reflection in the line $y = x$
 (d) (i) $\sqrt{x-1}$ (ii) $y > 3$
 (iii) $x > 10$
 (e) $x = -4, 1$
2. (a) (i) 15 (ii) $y \in \mathbb{R}$
 (iii) $\frac{3x+5}{x-1}$ (iv) $4x+3$
 (b) $f(x)$ can be 1, which is not in the domain of g .
 (c) (i) $\frac{x+3}{x-1}$ (ii) $x \neq 1$ (iii) $y \neq 1$

3. (a) $(x+2)^2 + 5$ (b)



- (c) Range of $f(x)$ is $y \geq 5$, Range of $g(x)$ is $y > 0$
 (d) $y > 9$

4. (a) $y = \frac{8x}{2x+3}$
 (b)



- (c) (i) $\frac{16x+8k}{4x+2k+3}$ (ii) $x = -\frac{2k+3}{4}, y = 4$

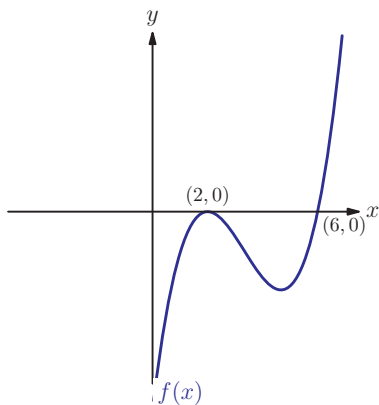
(iii) $f(x) = f^{-1}(x) = \frac{16x-76}{4x-16}$

5. (b) $f\left(\frac{1}{x}\right) + 2f(x) = \frac{2}{x} + 1$ (c) $\frac{1}{3}\left(\frac{4}{x} - 2x + 1\right)$

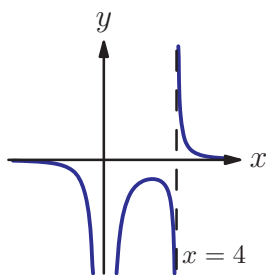
Mixed examination practice 6

Short questions

1. (a)



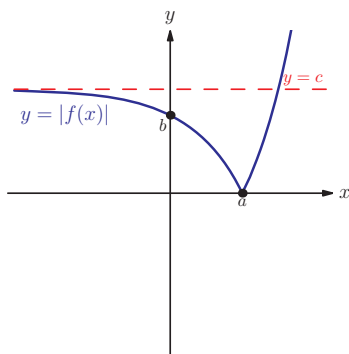
(b)



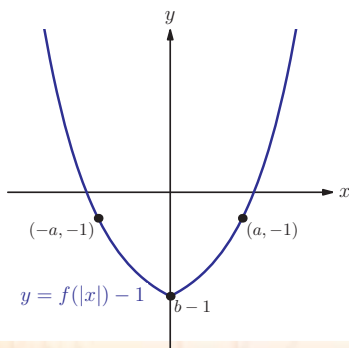
2. $y = 2x^2 - 12x^2 + 24x - 18$

3. $\frac{1}{3} < x < 1$

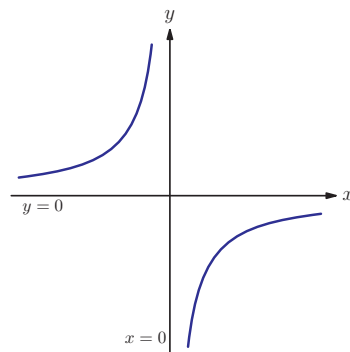
4. (a)



(b)



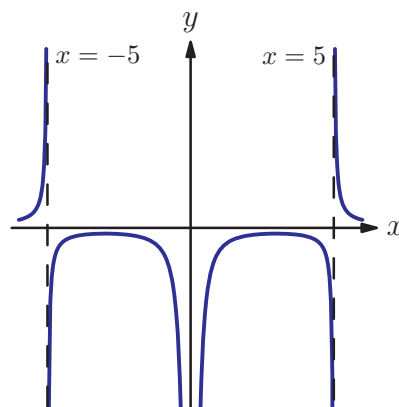
5. (a)



(b) Vertical stretch with scale factor 3 and reflection in the x -axis (or y -axis)

(c) $f^{-1}(x) = -\frac{3}{x}$

6. (a)

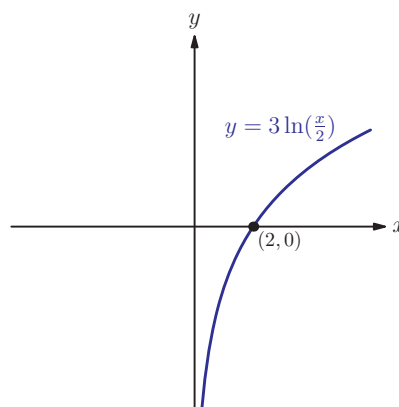


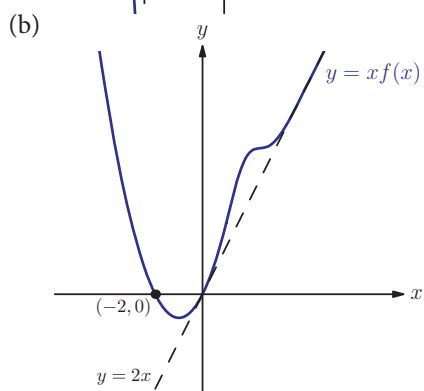
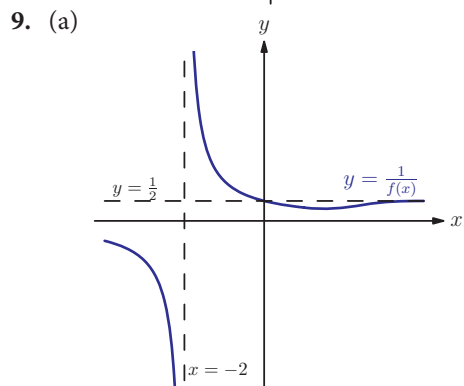
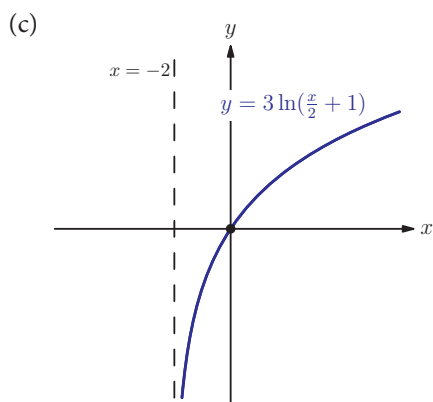
(b) $\left(-3, -\frac{1}{5}\right), \left(3, -\frac{1}{5}\right)$

7. Translation by $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ and vertical stretch with scale factor (sf)3.

8. (a) Horizontal stretch with sf 2; vertical stretch with sf 3

(b)

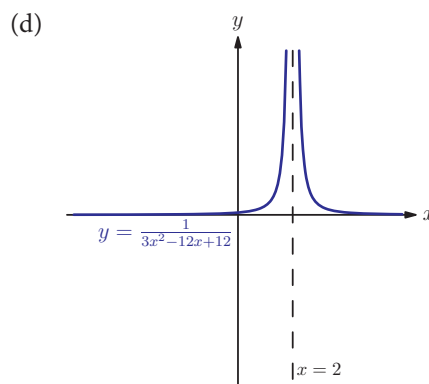




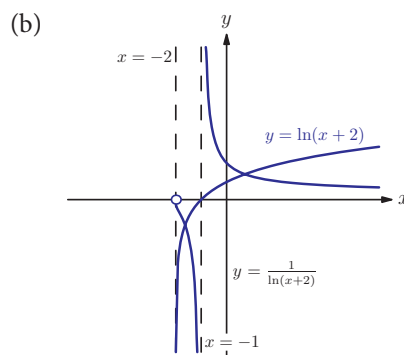
10. $x \geq 0$

Long questions

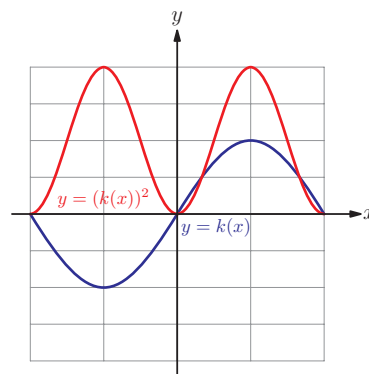
1. (a) Translation by $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$ and vertical stretch with sf 3.
- (b) Translation by $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$ and translation by $\begin{pmatrix} 0 \\ 10 \end{pmatrix}$
- (c) Translation by $\begin{pmatrix} 5 \\ 10 \end{pmatrix}$ and vertical stretch with scale factor 3.



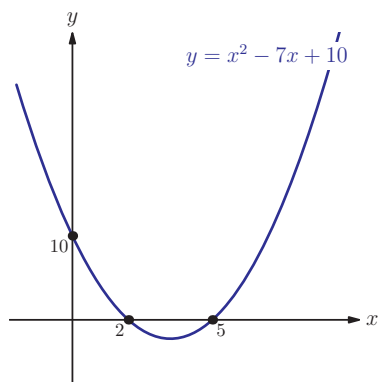
2. (a) $y = 3$
 - (b) $p = 3, q = 1$
 - (c) Translation with vector $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$
 - (d) $f^{-1}(x) = \frac{2x-5}{x-3}, x \neq 3$
 - (e) Reflection in the line $y = x$
3. (a) Translation by $\begin{pmatrix} -2 \\ 0 \end{pmatrix}$



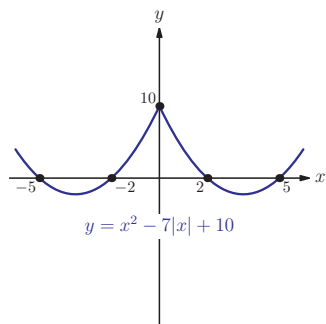
- (c) (i) $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$
 - (ii) $a = -1, b = 6, c = -10,$
 $d = -1$
- (d)



4. (a)



(c)

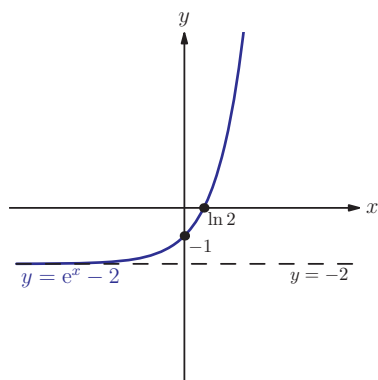


(d) $x = \pm \frac{10}{7}$ (e) $x = \pm 3, \pm 4$

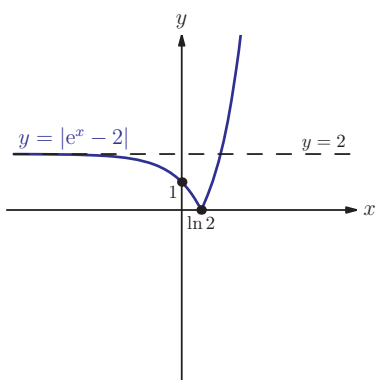
5. (a) -18 (b) 6

(c) $p = 3, q = 17$ (d) $x \in \mathbb{R}$

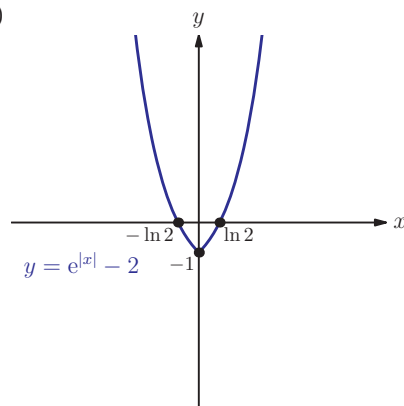
6. (a)



(b) (i)



(ii)



(c) $x = \ln(2 - \sqrt{3}), x \geq \ln 2$

Chapter 7

Exercise 7A

- (a) (i) 3.1, 8.1, 13.1, 18.1, 23.1
 (ii) 10, 6, 2, 2.4, -1.4, -5.2

(b) (i) 0, 1, 4, 13, 40
 (ii) 1, -1, -19, -181, -1639

(c) (i) 2, 3, 6, 18, 108
 (ii) $2, 1, \frac{1}{2}, \frac{1}{2}, 1$

(d) (i) 3, 4, 8, 9, 13
 (ii) -3, 3, -5, 7, -9

(e) (i) 0, 4, 8, 12, 16
 (ii) 13, 11, 9, 7, 5
- (a) (i) 5, 8, 11, 14, 17
 (ii) -4.5, -3, -1.5, 0, 1.5

(b) (i) 0, 7, 26, 63, 124
 (ii) 5, 20, 45, 80, 125

(c) (i) 3, 9, 27, 81, 243
 (ii) $4, 2, 1, \frac{1}{2}, \frac{1}{4}$

(d) (i) 1, 4, 27, 256, 3125
 (ii) 1, 0, -1, 0, 1
- (a) (i) $u_{n+1} = u_n + 3, u_1 = 7$
 (ii) $u_{n+1} = u_n - 0.8, u_1 = 7$

(b) (i) $u_{n+1} = 2u_n, u_1 = 3$
 (ii) $u_{n+1} = 1.5u_n, u_1 = 12$

- (b) 235 months
6. (a) 12 days
(b) Day 102
7. (a) 0.8192 m
(b) 15.85 m
8. (b) $25000(1.04^n - 1)$
(c) Year 29

Mixed examination practice 7

Short questions

1. 97.2
2. (a) 1, 5, 9
(b) $4n - 3$
3. 13th
4. 2
5. $d = 0, -\frac{1}{4}$
6. 4.5
7. 19 264
8. $\ln\left(\frac{a^{69}}{b^{138}}\right)$

Long questions

1. (a) $10000 + 800n$
(b) 10000×1.05^n
(c) $n < 19$ years
2. (a) $2n - 1$ (b) 6
(c) 64
3. (a) n (b) $\frac{n(n+1)}{2}$
(c) $\frac{n(n-1)}{2} + 1$
(e) 32
4. (b) $150000 \times 1.06^n - \frac{500000(1.06^n - 1)}{3}$
(c) 40 years

Chapter 8

Exercise 8A

1. (a) 4
(b) 35
(c) 7
(d) 56
2. (a) $792x^5y^7$ (b) $11440a^7b^9$
(c) $10c^3d^2$ (d) $36a^2b^7$
(e) $15x^2y^4$

Exercise 8B

1. (a) (i) 216 (ii) 20
(b) (i) $560x^3y^4$ (ii) $-280x^3y^4$
(c) (i) -5 (ii) 78 030
2. (a) (i) 56 (ii) 80
(b) (i) -672 (ii) -32
3. (a) (i) $32 - 80x + 80x^2 - 40x^3 + 10x^4 - x^5$
(ii) $729 + 1458x + 1215x^2 + 540x^3 + 135x^4 + 18x^5 + x^6$
(b) (i) $243x^5 + 405x^4y + 270x^3y^2$
(ii) $16c^4 - 32c^3d + 24c^2d^2$
(c) (i) $8x^6 - 36x^5 + 54x^4 - 27x^3$
(ii) $8x^{-3} + 60x^{-2}y + 150x^{-1}y^2 + 125y^3$
(d) (i) $16z^8 + 96z^5 + 216z^2 + 216z^{-1} + 81z^{-4}$
(ii) $27x^3y^3 + 135x^3y + 225x^3y^{-1} + 125x^3y^{-3}$
4. (a) n (b) $\frac{1}{2}n^2 - \frac{1}{2}n$
(c) $\frac{1}{6}n^3 - 6n^2 + \frac{1}{3}n$
5. (a) $80x y^4$ (b) $-80x^2y^3$
6. 720
7. $-945x^5$
8. 79 200 000
9. 14
10. 12
11. 9
12. 7

Exercise 8C

- (a) (i) -4 (ii) 126
(b) (i) -5 (ii) -28
- (i) 15 (ii) 40
- (i) 5733 (ii) -272
- (a) (i) $3x^7 - 17x^8 + 16x^7$
(ii) $-x^7 + 16x^6 - 105x^5$
(b) (i) $1 + x - 4x^2$
(ii) $128 + 64x - 96x^2$

ANSWER HINT (5,6,7)

In questions 5, 6 and 7 there are algebraic tricks that make the expansions much easier.

- $y^6 + 18y^7 + 135y^8 + 540y^9$
- $1 - 10x^2 + 45x^4$
- $1 - 20x + 190x^2 - 1140x^3$
- $m = 3, n = 15$ and $m = -5, n = -17$
- $n = 5, k = 2$ and $n = 17, k = -1$

Exercise 8D

- (a) $1 + 35x + 525x^2 + 4375x^3$; 1.407
(b) $64 + 576x + 2160x^2$; 64.5782
- (a) $81 - 540x + 1350x^2$
(b) 80.4614
- (a) $128 + 2240x + 16800x^2$
(b) 130.257
- (a) $128 + 1344x + 6048x^2$
(b) (i) 322.28 (ii) 142.0448
(c) part (ii) Smaller value of x means higher order terms much smaller and therefore less important.

Mixed examination practice 8

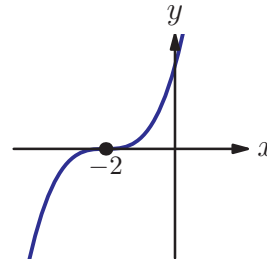
Short questions

- 101376
- $232 - 164\sqrt{2}$

- (a) $32 + 80x + 80x^2 + 40x^3 + 10x^4 + x^5$
(b) 32.808 040 1001
- $243 + 162x - 2484x^2$
- $x^8 - 8x^5 + 24x^2 - 32x^{-1} + 16x^{-4}$
- 3 or -3
- $m = -8, n = -34$ or $m = 5, n = 31$

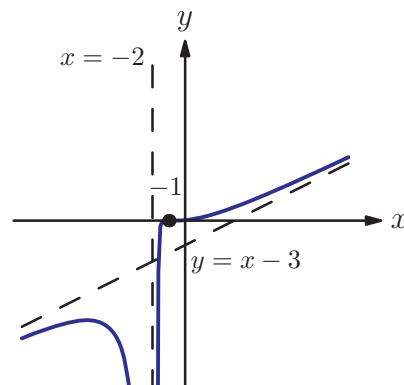
Long questions

- (a)



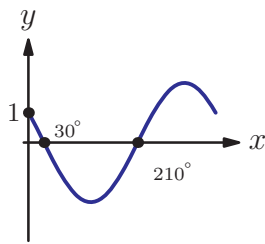
- (b) $x^3 + 6x^2 + 12x + 8$
(c) 8.012 006 001
(d) $x = -4$
- (a) $x = -2, \left(0, \frac{1}{16}\right), (-1, 0)$
(b) $f(x) = x^5 + 5x^4 + 10x^3 + 10x^2 + 5x + 1,$
 $g(x) = x^4 + 8x^3 + 24x^2 + 32x + 16$
(c) (i) $k = 3, a = 10$ (ii) $y = x - 3$

- (d)



- (a) $7 + 5\sqrt{2}$
(b) $\binom{n}{k} (\sqrt{2})^k$ (d) 24
- (c) $\frac{r+2}{n-r-1}$

7. (a)



- (b) $(120^\circ, -2), (300^\circ, 2)$
 (c) $(120^\circ, -3), (300^\circ, 1)$

Exercise 9F

1. $a = 1.5$ $b = \frac{\pi}{6}$ $m = 4.5$
 2. (a) 9 m, 23 m (b) 1:42 am to 10:18 am
 3. (a) $a = 5, k = \frac{\pi}{5}$ (b) 6.02s, 8.98s
 4. (a) 110, 130 cm (b) $\frac{\pi}{200}$ s (c) $\frac{\pi}{400}$ s

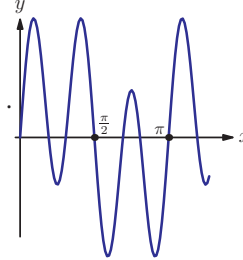
Exercise 9G

1. (a) (i) 0.927 (ii) 0.201
 (b) (i) -1.25 (ii) -0.927
 2. (a) (i) $\frac{\pi}{6}$ (ii) $\frac{\pi}{6}$
 (b) (i) $-\frac{\pi}{3}$ (ii) $\frac{3\pi}{4}$
 (c) (i) $-\frac{\pi}{2}$ (ii) $\frac{\pi}{4}$
 3. (a) (i) 44.4° (ii) 17.5°
 (b) (i) 128.3° (ii) 138.6°
 (c) (i) 81.1° (ii) -82.0°
 4. (a) (i) 0.6 (ii) -0.3
 (b) (i) -2 (ii) -1
 5. (a) (i) $\frac{\sqrt{3}}{2}$ (ii) $\frac{\sqrt{2}}{2}$
 (b) (i) $\frac{1}{2}$ (ii) $\sqrt{3}$
 6. (a) (i) $\frac{\pi}{3}$ (ii) $\frac{5\pi}{6}$
 (b) (i) $\frac{\pi}{3}$ (ii) π
 7. (a) 0.866 (b) -0.433
 (c) 0.141
 8. (b) $\arcsin x = \frac{\pi}{2} - \arccos x$ (c) $x = 1$
 9. (a) $y = \arccos(0.6 - \sin x)$
 $y = \arcsin(\cos x - 0.2)$
 (b) $x = 0, y = 0.927$

Mixed examination practice 9

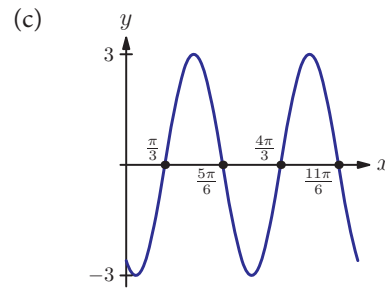
Short questions

1. (a) 1.4 m (b) 2.09 m
 2. period = π



3. (a) 78.5 s (b) 377 m (c) 4.8 ms^{-1}
 4. (a) π

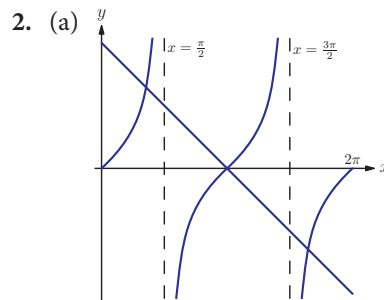
- (b) $\left(\frac{\pi}{3}, 0\right), \left(\frac{5\pi}{6}, 0\right), \left(\frac{4\pi}{3}, 0\right), \left(\frac{11\pi}{6}, 0\right)$



5. $a = 5, b = \frac{\pi}{4}$

Long questions

1. (a) (i) $\frac{2\pi}{3}, \frac{3}{2}$ (ii) $k = \frac{\pi}{6}, c = \frac{1}{2}$
 (b) $0, -\frac{2\pi}{3}, -2\pi, -\frac{8\pi}{3}, -4\pi$
 (c) (i) 8 (ii) $\frac{10\pi}{3} - \alpha, \alpha + 2\pi$



- (b) (i) $\pi, 2\pi - x_0$ (ii) Infinitely many
 (c) (i) s, c (iii) $\sqrt{3}, \frac{1}{\sqrt{3}}$ (iv) $\frac{\pi}{6}, \frac{\pi}{3}$
 (d) 1.2 (e) (ii) $x_1 = 2\pi - x_0$
 3. (a) -1; π
 (b) (i) Translation $\begin{pmatrix} -\pi/6 \\ 0 \end{pmatrix}$ and verticle stretch with scale factor 2

(ii) $-2; \frac{5\pi}{6}$

- (c) (i) No; $\cos(A) \geq -1$ so $2 \cos(A) + 3 \geq 1$, never 0
(ii) $[1, 5]$

Chapter 10

Exercise 10A

1. (a) (i) $30^\circ, 150^\circ$ (ii) $45^\circ, 135^\circ$
(b) (i) $60^\circ, 300^\circ$ (ii) $30^\circ, 330^\circ$
(c) (i) $240^\circ, 300^\circ$ (ii) $210^\circ, 330^\circ$
(d) (i) $45^\circ, 225^\circ$ (ii) $60^\circ, 240^\circ$
2. (a) (i) $\frac{\pi}{6}, \frac{11\pi}{6}$ (ii) $\frac{\pi}{4}, \frac{7\pi}{4}$
(b) (i) $\frac{2\pi}{3}, \frac{4\pi}{3}$ (ii) $\frac{5\pi}{6}, \frac{7\pi}{6}$
(c) (i) $\frac{\pi}{4}, \frac{3\pi}{4}$ (ii) $\frac{\pi}{3}, \frac{2\pi}{3}$
(d) (i) $\frac{\pi}{6}, \frac{7\pi}{6}$ (ii) $\frac{3\pi}{4}, \frac{7\pi}{4}$
3. (a) (i) $26.7^\circ, 153.3^\circ$ (ii) $44.4^\circ, 135.6^\circ$
(b) (i) $138.6^\circ, -138.6^\circ$ (ii) $101.5^\circ, -101.5^\circ$
(c) (i) $18.4^\circ, 198.4^\circ, 378.4^\circ, 558.4^\circ$
(ii) $53.1^\circ, 233.1^\circ, 413.1^\circ, 593.1^\circ$
(d) (i) $-138.2^\circ, -41.8^\circ, 221.8^\circ, 318.2^\circ$
(ii) $-165.5^\circ, -14.5^\circ, 194.5^\circ, 345.5^\circ$
4. (a) (i) $0.644, 5.64, 6.93, 11.9$
(ii) $0.841, 5.44, 7.12, 11.7$
(b) (i) $-2.21, -0.927, 4.07, 5.36$
(ii) $-2.78, -0.36, 3.50, 5.93$
(c) (i) $-0.588, 2.55$ (ii) $-1.25, 1.89$
(d) (i) $0, 6.28, 12.6$
(ii) $1.57, 4.71, 7.85, 11.0$
5. (a) (i) $30^\circ, 150^\circ$ (ii) $45^\circ, 135^\circ$
(b) (i) $\pm 180^\circ$ (ii) -90°
(c) (i) $60^\circ, 240^\circ$ (ii) $45^\circ, 225^\circ$
(d) (i) $\pm 225^\circ, \pm 135^\circ$ (ii) $\pm 210^\circ, \pm 150^\circ$
6. (a) (i) $\pm \frac{5\pi}{3}, \pm \frac{\pi}{3}$ (ii) $\pm \frac{11\pi}{6}, \pm \frac{\pi}{6}$
(b) (i) $-\frac{2\pi}{3}, -\frac{\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$ (ii) $-\frac{3\pi}{4}, -\frac{\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$
(c) (i) $-\frac{\pi}{6}, \frac{5\pi}{6}$ (ii) $-\frac{\pi}{4}, \frac{3\pi}{4}$

(d) (i) $\frac{\pi}{2}, \frac{3\pi}{2}, \frac{5\pi}{2}$

(ii) $\pi, 2\pi$

(e) $-\frac{5\pi}{4}, -\frac{7\pi}{4}$

7. (a) (i) $5.74^\circ, 174^\circ$ (ii) $-14.5^\circ, 195^\circ$
(b) (i) $1.11, 5.17$ (ii) $1.00, 5.28$
(c) (i) $1.03, -2.11$ (ii) $1.14, 4.29$
8. $-\frac{\pi}{6}, -\frac{5\pi}{6}$

Exercise 10B

1. (a) (i) $\pm 2.19, \pm 0.955$ (ii) $\pm 2.26, \pm 0.886$
(b) (i) $48.2^\circ, 132^\circ, 228^\circ, 312^\circ$
(ii) $52.2^\circ, 128^\circ, 232^\circ, 308^\circ$
2. (a) (i) $0^\circ, 180^\circ, 360^\circ$ (ii) $\frac{\pi}{2}, \frac{3\pi}{2}$
(b) (i) $0, \pm\pi, 0.848, 2.29$ (ii) $\pm \frac{\pi}{2}, \pm 1.91$
(c) (i) $0.944, 1.30, 4.09, 4.44$
(ii) $\frac{3\pi}{4}, \frac{7\pi}{4}, 0.464, 3.61$
(d) (i) $0, \pi, \frac{7\pi}{6}, \frac{11\pi}{6}$ (ii) $\frac{\pi}{2}, \frac{3\pi}{2}, 0.983, 4.12$
(e) (i) 60° (ii) No solutions
3. (a) (i) $35.3^\circ, 145^\circ, 215^\circ, 325^\circ$
(ii) $22.1^\circ, 97.9^\circ, 142^\circ, 218^\circ, 262^\circ, 338^\circ$
(b) (i) $0.266, 1.45, 2.36$
(ii) $0.706, 3.01, 3.85, 6.15$
(c) (i) $-71.6^\circ, 108^\circ$ (ii) $-132^\circ, 48.4^\circ$
4. (a) (i) $\frac{\pi}{12}, \frac{5\pi}{12}, \frac{13\pi}{12}, \frac{17\pi}{12}$
(ii) $\frac{7\pi}{18}, \frac{11\pi}{18}, \frac{19\pi}{18}, \frac{23\pi}{18}, \frac{31\pi}{18}, \frac{35\pi}{18}$
(b) (i) $67.5^\circ, 112.5^\circ, 247.5^\circ, 292.5^\circ$
(ii) $\pm 20^\circ, \pm 100^\circ, \pm 140^\circ$
(c) (i) $\frac{\pi}{12}, \frac{\pi}{3}, \frac{7\pi}{12}, \frac{5\pi}{6}$ (ii) $\frac{\pi}{12}, \frac{7\pi}{12}$
5. (a) (i) $270^\circ, 330^\circ$ (ii) $0, \frac{2\pi}{3}$
(b) (i) $\frac{\pi}{6}, -\frac{\pi}{2}$ (ii) $75^\circ, 345^\circ$
(c) (i) $\frac{3\pi}{4}, \frac{7\pi}{4}$ (ii) π
6. $1.01, 2.13$

7. (a) $-\frac{1}{2}$
 (b) $210^\circ, 330^\circ$
8. $0, \pm\pi$
9. $\pm\sqrt{\frac{\pi}{6}}, \pm\sqrt{\frac{5\pi}{6}}$

Exercise 10C

1. (a) $\cos x = \frac{\sqrt{8}}{3}, \tan x = \frac{1}{\sqrt{8}}$
 (b) $\cos x = \frac{3}{5}, \tan x = \frac{4}{3}$
2. (a) $\sin x = -\frac{\sqrt{8}}{3}, \tan x = \sqrt{8}$
 (b) $\cos x = -\frac{\sqrt{7}}{4}, \tan x = \frac{3}{\sqrt{7}}$
3. (a) (i) $-\frac{2\sqrt{6}}{5}$ (ii) $-\frac{\sqrt{3}}{2}$
 (b) (i) $-\frac{4}{3}$ (ii) 0
4. (a) $\pm\frac{3}{\sqrt{13}}$ (b) $\pm\frac{1}{\sqrt{5}}$
5. (a) 3 (b) 1
 (c) -2 (d) -2
 (e) 1 (f) $\frac{3}{2}$
6. (a) (i) $4 - \sin^2 x$ (ii) $2\cos^2 x - 1$
7. (a) $\frac{1}{1+t^2}$ (b) $\frac{t^2}{1+t^2}$
 (c) $\frac{1-t^2}{1+t^2}$ (d) $\frac{2+3t^2}{t^2}$
9. $5 - \frac{2}{\cos^2 x}$
10. $\frac{1}{1-2\sin^2 x + \sin^4 x}$

Exercise 10D

1. (a) (i) 33.7° (ii) 59.0°
 (b) (i) 0.322 (ii) 1.89
 (c) (i) 2.11, 5.25 (ii) 2.21, 5.36
 (d) (i) $-113^\circ, 66.8^\circ$ (ii) $-101^\circ, 78.7^\circ$
2. (a) (i) $\frac{\pi}{12}, \frac{5\pi}{12}$ (ii) $\frac{\pi}{6}, \frac{2\pi}{3}$
 (b) (i) $\frac{\pi}{3}, \frac{5\pi}{6}, \frac{4\pi}{3}, \frac{11\pi}{6}$ (ii) $\frac{\pi}{4}$

3. (a) $0^\circ, 135^\circ, 180^\circ, 315^\circ, 360^\circ$
 (b) $-2.55, 0, 0.588, \pm\pi$
 (c) 26.6° (d) $2.50, 5.64$
4. (a) (i) $45^\circ, 135^\circ, 225^\circ, 315^\circ$
 (ii) $54.7^\circ, 125^\circ, 235^\circ, 305^\circ$
 (b) (i) $45^\circ, 135^\circ, 225^\circ, 315^\circ$
 (ii) $0, 180^\circ, 360^\circ$
5. $-180^\circ, -30^\circ, 0, 30^\circ, 180^\circ$
6. $\pm 41.8^\circ, \pm 138^\circ$
7. $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{3\pi}{6}$
8. $-0.253, -2.89, -\frac{\pi}{2}$
9. $\frac{1}{3}$
10. (a) $\frac{2}{3}, -\frac{1}{2}$
 (b) $48.2^\circ, 120^\circ, 240^\circ, 312^\circ$
11. (b) $0.464, -2.68, \frac{\pi}{4}, -\frac{3\pi}{4}$

Mixed examination practice 10

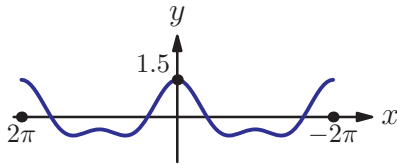
Short questions

1. $-31.8^\circ, 148^\circ$
3. $\pm 2.41, \pm 0.730$
5. $\frac{\pi}{2}, \frac{3\pi}{2}, \frac{2\pi}{3}, \frac{4\pi}{3}$
6. $48.2^\circ, 311.8^\circ, 120^\circ, 240^\circ$
7. $-\frac{7\pi}{24}, -\frac{\pi}{24}, \frac{17\pi}{24}, \frac{23\pi}{24}$
8. (a) $\pm\frac{1}{2}, \pm\frac{\sqrt{3}}{2}$
 (b) $\pm\frac{\pi}{6}, \pm\frac{\pi}{3}$

Long questions

1. (a) 3π m
 (b) 5.05 m
 (c) 1.50 m

2. (a)



- (b) 2π
 (c) $0, \pm\pi, \pm 2\pi$
 (d) 1.2
 (e) (ii) $2\pi - x_0$

3. (a) $k = \pm 4$
 (c) (i) 1
 (ii) $\pm \frac{\pi}{3}, \pm \frac{5\pi}{3}$
 (iii) $k = 5$
 (iv) 7

Chapter 11

Exercise 11B

1. (a) (i) 6.04 (ii) 14.4
 (b) (i) 10.6 cm (ii) 23.3 cm
2. (a) (i) 49.7° (ii) 59.2°
 (b) (i) 74.6° or 105° (ii) 62.0° or 118°
 (c) (i) 50.9° (ii) 54.4°
3. $21.0^\circ, 29.0^\circ, 8.09$ cm
4. 10.4 cm, $49.9^\circ, 95.1^\circ$; 269 cm, $130^\circ, 15^\circ$
5. 9.94 cm

Exercise 11C

1. (a) (i) 5.37 (ii) 3.44
 (b) (i) 8.00 (ii) 20.5
2. (a) (i) 60.6° (ii) 120°
 (b) (i) 81.5° (ii) 100°
3. (i) 106° (ii) 36.2°
4. 6.12 km
5. 7.95
6. 4.4
7. $2\sqrt{2} + \sqrt{41}$

Exercise 11D

1. (a) (i) 10.7 cm^2 (ii) 24.3 cm^2
 (b) (i) 27.6 cm^2 (ii) 26.2 cm^2
2. (a) 81.7 (b) 60.9
3. 17.7 cm, 29.7 cm^2
4. $4\sqrt{3} \text{ cm}^2$

Exercise 11E

1. (a) $\sqrt{134}$ cm (b) $4\sqrt{6}$ cm
2. $A = 59.7^\circ, B = 47.5^\circ, C = 72.3^\circ, \text{Area} = 85.6 \text{ cm}^2$
3. 62.5°
4. $4\sqrt{11} = 13.3$ cm
5. (a) 12.0 cm (b) 17.0 cm
6. (a) 18.8 cm (b) 23.1 m
7. (a) $RA = \frac{h}{\tan \alpha}$ $RB = \frac{h}{\tan \beta}$
 (b) 13 m

Exercise 11F

1. (a) 7.8 cm (b) 1.8 cm
2. (a) 82.2 cm (b) 6.84 cm
3. 25 cm
4. (a) 0.938 (b) 53.7°
5. 2.53
6. 7.5 cm
7. 6.69 cm
8. 15.7 cm
9. 31.6 cm
10. $\left(\frac{25\pi}{6} + 10\right)$ cm
11. 5 cm
12. $\frac{6\pi}{5}$

Exercise 11G

1. (a) 16.25 cm^2 (b) 0.072 cm^2
2. (a) 463 cm^2 (b) 4.79 cm^2
3. 0.8
4. 167°
5. 9.49 cm

6. 11.3 cm
7. 5.14 cm²
8. 48.4 cm²
9. 2 cm or 1.5 cm
10. 2.54

Exercise 11H

1. (a) (i) 0.935 cm (ii) 3.39 cm
(b) (i) 21.7 cm (ii) 15.8 cm
2. (a) (i) 1.89 cm (ii) 6.99 cm
(b) (i) 52.5 cm (ii) 37.1 cm
3. (a) (i) 0.0595 cm² (ii) 1.21 cm²
(b) (i) 149 cm² (ii) 70.1 cm²
4. (a) 12.5(θ - sin θ) (b) 2.08
5. (b) 70.1° 3.67 cm²

Mixed examination practice 11

Short questions

1. (a) $\frac{\pi}{3}$ (b) 28.9 cm²
(c) 23.8 cm
2. 80 cm²
3. 58.7°, 121°
4. (a) 8.09 m (b) 6.58 m
5. (a) 10.2 cm (b) 18.8 cm
6. $2\sqrt{43}$
7. 4 cm or 13 cm
8. 12.3 cm²
9. (a) 1.14 cm² (b) 2.00 cm²
10. (a) $\pi - 2\theta$
(b) $54 - 2\pi$ cm²
11. 7.23 cm²
12. (a) $\cos B = \frac{23}{32}$
(b) $\sin B = \frac{3\sqrt{55}}{32}$
(c) $\frac{15\sqrt{55}}{4}$ cm²
13. (b) 7

Long questions

1. (a) $MB^2 = \left(\frac{x}{2}\right)^2 - 5x \cos \theta + 25$
(c) 41.4°
2. (b) $\sqrt{2}r$
(c) $\frac{\pi r^2}{4}$
(d) $\left(\frac{\pi}{2} - 1\right)r^2$
3. (b) $\frac{1}{2}r^2(2\pi - \theta)$
(d) 2.50
4. (a) $\frac{4.42}{3x^2}$
(b) $\frac{3x^2 - 2x - 3}{2x^2}$
(c) (ii) $x = 1.24, \theta = 1.86$
 $x = 2.94, \theta = 0.171$
5. (b) $-1 \leq \cos \theta < \frac{-\sqrt{3}}{2}$ or $\frac{\sqrt{3}}{2} < \cos \theta \leq 1$
(c) $0 < \theta < \frac{\pi}{6}$ or $\frac{5\pi}{6} < \theta < \pi$
6. (a) (ii) $\sqrt{x^2 + 100}$
(c) 38.7°
(d) 5.63
(e) (ii) $\frac{40}{3}$
7. (a) (i) 5 (ii) 144
(b) (i) $z = 10 - x$
(ii) $z^2 = x^2 + 36 - 12x \cos Z$
(e) (i) 12
(ii) Isosceles
8. (a) $\frac{\pi}{2}$, right angle between a tangent and a radius
(b) ABO₂P is a rectangle, because there are right angles at A and B, and AB is parallel to PO₂.
(c) 24.5 cm
(d) 1.369
(e) 85.6 cm

Chapter 12

Exercise 12A

1. (a) (i) $-\frac{7}{8}$ (ii) $\frac{1}{7}$

- (b) (i) $\frac{2\sqrt{2}}{3}$ (ii) $\frac{4}{5}$
- (c) (i) $\frac{4\sqrt{2}}{9}$ (ii) $\frac{24}{25}$
2. (a) $\frac{2-\sqrt{2}}{4}$ (b) $\frac{2-\sqrt{3}}{4}$ (c) $\frac{\sqrt{3}+2}{4}$
3. $\sqrt{2}-1$
4. (a) $\cos(6A)$
 (b) $2\sin 10x$ (c) $3\cos b$
 (d) $\frac{5}{2}\sin\left(\frac{2x}{3}\right)$
5. (a) $0, \pi, 2\pi$
 (b) 90°
 (c) $-\frac{\pi}{2}, \frac{\pi}{2}, 0.305, 2.84$
 (d) $0^\circ, 180^\circ, 360^\circ$
7. $0.955, -0.955, 2.19, -2.19$
9. (a) $\pm \frac{\sqrt{3}}{2}$
 (b) $-\frac{5\pi}{6}, -\frac{\pi}{6}, \frac{\pi}{6}, \frac{5\pi}{6}$
10. (a) $8\cos^4 \theta - 8\cos^2 \theta + 1$
 (b) $8\sin^4 \theta - 8\sin^2 \theta + 1$
11. (b) $\frac{1-\cos x}{1+\cos x}$
12. $\frac{2a-b}{4a}$

Exercise 12B

1. (a) $\frac{1}{2}\sin x + \frac{\sqrt{3}}{2}\cos x$
 (b) $\frac{\sqrt{2}}{2}\sin x - \frac{\sqrt{2}}{2}\cos x$
 (c) $-\frac{\sqrt{2}}{2}\sin x - \frac{\sqrt{2}}{2}\cos x$
 (d) $-\sin x$
2. (a) $\frac{\sqrt{6}-\sqrt{2}}{4}$
 (b) $\frac{\sqrt{2}+\sqrt{6}}{4}$
 (c) $-2-\sqrt{3}$

3. (a) $\frac{56}{65}$ (b) $\frac{8+3\sqrt{5}}{15}$
4. (b) $\sqrt{2}\cos x$
5. (a) $\frac{\tan \theta - 1}{\tan \theta + 1}$
 (b) $-\frac{1}{2}, -\frac{1}{3}$ (c) $2.68, 2.82$
6. (a) $\sin\left(x + \frac{\pi}{4}\right), 1, x = \frac{\pi}{4}$
 (b) $2\cos(x-25^\circ), 2, x = 25^\circ$
8. (a) $4\cos^3 A - 3\cos A$
 (b) $\frac{3\tan A - \tan^3 A}{1-3\tan^2 A}$
9. (b) $x = \frac{\pi}{3}$
10. (b) $\frac{2}{9}$
11. (b) $\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$
12. (a) $\frac{17}{4}$
 (b) $\frac{3}{4}$

Exercise 12C

1. (a) $2\sqrt{13}\sin(x+0.983)$
 (b) $\sqrt{10}\sin(x+0.322)$
2. (a) $2\sqrt{2}\sin(x-45^\circ)$
 (b) $2\sin(\theta-60^\circ)$
3. (a) $2\sqrt{2}\cos\left(x + \frac{\pi}{6}\right)$
 (b) $5\sqrt{2}\cos\left(x + \frac{\pi}{4}\right)$
4. (a) $\sqrt{85}\cos(x-0.709)$
 (b) $13\cos(x-0.395)$
5. (a) $13\sin(x+1.18)$
 (b) Vertical stretch with scale factor 13;
 Translation 1.18 units to the left
6. (a) $\sqrt{58}\sin(x-1.16)$
 (b) $y \in [-\sqrt{58}, \sqrt{58}]$
7. (a) $\sqrt{41}\cos(x+0.896)$

- (b) 0.675
8. (a) $2\cos\left(x - \frac{\pi}{3}\right)$
- (b) minimum: $\left(\frac{4\pi}{3}, -2\right)$, maximum: $\left(\frac{\pi}{3}, 2\right)$
9. $-\pi, -\frac{3\pi}{4}, 0, \frac{\pi}{4}, \pi$

Exercise 12D

1. (a) (i) 2.760 (ii) 1.480
 (b) (i) -2.670 (ii) 1.212
 (c) (i) 1.051 (ii) 0.5774
2. (a) (i) $\frac{2\sqrt{3}}{3}$ (ii) $\sqrt{2}$
 (b) (i) $-\sqrt{2}$ (ii) $-\frac{2\sqrt{3}}{3}$
- (c) (i) -1 (ii) $\frac{\sqrt{3}}{3}$
 (d) (i) -1 (ii) 0
3. $\csc A = \frac{5}{4}$, $\sec B = \frac{3\sqrt{5}}{5}$
4. (a) (i) 1.05, 5.24
 (ii) 1.23, 5.05
 (b) (i) 0.730, 2.41
 (ii) 0.379, 2.76
 (c) (i) 0.197, 3.34
 (ii) 1.11, 4.25
 (d) (i) 0.615, 2.53, 3.76, 5.67
 (ii) 0.126, 1.44, 3.27, 4.59
5. (a) (i) $-\frac{\pi}{6}, -\frac{5\pi}{6}$ (ii) $-\frac{\pi}{2}$
 (b) (i) $\frac{\pi}{6}, -\frac{5\pi}{6}$
 (ii) $\frac{\pi}{4}, -\frac{3\pi}{4}$
 (c) (i) 0
 (ii) $\frac{5\pi}{6}, -\frac{5\pi}{6}$
 (d) (i) $\frac{\pi}{2}, -\frac{\pi}{2}$ (ii) $-\frac{\pi}{4}, \frac{3\pi}{4}$
6. (a) (i) $\frac{5}{3}$ (ii) $\frac{\sqrt{29}}{5}$
 (b) (i) $2\sqrt{6}$ (ii) $2\sqrt{2}$
 (c) (i) $-\frac{1}{\sqrt{10}}$ (ii) $-\frac{2}{\sqrt{5}}$

(d) (i) $\pm\frac{3}{\sqrt{7}}$ (ii) $\pm\frac{2}{\sqrt{3}}$

8. 1.08
9. (a) $(0.715, 2.39), (-0.715, -2.39)$
 (b) $]-\infty, -2.39] \cup [2.39, \infty[$
12. (b) 1, 2
 (c) $\frac{\pi}{4}, \frac{5\pi}{4}, 1.11, 4.25$
15. $\arccos\left(\frac{1}{x}\right)$

Mixed examination practice 12

Short questions

1. $-\frac{3}{2}$
2. (a) $\frac{1}{2}\cos x - \frac{\sqrt{3}}{2}\sin x$
 (b) $-2\pi, -\pi, 0, \pi, 2\pi$
3. (b) $\frac{2\pi}{3}, \frac{4\pi}{3}$
4. $20.9^\circ, 69.1^\circ$
5. (a) $2\sqrt{5}\sin\left(2x + \frac{\pi}{6}\right)$
 (b) (i) $1 + \frac{2}{5}\sqrt{5}$ (ii) $x = \frac{2\pi}{3}$
6. (a) $\sin(\arcsin x) = x$
 (c) $\frac{1}{\sqrt{2}}$

Long questions

1. (a) $AB = 2r\sin\theta, BC = 2r\cos\theta$
 (b) $2r^2\sin\theta\cos\theta$
 (c) $r^2\sin\theta\cos\theta$
 (d) $\frac{1}{2}$
2. (b) -1
 (c) $1 + \sqrt{2}$
3. (a) $a = 1.2, p = \frac{2\pi}{3}$
 (b) amplitude = 0.9, period = 3
 (c) $1.5\sin\left(\frac{2\pi}{3}x + 0.927\right)$
 (d) amplitude = 1.5, period = 3

- (e) 1.06
 (f) 0.058, 0.557

4. (a) $r = 2, \alpha = \frac{\pi}{6}$
 (b) $[-2, 2]$
 (c) $\frac{\pi}{2}, \frac{7\pi}{6}$
 5. (a) $(t+1)(t^2 - 4t + 1)$
 (c) 1
 (d) $\tan 15^\circ = 2 - \sqrt{3}$,
 $\tan 75^\circ = 2 + \sqrt{3}$

Chapter 13

Exercise 13A

1. (a) (i) \mathbf{b} (ii) $\mathbf{a} + \mathbf{b}$
 (b) (i) $-\mathbf{a}$ (ii) $-\frac{1}{2}\mathbf{a}$
 (c) (i) $\mathbf{a} + \frac{1}{2}\mathbf{b}$
 (ii) $\frac{1}{2}\mathbf{b} - \frac{1}{2}\mathbf{a}$
 2. (a) (i) $\mathbf{a} + \frac{4}{3}\mathbf{b}$ (ii) $\mathbf{a} + \frac{1}{2}\mathbf{b}$
 (b) (i) $-\frac{3}{2}\mathbf{a} + \mathbf{b}$
 (ii) $-\frac{1}{2}\mathbf{b} + \frac{1}{2}\mathbf{a}$
 (c) (i) $\frac{3}{2}\mathbf{a} - \mathbf{b}$
 (ii) $-\frac{4}{3}\mathbf{b} + \frac{1}{2}\mathbf{a}$
 3. (a) (i) $\begin{pmatrix} 4 \\ 0 \\ 0 \end{pmatrix}$ (ii) $\begin{pmatrix} 0 \\ -5 \\ 0 \end{pmatrix}$
 (b) (i) $\begin{pmatrix} 3 \\ 0 \\ 1 \end{pmatrix}$ (ii) $\begin{pmatrix} 0 \\ 2 \\ -1 \end{pmatrix}$
 4. (a) $\mathbf{b} - \mathbf{a}$
 (b) $\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b}$
 (c) $4\mathbf{a} - 3\mathbf{b}$

5. (a) $\overline{AB} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}, \overline{AC} = \begin{pmatrix} 0.5 \\ 1 \end{pmatrix}$

(b) $(10, -2)$

6. (a) $\begin{pmatrix} 1 \\ -3 \\ 7 \end{pmatrix}$ (b) $\begin{pmatrix} 3.5 \\ -0.5 \\ 1.5 \end{pmatrix}$

7. $\begin{pmatrix} 3 \\ -4 \end{pmatrix}$

8. $\begin{pmatrix} 1.6 \\ 0.8 \\ 1.8 \end{pmatrix}$

9. (a) $\frac{3}{2}\mathbf{i} + \frac{3}{2}\mathbf{j} - 2\mathbf{k}$

(b) $\left(\frac{1}{2}, \frac{13}{2}, 0\right)$

10. $\begin{pmatrix} 0 \\ -1 \\ 6 \end{pmatrix}$

Exercise 13B

1. (a) (i) $\begin{pmatrix} 21 \\ 3 \\ 36 \end{pmatrix}$ (ii) $\begin{pmatrix} 20 \\ -8 \\ 12 \end{pmatrix}$

(b) (i) $\begin{pmatrix} 2 \\ 3 \\ 9 \end{pmatrix}$ (ii) $\begin{pmatrix} 6 \\ -1 \\ 5 \end{pmatrix}$

(c) (i) $\begin{pmatrix} 11 \\ -3 \\ 8 \end{pmatrix}$ (ii) $\begin{pmatrix} -3 \\ 5 \\ 6 \end{pmatrix}$

(d) (i) $\begin{pmatrix} 10 \\ -3 \\ 11 \end{pmatrix}$ (ii) $\begin{pmatrix} 17 \\ 6 \\ 35 \end{pmatrix}$

2. (a) (i) $-5\mathbf{i} + 5\mathbf{k}$ (ii) $4\mathbf{i} + 8\mathbf{j}$

(b) (i) $\mathbf{i} - 3\mathbf{j} + 3\mathbf{k}$ (ii) $2\mathbf{j} + \mathbf{k}$

(c) (i) $4\mathbf{i} + 7\mathbf{k}$
 (ii) $5\mathbf{i} - 4\mathbf{j} + 15\mathbf{k}$

3. (a) $-4\mathbf{i} + 2\mathbf{j} - \mathbf{k}$

(b) $-\frac{8}{3}\mathbf{i} + \frac{4}{3}\mathbf{j} - \frac{2}{3}\mathbf{k}$

(c) $4\mathbf{i} - 3\mathbf{j} + \mathbf{k}$

(d) $-\frac{1}{2}\mathbf{i} + \mathbf{j} - \frac{1}{2}\mathbf{k}$