

Answers

For answers that require a proof (normally indicated by: 'prove', 'show', 'verify' or 'explain') no answer has been provided.

Chapter 1

Exercise 1A

1. (i) A1, B3, C2 (ii) A3, B1, C2
2. (a) (i) $2x^2 + 8x - 10$ (ii) $5x^2 - 20x + 15$
(b) (i) $4x^2 - 8x - 32$ (ii) $-x^2 + 3x - 2$
(c) (i) $3x^2 - 6x + 6$ (ii) $4x^2 + 16x + 11$
(d) (i) $-4x^2 + 8x - 5$ (ii) $-2x^2 - 8x - 11$
3. (a) (i) $(0, -6)$ (ii) $(0, -3)$
(b) (i) $(0, 0)$ (ii) $(0, 0)$
(c) (i) $(0, 2)$ (ii) $(0, 6)$
(d) (i) $(0, 19)$ (ii) $(0, 2)$
4. (a) (i) 5 (ii) 2
(b) (i) -3 (ii) -1
(c) (i) -2 (ii) 2
5. (a) (i) 3 (ii) 2
(b) (i) 2 (ii) 5
(c) (i) -3 (ii) -1
6. (a) (i) $a = 2, b = -8, c = 6$
 (ii) $a = 5, b = 5, c = -10$

(b) (i) $a = -\frac{1}{4}, b = \frac{3}{4}, c = 1$
 (ii) $a = -1, b = 0, c = 1$

7. (a) (i) $\left(\frac{2}{3}, -\frac{1}{3}\right)$ (ii) $\left(-\frac{1}{4}, -\frac{33}{8}\right)$
(b) (i) $(0.2, 10.2)$ (ii) $(2, -1)$
8. (a) (i) -0.535, 1.87 (ii) -1, 0.75
(b) (i) -0.449, 4.45 (ii) -1.35, 1.85
(c) (i) 3 (ii) 1.5
9. (a) (i) $x = 2$ (ii) $x = -\frac{1}{4}$
(b) (i) $x = \frac{3}{4}$ (ii) $x = \frac{1}{6}$
10. (a) (i) -3.46, 2.12 (ii) -2.56, 1.56
(b) (i) -0.387, 1.72 (ii) -5.19, 0.193

Exercise 1B

1. (a) (i) $(3, 4)$ (ii) $(5, 1)$
(b) (i) $(2, -1)$ (ii) $(1, -5)$

- | | |
|-------------------------------------|-----------------|
| (c) (i) $(-1, 3)$ | (ii) $(-7, -3)$ |
| (d) (i) $(-2, -4)$ | (ii) $(-1, 5)$ |
| 2. (a) (i) $(x-3)^2 - 5$ | |
| (b) (i) $(x+2)^2 - 3$ | |
| (c) (i) $2(x-3)^2 - 13$ | |
| (d) (i) $-(x-1)^2 - 4$ | |
| (e) (i) $(x+1.5)^2 - 1.25$ | |
| (f) (i) $2(x+1.5)^2 + 10.5$ | |
| (ii) $2(x-1.25)^2 - 4.125$ | |
| 3. (a) (i) $y = 2(x-2)^2 + 4$ | |
| (b) (i) $y = -2(x+1)^2 + 3$ | |
| (ii) $y = -3(x-2)^2 + 1$ | |
| 4. (a) $(x-3)^2 + 2$ | |
| (b) 2 | |
| 5. (a) $b = -3, c = 6$ | |
| (b) $a = 2$ | |
| 6. (a) $2(x+1)^2 - 3$ | |
| (b) $x = -1$ | |
| (c) $x = -1 \pm \sqrt{\frac{3}{2}}$ | |

ANSWER HINT

(a) Did you notice that inside the bracket we had $x+b$?

Exercise 1C

1. (a) (i) $-2, 3$ (ii) $-1, 5$
(b) (i) $-3, 0$ (ii) $0, 2$
(c) (i) $-2, 5$ (ii) $-1, 1$
(d) (i) $\frac{1}{2}, -\frac{5}{3}$ (ii) $\frac{3}{4}, -\frac{1}{3}$
2. (a) (i) -5, 1 (ii) 2, 4
(b) (i) $\frac{3}{2}, -2$ (ii) $2, -\frac{5}{3}$
(c) (i) $\frac{3}{2}, -\frac{1}{3}$ (ii) $\frac{5}{4}, -\frac{1}{2}$
(d) (i) -4, 3 (ii) -5, 2
3. (a) (i) $y = 3x^2 - 15x + 12$ (ii) $y = 4x^2 + 4x - 8$
(b) (i) $y = -2x^2 - 2x + 4$ (ii) $y = -x^2 - 6x - 5$
4. (a) $(2x-3)(x+4)$
(b) $(-4, 0)$ and $\left(\frac{3}{2}, 0\right)$

5. $a = -\frac{3}{10}, b = -\frac{9}{10}, c = 3$

Exercise 1D

1. (a) (i) 36 (ii) 68
 (b) (i) -47 (ii) -119
 (c) (i) 0 (ii) 0
 (d) (i) 49 (ii) 49
2. (a) (i) (ii) Two (b) (i) (ii) None
 (c) (i) (ii) One (d) (i) (ii) Two
3. (a) (i) $x = \frac{3 \pm \sqrt{5}}{2}$ (ii) $x = \frac{1 \pm \sqrt{5}}{2}$
 (b) (i) $x = -1, \frac{2}{3}$ (ii) $x = \frac{3 \pm \sqrt{7}}{2}$
 (c) (i) $x = \frac{4}{3}, -1$ (ii) $x = \frac{1}{2}, -1$
 (d) (i) $x = 2 \pm \sqrt{7}$ (ii) $x = 1, -\frac{3}{2}$
4. (a) (i) $k < \frac{1}{24}$ (ii) $k > -\frac{25}{12}$
 (b) (i) $k = \frac{3}{5}$ (ii) $k = -\frac{17}{24}$
 (c) (i) $k \geq -\frac{5}{4}$ (ii) $k \leq \frac{1}{16}$
 (d) (i) $k > \frac{3}{8}$ (ii) $k < -\frac{25}{12}$
 (e) (i) $k = \frac{17}{4}$ (ii) $k = \frac{55}{32}$
 (f) (i) $k = 1$ (ii) $k = \frac{1}{32}$
 (g) (i) $k < 0$ (ii) $k < 0$
5. $x = \frac{2 \pm \sqrt{7}}{3}$
7. $m = \pm \sqrt{2}$
8. $k = \frac{11 \pm 2\sqrt{30}}{2}$
9. $k > \frac{9}{2}$
10. $c \geq \frac{17}{16}$
11. $m < -\frac{9}{16}$
12. $k = \pm 9$

Exercise 1E

1. (a) (i) $(-2, -3), (1, 0)$ (ii) $(3, 0)$
 (b) (i) $(-3, -9), (4, 5)$ (ii) No intersection

2. (a) (i) $\left(-\frac{11}{5}, -\frac{8}{5}\right), (3, 1)$ (ii) $(-3, 3), (5, -1)$
 (b) (i) $(1, 3), (3, 1)$ (ii) $(-3, -5), (-5, -3)$
 (c) (i) $(-1, 6), (2, 3)$ (ii) $(1, -3), (-1, -5)$
3. $(-4, 12), (3, 5)$
4. $x = -0.25, y = 2.88$ and $x = 1, y = 1$
6. $-1 \pm 2\sqrt{6}$

Exercise 1F

1. 1.5, 6.5
2. Area = $x(6 - x)$; 9 cm²
3. (a) $210x - 2x^2$ (b) $x = 52.5, y = 105$
4. (a) 1.63 s (b) 3.27 m
5. (c) $x = 24.2, y = 7.38$
6. 25

Mixed examination practice 1

Short questions

1. (a) $(x+7)(x-2)$ (b) $x = -7, 2$
2. (a) Minimum (b) $a = 3, b = 7$
3. $a = -3, b = 2, c = 48$
4. $k + 2$
5. (a) $p = -\frac{1}{2}, q = 2$ (b) $\frac{3}{4}$

Expression	Positive	Negative	zero
a		✓	
c		✓	
$b^2 - 4ac$			✓
b	✓		

7. (a) $(x-5)^2 + 10$ (b) $\frac{1}{1000}$
8. $3 \pm 2\sqrt{2}$
9. $k > 4.5$
10. $k = -1 \pm 2\sqrt{3}$

11. (a) $\alpha = k - 1, \beta = 1$ (a) -3, 5

Long questions

1. (a) (i) $4x$ (ii) $2\pi y$
- (b) $x = 2 - \frac{\pi}{2}y$
- (d) 44.0%
2. (b) 6 km
3. (a) 9
- (b) $y = -\frac{1}{5}x^2 - \frac{4}{5}x + \frac{21}{25}$
- (c) $\left(\frac{4}{3}, \frac{25}{9}\right)$

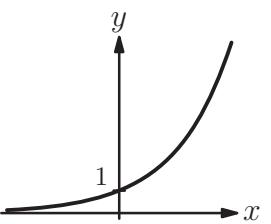
Chapter 2

Exercise 2A

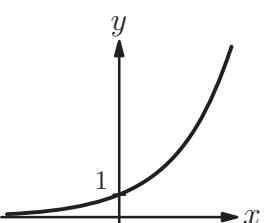
1. (a) (i) 6^7 (ii) 5^8
- (b) (i) a^8 (ii) x^9
- (c) (i) 7^{-3} (ii) 5^5
- (d) (i) x^2 (ii) x^5
- (e) (i) g^{-12} (ii) k^{-8}
2. (a) (i) 6^1 (ii) 5^{-2}
- (b) (i) a^{-2} (ii) x^3
- (c) (i) 5^9 (ii) 7^{15}
- (d) (i) x^6 (ii) x^{11}
- (e) (i) 2^2 (ii) 3^{-14}
- (f) (i) g^6 (ii) k^{-8}
3. (a) (i) 2^{12} (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) 2
- (d) (i) $\frac{1}{2x}$ (ii) $\frac{y^2}{9}$
- (e) (i) $\frac{2}{x}$ (ii) $3y^2$
6. (a) (i) $\frac{3}{4}$ (ii) $\frac{7}{81}$
- (b) (i) $\frac{1}{36}$ (ii) $\frac{1}{1000}$
- (c) (i) 40 (ii) $\frac{9}{64}$
- (d) (i) $\frac{3}{4}$ (ii) $\frac{4}{27}$
7. (a) (i) 2 (ii) 2
- (b) (i) 100 (ii) 3
- (c) (i) $\frac{1}{5}$ (ii) $\frac{3}{4}$
- (d) (i) 4 (ii) 125
- (e) (i) 100 000 (ii) 27
- (f) (i) $\frac{1}{32}$ (ii) $\frac{32}{243}$
- (g) (i) $\frac{1}{2}$ (ii) $\frac{1}{7}$
- (h) (i) $\frac{3}{4}$ (ii) $\frac{64}{27}$
8. (a) (i) x^3 (ii) x^{12}
- (b) (i) $2x^5$ (ii) $\frac{1}{2x^4}$
- (c) (i) $\frac{4}{3x^3}$ (ii) $\frac{y^{12}}{x^6}$
9. (a) (i) $\frac{5}{3}$ (ii) $-\frac{3}{2}$
- (b) (i) $-\frac{1}{2}$ (ii) $-\frac{3}{4}$
- (c) (i) 4 (ii) 2
10. 5×10^{-4}
11. 8 cm
12. (a) $\frac{1}{3}$ (b) 16 cm^2
13. 4
14. 0
15. 11
16. 4
17. 3
18. 3

Exercise 2B

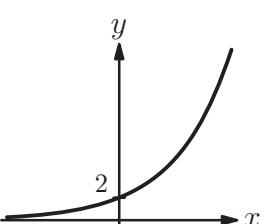
1. (a) (i) $y = 0$



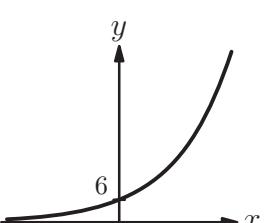
(ii) $y = 0$



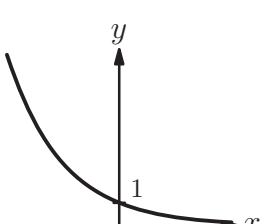
(b) (i) $y = 0$



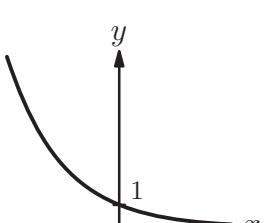
(ii) $y = 0$



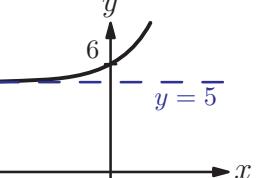
(c) (i) $y = 0$



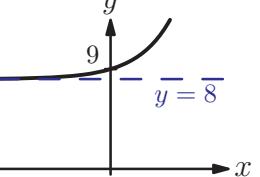
(ii) $y = 0$



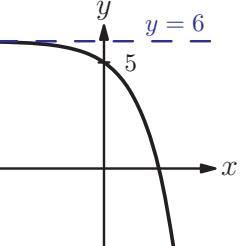
(d) (i)



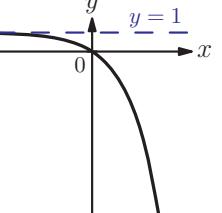
(ii)



(e) (i)

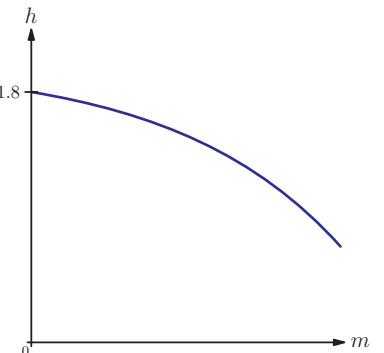


(ii)



2. 13.31 m^2

3. (a)

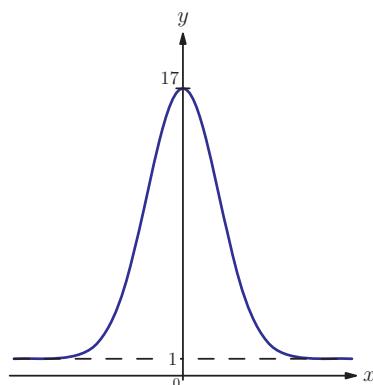


(b) 1.8 m

(c) 1.60 m

(d) The branch might break before reaching the ground.

4. (a)

**ANSWER HINT 4(a)**

This is not a graph you are expected to know. Use your calculator to sketch unfamiliar functions.

(b) $x = \pm 0.866$

5. 41.2°C

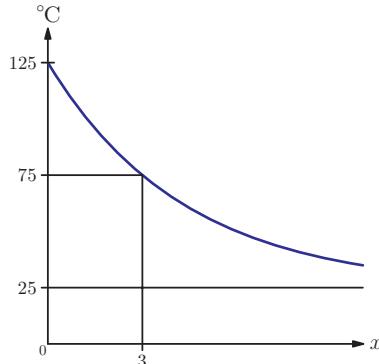
6. (a) 0 m/s

(b) 40 m/s

7. (a) $A = 25, B = 100, k = 3$

(b) 26.0°C

(c)

**Exercise 2C**

- | | |
|-----------------|--------------|
| 1. (a) (i) 3.72 | (ii) -1.28 |
| (b) (i) 8.15 | (ii) 1.36 |
| (c) (i) 7.39 | (ii) 0.0498 |
| (d) (i) 8.24 | (ii) 0.00274 |

2. $2.718281809\dots$

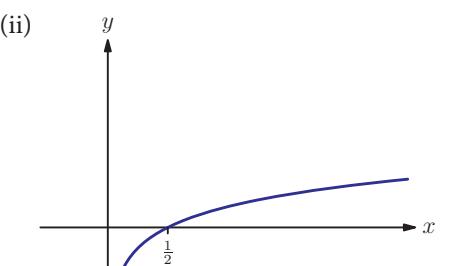
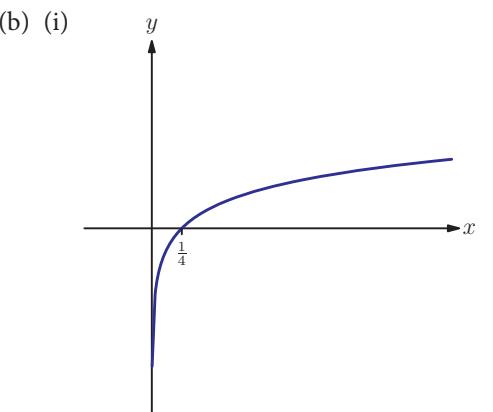
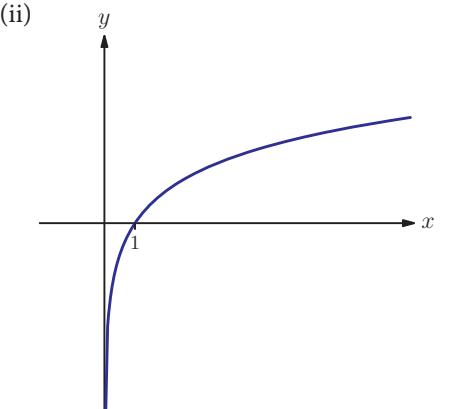
3. $e^4 + 4 + \frac{4}{e^4}$

Exercise 2D

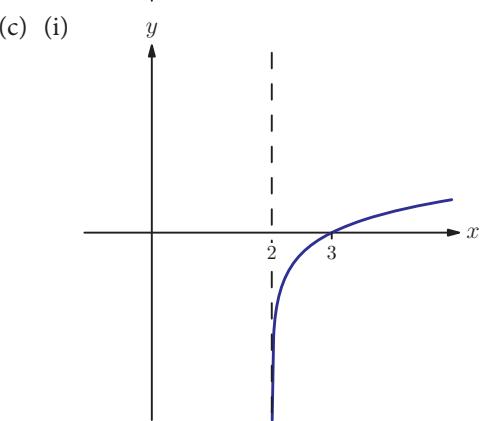
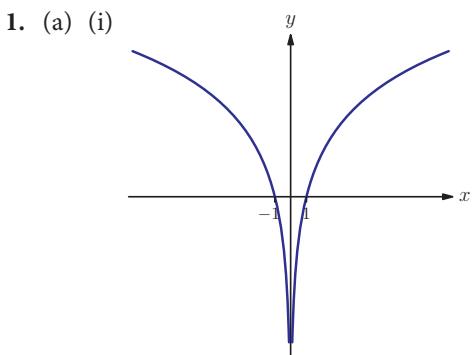
- | | |
|---|----------------------------------|
| 1. (a) (i) 3 | (ii) 2 |
| (b) (i) 1 | (ii) 1 |
| (c) (i) 0 | (ii) 0 |
| (d) (i) -1 | (ii) -3 |
| (e) (i) $\frac{1}{2}$ | (ii) $\frac{1}{3}$ |
| (f) (i) $\frac{1}{2}$ | (ii) $\frac{1}{2}$ |
| (g) (i) $\frac{2}{3}$ | (ii) $\frac{3}{4}$ |
| (h) (i) $\frac{3}{2}$ | (ii) $\frac{5}{4}$ |
| (i) (i) $\frac{3}{4}$ | (ii) $\frac{9}{4}$ |
| (j) (i) $-\frac{1}{2}$ | (ii) $-\frac{1}{2}$ |
| 2. (a) (i) 1.70 | (ii) -0.602 |
| (b) (i) -2.30 | (ii) 2.30 |
| 3. (a) (i) $5 \log x$ | (ii) $5 \log x$ |
| (b) (i) $\log x \log y - \log y + 3 \log x - 3$ | |
| | (ii) $(\log x)^2 + 4 \log x + 4$ |
| (c) (i) $\frac{1}{\log b} + \frac{1}{\log a}$ | (ii) $\log a + 1$ |
| 4. (a) (i) $x = 3^y$ | (ii) $x = 16^y$ |
| (b) (i) $x = a^{y+1}$ | (ii) $x = a^{y^2}$ |
| (c) (i) $x = \sqrt[3]{3y}$ | (ii) $x = \sqrt{y}$ |
| 5. (a) (i) 32 | (ii) 16 |
| (b) (i) 0.4 | (ii) 0.25 |
| (c) (i) 6 | (ii) 100 |
| 6. $x = 111$ | |
| 7. $x = -3$ | |
| 8. $x = \frac{e^2 + 1}{3}$ | |
| 9. $9, \frac{1}{9}$ | |
| 10. $x = 10^{1.5} = 31.6$ | |
| 11. $x = \sqrt[9]{4} = 1.17$ | |
| 12. $x = 81, y = 25$ | |
| 13. 5.50 | |

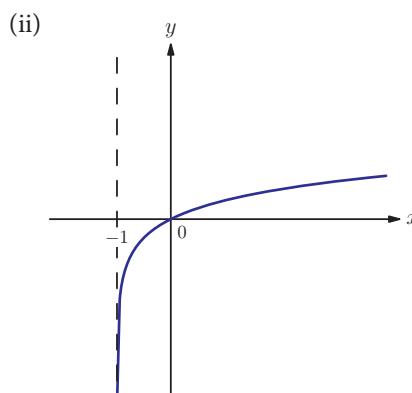
Exercise 2E

1. (a) (i) 4 (ii) $\frac{1}{2}$
 (b) (i) 6 (ii) $\frac{3}{2}$
2. (a) (i) $y+z$ (ii) $z-x$
 (b) (i) $3x$ (ii) $5y$
 (c) (i) $z+7y$ (ii) $2x+y$
 (d) (i) $x+2y-z$ (ii) $2x-y-3z$
 (e) (i) $2-y-5z$ (ii) $1+y+2z$
3. (a) (i) $x = \frac{13}{7}$ (ii) $x = 4$
 (b) (i) $x = 9$ (ii) $x = 2$
 (c) (i) $x = \frac{1}{4}$ (ii) $x = 8$
 (d) (i) $x = 2^{\frac{12}{5}} = 5.28$ (ii) $x = 2^{10} = 1024$
 (e) (i) $x = 8$ (ii) $x = 4$
 (f) (i) $x = \frac{1}{3}$ (ii) $x = 8$
4. $x = \frac{1}{3}e^{\frac{3}{2}}$
5. (a) $a+2b$ (b) $2(a-b)$
6. $x = 2, \frac{1}{2}$
7. (a) $x-4y$ (b) $2+2x+y+2z$
8. -1
9. (a) $2 + \frac{y}{x}$ (b) $\frac{x+2z}{x+y}$
10. (a) $\frac{x-y-z}{y} = \frac{x-z}{y} - 1$ (b) $\frac{y}{x} \times 10^{x-y}$



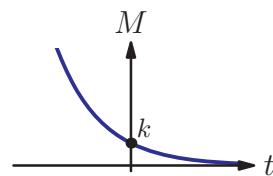
Exercise 2F





Exercise 2G

1. (a) (i) 2.45 (ii) 116
 (b) (i) -0.609 (ii) 4.62
 (c) (i) -1.71 (ii) 0.527
 (d) (i) 1.11 (ii) -2.98
2. (a) (i) $\frac{\ln 5}{2\ln 3}$ (ii) $\frac{\ln 7}{3\ln 10}$
 (b) (i) $\frac{\ln 2}{\ln 5 - \ln 2}$ (ii) $\frac{2\ln 5}{\ln 5 - \ln 3}$
 (c) (i) $\frac{\ln 3}{3\ln 2 - 1}$ (ii) $\frac{\ln 5}{2 - \ln 2}$
3. (a) 100
 (b) 48 299
 (c) 2.24 hours
4. (a) 18
 (c) 64
 (d) 1:58 p.m.
5. (a) k
 (b)



- (c) 2.31 minutes
6. $\frac{\log 15}{\log 45}$
7. $x = 10 + \log_7 3$
8. $x = \frac{\ln\left(\frac{5}{4}\right)}{\ln\left(\frac{1}{36}\right)}$

ANSWER HINT

Sketch the graph.

9. (b) $x = 0.742$

Mixed examination practice 2

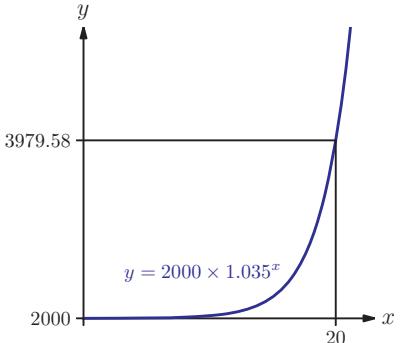
Short questions

1. $x = 24$
2. (a) $2a + \frac{b}{2} - c$
 (b) $\frac{a-1}{2}$
 (c) $\frac{b-c}{2}$
3. 1.68
4. $\frac{\ln 4}{\ln 5 - 2\ln 3}$
5. $x = e^{\frac{4}{3}} = 3.79, y = e^{\frac{10}{3}} = 28.0$
6. $x = 1 \pm \sqrt{1 - e^y}$
7. $x = \frac{\ln 8}{\ln 12}$
8. $a = b^{-2}$
9. $x = e^2$ or e^{-2}

Long questions

1. (a)
- (b) 0 ms^{-1}
 (c) 42 ms^{-1}
 (d) 3.71 s
2. (a) (i) $k = 37000$
 (b) 2750
 (c) 2039
 (d) $T = 7778 \times 1.025^m$
 (e) 2.5%

3. (a) (i) \$2070
 (b) 20 years
 (c)



- (d) 28
 (e) \$2678.14

Chapter 3

Exercise 3A

1. (a) (i) $x=3$
 (ii) $x=-1$
 (b) (i) $x=\frac{1}{2}, -\frac{3}{5}$
 (ii) $x=3, -3$
 (c) (i) $x=27, 1$
 (ii) $x=16, \frac{1}{81}$
 (d) (i) $x=7, \pm\sqrt{3}$
 (ii) $x=\frac{6}{5}, -1, -4$

2. $x=2$

3. $x=\frac{\log 2 - \log 7}{\log 2}$

4. $x=\frac{1}{3}, \pm 2$

Exercise 3B

1. (a) (i) $a=\pm\sqrt{3}, \pm\sqrt{7}$
 (ii) $x=\pm 2, \pm\sqrt{3}$
 (b) (i) $x=-\sqrt[3]{5}, \sqrt[3]{1.5}$
 (ii) $a=1, -2$
 (c) (i) $x=\pm\sqrt{2+\sqrt{6}}$
 (ii) $x=\pm\sqrt{6}$
 (d) (i) $x=4, 16$
 (ii) $x=16, 36$

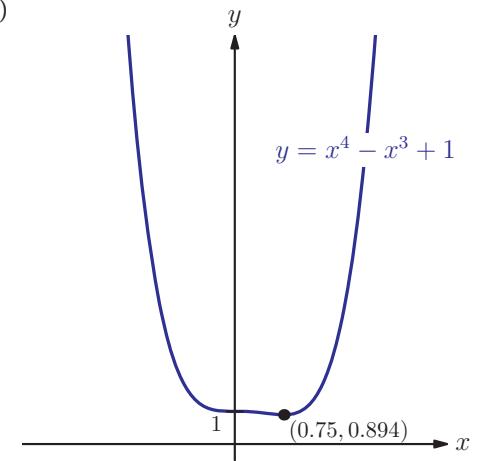
2. (a) $x=\ln 4$
 (b) $x=1, \frac{1}{\log 5}$
 (c) $x=1, \sqrt{2}$

3. (a) $x=\ln 4, \ln 5$
 (b) $x=2, \frac{\log 3}{\log 2}$
 (c) $x=3, 9$

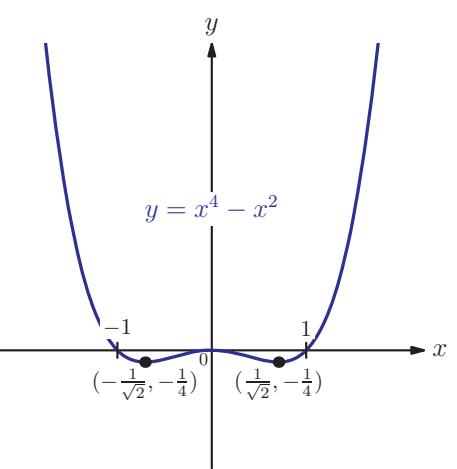
4. $x=0, 2$
 5. $x=0, \frac{\log 5}{\log a}$
 6. $x=2, 32$

Exercise 3C

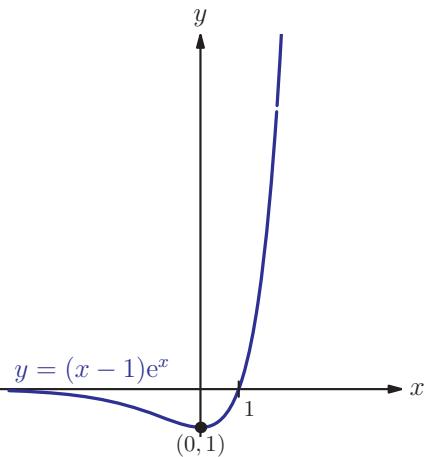
1. (a) (i)



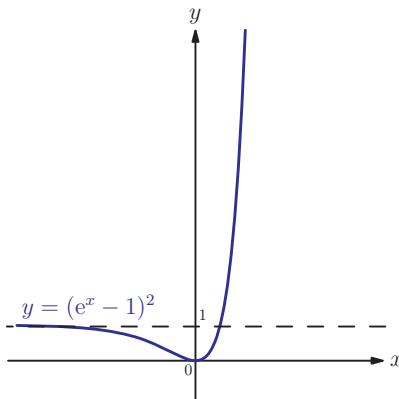
(ii)



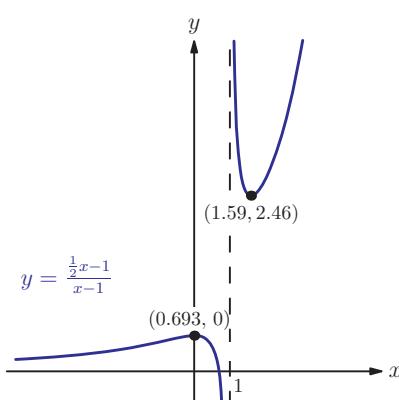
- (b) (i)



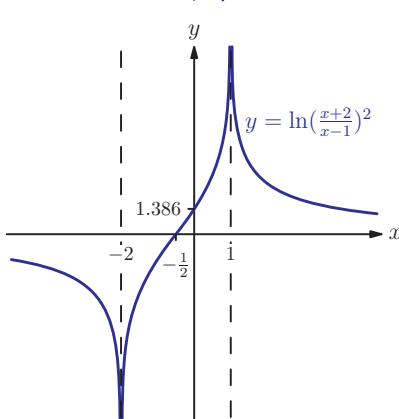
(ii)



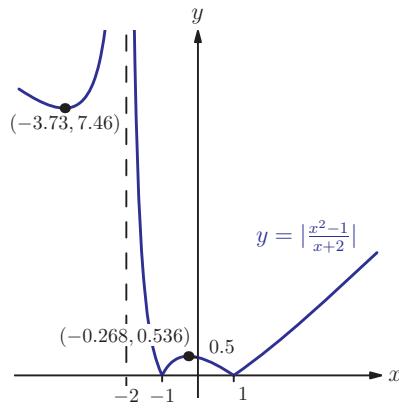
(c) (i)



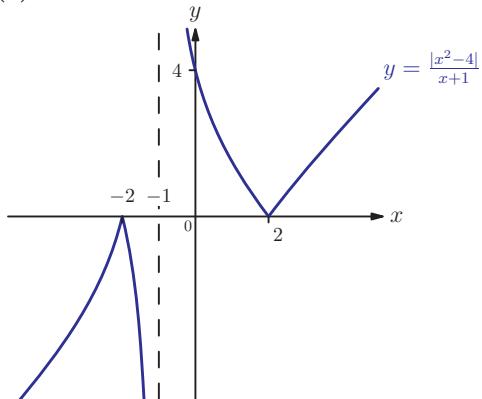
(ii)



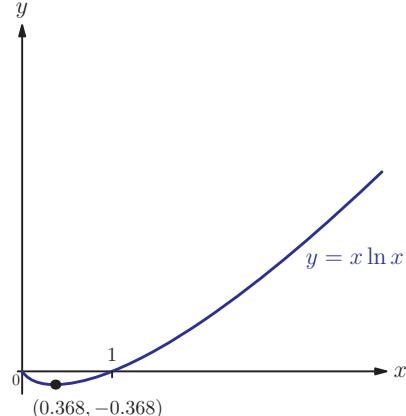
(d) (i)



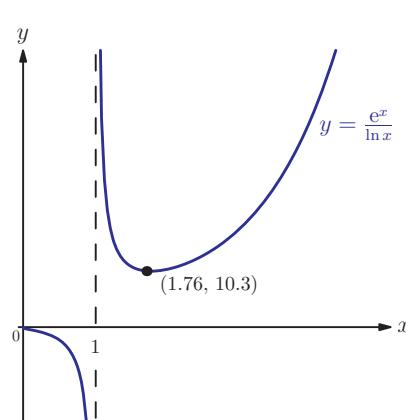
(ii)



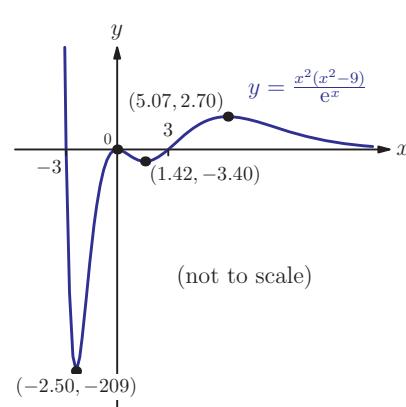
2.



3.



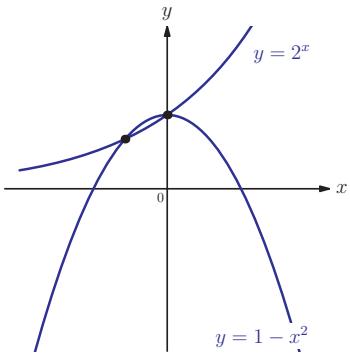
4.



Exercise 3D

Mixed examination practice 3

1. (a)



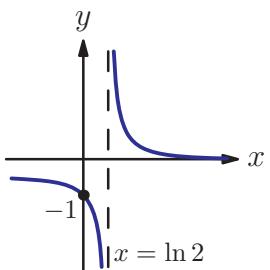
(b) 2

2. 0.541

$$3. \quad x = e^3$$

$$4. \quad x = -\frac{b}{a} \text{ and } x = c$$

5. (a)



$$(b) \ x = \ln 2$$

6. (a) $x = \pm 2, \pm 3$

Z. $x \equiv 1$



Chapter 4

Exercise 4A

1. (a) (i) 24 (ii) 140
(b) (i) 14 (ii) 4
(c) (i) $3z^2 - z$ (ii) $3a^2 - a$
(d) (i) $3x^2 + 5x + 2$ (ii) $3x^2 - 13x + 14$

- (e) (i) $-x$ (ii) $57x^2 - 11x$
 (f) (i) $\frac{3-x}{x^2}$ (ii) $3x - \sqrt{x}$

(a) (i) 3 (ii) 7
 (b) (i) 0 (ii) 1
 (c) (i) $1 + \log_{10} y$ (ii) $1 + \log_{10} z$
 (d) (i) $2 + \log_{10} x$ (ii) $3 + \log_{10} y$
 (e) (i) $2 + 3\log_{10} x$ (ii) 1
 (a) (i) 4 (ii) -8
 (b) (i) $3x + 1 - \sqrt{y}$ (ii) $6x + 4 + 2\sqrt{x}$
 (c) (i) $24x + 2 - 6\sqrt{x}$ (ii) $6x^2 + x - \sqrt{x^2 + 1}$

Exercise 4B

- (a) Domain: \mathbb{R} ; range: $]0, \infty[$
 (b) Domain: \mathbb{R} ; range: $]0, \infty[$
 (c) Domain: $]0, \infty[$; range: \mathbb{R}
 (d) Domain: $]0, \infty[$; range: \mathbb{R}
 - (a) (i) $x \neq -2$ (ii) $x \neq 7$
 (b) (i) $x \neq 2$ or -4 (ii) $x \neq \pm 3$
 (c) (i) $y \geq 1$ (ii) $x \geq -3$
 (d) (i) $a > 1$ (ii) $x < \frac{2}{5}$
 (e) (i) $x \neq 0$ or -1 (ii) $x \geq -1$
 (f) (i) $x \leq -\sqrt{5}$ or $x \geq \sqrt{5}$ (ii) $x \leq -3$ or $x \geq 1$
 (g) (i) $x \geq 0$ (ii) $x \geq -\frac{3}{2}$
 - (a) (i) $y \leq 7$ (ii) $y \geq 3$
 (b) (i) $y \geq 12$ (ii) $y \geq 5, y \in \mathbb{Z}$
 (c) (i) $y \geq 0$ (ii) $y \geq 0$
 (d) (i) $y \leq -1$ or $y > 0$ (ii) $y > 0$
 - $x \geq 5$
 - $x \geq 1, x \neq 2, x \neq 3$
 - $x < -2$ or $x > -1$
 - $x \leq \frac{1}{2}$ or $x > 12$
 - (a) (i) $a \leq x < b$ (ii) \emptyset
 (b) $f(a) = \begin{cases} \ln(b-a) & \text{for } a < b \\ \text{undefined} & \text{for } a \geq b \end{cases}$

Exercise 4C

1. (a) (i) 5 (ii) 26
(b) (i) $9x+8$ (ii) $9x^2+12x+5$

- (c) (i) $9\sqrt{a} + 17$
(ii) $y^4 - 4y^3 + 8y^2 - 8y + 5$
(d) (i) $9y^2 + 17$ (ii) $27z^2 + 36z + 17$

2. (a) (i) x^2 (ii) x^3
(b) (i) $3x - 5$ (ii) $x^2 + 5x + 6$
(c) (i) $x + 4$ (ii) $x^{\frac{2}{3}}$
(d) (i) $\ln(\ln x)$ (ii) $\ln\left(\frac{x+1}{3}\right)$

3. $x = 0, -2$

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

5. (a) $y \neq 2$

(b) $x = 1.5$

(c) Domain: $x < -1$ or $x \geq 1.5$; range: $y > 0$ and $y \neq \sqrt{2}$

6. (a) $\sqrt[3]{2x+3}$ (b) $2\sqrt[3]{x} + 3$

7. (a) $a = -\frac{4}{3}, b = -\frac{2}{3}$

(b) $y \geq 0$

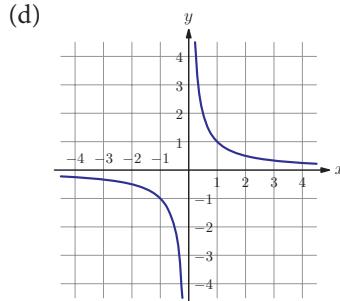
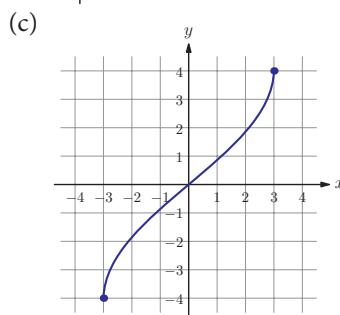
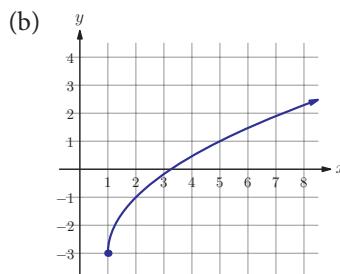
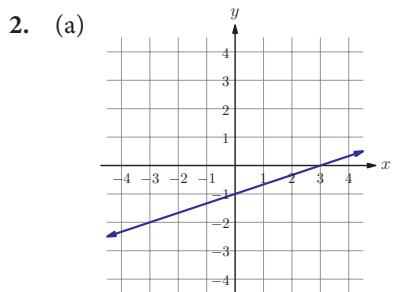
8. (a) x^2 is not always greater than 3

(b) $x \in]-\infty, -\sqrt{3}[\cup]\sqrt{3}, \infty[$

9. $\frac{x}{6} - \frac{1}{3}$

Exercise 4D

1. (a) (i) $\frac{x-1}{3}$ (ii) $\frac{x+3}{7}$
(b) (i) $\frac{2x}{3x-2}$ (ii) $\frac{x}{1-2x}$
(c) (i) $\frac{bx-a}{x-1}$ (ii) $\frac{x-1}{bx-a}$,
(d) (i) $1-x$ (ii) $\frac{x-2}{3}$
(e) (i) $\frac{x^2+2}{3}$ (ii) $\frac{2-x^2}{5}$
(f) (i) $\frac{1-e^x}{5}$ (ii) $\frac{e^x-2}{2}$
(g) (i) $2\ln\left(\frac{x}{7}\right)$ (ii) $\frac{1}{10}\ln\left(\frac{x}{9}\right)$
(h) (i) $5 - \sqrt{x+19}$ (ii) $-3 + \sqrt{x+10}$



3. (a) -1 (b) 1

4. -23

5. $f^{-1}(x) = \frac{1}{2}\ln\left(\frac{x}{3}\right)$

6. $(f \circ g)^{-1}(x) = \sqrt[3]{\frac{x-3}{2}}$

7. (a) $\ln 3$

8. $x = -1$

9. $f^{-1}(x) = -\sqrt{\frac{9x+4}{1-x}}, x \neq 1$

10. (a) $f^{-1}(x) = \frac{e^x}{3} + 1$

(b) $3x - 3$

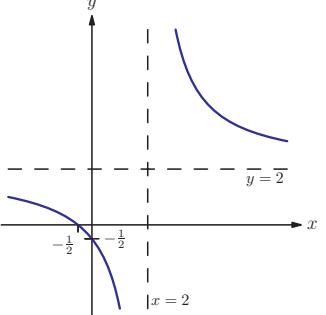
11. (b) $k = -3$

Exercise 4E

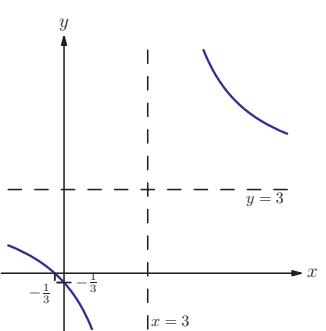
1. (a) (i) $\left(-\frac{1}{3}, 0\right), \left(0, \frac{1}{3}\right)$ (ii) $\left(-\frac{5}{2}, 0\right), (0, 5)$
(b) (i) $\left(\frac{3}{2}, 0\right), \left(0, -\frac{3}{7}\right)$ (ii) $\left(\frac{5}{3}, 0\right), \left(0, -\frac{5}{2}\right)$

2. (a) (i) $x=1, y=4$ (ii) $x=7, y=2$
 (b) (i) $x=\frac{1}{2}, y=\frac{3}{2}$ (ii) $x=\frac{5}{3}, y=\frac{4}{3}$
 (c) (i) $x=-\frac{5}{2}, y=-\frac{1}{2}$ (ii) $x=\frac{2}{3}, y=-\frac{2}{3}$
 (d) (i) $x=2, y=0$ (ii) $x=-\frac{1}{2}, y=0$

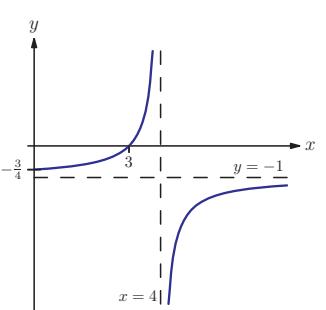
3. (a) (i)



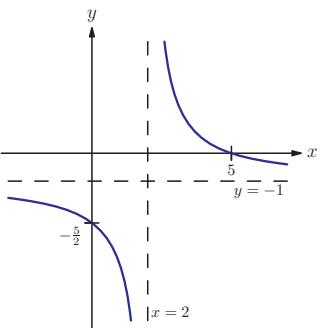
(ii)



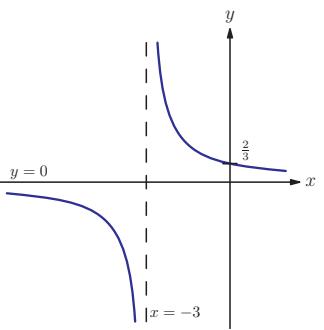
(b) (i)



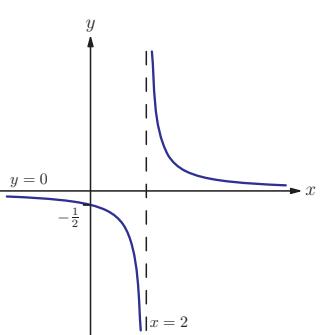
(ii)



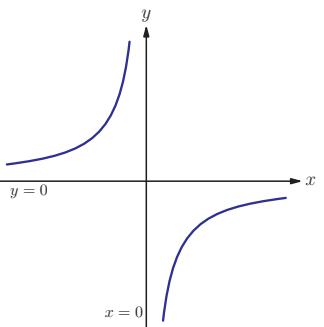
- (c) (i)



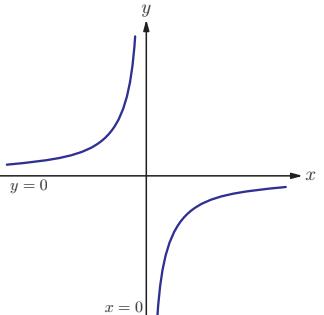
(ii)



- (d) (i)



(ii)



4. (a) (i) $x \neq 0, y \neq 0, f^{-1}(x) = \frac{3}{x}$

(ii) $x \neq 0, y \neq 0, f^{-1}(x) = \frac{7}{x}$

(b) (i) $x \neq 3, y \neq 0, f^{-1}(x) = \frac{3x+2}{x}$

(ii) $x \neq -1, y \neq 0, f^{-1}(x) = \frac{5-x}{x}$

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

(ii) $x \neq -\frac{1}{2}, y \neq 2, f^{-1}(x) = \frac{-x-5}{2x-4}$

(d) (i) $x \neq -2, y \neq -2, f^{-1}(x) = \frac{5-2x}{x+2}$

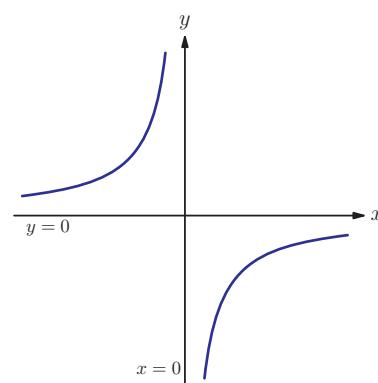
(ii) $x \neq \frac{3}{4}, y \neq \frac{3}{4}, f^{-1}(x) = \frac{3x-1}{4x-3}$

5. $x = \frac{4}{5}, y = -\frac{3}{5}$

6. (a) $x \neq -3, y \neq 0$

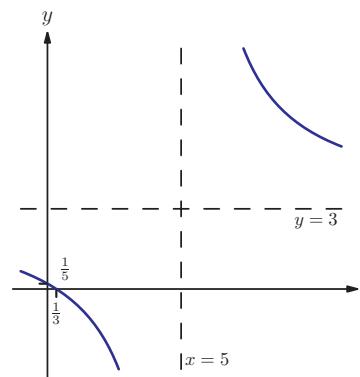
(b) $f^{-1}(x) = \frac{1-3x}{x}$

7. (a)



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

8.



9. (a) $y \in \mathbb{R}, y \neq \frac{a}{2}$

(b) $f^{-1}(x) = \frac{8x+3}{2x-a}$

(c) 8

Mixed examination practice 4

Short questions

1. $4x^2 - 4x + 2$

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

3. 0.549

4. (a) $x = 5, y = -4$

(b) $f^{-1}(x) = \frac{5x+3}{x+4}$

5. (a) $f^{-1}(x) = 3^x - 3$

(b) $f^{-1}(x) = \sqrt[3]{\ln\left(\frac{x}{3}\right) + 1}$

6. (a) $y = \log_2 x$ (b) (1, 0)

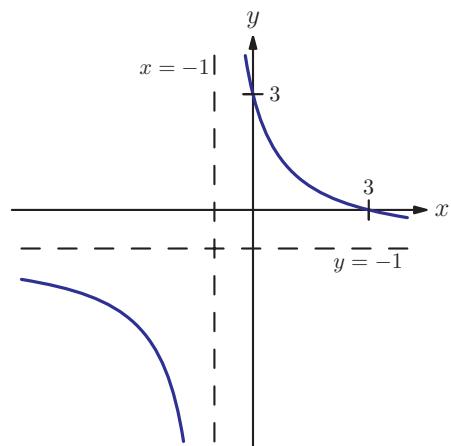
7. (a) $(x-3)^2 + 1$

(b) $\sqrt{x-1} + 3$

(c) $x \geq 1$

8. (a) $y \in \mathbb{R}, y \neq -1$

(b)



(c) $f^{-1}(x) = \frac{3-x}{x+1}, x \neq -1, y \neq -1$

9. (a) $(x-3)^2 - 7$

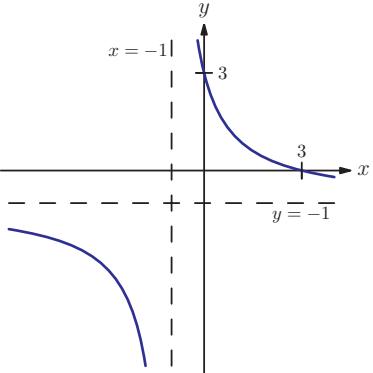
(b) $y > -7$

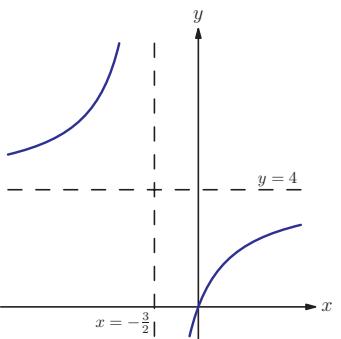
(c) $\sqrt{x+7} + 3$

10. (a) $a = -2, b = 1$

(b) $y \geq 0$

Long questions

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

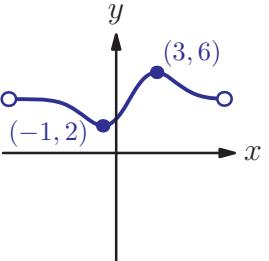
 (c) Range of f is $y \geq 5$; range of g is $y > 0$
 (d) $y > 9$
4. (a) $y = \frac{8x}{2x+3}$
 (b)
 

 (c) $\frac{16x+8k}{4x+2k+3}$
 (d) $x = -\frac{2k+3}{4}, y = 4$
 (e) $(hg)(x) = (hg)^{-1}(x) = \frac{16x-76}{4x-16}$

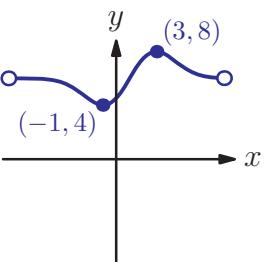
Chapter 5

Exercise 5A

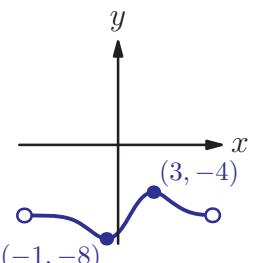
1. (a) (i)



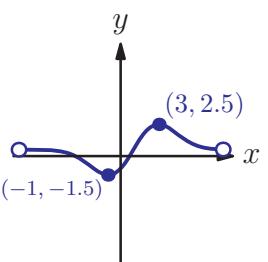
(ii)



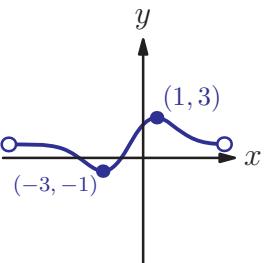
- (b) (i)

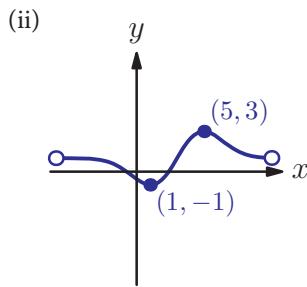
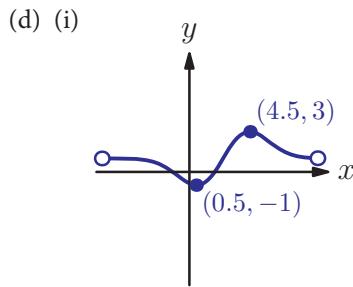
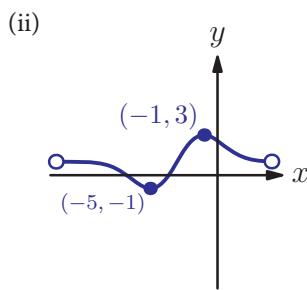


(ii)



- (c) (i)



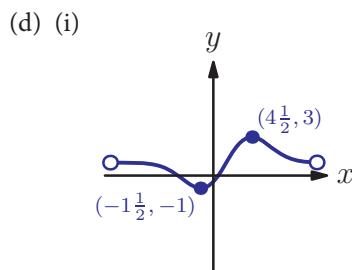
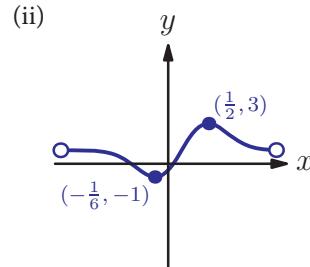
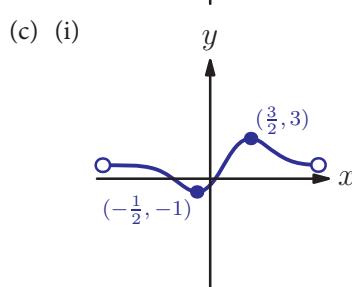
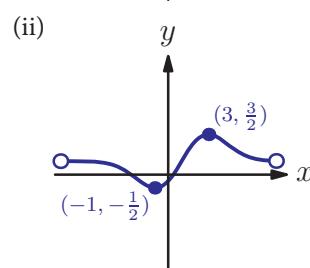
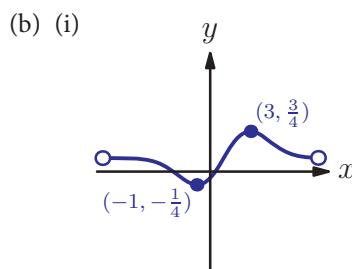
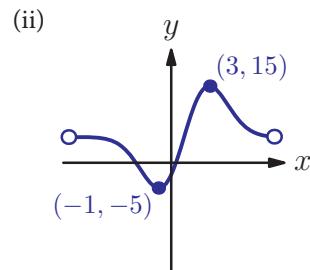
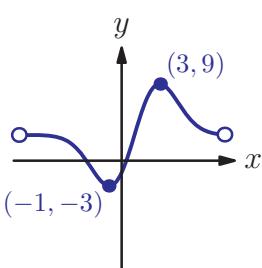


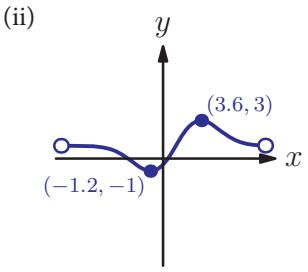
2. (a) (i) $y = 3x^2 + 3$ (ii) $y = 9x^3 - 7$
 (b) (i) $y = 7x^3 - 3x + 4$ (ii) $y = 8x^2 - 7x + 6$
 (c) (i) $y = 4(x-5)^2$ (ii) $y = 7(x+3)^2$
 (d) (i) $y = 3(x+4)^3 - 5(x+4)^2 + 4$
 (ii) $y = (x-3)^3 + 6(x-3) + 2$

3. (a) (i) Vertically down 5 units
 (ii) Vertically down 4 units
 (b) (i) Left 1 unit (ii) Left 5 units
 (c) (i) Right 4 units (ii) Right 5 units
 (d) (i) Left 3 units (ii) Right 2 units

Exercise 5B

1. (a) (i)



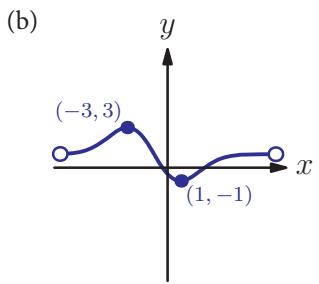
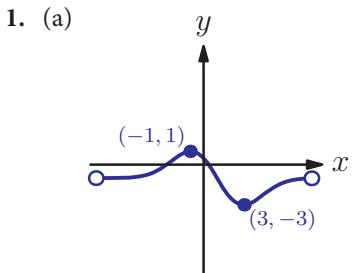


2. (a) (i) $y = 21x^2$ (ii) $y = 18x^3$
 (b) (i) $y = \frac{1}{3}(7x^3 - 3x + 6)$ (ii) $y = \frac{4}{5}(8x^2 - 7x + 1)$

(c) (i) $y = 4\left(\frac{x}{2}\right)^2$ (ii) $y = 7\left(\frac{x}{5}\right)^2$
 (d) (i) $y = 3(2x)^3 - 5(2x)^2 + 4$
 (ii) $y = \left(\frac{3x}{2}\right)^3 + 6\left(\frac{3x}{2}\right) + 2$

3. (a) (i) Vertical stretch, scale factor 4
 (ii) Vertical stretch, scale factor 6
 (b) (i) Horizontal stretch, scale factor $\frac{1}{3}$
 (ii) Horizontal stretch, scale factor $\frac{1}{4}$
 (c) (i) Horizontal stretch, scale factor 2
 (ii) Horizontal stretch, scale factor 5
 (d) (i) Horizontal stretch, scale factor $\frac{1}{3}$
 (ii) Horizontal stretch, scale factor 2

Exercise 5C



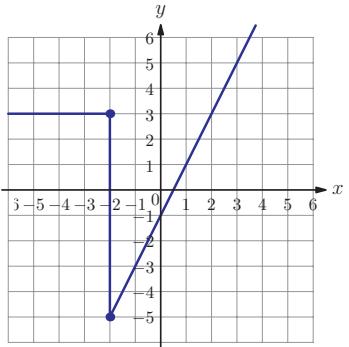
2. (a) (i) $y = -3x^2$ (ii) $y = -9x^3$
 (b) (i) $y = -7x^3 + 3x - 6$ (ii) $y = -8x^2 + 7x - 1$
 (c) (i) $y = 4x^2$ (ii) $y = -7x^3$
 (d) (i) $y = -3x^3 - 5x^2 + 4$ (ii) $y = -x^3 - 6x + 2$

3. (a) (i) Reflection in the x -axis
 (ii) Reflection in the x -axis
 (b) (i) Reflection in the y -axis
 (ii) Reflection in the y -axis
 (c) (i) Reflection in the y -axis
 (ii) Reflection in the x -axis
 (d) (i) Reflection in the y -axis
 (ii) Reflection in the y -axis

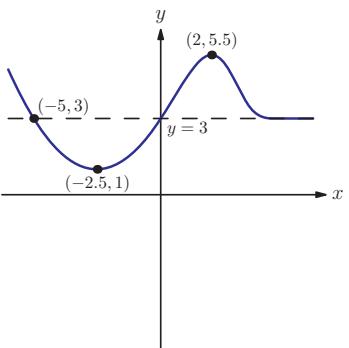
Exercise 5D

1. (a) $y = p(f(x) + c)$ (b) $y = f\left(\frac{x}{q} + d\right)$

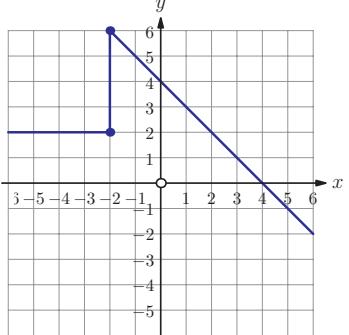
2. (a) (i)

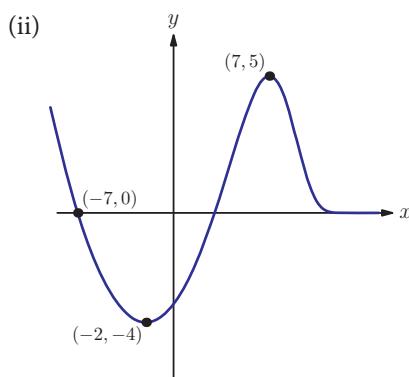
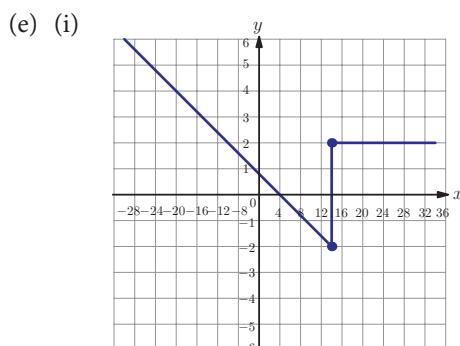
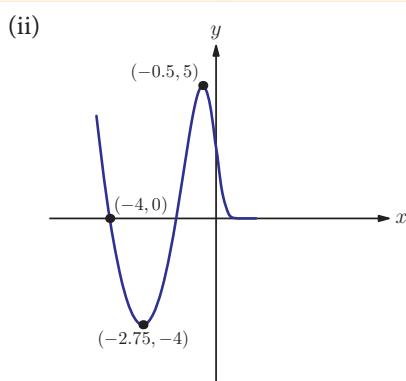
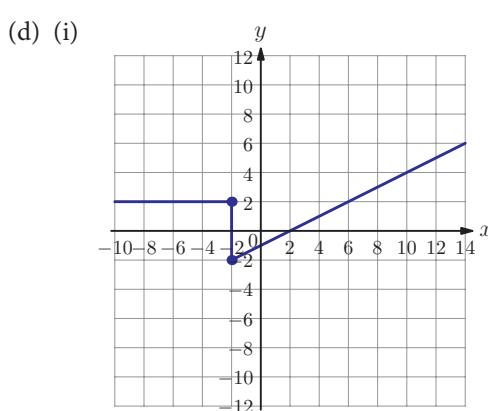
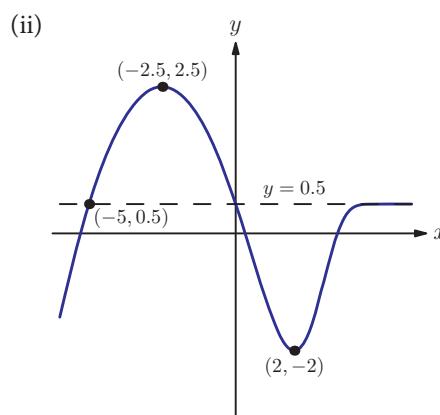
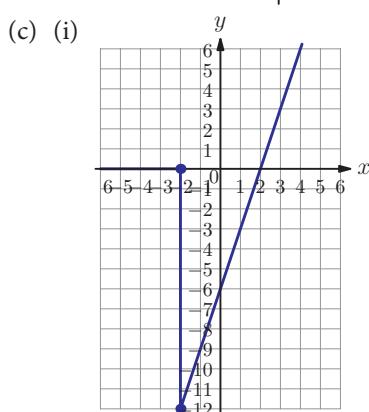
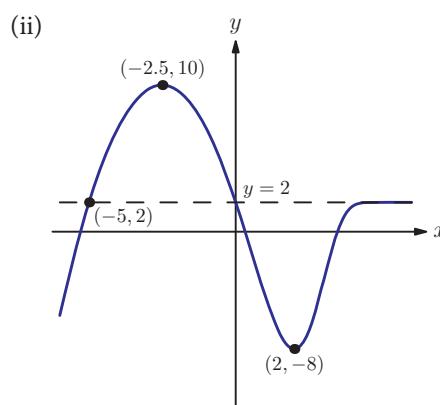


(ii)



- (b) (i)





3. (a) (i) $k(x) = 2f(x) - 6$; vertical stretch with scale factor 2 and then translation $\begin{pmatrix} 0 \\ -6 \end{pmatrix}$

(ii) $k(x) = 5f(x) + 4$; vertical stretch with scale factor 5 and then translation $\begin{pmatrix} 0 \\ 4 \end{pmatrix}$

(b) (i) $h(x) = 5 - 3f(x)$; vertical stretch with scale factor 3, reflection in x -axis and translation $\begin{pmatrix} 0 \\ 5 \end{pmatrix}$

(ii) $h(x) = 4 - 8f(x)$; vertical stretch with scale factor 8, reflection in x -axis and translation $\begin{pmatrix} 0 \\ 4 \end{pmatrix}$

ANSWER HINT (3)

There are alternative answers; for example, (a)(i) could be translation $\begin{pmatrix} 0 \\ -3 \end{pmatrix}$ followed by vertical sketch with s.f.2.

4. (a) (i) $g(x) = 6x^2 - 6$ (ii) $g(x) = x^2 + 1$
 (b) (i) $g(x) = x^2 + 4$ (ii) $g(x) = 7x^2 - 4$
 (c) (i) $g(x) = 4 - 2x^2$ (ii) $g(x) = 6 - 2x^2$
 (d) (i) $g(x) = 5 - x^2$ (ii) $g(x) = -3 - 3x^2$
5. (a) (i) $f(x+1)$; translation $\begin{pmatrix} -1 \\ 0 \end{pmatrix}$
 (ii) $f(x-3)$; translation $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$
 (b) (i) $f(2x)$; horizontal stretch with scale factor $\frac{1}{2}$; or $4f(x)$; vertical sketch with scale factor 4
 (ii) $f\left(\frac{x}{3}\right)$; horizontal stretch with scale factor 3; or $\frac{1}{9}f(x)$; vertical sketch with scale factor $\frac{1}{9}$
 (c) (i) $f(2x+2)$; translation $\begin{pmatrix} -2 \\ 0 \end{pmatrix}$ and then horizontal stretch with scale factor $\frac{1}{2}$ or horizontal stretch with scale factor $\frac{1}{2}$ and then translation $\begin{pmatrix} -1 \\ 0 \end{pmatrix}$
 (ii) $f(3x-1)$; translation $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$ then horizontal stretch with scale factor $\frac{1}{3}$ or horizontal stretch with scale factor $\frac{1}{3}$ and then translation $\begin{pmatrix} 1/3 \\ 0 \end{pmatrix}$
6. (a) (i) $g(x) = 32x^2 - 16x - 2$
 (ii) $g(x) = 8x^2 + 16x + 4$

(b) (i) $g(x) = 8x^2 + 64x + 124$

(ii) $g(x) = \frac{9x^2}{2} - 9x + \frac{1}{2}$

(c) (i) $g(x) = 2x^2 - 12x + 14$

(ii) $g(x) = 2x^2 + 12x + 14$

7. (a) (i) $g(x) = 2f(x+1) - 2$; translation by $\begin{pmatrix} -1 \\ -1 \end{pmatrix}$,

then vertical stretch with scale factor 2

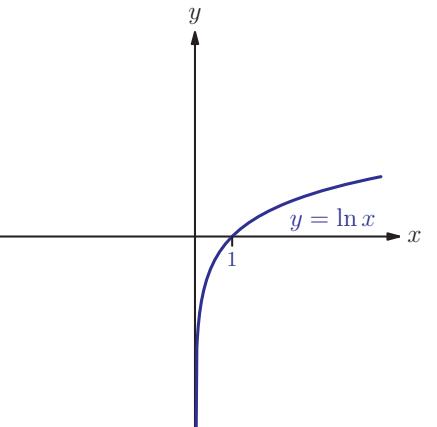
(ii) $g(x) = 3f(x-4) - 40$; vertical stretch with scale factor 3, then translation by $\begin{pmatrix} 4 \\ -40 \end{pmatrix}$

(b) (i) $g(x) = f(x-3) - 4$; translation by $\begin{pmatrix} 3 \\ -4 \end{pmatrix}$

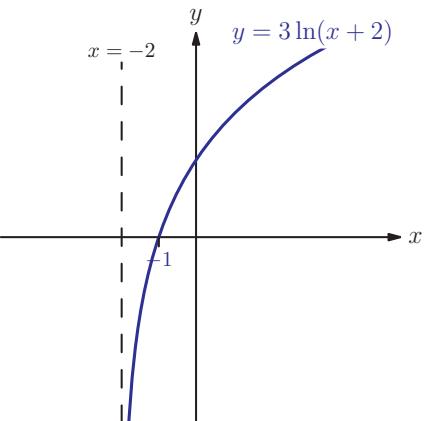
(ii) $g(x) = -4f(x-1) + 8$; vertical stretch with scale factor 4, then translation by $\begin{pmatrix} 8 \\ 1 \end{pmatrix}$

8. $h(x) = 4^{x+1} + 16x - 4$

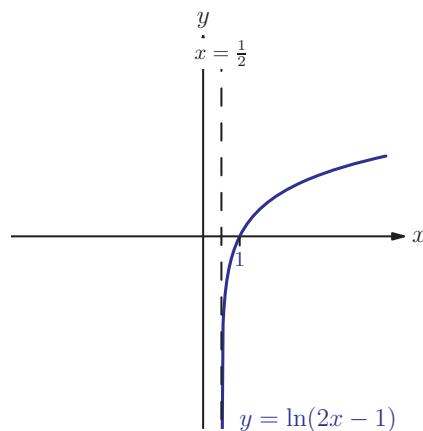
9. (a)



(b)



(c)

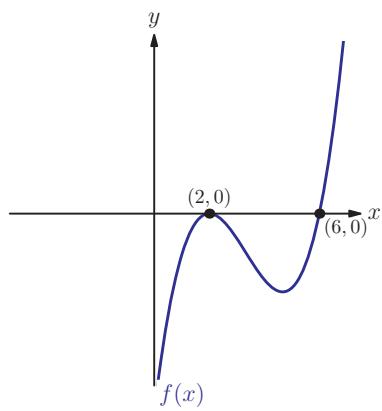


10. (i) $a = 5, b = -1$
(ii) $a = 16, b = 0, c = -25$

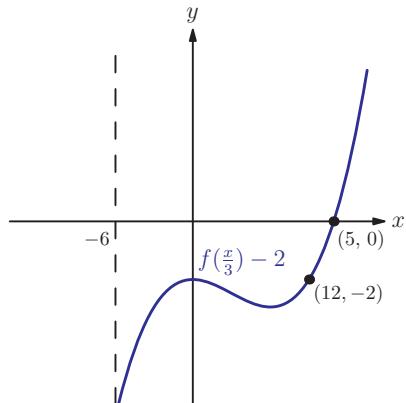
Mixed examination practice 5

Short questions

1. (a)

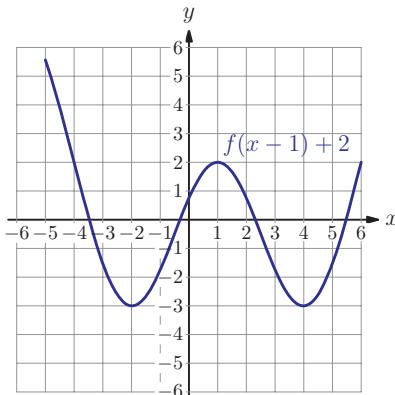


(b)



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

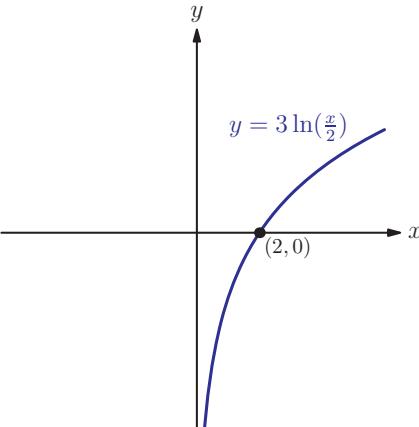
3. (a)



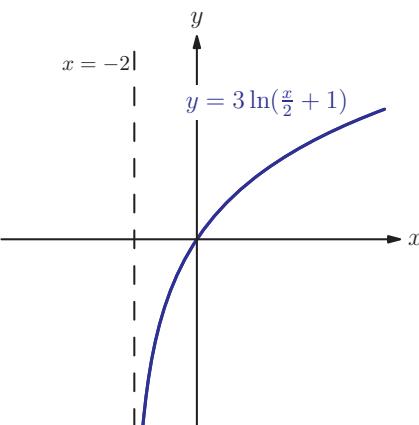
- (b) $(-2, -3)$ and $(4, -3)$

4. Translation by $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ and vertical stretch with scale factor 3
5. (a) Vertical stretch with scale factor 3; horizontal stretch with scale factor 2

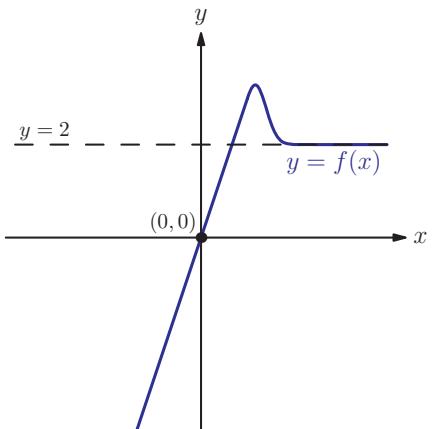
(b)



(c)



6.



Long questions

1. (a) Translation by $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$ and vertical stretch with scale factor 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) Translation by $\begin{pmatrix} -2 \\ 0 \end{pmatrix}$
 (b)
-
- (c) (i) $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$ (ii) $a = -1, b = 6, c = -10, d = -1$

3. (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 $y = x$

Chapter 6

Exercise 6A

1. (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
2. (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
3. (a) (i) $u_{n+1} = u_n + 3, u_1 = 7$
 (ii) $u_{n+1} = u_n - 0.8, u_1 = 1$
 (b) (i) $u_{n+1} = 2u_n, u_1 = 3$
 (ii) $u_{n+1} = 1.5u_n, u_1 = 12$
 (c) (i) $u_{n+1} = u_n + n + 1, u_1 = 1$
 (ii) $u_{n+1} = (n+1)u_n, u_1 = 1$
4. (a) (i) $u_n = 2n$ (ii) $u_n = 2n - 1$
 (b) (i) $u_n = 2^n$ (ii) $u_n = 5^n$
 (c) (i) $u_n = n^2$ (ii) $u_n = n^3$
 (d) (i) $u_n = \frac{n}{n+1}$ (ii) $u_n = \frac{2n-1}{2^n}$
5. (a) 2 (b) $2\left(1 + \frac{1}{n}\right)$
6. (a) 4, 8, 16 (b) (i) $u_n = 2^n$

Exercise 6B

1. (a) (i) 27 (ii) 39
 (b) (i) 116 (ii) $\frac{665}{48}$
 (c) (i) 14b (ii) 19p
2. (a) (i) $\sum_{r=2}^{43} r$ (ii) $\sum_{r=3}^{30} 2r$
 (b) (i) $\sum_{r=1}^6 \frac{1}{2^{r+1}}$ (ii) $\sum_{r=0}^5 \frac{2}{3^r}$
 (c) (i) $\sum_{r=2}^{10} 7ra$ (ii) $\sum_{r=1}^{19} r^b$

Exercise 6C

1. (a) (i) $u_n = 9 + 3(n-1)$ (ii) $u_n = 57 + 0.2(n-1)$
(b) (i) $u_n = 12 - (n-1)$ (ii) $u_n = 18 - \frac{1}{2}(n-1)$
(c) (i) $u_n = 1 + 3(n-1)$ (ii) $u_n = 9 + 10(n-1)$
(d) (i) $u_n = 4 - 4(n-1)$ (ii) $u_n = 27 - 7(n-1)$
(e) (i) $u_n = -17 + 11(n-1)$
(ii) $u_n = -32 + 10(n-1)$
2. (a) (i) 33 (ii) 29
(b) (i) 100 (ii) 226
3. (a) $a_n = 5 + 8(n-1)$ (b) 50
4. 121
5. 25th
6. 17
7. $a = 2, b = -3$
8. (b) 456

Exercise 6D

1. (a) (i) 3060 (ii) 1495
(b) (i) 9009 (ii) 23798
(c) (i) -204 (ii) 1470
(d) (i) 667.5 (ii) 14.25
2. (a) (i) 13 (ii) 32 (iii) 53
(b) $\frac{x}{2}$
3. $a = 15, d = -8$
4. (a) $S_n = \frac{n}{2}(3n+1)$ (b) 30
5. (a) 1, 5, 9 (b) $u_n = 4n - 3$
6. 559
7. $a = 14, d = -8$
8. 55
9. $u_n = 6n - 5$
10. 20°
11. 10300
12. 23926

Exercise 6E

1. (a) (i) $u_n = 6 \times 2^{n-1}$ (ii) $u_n = 12 \times (1.5)^{n-1}$
(b) (i) $u_n = 20 \times (0.25)^{n-1}$ (ii) $u_n = \left(\frac{1}{2}\right)^{n-1}$

- (c) (i) $u_n = (-2)^{n-1}$ (ii) $u_n = 5 \times (-1)^{n-1}$
(d) (i) $u_n = ax^{n-1}$ (ii) $u_n = 3 \times (2x)^{n-1}$
2. (a) (i) 13 (ii) 7
(b) (i) 10 (ii) 10
(c) (i) 10 (ii) 8
3. (a) (i) 15 (ii) 31
(b) (i) 33 (ii) 17
4. 39366
5. 10th
6. 16th
7. 2.5
8. ± 384
9. 7 or -3.5
10. $a = -2, b = 4$
11. 7

Exercise 6F

1. (a) (i) 17089842
(ii) $\frac{36855}{16} \approx 2300$
- (b) (i) 515 (ii) 9.49
(c) (i) 39400 (ii) 9840
(d) (i) 192 OR 64.0
(ii) 2.44×10^7 or 1.63×10^7
2. (a) (i) 3 (ii) 0.2
(b) (i) -6 (ii) -0.947
3. (a) 5 (b) $S_n = \frac{375(5^n - 1)}{4}$
4. $a = 5, r = 1.5$
5. 0.8 or -1.16
6. (a) 1.5 (b) 160

Exercise 6G

1. (a) (i) $\frac{27}{2}$ (ii) $\frac{196}{3}$
(b) (i) $\frac{1}{3}$ (ii) $\frac{26}{33}$
(c) (i) Divergent (ii) Divergent
(d) (i) $\frac{25}{3}$ (ii) $\frac{18}{5}$
(e) (i) Divergent (ii) $\frac{7}{3}$

2. (a) (i) $|x| < 1$ (ii) $|x| < 1$
 (b) (i) $|x| < \frac{1}{3}$ (ii) $|x| < \frac{1}{10}$
 (c) (i) $|x| < \frac{1}{5}$ (ii) $|x| < \frac{1}{3}$
 (d) (i) $|x| < 4$ (ii) $|x| < 12$
 (e) (i) $|x| < 3$ (ii) $|x| < \frac{4}{5}$
 (f) (i) $|x| > 2$ (ii) $|x| > \frac{1}{2}$
 (g) (i) $1 < x < 2$ (ii) $0 < x < 4$
 (h) (i) $\frac{1}{2} < x < 1$ (ii) $x < -0.5$
 (i) (i) $|x| < 1$ (ii) $|x| < \frac{1}{\sqrt[3]{4}}$
3. $-\frac{54}{5}$
4. (a) $S_n = \frac{18(1 - (-\frac{1}{3})^n)}{\frac{4}{3}}$ (b) $\frac{27}{2}$
5. (a) 3 (b) Divergent
6. (a) $\frac{2}{3}$ (b) 9
7. $\frac{1}{8}$
8. (a) $|x| < \frac{3}{2}$ (b) 5
9. 9
10. (a) $1 < x < \frac{5}{3}$ (b) 7
11. (a) $x < 0$ (b) $x = -3$

Exercise 6H

1. (a) £34.78 (b) £1194.05
2. (a) £60,500 (b) 22
3. (a) 5000×1.063^n
 (b) \$6786.35
 (c) (i) $5000 \times 1.063^n > 10000$
 (ii) 12
4. (a) 10 (b) 23.7%
5. (a) \$265.33 (b) 235
6. (a) 12 (b) Day 102
7. (a) 0.8192 m (b) 15.32 m
8. (b) $25000(1.04^n - 1)$
 (c) Year 29

Mixed examination practice 6

Short questions

1. 97.2
 2. 13th
 3. 2
 4. 4.5
 5. 19264
 6. $0, -\frac{1}{4}$
 7. $\ln\left(\frac{a^{69}}{b^{138}}\right)$

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) $150000 \times 1.06^n - \frac{500000 \times (1.06^n - 1)}{3}$
 (c) 40

Chapter 7

Exercise 7A

1. (i) $792x^5y^7$ (ii) $11440a^7b^9$
 (iii) $10c^3d^2$ (iv) $36a^2b^7$
 (v) $15x^2y^4$
2. (a) 12
 (b) 9375
 (c) 3125
3. 0

Exercise 7B

1. (a) 1, 2, 1
(b) 1, 3, 3, 1
(c) 1, 5, 10, 10, 5, 1
2. (a) (i) 35
(b) (i) 1
(c) (i) 8
 (ii) 36
 (ii) 1
 (ii) 45
3. (i) 4
 (ii) 35
 (iii) 7
 (iv) 56
4. 240
5. (a) 5
 (b) 80
6. (a) 10
 (b) 180

Exercise 7C

1. (a) (i) 216
 (b) (i) $560x^3y^4$
 (c) (i) -5
 (ii) 20
 (ii) $-280x^3y^4$
 (ii) 78030
2. (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) $8x^6 - 36x^5 + 54x^4 - 27x^3$
3. (a) $81 - 540x + 1350x^2$
 (b) 80.4614
4. $y^6 + 18y^7 + 135y^8 + 540y^9$
5. (a) $40x^3y^2$
 (b) $-80x^2y^3$
6. -10500
7. 20412 x^2
8. 720
9. 56
10. (a) 128 + 1344x + 6048x²
 (b) (i) 322.88
 (ii) 142.0448
 (c) The answer in (ii) is more accurate; a smaller value of x means that higher-power terms are much smaller and therefore less important, so the error is less.
11. (a) $e^5 + 10e^3 + 40e + \frac{80}{e} + \frac{80}{e^3} + \frac{32}{e^5}$
 (b) $2e^5 + 80e + \frac{160}{e^3}$
12. (a) 6
 (b) 2

13. $16z^8 + 96z^5 + 216z^2 + 216z^{-1} + 81z^{-4}$
14. (a) $(1-x^2)^n$
 (b) $1 - 10x^2 + 45x^4$
15. (a) 3
 (b) $27x^6y^3 + 135x^5y + 225x^4y^{-1} + 125x^3y^{-3}$
16. 80
17. -672
18. $-945x^5$
19. 79 200 000
20. 126
21. $a = 2, n = 5$

Mixed examination practice 7

Short questions

1. -101376
2. $8x^{-3} + 60x^{-2}y + 150x^{-1}y^2 + 125y^3$
3. $232 - 164\sqrt{2}$
4. -32
5. $x^8 - 8x^5 + 24x^2 - 32x^{-1} + 16x^{-4}$
6. 5733
7. -5

Long questions

1. (a)

A Cartesian coordinate system showing a curve. The x-axis is labeled x and the y-axis is labeled y . A point on the curve is marked with a black dot at $(-2, 0)$. The curve has a sharp corner or cusp at $x = -2$, where it appears to have a vertical tangent line.

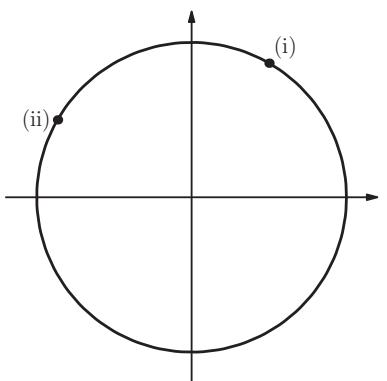
 (b) $x^3 + 6x^2 + 12x + 8$
 (c) 8.012006001
 (d) $x = -4$
2. (a) 5
 (b) 0.5
 (c) $32x^5 + 40x^4y + 20x^3y^2 + 5x^2y^3$
 (d) 3 240 200



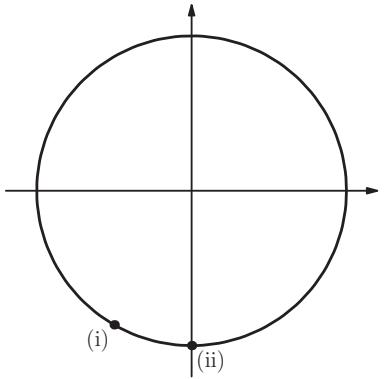
Chapter 8

Exercise 8A

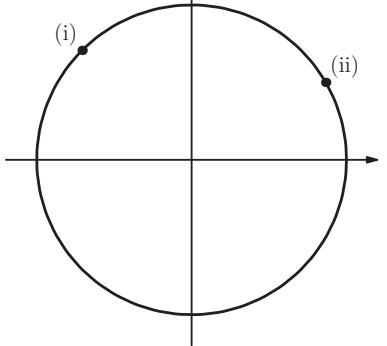
1. (a)



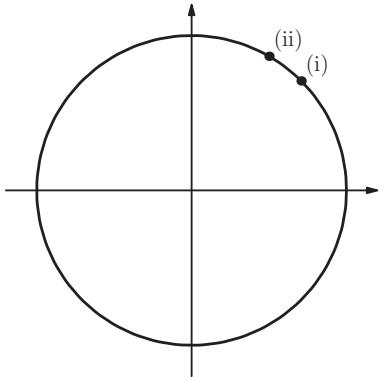
(b)



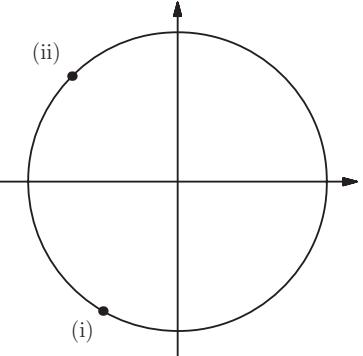
(c)



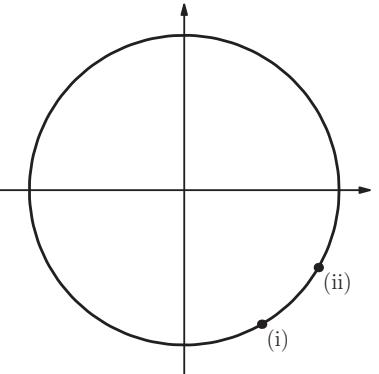
2. (a)



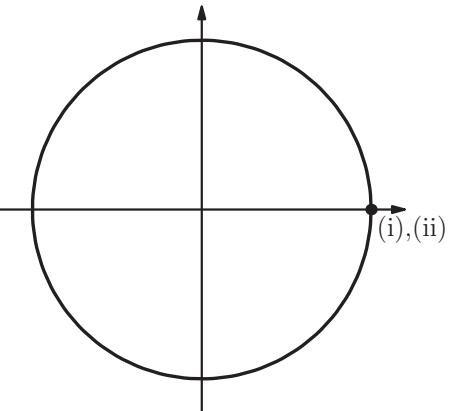
(b)



(c)



(d)



3. (a) (i) $\frac{3\pi}{4}$

(ii) $\frac{\pi}{4}$

(b) (i) $\frac{\pi}{2}$

(ii) $\frac{3\pi}{2}$

(c) (i) $\frac{2\pi}{3}$

(ii) $\frac{5\pi}{6}$

(d) (i) $\frac{5\pi}{18}$

(ii) $\frac{4\pi}{9}$

4. (a) (i) 5.585

(ii) 0.349

(b) (i) 4.712

(ii) 1.571

(c) (i) 1.134

(ii) 2.531

(d) (i) 1.745

(ii) 1.449

5. (a) (i) 60°

(ii) 45°

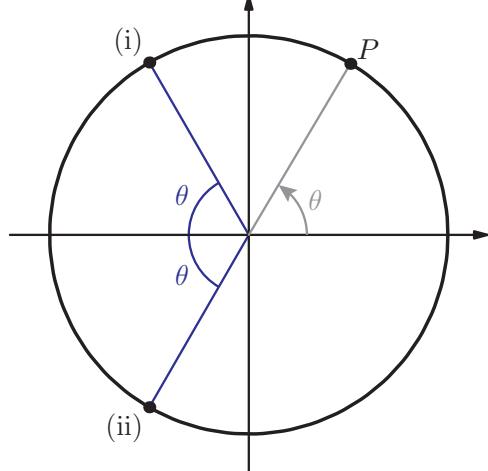
(b) (i) 150°

(ii) 120°

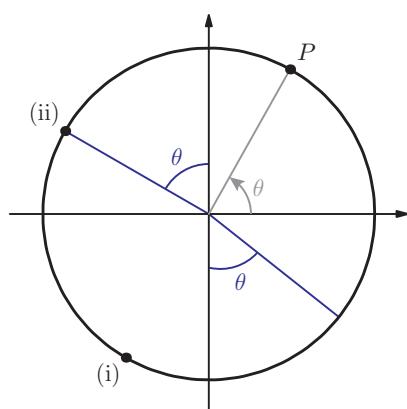
- (c) (i) 270°
 (d) (i) 69.9°

- (ii) 300°
 (ii) 265.3°

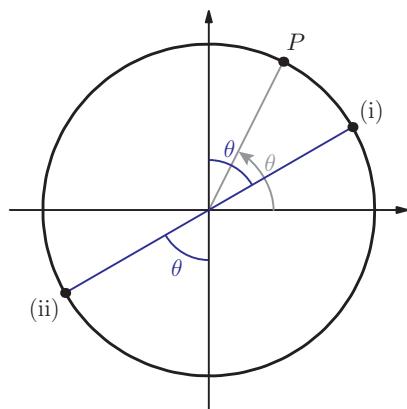
6. (a)



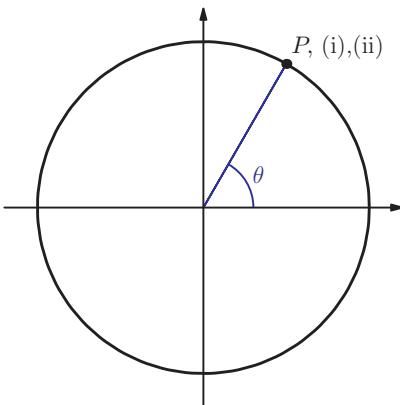
(b)



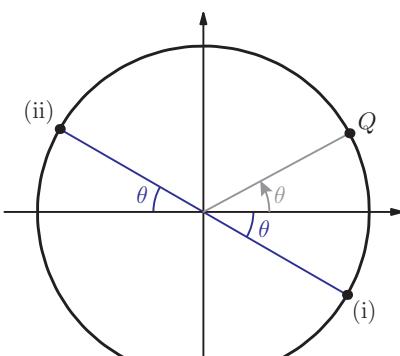
(c)



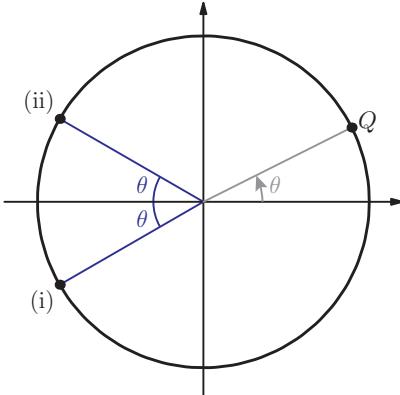
(d)



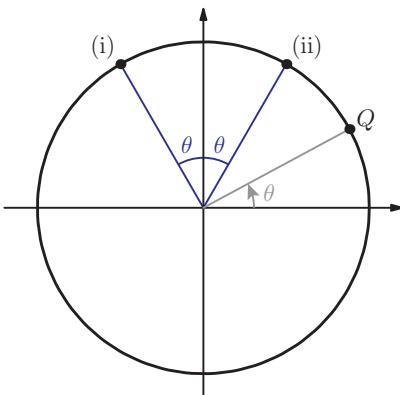
7. (a)

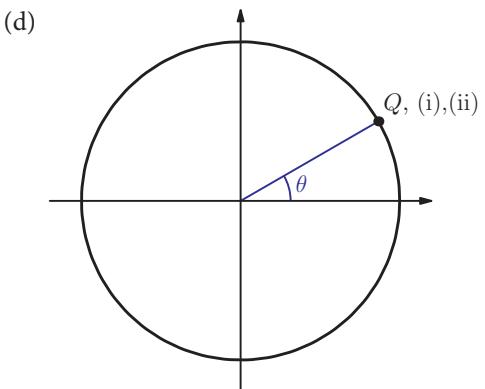


(b)



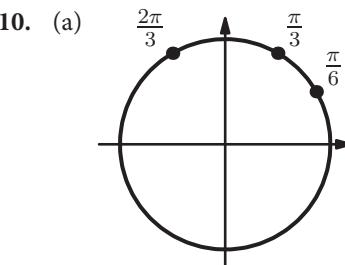
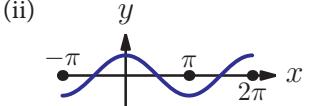
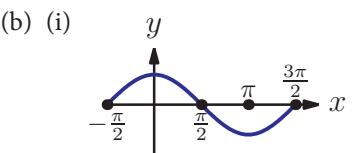
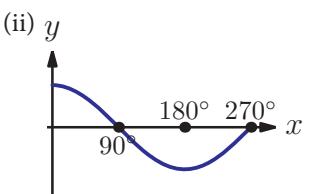
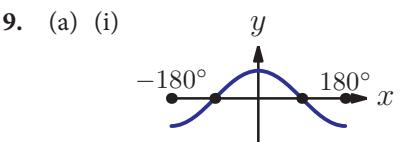
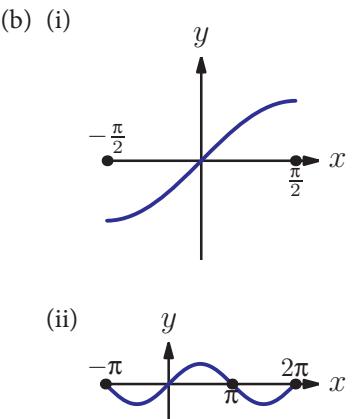
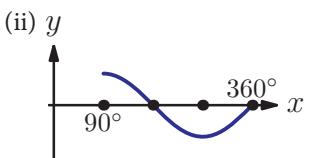
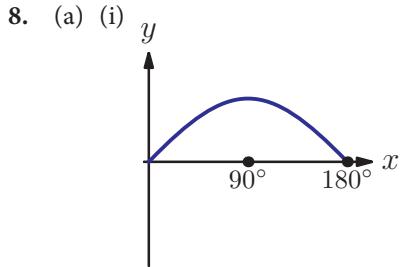
(c)





Exercise 8B

- (a) $\sin x \approx 0.85$, $\cos x \approx 0.5$
 (b) $\sin x \approx -1$, $\cos x \approx 0$
 (c) $\sin x \approx 0.35$, $\cos x \approx -0.95$
 2. (a) (i) 1
 (b) (i) 1
 (c) (i) -1
 (ii) 0
 (ii) -1
 (ii) 0
 3. (a) (i) 0
 (b) (i) -1
 (c) (i) 0
 (ii) -1
 (ii) 1
 (ii) 0
 4. (a) -0.809
 (b) 0.809
 (c) 0.809
 (d) -0.809
 5. (a) -0.866
 (b) -0.866
 (c) -0.866
 (d) 0.866
 6. (a) 0.766
 (b) 0.766
 (c) -0.766
 (d) -0.766
 7. (a) 0.766
 (b) 0.766
 (c) -0.766
 (d) -0.766



13. $-2\cos x$

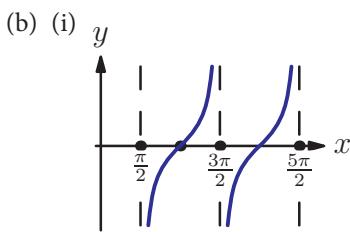
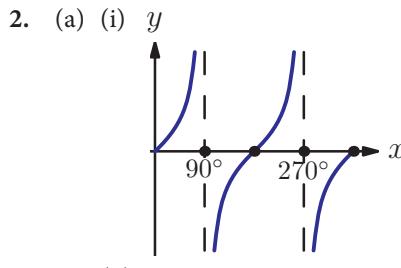
14. $\sin x$

Exercise 8C

1. (a) $\tan x \approx \frac{0.5}{0.85} = 0.59$

(b) $\tan x \approx \frac{-0.5}{-0.85} = 0.59$

(c) $\tan x \approx \frac{-0.5}{0.85} = -0.59$



3. (a) (i) 2.57 (ii) 80.71
(b) (i) -0.760 (ii) -1.62

4. (a) (i) 0.625 (ii) -0.213
(b) (i) 0 (ii) 1.28

5. (a) $-\tan x$ (b) $-\frac{1}{\tan x}$
(c) $\tan x$ (d) $\tan x$

6. (a) $-\tan \theta^\circ$

(c) $\frac{1}{\tan \theta^\circ}$

(b) $-\tan \theta^\circ$

(d) $\tan \theta^\circ$

7. (i)

(ii)

8. (i) 0, 180, 360

(ii) 57.9, 122

9. (i) max (0.805, 1.122); min (5.48, -1.122)
(ii) max (-1.11, 2.24); min (2.03, -2.24)

10. (i) 1.87, 5.07 (ii) 0, 1.57, 3.14

Exercise 8D

1. (a) $-\frac{\sqrt{2}}{2}$ (b) 0

(c) $-\frac{\sqrt{2}}{2}$ (d) -1

2. (a) $\frac{1}{2}$ (b) $-\frac{1}{2}$

(c) $-\frac{1}{2}$ (d) $-\sqrt{3}$

3. (a) $\frac{\sqrt{2}}{2}$ (b) $\frac{\sqrt{2}}{2}$
(c) $-\frac{\sqrt{2}}{2}$ (d) 1

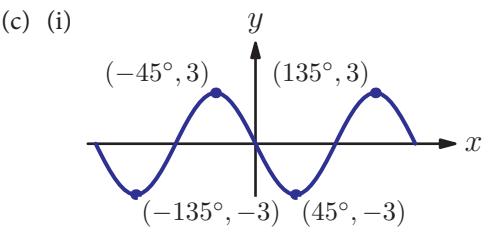
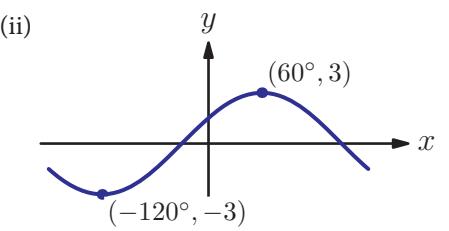
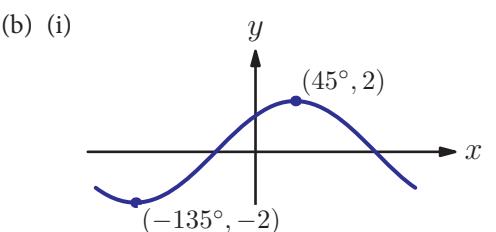
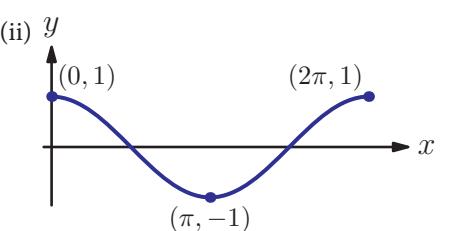
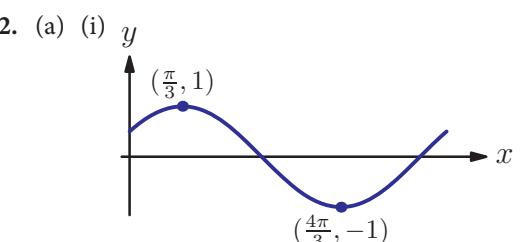
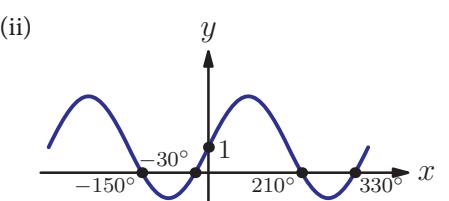
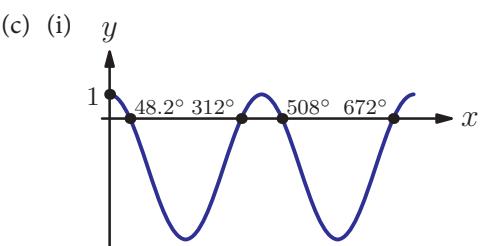
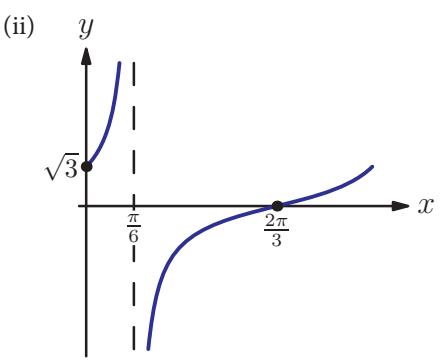
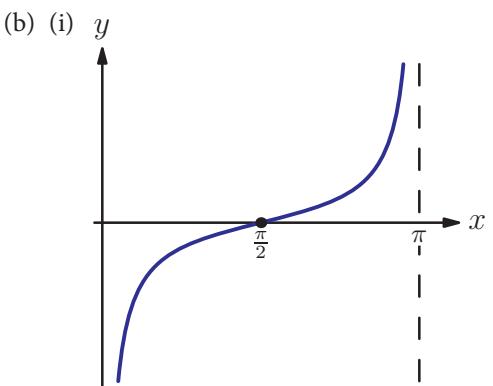
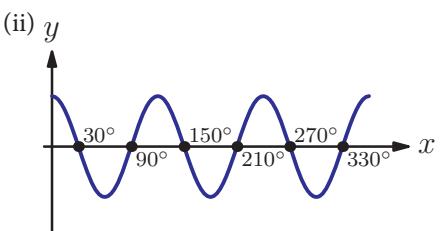
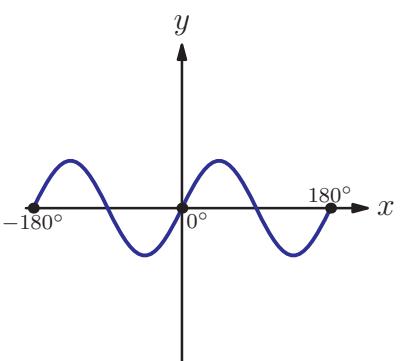
4. (a) $-\frac{1}{2}$ (b) $-\frac{\sqrt{3}}{2}$

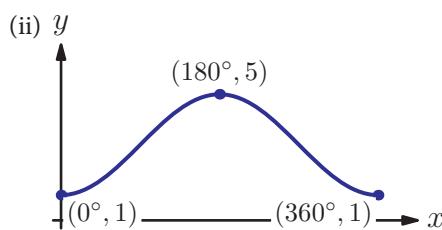
(c) $\frac{\sqrt{3}}{3}$ (d) $-\frac{\sqrt{3}}{3}$

5. (a) $\frac{3}{4}$
 (b) $\frac{\sqrt{2} + \sqrt{3}}{2}$
 (c) $\frac{1 - \sqrt{3}}{2}$

Exercise 8E

1. (a) (i)

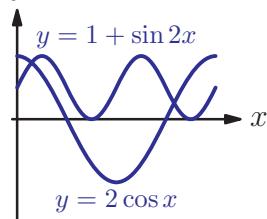




3. (a) Amplitude 3, period $\frac{\pi}{2}$
 (b) Amplitude ∞ , period $\frac{\pi}{3}$
 (c) Amplitude 1, period $\frac{2\pi}{3}$
 (d) Amplitude 2, period 2

4. $p = 5, q = 2$
 5. $a = 2, b = 20^\circ$

6. (a) y



- (b) 2
 - (c) 8

7. (a)

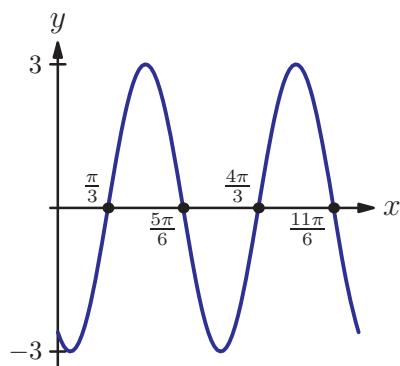
- (b) max $(300^\circ, 2)$; min $(120^\circ, -2)$
 (c) max $(300^\circ, 1)$; min $(120^\circ, -3)$

Exercise 8F

- (a) 9 m, 23 m (b) 6 a.m.
 - $a = 1.5$, $b = \frac{\pi}{6}$, $m = 4.5$
 - (a) $a = 5$, $k = \frac{\pi}{5}$ (b) 6.02 s and 8.98 s
 - (a) 110 cm, 130 cm
 (b) $\frac{\pi}{200}$ s
 (c) $\frac{\pi}{400}$ s

Mixed examination practice 8

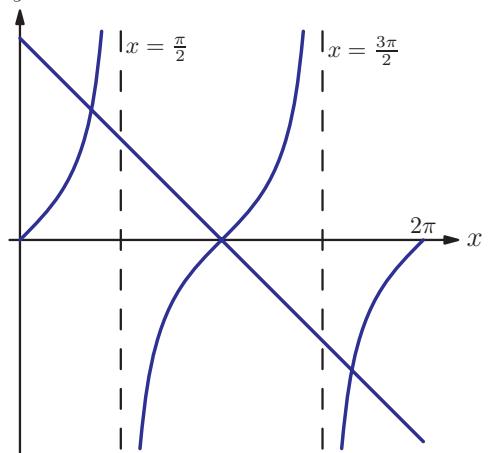
Short questions



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

Long questions

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



- (b) (i) $\pi, 2\pi - x_0$ (ii) infinitely many
- (c) (i) s, c (iii) $\sqrt{3}, \frac{1}{\sqrt{3}}$ (iv) $\frac{\pi}{6}, \frac{\pi}{3}$
3. (a) $-1; \pi$
(b) (i) translation $\begin{pmatrix} -\frac{\pi}{6} \\ 0 \end{pmatrix}$ and vertical 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 9

Exercise 9A

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) $30^\circ, 150^\circ$ (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) $60^\circ, 240^\circ$
6. (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) $\frac{3\pi}{4}, \frac{7\pi}{4}$
7. (a) (i) $26.7^\circ, 153.3^\circ$ (ii) $44.4^\circ, 135.6^\circ$
(b) (i) $\pm 138.6^\circ$ (ii) $\pm 101.5^\circ$
(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) $-165.5^\circ, -14.5^\circ, 194.5^\circ, 345.5^\circ$

8. (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) $-2.78, -0.358, 3.50, 5.93$
(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

9. (a) (i) $30^\circ, 150^\circ, -330^\circ, -210^\circ$
(ii) $45^\circ, 135^\circ, -315^\circ, -225^\circ$
(b) (i) $\pm 180^\circ$ (ii) -90°
(c) (i) $-300^\circ, -120^\circ$ (ii) $-315^\circ, -135^\circ$
(d) (i) $\pm 225^\circ, \pm 135^\circ$ (ii) $\pm 210^\circ, \pm 150^\circ$

10. (a) (i) $\pm \frac{5\pi}{3}, \pm \frac{\pi}{3}$ (ii) $\pm \frac{\pi}{6}, \pm \frac{11\pi}{6}$
(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) $-\frac{7\pi}{4}, -\frac{5\pi}{4}$

11. (a) (i) $5.74^\circ, 174.3^\circ$ (ii) $-14.5^\circ, 194.5^\circ$
(b) (i) 1.11, 5.17 (ii) 1.00, 5.28
(c) (i) 1.03, -2.11 (ii) 1.14, 4.29

12. $-\frac{\pi}{6}, -\frac{5\pi}{6}$

Exercise 9B

1. (a) (i) $\pm 0.955, \pm 2.19$
(ii) $\pm 0.866, \pm 2.26$
(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) $90^\circ, 270^\circ$
(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) $0, \pi, \frac{7\pi}{6}, \frac{11\pi}{6}, 2\pi$
(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. $\pm\sqrt{\frac{\pi}{6}}, \pm\sqrt{\frac{5\pi}{6}}, \pm\sqrt{\frac{13\pi}{6}}, \pm\sqrt{\frac{17\pi}{6}}$

Exercise 9C

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

7. (a) $5 - \frac{2}{\cos^2 x}$ (b) $\frac{1}{1 - 2\sin^2 x + \sin^4 x}$
8. (a) $\frac{1}{1+t^2}$ (b) $\frac{t^2}{1+t^2}$
(c) $\frac{1-t^2}{1+t^2}$ (d) $\frac{2+3t^2}{t^2}$

Exercise 9D

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) $-\pi, -2.55, 0, 0.588, \pi$
(c) 26.6°
(d) $\frac{\pi}{2}, \frac{3\pi}{2}, 2.50, 5.64$
4. (a) (i) $45^\circ, 135^\circ, 225^\circ, 315^\circ$
(ii) $54.7^\circ, 125.3^\circ, 234.7^\circ, 305.3^\circ$
(b) (i) $45^\circ, 135^\circ, 225^\circ, 315^\circ$
(ii) $0^\circ, 180^\circ, 360^\circ$
5. $\pm 41.8^\circ, \pm 138.2^\circ$
6. $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{3\pi}{2}$
7. $-0.253, -2.89, -\frac{\pi}{2}$
8. $\frac{1}{3}$
9. (a) $-\frac{1}{2}, \frac{2}{3}$
(b) $48.2^\circ, 120^\circ, 240^\circ, 311.8^\circ$
10. (b) $\frac{\pi}{4}, -\frac{3\pi}{4}, 0.464, -2.68$

Exercise 9E

1. (a) (i) $-\frac{7}{8}$ (ii) $\frac{1}{9}$
(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) $\frac{2+\sqrt{3}}{4}$
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) $\pm\frac{\pi}{2}, 0.305, 2.84$ (d) $0^\circ, 180^\circ, 360^\circ$
6. $\pm 0.955, \pm 2.19$

ANSWER HINT

Did you use your GDC to solve this?

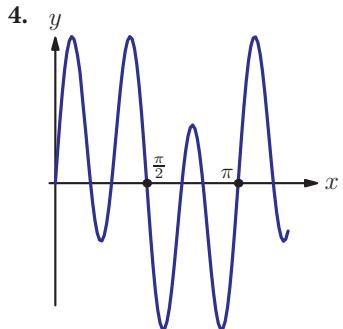
8. (a) $8\cos^4 \theta - 8\cos^2 \theta + 1$
 (b) $8\sin^4 \theta - 8\sin^2 \theta + 1$
9. (b) $\frac{1-\cos x}{1+\cos x}$
10. $\frac{2a-b}{4a}$

Mixed examination practice 9

Short questions

1. $-31.8, 148.2$
2. (a) $\frac{\sqrt{5}}{3}$ (b) $\frac{1}{9}$

3. $\pm 0.730, \pm 2.41$



6. $\frac{\pi}{2}, \frac{3\pi}{2}, \frac{2\pi}{3}, \frac{4\pi}{3}$

7. $48.2^\circ, 311.8^\circ, 120^\circ, 240^\circ$

8. $\frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{3\pi}{2}$

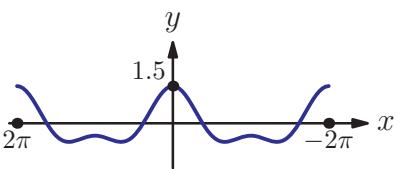
Long questions

1. (a) 3π metres

(b) 5.05 m

(c) 1.50 m

2. (a)



(b) 2π

(d) 1.2

(c) $0, \pm\pi, \pm 2\pi$

(e) (ii) $2\pi - x_0$

3. (a) ± 4

(c) (i) 1

(ii) $\pm\frac{\pi}{3}, \pm\frac{5\pi}{3}$

(iii) 5

(iv) 7

Chapter 10

Exercise 10B

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. $A = 49.9^\circ, B = 95.1^\circ$ and $AC = 10.4$ cm or
 $A = 130.1^\circ, B = 14.9^\circ$ and $AC = 2.69$ cm

5. 9.94 cm

6. 23.3 m

Exercise 10C

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) 99.9°
3. (i) 106° (ii) 36.3°
4. 6.12 km
5. 7.95

6. 4.4

7. $2\sqrt{2} + \sqrt{41}$

Exercise 10D

1. (a) (i) 10.7 cm^2 (ii) 24.3 cm^2
(b) (i) 27.6 cm^2 (ii) 26.2 cm^2
2. (i) $81.7^\circ, 98.3^\circ$ (ii) $60.9^\circ, 119^\circ$
3. $LN = 17.7 \text{ cm}$, area = 29.7 cm^2
4. $4\sqrt{3}$

Exercise 10E

1. (i) $\sqrt{134} = 11.6 \text{ cm}$ (ii) $\sqrt{96} = 9.80 \text{ cm}$
2. Angles $47.6^\circ, 59.7^\circ, 72.7^\circ$; area 85.6 cm^2
3. 62.5°
4. $\sqrt{176} = 13.3 \text{ cm}$
5. (a) $\sqrt{145} = 12.0 \text{ cm}$ (b) $\sqrt{290} = 17.0 \text{ cm}$
6. (a) 18.8 m (b) 28.1 m
7. (a) $RA = \frac{h}{\tan \alpha}$ $RB = \frac{h}{\tan \beta}$
(b) 13 m

Exercise 10F

1. (i) 7.8 cm (ii) 1.8 cm
2. (i) 82.2 cm (ii) 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. $\left(\frac{25\pi}{6} + 10\right) \text{ cm}$
11. 5 cm
12. $\frac{6\pi}{5}$

Exercise 10G

1. (i) 16.25 cm^2 (ii) 0.072 cm^2
2. (i) 463 cm^2 (ii) 4.79 cm^2
3. 0.8

4. 167°

5. $\sqrt{90} = 9.49 \text{ cm}$

6. 11.3 cm

7. 5.14 cm^2

8. 48.4 cm^2

9. 2 cm or 1.5 cm

10. $\pi - 0.6 = 2.54$

Exercise 10H

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 cm^2 (ii) 1.21 cm^2
(b) (i) 149 cm^2 (ii) 70.1 cm^2
4. (a) $\frac{25}{2}(\theta - \sin \theta) \text{ cm}^2$ (b) 2.08
5. (b) 70.1° (c) 3.67 cm^2

Mixed examination practice 10

Short questions

1. (a) $\frac{\pi}{3}$
(b) 28.9 cm^2
(c) 23.8 cm
2. 80 cm^2
3. $58.7^\circ, 121.3^\circ$
4. (a) 8.09 m (b) 6.58 m
5. (a) 10.2 cm^2 (b) 18.8 cm
6. (b) 7
7. 12.3 cm^2
8. (a) 1.14 cm^2 (b) 2 cm^2
9. (a) $\frac{\pi}{2} - \theta$ (b) 47.7 cm^2
10. 4 cm or 13 cm
11. $2\sqrt{43}$
12. 7.23 cm^2
13. (a) $\frac{23}{32}$
(b) $\frac{3\sqrt{55}}{32}$
(c) $\frac{15\sqrt{55}}{4} \text{ cm}^2$

Long questions

1. (a) $25 + \frac{x^2}{4} - 5x \cos \theta$
 (c) 41.4°

2. (b) $r\sqrt{2}$
 (c) $\frac{\pi r^2}{4}$

(d) $r^2 \left(\frac{\pi}{2} - 1 \right)$

3. (b) $\pi r^2 - \frac{1}{2}r^2\theta$
 (d) 2.50

4. (a) $\frac{4.42}{3x^2}$
 (b) $\frac{3x^2 - 2x - 3}{2x^2} = \frac{3}{2} - \frac{1}{x} - \frac{3}{2x^2}$

(d) (i) 1.24, 2.94 (ii) 1.86, 0.172

5. (b) $\frac{\sqrt{3}}{2} \leq \cos \theta < 1$ or $-1 < \cos \theta \leq -\frac{\sqrt{3}}{2}$
 (c) $0^\circ < \theta \leq 30^\circ$ or $150^\circ \leq \theta < 180^\circ$

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) $z^2 = 36 + x^2 - 12x \cos Z$

(e) (i) 12 (ii) isosceles

8. (a) $\frac{\pi}{2}$; a tangent to a circle makes a right angle with the radius
 (b) ABO₂P is a rectangle, because there are right angles at A and B, and AB is parallel to PO₂.
 (c) $\sqrt{600} = 24.5$ cm
 (d) 1.369
 (e) 85.6 cm

Chapter 11

Exercise 11A

1. (a) (i) \mathbf{b}
 (b) (i) $-\mathbf{a}$

(ii) $\mathbf{a} + \mathbf{b}$
 (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) $\mathbf{a} + \frac{4}{3}\mathbf{b}$
 (b) (i) $-\frac{3}{2}\mathbf{a} + \mathbf{b}$
 (c) (i) $\frac{3}{2}\mathbf{a} - \mathbf{b}$

(ii) $\mathbf{a} + \frac{1}{2}\mathbf{b}$
 (ii) $-\frac{1}{2}\mathbf{b} + \frac{1}{2}\mathbf{a}$
 (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 11B

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) $-\frac{1}{2}\mathbf{i} + \mathbf{j} - \frac{1}{2}\mathbf{k}$
4. $\begin{pmatrix} 2 \\ 0 \\ -3/4 \end{pmatrix}$
5. -2
6. $-\frac{4}{3}$
7. -2
8. $p = \frac{3}{8}, q = \frac{1}{8}$

Exercise 11C

1. $|\mathbf{a}| = 2\sqrt{5}, |\mathbf{b}| = \sqrt{26}, |\mathbf{c}| = 2\sqrt{5}, |\mathbf{d}| = \sqrt{2}$
2. $|\mathbf{a}| = \sqrt{21}, |\mathbf{b}| = \sqrt{2}, |\mathbf{c}| = \sqrt{21}, |\mathbf{d}| = \sqrt{2}$
3. (a) (i) $\sqrt{29}$ (ii) $\sqrt{2}$
 (b) (i) $\sqrt{58}$ (ii) $\sqrt{5}$
4. (a) (i) $\sqrt{19}$ (ii) $\sqrt{38}$
 (b) (i) $\sqrt{74}$ (ii) $\sqrt{13}$
5. (a) $\sqrt{53}$ (b) $\sqrt{94}$
 (c) $\sqrt{53}$ (d) $\sqrt{2}$
6. (a) (i) $\frac{1}{3} \begin{pmatrix} 2 \\ 2 \\ 1 \end{pmatrix}$ (ii) $\frac{1}{3} \begin{pmatrix} 2 \\ 2 \\ -1 \end{pmatrix}$
 (b) (i) $\frac{1}{\sqrt{3}} \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$ (ii) $\frac{1}{5} \begin{pmatrix} 4 \\ -1 \\ 2\sqrt{2} \end{pmatrix}$
7. $\pm 2\sqrt{6}$
8. $\frac{3}{2}$

9. $3, -\frac{5}{3}$
10. (a) $\begin{pmatrix} 4\sqrt{2} \\ -\sqrt{2} \\ \sqrt{2} \end{pmatrix}$ (b) $\begin{pmatrix} \sqrt{6} \\ -\sqrt{6}/2 \\ \sqrt{6}/2 \end{pmatrix}$

11. $-2, -\frac{23}{15}$

12. $t = \frac{1}{3}, d = \sqrt{\frac{14}{3}}$

Exercise 11D

1. (a) (i) 1.12 (ii) 1.17
 (b) (i) 1.88 (ii) 1.13
 (c) (i) 1.23 (ii) 1.77
2. (a) (i) $-\frac{5}{2\sqrt{21}}$ (ii) $-\frac{20}{\sqrt{570}}$
 (b) (i) $-\frac{2}{\sqrt{102}}$ (ii) $\frac{1}{\sqrt{35}}$
 (c) (i) 0 (ii) 0
3. (i) $61.0^\circ, 74.5^\circ, 44.5^\circ$ (ii) $94.3^\circ, 54.2^\circ, 31.5^\circ$
4. (a) (i) No (ii) Yes
 (b) (i) Yes (ii) No
5. 87.7°
6. 40.0°
7. (b) $73.2^\circ, 106.8^\circ$ (c) $\frac{5}{4}$
 8. (b) $41.8^\circ, 48.2^\circ$ (c) $6\sqrt{5}$

Exercise 11E

1. (a) (i) 16 (ii) -56
 (b) (i) 16 (ii) -16
 (c) (i) 9 (ii) 9
 (d) (i) -4 (ii) 0
2. (a) (i) $\frac{7}{3\sqrt{6}}$ (ii) $\frac{5}{\sqrt{39}}$
 (b) (i) $\frac{2}{3}$ (ii) $\frac{1}{\sqrt{10}}$
3. (i) 48.2° (ii) 98.0°
4. (a) 19.2
 (b) 3
6. (a) (i) $-\frac{1}{2}$ (ii) $\frac{2}{7}$
 (b) (i) $\frac{4}{5}$ (ii) $0, \frac{3}{2}$

7. (a) 19
(b) 7
(c) 32
8. (a) 2
(b) 6
9. (a) $\frac{52}{9}$
10. (a) 1.6
(b) $21.3^\circ, 68.7^\circ, 90^\circ$
(c) 88.7
11. (a) $\overrightarrow{AC} = \mathbf{a} + \mathbf{b}, \overrightarrow{BD} = \mathbf{b} - \mathbf{a}$
(b) $|\mathbf{b}|^2 - |\mathbf{a}|^2$
12. (b) 2
(c) $4\sqrt{5}$

Exercise 11F

1. (a) (i) $r = \begin{pmatrix} 4 \\ -1 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 4 \end{pmatrix}$ (ii) $r = \begin{pmatrix} 4 \\ 1 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ -3 \end{pmatrix}$
(b) (i) $r = \begin{pmatrix} 1 \\ 0 \\ 5 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 3 \\ -3 \end{pmatrix}$ (ii) $r = \begin{pmatrix} -1 \\ 1 \\ 5 \end{pmatrix} + \lambda \begin{pmatrix} 3 \\ -2 \\ 2 \end{pmatrix}$
(c) (i) $r = \begin{pmatrix} 4 \\ 0 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ 3 \end{pmatrix}$ (ii) $r = \begin{pmatrix} 0 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ -3 \end{pmatrix}$
(d) (i) $r = \begin{pmatrix} 0 \\ 2 \\ 3 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 0 \\ -3 \end{pmatrix}$ (ii) $r = \begin{pmatrix} 4 \\ -3 \\ 0 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ 3 \\ -1 \end{pmatrix}$
2. (a) (i) $r = \begin{pmatrix} 4 \\ 1 \end{pmatrix} + \lambda \begin{pmatrix} -3 \\ 1 \end{pmatrix}$ (ii) $r = \begin{pmatrix} 2 \\ 7 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ -9 \end{pmatrix}$
(b) (i) $r = \begin{pmatrix} -5 \\ -2 \\ 3 \end{pmatrix} + \lambda \begin{pmatrix} 9 \\ 0 \\ 0 \end{pmatrix}$ (ii) $r = \begin{pmatrix} 1 \\ 1 \\ 3 \end{pmatrix} + \lambda \begin{pmatrix} 9 \\ -6 \\ 3 \end{pmatrix}$
3. (a) (i) Yes
(b) (i) No
4. (b) $(0, 3, 0)$
5. (a) $r = \begin{pmatrix} 7 \\ 1 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} -4 \\ -2 \\ 3 \end{pmatrix}$
(b) $(-5, -5, 11)$ or $(19, 7, -7)$
6. (a) $r = \begin{pmatrix} 2 \\ 1 \\ 4 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ -3 \\ 6 \end{pmatrix}$

- (b) 7
(c) $(-8, 16, -26)$ and $(12, -14, 34)$

Exercise 11G

1. (a) (i) 44.5°
(b) (i) 26.6°
(ii) 56.5°
(ii) 82.1°
2. (a) Perpendicular
(b) None (skew)
(c) Parallel
(d) Same line
3. (a) (i) $(10, -7, -2)$
(b) (i) No intersection
(ii) $(4.5, 0, 0)$
(ii) No intersection
4. $\left(\frac{64}{9}, \frac{4}{9}, \frac{19}{9} \right)$
5. $\frac{\sqrt{66}}{11}$
6. (a) $(4, 1, -2)$
(c) $(1, 1, 2)$
(d) $\frac{5\sqrt{26}}{2}$
7. 3
8. (a) $\left(\frac{5}{6}, \frac{19}{6}, \frac{9}{2} \right)$
(b) 48.5°
(d) $\frac{11\sqrt{11}}{6} (= 6.08)$
(e) 4.55
9. (a) $(9, -5, 8)$
(c) $(3, 4, -1)$
10. (b) $(2 + \sqrt{6}, -1 - 2\sqrt{6}, 2\sqrt{6})$ or
 $(2 - \sqrt{6}, 2\sqrt{6} - 1, -2\sqrt{6})$

Mixed examination practice 11

Short questions

1. $r = \begin{pmatrix} 3 \\ -1 \\ 1 \end{pmatrix} + \lambda \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$
2. (a) $\frac{1}{2}\overrightarrow{AD} - \overrightarrow{AB}$
3. $(11, 13, 8)$
4. $\left(\frac{11}{3}, \frac{20}{3}, \frac{2}{3} \right)$ or $\left(-\frac{29}{3}, -\frac{20}{3}, \frac{22}{3} \right)$

5. (a) $\mathbf{r} = \begin{pmatrix} 4 \\ 1 \\ 12 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ -3 \\ 2 \end{pmatrix}$

(b) $\left(\frac{31}{14}, \frac{89}{14}, \frac{59}{7} \right)$

6. 74.4°

7. $\frac{\pi}{2} - 2\theta$

8. 0

Long questions

1. (a) $\begin{pmatrix} 2 \\ 0 \\ k-7 \end{pmatrix}$

(c) $(3, 6, 1)$

(d) $-\frac{1}{\sqrt{10}}$

2. (b) $\sqrt{33}$

(c) 45.7°

(d) 4.11

3. (a) $\begin{pmatrix} -1 + \frac{3}{k+1} \\ \frac{3}{k+1} \\ -4 \end{pmatrix}$

(b) 5

(c) $\left(\frac{3}{2}, \frac{3}{2}, 2 \right)$

(d) $\sqrt{\frac{33}{2}}$

4. (a) (a, a^2)

(b) $\overrightarrow{PO} = \begin{pmatrix} -a \\ -a^2 \end{pmatrix}, \overrightarrow{PS} = \begin{pmatrix} -a \\ 4-a^2 \end{pmatrix}$

(c) $\sqrt{3}$

(d) $2\sqrt{3}$

5. (a) $\begin{pmatrix} 3t \\ 4t \end{pmatrix}$

(b) $\begin{pmatrix} 3t \\ 18-5t \end{pmatrix}$

(d) $t=2$

(e) 2 hours

6. (a) $\begin{pmatrix} 3t \\ 5-4t \\ t \end{pmatrix}$

(d) 30 km

7. (b) (i) $\begin{pmatrix} \mu - 2\lambda + 8 \\ \mu + \lambda - 3 \\ -\mu + 8\lambda - 16 \end{pmatrix}$

(iii) $3\mu - 9\lambda + 21 = 0$

(iv) $P(1, 1, 2), Q(4, -1, 3)$

(v) $\sqrt{14}$

8. (a) $\mathbf{r} = \begin{pmatrix} -2 \\ 4 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$

(b) $\frac{1}{2}$

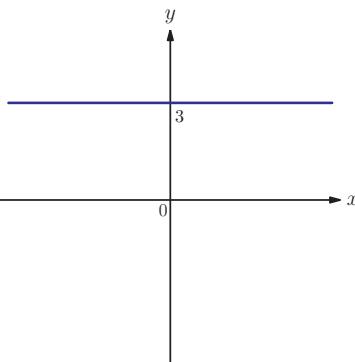
(c) $3\sqrt{2}$

(d) $\frac{3\sqrt{2}}{2}$

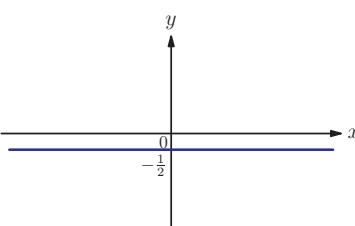
Chapter 12

Exercise 12A

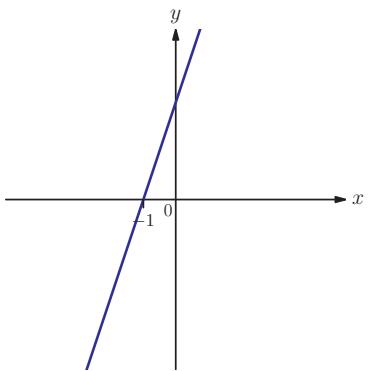
1. (a) (i)



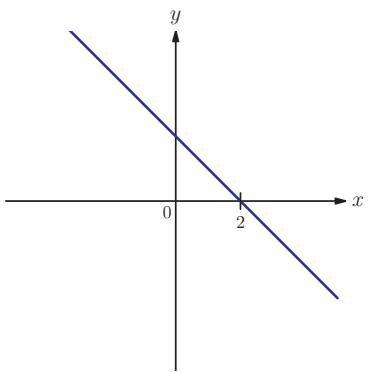
(ii)



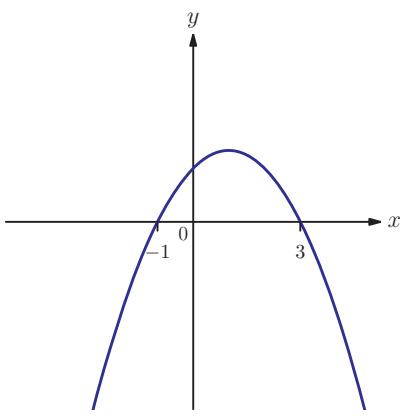
(b) (i)



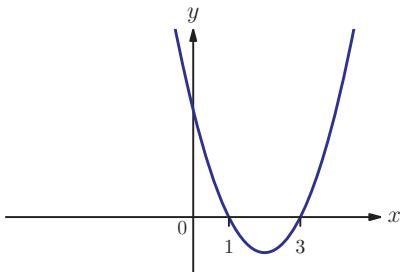
(ii)



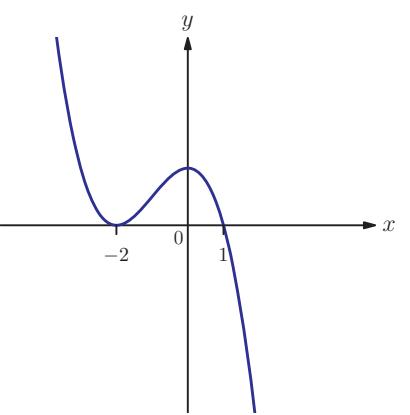
(c) (i)



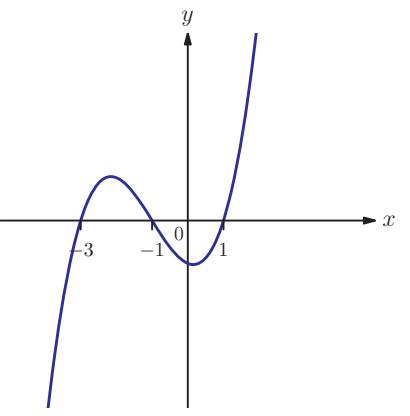
(ii)



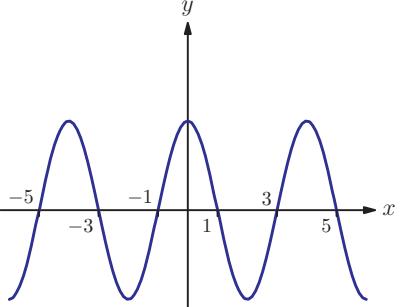
(d) (i)



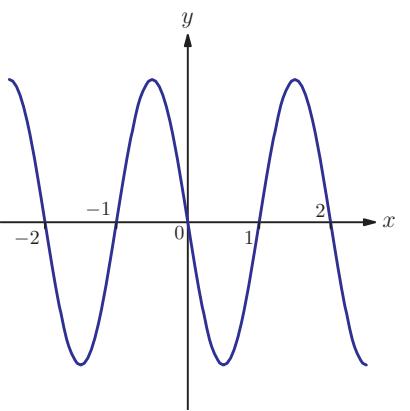
(ii)



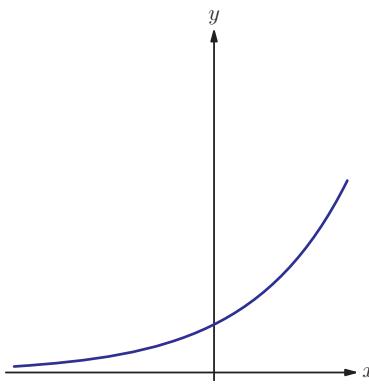
(e) (i)



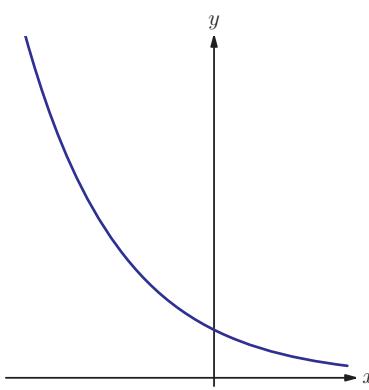
(ii)



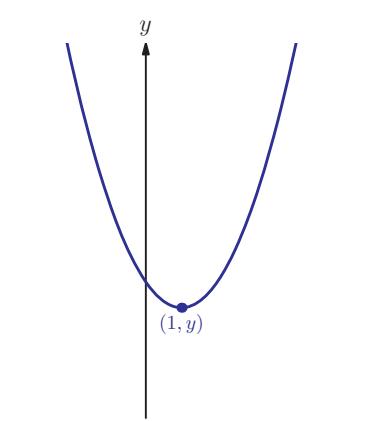
(f) (i)



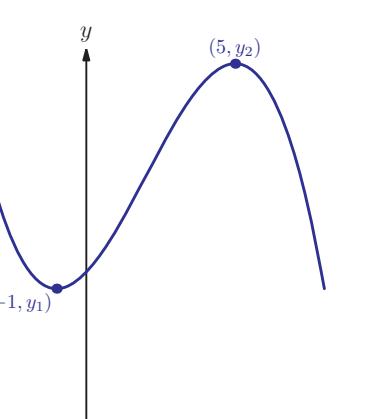
(ii)



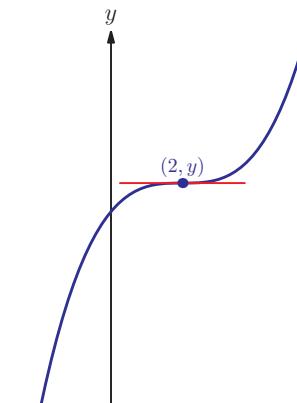
2. (a)



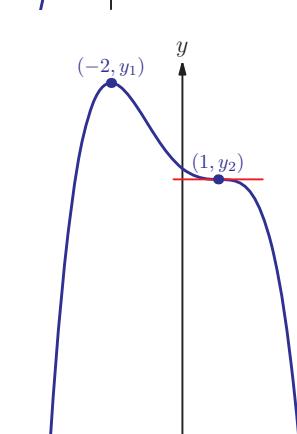
(b)



(c)



(d)



3. (a) Sometimes true
 (b) Sometimes true
 (c) Always true
 (d) Sometimes true
 (e) Sometimes true
 (f) Sometimes true

Exercise 12B

- | | |
|---------------------------|-----------------------|
| 1. (a) (i) $f'(x) = 3x^2$ | (ii) $f'(x) = 4x^3$ |
| (b) (i) $f'(x) = -4$ | (ii) $f'(x) = 6x$ |
| (c) (i) $f'(x) = 2x - 6$ | (ii) $f'(x) = 2x - 3$ |

Exercise 12C

- | | |
|--------------------------------|-----------------------------|
| 1. (a) (i) $y' = 4x^3$ | (ii) $y' = 1$ |
| (b) (i) $y' = 21x^6$ | (ii) $y' = -20x^4$ |
| (c) (i) $y' = 0$ | (ii) $y' = 0$ |
| (d) (i) $y' = 12x^2 - 10x + 2$ | (ii) $y' = 8x^3 + 9x^2 - 1$ |
| (e) (i) $y' = 2x^5$ | (ii) $y' = -\frac{3}{2}x$ |

(f) (i) $y' = 7 - \frac{3}{2}x^2$ (ii) $y' = -20x^3 + x^4$

(g) (i) $y' = \frac{3}{2}x^{\frac{1}{2}}$ (ii) $y' = \frac{2}{3}x^{-\frac{1}{3}}$

(h) (i) $y' = 8x^{\frac{1}{3}}$ (ii) $y' = \frac{1}{2}x^{-\frac{1}{6}}$

(i) (i) $y' = 12x^3 - 2x + 6x^{-\frac{3}{5}}$

(ii) $y' = 3x^2 - x^3 + \frac{2}{3}x^{-\frac{1}{2}}$

(j) (i) $y' = -x^{-2}$ (ii) $y' = 3x^{-4}$

(k) (i) $y' = -\frac{1}{2}x^{-\frac{3}{2}}$ (ii) $y' = 6x^{-\frac{7}{4}}$

(l) (i) $y' = 5 + \frac{4}{3}x^{-\frac{7}{2}}$ (ii) $y' = x^{-\frac{10}{7}} - 8x^{-7}$

2. (a) (i) $\frac{1}{3}x^{-\frac{2}{3}}$ (ii) $\frac{4}{5}x^{-\frac{1}{5}}$

(b) (i) $-6x^{-3}$ (ii) $4x^{-11}$

(c) (i) $-\frac{1}{2}x^{-\frac{3}{2}}$ (ii) $-2x^{-\frac{7}{4}}$

(d) (i) $9x^2 - 8x$ (ii) $\frac{7}{2}x^{\frac{5}{2}} - 3x^{\frac{1}{2}} + 4x^{-\frac{1}{2}}$

(e) (i) $\frac{4}{3}x^{\frac{1}{3}} + \frac{2}{3}x^{-\frac{2}{3}} - 1$ (ii) $2x - 8x^{-3}$

(f) (i) $9x^2 + 2x^{-2}$ (ii) $\frac{15}{2}x^{\frac{2}{3}} - \frac{1}{2}x^{-\frac{4}{3}}$

3. (a) (i) -1 (ii) $\frac{1}{2}$

(b) (i) $-2x - 1$ (ii) $4x^3 + 2$

Exercise 12D

1. (a) $\frac{dz}{dt}$

(b) $\frac{dQ}{dP}$

(c) $\frac{dR}{dm}$

(d) $\frac{dV}{dt}$

(e) $\frac{dy}{dx}$

(f) $\frac{d^2z}{dy^2}$

(g) $\frac{d^2H}{dm^2}$

2. (a) (i) $\frac{5}{3}x^{-\frac{2}{3}}$ (ii) $15q^4$

(b) (i) $3 - 7t^{-2}$ (ii) $1 - c^{-2}$

(c) (i) $18 + 6x$ (ii) $6t^{-3}$

3. (a) (i) 30 (ii) $\frac{227}{36}$

ANSWER HINT 3(a)

Did you think about doing this on the calculator?

(b) (i) 7 (ii) -29999.8

(c) (i) 12 (ii) -10

(d) (i) 24 (ii) 32

(e) (i) 6 (ii) $\frac{7}{2\sqrt{6}}$

4. (a) (i) $2ax + 1 - a$ (ii) $3x^2$

(b) (i) $\frac{1}{2}\sqrt{\frac{b}{a}}$ (ii) $6a^2v$

5. (a) (i) 54 (ii) 384

(b) (i) 8 (ii) $\frac{1}{108}$

(c) (i) 0 (ii) 42

6. (a) (i) 2 or -2 (ii) 1

(b) (i) 17 or -17 (ii) 6

7. (a) (i) $x > \frac{1}{2}$ (ii) $x < -1$

(b) (i) $x > 1$ (ii) $x < 0$

9. $(-0.199, 0.913), (1.29, -0.181), (3.91, 30.3)$

10. $x > -\frac{1}{3}$

11. $n!$

Exercise 12E

1. (a) (i) $y' = 3\cos x$ (ii) $y' = -2\sin x$

(b) (i) $y' = 2 + 5\sin x$ (ii) $y' = \frac{1}{\cos^2 x}$

(c) (i) $y' = \frac{\cos x - 2\sin x}{5}$

(ii) $y' = \frac{1}{2\cos^2 x} - \frac{1}{3}\cos x$

2. π

3. $\frac{22 - \pi^2}{12}$

4. $\frac{\pi}{4}, \frac{5\pi}{4}$

5. $x = \frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$

Exercise 12F

1. (a) (i) $y' = 3e^x$ (ii) $y' = \frac{2e^x}{5}$
 (b) (i) $y' = \frac{-2}{x}$ (ii) $y' = \frac{1}{3x}$
 (c) (i) $y' = \frac{1}{5x} - 3 + 4e^x$ (ii) $y' = -\frac{e^x}{2} + \frac{3}{x}$

2. $2 - \frac{7}{\ln 4}$

3. $3 - \frac{1}{2\ln 3}$

4. $\ln 3$

5. $x > \ln 2$

6. 3

ANSWER HINT

Q6. Did you exclude the solution $x = -2$ because it cannot go into $g(x)$?

7. (a) (i) $y' = \frac{3}{x}$ (ii) $y' = \frac{1}{x}$
 (b) (i) $y' = e^3 e^x$ (ii) $y' = \frac{e^x}{e^3}$
 (c) (i) $y' = 2x$ (ii) $y' = 3e^2 x^2$

Exercise 12G

1. (a) Tangent: $11x - 4y - 4 = 0$;
 normal: $4x + 11y - 126 = 0$
 (b) Tangent: $4x - y + 1 - \pi = 0$;
 normal: $4x + 16y - \pi - 16 = 0$
2. $x - 5y - 10 - \ln 25 = 0$
3. $(-1, -4)$
4. $2.05, -0.0541$
5. $y = 3x - \ln 4 + 2$
6. $(0.410, 0.348)$

Exercise 12H

1. (a) (i) $(0, 0)$ local maximum;
 $\left(\frac{10}{3}, \frac{-500}{27}\right)$ local minimum

(ii) $(0, 0)$ local maximum; $(2, -16)$ local minimum; $(-2, -16)$ local minimum

- (b) (i) $\left(\frac{2\pi}{3}, \frac{3\sqrt{3}+2\pi}{6}\right)$ local maximum;
 $\left(-\frac{2\pi}{3}, -\frac{3\sqrt{3}+2\pi}{6}\right)$ local minimum
 (ii) $(0, 3)$ local maximum; $(\pi, -1)$ local minimum
 (c) (i) $(4, \ln 4 - 2)$ local maximum
 (ii) $\left(\ln\left(\frac{5}{2}\right), 5 - 5\ln\left(\frac{5}{2}\right)\right)$ local minimum

ANSWER HINT

In the exam you should give the value of $\frac{d^2y}{dx^2}$ for each stationary point to justify your classification

2. $(-4, 92)$ local maximum; $(2, -16)$ local minimum
 3. $\left(\frac{1}{4}, -\frac{1}{4}\right)$ local minimum
 4. $(0.245, 4.12)$ local maximum;
 $(3.39, -4.12)$ local minimum
 6. $y \geq -21$
 7. $y \geq 6 - 4\ln 4$
 8. $(0, 0)$ local minimum; $\left(-\frac{4}{k}, \frac{32}{k^2}\right)$ local maximum

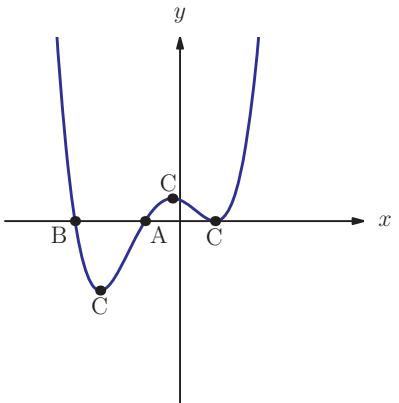
Exercise 12I

1. $(\ln 2, 2 - (\ln 2)^2)$
 2. $(1, 4)$ and $(-1, -10)$
 4. $\left(\frac{\pi}{2}, \frac{\pi}{2}\right)$ and $\left(\frac{3\pi}{2}, \frac{3\pi}{2}\right)$

ANSWER HINT

As the question doesn't state how many points of inflection there are, you need to show that both of these are actually points of inflection by checking the sign of $\frac{d^2y}{dx^2}$ on either side.

6.



Exercise 12J

1. Minimum 1, maximum e
2. (a) 225 m^2
(b) 60 m
3. Minimum $-6\sqrt{3}$, maximum 80
4. Minimum $3 - 3\ln 3$, maximum $e^2 - 6$
5. Minimum 0, maximum 4π
6. 2
7. 2.25
8. Minimum: 2 minutes; maximum: 4 minutes
9. (a) 40 million litres
(b) After 1.6 and 3.8 days
10. (a) 2 units
(b) 0 units
(c) 1.94 units
11. (a) 4 litres
(b) 41.5 litres
(c) $t = 20$ seconds
12. (a) $(2x - \frac{x^2}{10}) \text{ kJ}$
(b) 10 m^2
(c) $0 < x < 10$

Mixed examination practice 12

Short questions

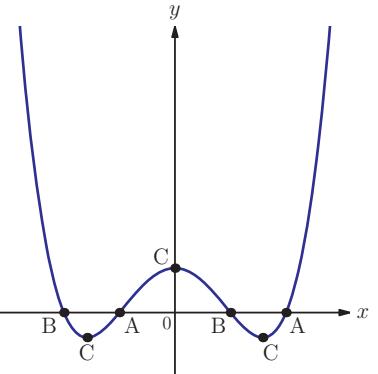
1. $y = e^{\frac{\pi}{2}}x - \frac{\pi}{2}e^{\frac{\pi}{2}} + e^{\frac{\pi}{2}} + 2$
2. $x = 2$
3. $b = 8, c = -7$

4. $\left(\frac{1}{16}, \frac{7}{16}\right)$

5. $\left(2, -\frac{2}{3}\right)$

6. $x = \frac{\pi}{6} \pm k\pi$ local minima,
 $x = -\frac{\pi}{6} \pm k\pi$ local maxima ($k \in \mathbb{Z}$)

7.



8. $3^{-\frac{1}{4}} = \frac{1}{\sqrt[4]{3}}$

Long questions

1. (b) $3a + b = 6$
(c) $a = 1, b = 3$
(d) $(-7, -192)$
2. (a) (i) $\left(-\frac{1}{3}, \frac{86}{27}\right)$
(ii) $\left(\frac{1}{3}, \frac{70}{27}\right)$
(b) (i) $y = -\frac{8}{9}x + \frac{78}{27}$
(ii) $y = -\frac{8}{9}\left(x - \frac{3+2\sqrt{3}}{9}\right) + \frac{70}{27} - \frac{64\sqrt{3}}{243}$ or
 $y = -\frac{8}{9}\left(x - \frac{3-2\sqrt{3}}{9}\right) + \frac{70}{27} + \frac{64\sqrt{3}}{243}$
3. (a) (i) 11 000
(ii) 9.55 hours
(b) (i) $\frac{dP}{dt} = e^t - 3$
(ii) 8.70 hours
(c) (i) $\frac{d^2P}{dt^2} = e^t$
(ii) 9704

Chapter 13

Exercise 13A

1. (a) (i) $y = x^3$ (ii) $y = x^5$
 (b) (i) $y = \frac{1}{x}$ (ii) $y = \frac{1}{x^4}$
 (c) (i) $y = \sqrt{x}$ (ii) $y = \sqrt[3]{x}$
 (d) (i) $y = 2x^5$ (ii) $y = 4x^3$

Exercise 13B

1. (a) $\frac{3}{4}x^4 + \text{any three constants}$
 (b) Any three constants
 2. (a) (i) $\frac{7}{5}x^5 + c$ (ii) $\frac{1}{9}x^3 + c$
 (b) (i) $-\frac{1}{2t} + c$ (ii) $-\frac{4}{y^2} + c$

Exercise 13C

1. (a) (i) $x^9 + c$ (ii) $x^{12} + c$
 (b) (i) $\frac{x^2}{2} + c$ (ii) $\frac{x^4}{4} + c$
 (c) (i) $9x + c$ (ii) $\frac{x}{2} + c$
 (d) (i) $\frac{x^6}{2} + c$ (ii) $\frac{9}{5}x^5 + c$
 (e) (i) $2x^{\frac{3}{2}} + c$ (ii) $\frac{9}{4}x^{\frac{4}{3}} + c$
 (f) (i) $-\frac{5}{x} + c$ (ii) $-\frac{1}{x^2} + c$
 2. (a) (i) $3t + c$ (ii) $7z + c$
 (b) (i) $\frac{q^6}{6} + c$ (ii) $\frac{r^{11}}{11} + c$
 (c) (i) $\frac{15}{2}g^{\frac{8}{5}} + c$ (ii) $\frac{10}{9}y^{\frac{9}{2}} + c$
 (d) (i) $-\frac{4}{h} + c$ (ii) $-\frac{1}{3p^3} + c$
 3. (a) (i) $\frac{x^3}{3} - \frac{x^4}{4} + 2x + c$ (ii) $\frac{x^5}{5} - x^2 + 5x + c$
 (b) (i) $-\frac{1}{6t^2} - \frac{1}{12t^3} + c$ (ii) $-\frac{5}{v} + \frac{1}{v^4} + c$
 (c) (i) $\frac{2}{5}x^{\frac{5}{2}} + c$ (ii) $\frac{18}{7}x^{\frac{7}{6}} + c$

(d) (i) $\frac{x^4}{4} + x^3 + \frac{3x^2}{2} + x + c$

(ii) $\frac{x^4}{4} + \frac{4x^3}{3} + 2x^2 + c$

4. $2\sqrt{x} + \frac{2}{3}x^{\frac{3}{2}} + c$

Exercise 13D

1. (a) (i) $2\ln x + c$ (ii) $3\ln x + c$
 (b) (i) $\frac{1}{2}\ln x + c$ (ii) $\frac{1}{3}\ln x + c$
 (c) (i) $\frac{x^2}{2} - \ln x + c$ (ii) $\frac{x^3}{3} + 5\ln x + c$
 (d) (i) $3\ln x - \frac{2}{x} + c$ (ii) $\ln x + \frac{2}{\sqrt{x}} + c$
 2. (a) (i) $5e^x + c$ (ii) $9e^x + c$
 (b) (i) $\frac{2e^x}{5} + c$ (ii) $\frac{7e^x}{11} + c$
 (c) (i) $\frac{e^x}{2} + \frac{3x^2}{4} + c$ (ii) $\frac{e^x}{5} + \frac{x^4}{20} + c$

Exercise 13E

1. (a) (i) $-\cos x - \sin x + c$
 (ii) $3\sin x - 4\cos x + c$
 (b) (i) $\frac{x^2}{14} - \frac{\cos x}{7} + c$ (ii) $\frac{1}{9}x^{\frac{3}{2}} + \frac{\sin x}{6} + c$
 (c) (i) $x - \sin x + \cos x + c$
 (ii) $-2\cos x - \sin x + c$
 2. $\pi \sin x - \pi x + c$
 3. $\sin x - \cos x + c$

ANSWER HINT

Q3. Use a trigonometric identity to simplify first.

Exercise 13F

1. (a) (i) $y = \frac{x^2}{2} + 5$ (ii) $y = 2x^3 + 5$
 (b) (i) $y = 2\sqrt{x} + 4$ (ii) $y = -\frac{1}{x} + 4$
 (c) (i) $y = 2e^x + 2x - 1 - 2e$
 (ii) $y = e^x - 5$
 (d) (i) $y = x + \ln x - 1$ (ii) $y = \frac{1}{2}\ln x + 4$
 (e) (i) $y = \sin x - \cos x$ (ii) $y = 3\cos x + 1$

2. (a) $f(x) = \frac{1}{2} \ln x + c$

(b) $y = \frac{1}{2} \ln x - \frac{1}{2} \ln 2 + 7$

3. (a) -2

4. $y = \ln \frac{e^5}{x}$

Exercise 13G

1. (a) (i) 320 (ii) 28.5
 (b) (i) 1 (ii) -2

(c) (i) $e - 1$ (ii) $3e - \frac{3}{e}$

2. (a) (i) 0.995 (ii) 0.0997
 (b) (i) 1.46 (ii) 1

3. $e^\pi + \pi + 1$

5. 20

6. $a = 16$

Exercise 13H

1. (a) (i) $\frac{7}{3}$ (ii) $\frac{1}{4}$
 (b) (i) $\frac{2}{3}$ (ii) $\frac{22}{3}$

(c) (i) $\frac{11}{4}$ (ii) $\frac{79}{6}$

2. 9

3. (a) 6

(b) $\frac{22}{3}$

4. 2

ANSWER HINT

Q4. There is an easier way than splitting the integral into two parts.

5. $\frac{9}{2}$

Exercise 13I

1. (a) (i) $\frac{32}{3}$ (ii) $\frac{1}{6}$

(b) (i) 9 (ii) $\frac{1}{3}$

(c) (i) $\frac{9}{8}$ (ii) $\frac{1}{3}$

2. $\frac{32}{3}$

3. $e^2 - \frac{11}{3}$

4. 0.462

6. $2 - \sqrt{2}$

7. 8

8. 4

Mixed examination practice 13

Short questions

1. $f(x) = \frac{1}{2} - \cos x$

2. $\frac{4k^3}{3}$

3. $\ln x + \frac{2}{5}x^{\frac{5}{2}} + c$

4. (a) $a = \sqrt{2}$

(b) $\frac{1}{2}$

5. (a) (i) a^{n+1} (ii) $\frac{b^{n+1}}{n+1} - \frac{a^{n+1}}{n+1}$

(b) $n = 3$

ANSWER HINT

Q5. You did not need to calculate an integral for the red area to answer this question.

6. $2\sqrt{3} - \frac{2}{3}\pi$

7. (a) Local minimum
 (b) $x^3 + 3x^2 - 45x + 100$

Long questions

1. (a) $3 - e$
 (b) 5
 (c) $e^x + (3 - e)x + 2$
 (d) $\frac{e+5}{2}$

2. (b) $(-a, 0)$ and $(3a, 8a^2)$

(c) $\frac{64}{3}a^3$

(d) $\frac{15}{16}$

Chapter 14

Exercise 14A

1. (a) (i) $15(3x+4)^4$ (ii) $35(5x+4)^6$
(b) (i) $\frac{3}{2\sqrt{3x-2}}$ (ii) $\frac{1}{2\sqrt{x+1}}$
(c) (i) $\frac{1}{(3-x)^2}$ (ii) $-\frac{4}{(2x+3)^3}$
(d) (i) $10e^{10x+1}$ (ii) $-3e^{4-3x}$
(e) (i) $4\cos 4x$ (ii) $-3\sin(3x+\pi)$
(f) (i) $-\frac{1}{5-x}$ (ii) $-\frac{2}{3-2x}$
2. (a) (i) $7(2x-3)(x^2-3x+1)^6$
(ii) $15x^2(x^3+1)^4$
(b) (i) $(2x-2)e^{x^2-2x}$ (ii) $-3x^2e^{4-x^3}$
(c) (i) $-6e^x(2e^x+1)^{-4}$ (ii) $20e^x(2-5e^x)^{-5}$
(d) (i) $6x\cos(3x^2+1)$
(ii) $-(2x+2)\sin(x^2+2x)$
(e) (i) $-3\sin x \cos^2 x$ (ii) $4\cos x \sin^3 x$
(f) (i) $\frac{2-15x^2}{(2x-5x)^3}$ (ii) $\frac{8x}{4x^2-1}$
(g) (i) $\frac{16}{x}(4\ln x-1)^3$ (ii) $-\frac{5}{x}(\ln x+3)^{-6}$
3. (a) (i) $10(2x+3)^4$ (ii) $32(4x-1)^7$
(b) (i) $4(5-x)^{-5}$ (ii) $7(1-x)^{-8}$
(c) (i) $4\sin(1-4x)$ (ii) $\sin(2-x)$
(d) (i) $\frac{5}{5x+2}$ (ii) $\frac{1}{x-4}$
4. (a) (i) $\frac{6\sin 3x}{\cos^3 3x}$ (ii) $4\tan(2x)\frac{1}{\cos^2 2x}$
(b) (i) $6\sin(3x)\cos(3x)e^{\sin^2(3x)}$
(ii) $\frac{2\ln(2x)}{x}e^{(\ln 2x)^2}$
(c) (i) $-16\sin(2x)\cos(2x)(1-2\sin^2(2x))$

(ii) $-24\sin 3x(4\cos 3x+1)$

(d) (i) $\frac{6\sin 2x}{1-3\cos 2x}$ (ii) $\frac{5\sin 5x}{2-\cos 5x}$

5. $y = 66x - 11$

6. $y = \frac{27\sqrt{2}}{8}x - \frac{77}{12}$

7. $\left(\frac{\pi}{2}, e\right), \left(\frac{3\pi}{2}, e^{-1}\right)$

8. 7

9. (a) The left post, because $h(-1) > h(2)$

(c) $\sqrt[3]{2} + \frac{1}{\sqrt[3]{4}}$

Exercise 14B

1. (a) (i) $(1+x)^3 + 3x(1+x)^2$
(ii) $8x(x+3)^4 + 16x^2(x+3)^3$

(b) (i) $2x\sin x + x^2\cos x$

(ii) $5\tan x + \frac{5x}{\cos^2 x}$

(c) (i) $e^x \ln x + \frac{e^x}{x}$ (ii) $e^x \sin x + e^x \cos x$

2. (a) (i) $2x\cos x - x^2\sin x$

(ii) $-x^{-2}\sin x + x^{-1}\cos x$

(b) (i) $-2x^{-3}\ln x + x^{-3}$ (ii) $3x^2\ln x + x^2$

(c) (i) $3x^2\sqrt{2x+1} + x^3(2x+1)^{-\frac{1}{2}}$

(ii) $-x^{-2}\sqrt{4x} + 2x^{-1}(4x)^{-\frac{1}{2}}$

(d) (i) $2e^{2x}\tan x + e^{2x}\frac{1}{\cos^2 x}$

(ii) $e^{x+1}\sin 3x + 3e^{x+1}\cos 3x$

3. (a) (i) $3(x+1)^3(x-2)^4(3x-1)$

(ii) $(x-3)^6(x+5)^3(11x+23)$

(b) (i) $(2x-1)^3(1-3x)^2(-42x+17)$

(ii) $(1-x)^4(4x+1)(-28x+3)$

4. $(6x^2+4x+3)e^{2x}$

5. $y = 2ex - e$

6. $(9x^2+12x+2)e^{3x}$

7. $x = -\frac{1}{2}, 2$

8. $\left(-\frac{2}{3}, -\frac{2}{3\sqrt{3}}\right)$

9. $x = 3, -\frac{1}{3}, \frac{7}{4}$

10. (b) $(0.538, 0.474), (1.82, -0.877), (3.29, 0.957), (4.81, -0.979)$

11. $e^x(1+x)\cos(xe^x)$

12. (a) $\ln x + 1$

(b) $x \ln x - x + C$

13. $\left(\frac{3\pi}{4}, -\frac{\sqrt{2}}{2} e^{-\frac{3\pi}{4}}\right)$

14. $a = 4, b = 5$

15. (a) $y = e^{x \ln x}$

(b) $(\ln x + 1)x^x$

(c) $(e^{-1}, e^{-e^{-1}})$

Exercise 14C

1. (a) (i) $\frac{2}{(x+1)^2}$ (ii) $\frac{-5}{(x-3)^2}$

(b) (i) $\frac{x(2x+1)^{-\frac{1}{2}} - (2x+1)^{\frac{1}{2}}}{x^2} = \frac{-x-1}{x^2\sqrt{2x+1}}$

(ii) $\frac{2x(x-1)^{\frac{1}{2}} - \frac{1}{2}x^2(x-1)^{-\frac{1}{2}}}{x-1} = \frac{x(3x-4)}{2\sqrt{(x-1)^3}}$

(c) (i) $\frac{2(x^2-x-2)}{(x^2+2)^2}$ (ii) $-\frac{x^2+2x+4}{(1+x)^2}$

(d) (i) $\frac{1-\ln 3x}{x^2}$ (ii) $\frac{1-2\ln 2x}{x^3}$

2. $(0, 0), (1, 1)$

3. $y = \frac{\pi^2}{4}x + \frac{16 - \pi^4}{8\pi}$

4. -1

5. $\left(e, \frac{1}{e}\right)$ local maximum

6. $0 < x < 2, x \neq 1$

7. $a = 3, b = 4, p = \frac{3}{2}$

Exercise 14D

1. (a) (i) 2 (ii) $\frac{49}{12}$

(b) (i) $2\sqrt{3}$ (ii) $4\sqrt{2}$

(c) (i) $4\sqrt{2}$ (ii) $\frac{8}{3}$

2. (a) $x(12-2x)^2$

(b) $x = 2$

3. 48 cm^2

4. $\left(\frac{2\sqrt{3}}{3}, \frac{8}{3}\right)$

5. (a) (i) $(\pi - x, \sin x)$ (ii) $(\pi - 2x) \sin x$

(c) 1.12

6. 733 cm^3

7. 650 cm^3

8. (a) 3 and 3
(b) 0 and 6

9. (b) $r = 5.56, h = 7.86$

12. $\left(\sqrt{\frac{7}{2}}, \frac{7}{2}\right)$

Mixed examination practice 14

Short questions

1. $\frac{16}{225}$

2. (a) $5e^{5x}$
(b) $\frac{3}{2\sqrt{3x+2}}$

(c) $5e^{5x}\sqrt{3x+2} + \frac{3e^{5x}}{2\sqrt{3x+2}}$

3. $\frac{5}{2}$

4. 15 m

5. (b) $\left(-\frac{\ln b}{c}, \frac{a}{2b}\right)$

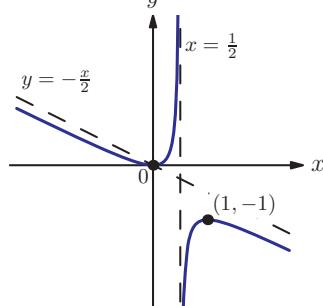
Long questions

1. (a) π
(b) (i) $e^x(\sin x + \cos x)$ (ii) 0
(d) (i) 0
(ii) $\left(\frac{\pi}{2}, e^{\frac{\pi}{2}}\right)$

2. (a) $x = \frac{1}{2}$

(b) $(0, 0)$ and $(1, -1)$

- (c) $(0, 0)$ local minimum; $(1, -1)$ local maximum
 (d)



3. (b) (ii) $\frac{(\ln 2)^2 x^2 - 4x \ln 2 + 2}{2^x}$

(c) (i) $\frac{2}{\ln 2}$

Chapter 15

Exercise 15A

1. (a) (i) $(x+3)^5 + c$ (ii) $\frac{1}{6}(x-2)^6 + c$
 (b) (i) $\frac{1}{32}(4x-5)^8 + c$ (ii) $2\left(\frac{1}{8}x+1\right)^4 + c$
 (c) (i) $-\frac{1}{9}(4-x)^9 + c$ (ii) $-\frac{8}{7}\left(3-\frac{1}{2}x\right)^7 + c$
 (d) (i) $\frac{1}{3}(2x-1)^{\frac{3}{2}} + c$ (ii) $-\frac{4}{5}(2-5x)^{\frac{7}{4}} + c$
 (e) (i) $2(4-3x)^{-1} + c$ (ii) $4\left(2+\frac{x}{3}\right)^{\frac{3}{4}} + c$
2. (a) (i) $e^{3x} + c$ (ii) $\frac{1}{2}e^{2x+5} + c$
 (b) (i) $2e^{\frac{1}{2}x} + c$ (ii) $6e^{\frac{2x-1}{3}} + c$
 (c) (i) $2e^{-3x} + c$ (ii) $-\frac{1}{4}e^{-4x} + c$
 (d) (i) $-\frac{3}{2}e^{-\frac{2}{3}x} + c$ (ii) $8e^{-\frac{x}{4}} + c$
3. (a) (i) $\ln(x+4) + c$ (ii) $\ln(5x-2) + c$
 (b) (i) $\frac{2}{3}\ln(3x+4) + c$ (ii) $-4\ln(2x-5) + c$
 (c) (i) $-\frac{1}{2}\ln(7-2x) + c$ (ii) $\frac{3}{4}\ln(1-4x) + c$
4. (a) $\frac{1}{3}\cos(2-3x) + c$
 (b) $\frac{1}{2}\sin 4x + c$
5. (a) $\frac{1}{6}(2x-3)^3 + c$

- (b) $\frac{1}{6}e^{6x} + c$
 (c) $-\frac{1}{5}\ln(2-5x) + c$

6. Both are right:

$$\frac{1}{3}\ln(3x) + c = \frac{1}{3}\ln x + \frac{1}{3}\ln 3 + c = \frac{1}{3}\ln x + c' \text{ where } c' = \frac{1}{3}\ln 3 + c \text{ is an unknown constant as well}$$

7. 0.492

Exercise 15B

1. (a) (i) $\frac{1}{3}(x^2+2)^{\frac{3}{2}} + c$
 (ii) $\frac{1}{3}(x^2+6x+4)^{\frac{3}{2}} + c$
 (b) (i) $\frac{1}{3}\ln(x^3+1) + c$ (ii) $\frac{3}{2}\ln(x^2+5) + c$
 (c) (i) $-\frac{1}{3}\cos^3 x + c$ (ii) $\frac{1}{2}(\ln x)^2 + c$
2. (a) (i) $\frac{1}{8}(x^2+3)^4 + c$ (ii) $\frac{1}{4}(x^2-1)^6 + c$
 (b) (i) $\frac{1}{15}(3x^2-15x+4)^5 + c$
 (ii) $\frac{1}{12}(x^3+3x^2-5)^4 + c$
 (c) (i) $\ln(x^2+3) + c$
 (ii) $2\ln(x^3-6x+1) + c$
 (d) (i) $-\frac{2}{9}\cos^6 3x + c$ (ii) $\frac{1}{8}\sin^4 2x + c$
 (e) (i) $\frac{1}{2}e^{3x^2-1} + c$ (ii) $\frac{3}{2}e^{x^2} + c$
 (f) (i) $\ln\sqrt{e^{2x+3}+4} + c$ (ii) $\ln\sqrt[4]{3+4\sin x} + c$

3. $e-1$

4. $\frac{2}{9}(x^3+5)^{\frac{3}{2}} + c$

5. $2\sqrt{e+1}-2\sqrt{2}$

6. $e^5 - e^{-1}$

7. $\ln 8$

8. (a) $\tan x = \frac{\sin x}{\cos x}$ (b) $-\ln(\cos x) + c$

9. $2\sqrt{3}-2$

10. They are all right, with different constants of integration ‘ c ’, because

$$\frac{1}{2}\sin^2 x = -\frac{1}{2}\cos^2 x + \frac{1}{2} = -\frac{1}{4}\cos 2x + \frac{1}{4} \text{ by trigonometric identities.}$$

Exercise 15C

1. (a) (i) $v = -8e^{-2t}$, $a = 16e^{-2t}$

(ii) $v = -6e^{3t}$, $a = -18e^{3t}$

(b) (i) $v = \frac{5}{2}\cos\left(\frac{t}{2}\right)$, $a = -\frac{5}{4}\sin\left(\frac{t}{2}\right)$

(ii) $v = 6\sin(2t)$, $a = 12\cos(2t)$

2. (a) (i) $t^3 - t$ (ii) $\frac{1}{2}t - \frac{1}{8}t^4$

(b) (i) $2 - 2e^{-t}$ (ii) $t + \frac{1}{2}e^{2t} - \frac{1}{2}$

(c) (i) $3\ln\left(\frac{t+2}{2}\right)$ (ii) $3t - \ln(t+1)$

3. (a) (i) 1.73 (ii) 3.16

(b) (i) 2.22 (ii) 0.746

(c) (i) 3.23 (ii) 7.06

5. (a) 13.6 m

(b) 16.4 m

6. (a) 4.4 m

(b) 10.3 m

7. (a) $\frac{1-t^2}{(t^2+1)^2}$

(b) $\frac{1}{2}\ln(26) = 1.63$ (3SF)

8. $\frac{25}{4}$

9. (b) It reverses for 4 s and then moves forward.

(c) $5\frac{1}{3}$ m

(d) $26\frac{2}{3}$ m

(e) $21\frac{1}{3}$ m

(f) $t = 7$ s

(g) 16 m/s

Exercise 15D

1. (a) (i) $\frac{1524}{5}\pi$ (ii) $\frac{18}{7}\pi$

(b) (i) $\left(\frac{e^4}{4} + e^2 - \frac{1}{4}\right)\pi$

(ii) $\left(\frac{25}{2} - 4e^{-2} - \frac{e^{-4}}{2}\right)\pi$

(c) (i) 2π (ii) π

2. (a) (i) 101 (ii) 134

(b) (i) 12.6 (ii) 45.7

(c) (i) 3.59 (ii) 0.771

3. 19.0

4. π

5. $\sqrt[3]{\frac{4}{3}}$

6. (a) (0, 3) and (4, 19)

(b) $\frac{3008}{15}\pi = 630$ (3 SF)

Mixed examination practice 15

Short questions

1. (a) $-\frac{1}{3}\ln(1-3x)+c$

(b) $-\frac{1}{2}(2x+3)^{-1}+c$

2. $\ln(e^x+1)+c$

3. 6.36

4. (a) $\ln x+1$

(b) $x\ln x-x+c$

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

6. 1

7. $\ln 2$

8. (b) $\ln(x-2)-\frac{5}{x-2}+c$

9. $\ln(\ln x)+c$

Long questions

1. (a) $x+c$

(b) $\ln(\sin x + \cos x) + c$

(c) $\frac{1}{2}(x - \ln(\sin x + \cos x)) + c$

2. (b) $\frac{1}{2}x + \frac{1}{4}\sin 2x + c$

(c) $\frac{\pi}{2}$

3. (a) -10 m/s^2

(b) $t = 0, 5$

(c) $\frac{25}{3} = 8.33 \text{ m}$

(d) 67 m

(e) 7.5 s

Chapter 16

Exercise 16A

1. (a) (i) Mean: 22.6; median 19; mode: none
 (ii) Mean: 1.2; median 0.4; mode: none

- (b) (i) Mean: $31\frac{1}{3}$; median 29; mode: 28
 (ii) Mean: 58.5; median 51; mode: none

2. (i) Mean: $25\frac{5}{6}$; median 24.5; mode: 15

- (ii) Mean: $4\frac{5}{6}$; median 4.5; mode: -8

4. (a) Sometimes (b) Sometimes
 (c) Sometimes (d) Sometimes
 (e) Always (f) Sometimes
 (g) Always
 (h) Sometimes (e.g. not true for 1, 1, 2, 2, 2, 2, 5)

5. 18.3

6. (a) 84%
 (b) 79%

7. 5 and 8

8. 8 or 9

Exercise 16B

1. (a) (i) $\sigma = 7.23$, IQR = 12.6
 (ii) $\sigma = 6.57$, IQR = 13.5

- (b) (i) $\sigma = 11.1$, IQR = 3
 (ii) $\sigma = 35.3$, IQR = 72

2. (a) False
 (b) Impossible to be sure; e.g. true for 20, 26, 26, 26, 26, 32

(c) True

(d) Impossible to be sure; e.g. true for 20, 20, 20, 20, 20, 32

(e) Impossible to be sure; e.g. true for 20, 21, 22, 23, 24, 32

3. 5

4. (a) 12
 (b) 2.92

5. 21

Exercise 16C

1. (a) $\bar{x} = 12.1$, $\sigma = 1.90$, $Q^2 = 12$

- (b) $\bar{x} = 0.263$, $\sigma = 0.137$, $Q^2 = 0.2$

2. (a) 17, 21

- (b) 17, 20

- (c) 16.5, 20.5

- (d) 16, 20

3. (a) (i) $\bar{x} = 26.1$, $\sigma = 20.4$

- (ii) $\bar{x} = 253$, $\sigma = 151$

- (b) (i) $\bar{x} = 6.38$, $\sigma = 5.23$

ANSWER HINT

(b) The first group starts at 0, not -0.5!

- (ii) $\bar{x} = 102$, $\sigma = 5.78$

- (c) (i) $\bar{x} = 6.58$, $\sigma = 5.11$

- (ii) $\bar{x} = 15.3$, $\sigma = 9.85$

4. (a) 1.5

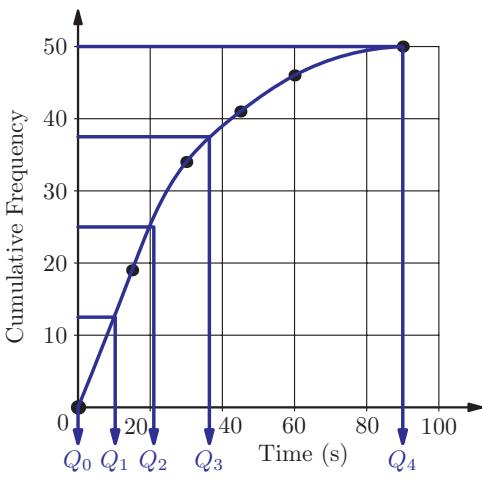
- (b) 1.84

5. $p = 14$, $q = 20$

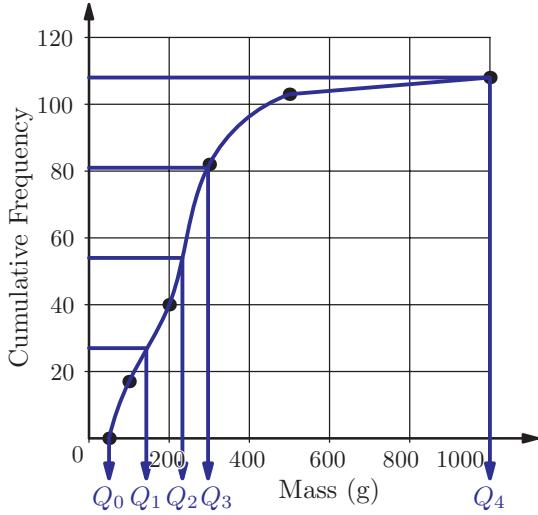
6. $p = 13$, $q = 0$

Exercise 16D

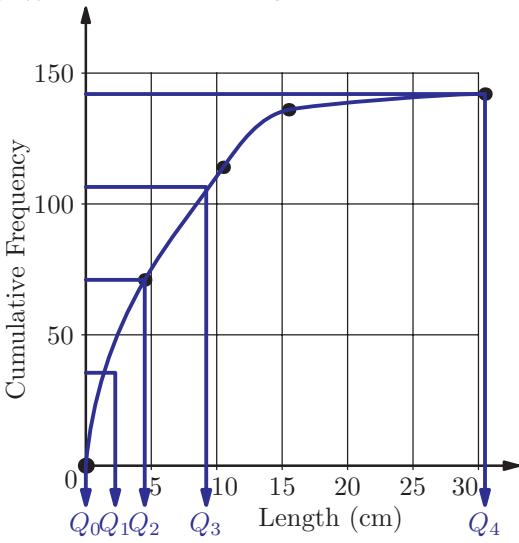
1. (a) (i) Median ≈ 21 s; IQR ≈ 26 s



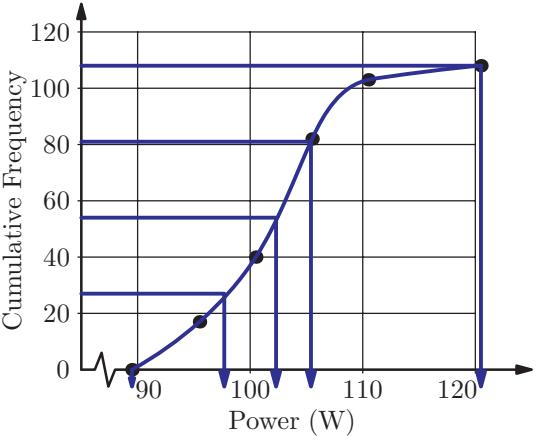
- (ii) Median ≈ 233 g; IQR ≈ 154 g



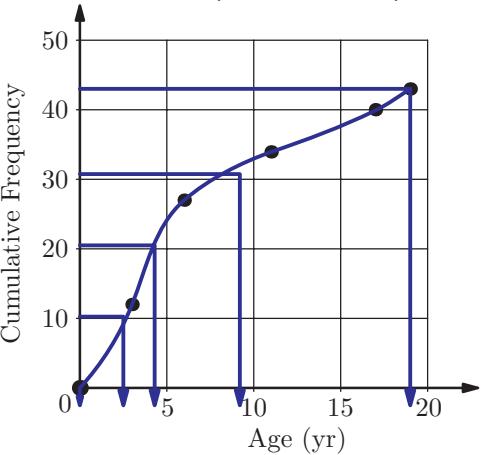
- (b) (i) Median ≈ 4.5 cm; IQR ≈ 7 cm



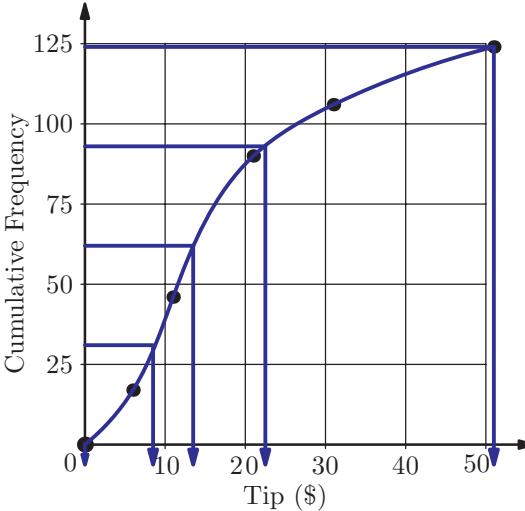
- (ii) Median ≈ 102 W; IQR ≈ 8 W



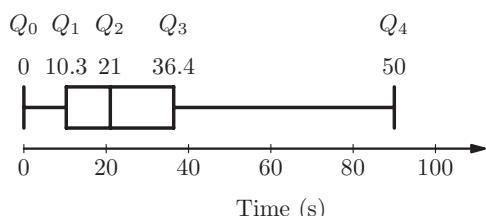
- (c) (i) Median ≈ 4.3 years; IQR ≈ 6.7 years



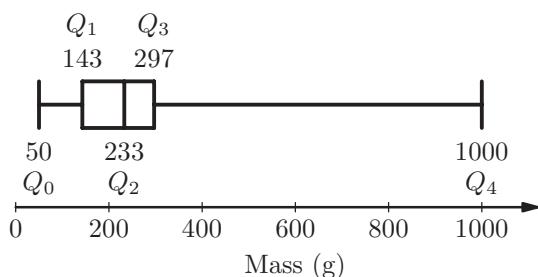
- (ii) Median $\approx \$13.50$; IQR $\approx \$14$



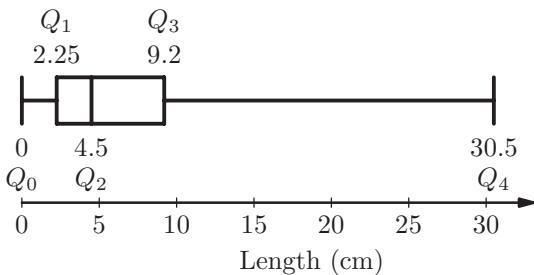
2. (a) (i)



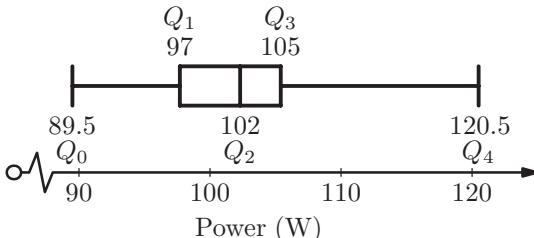
(ii)



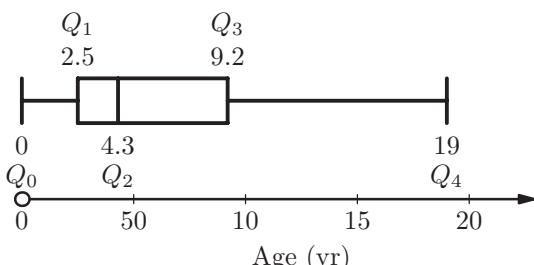
(b) (i)



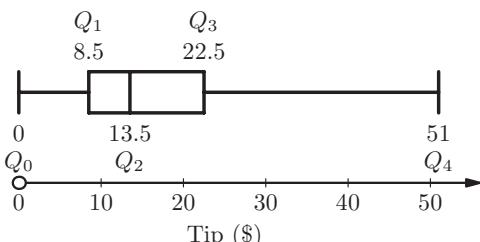
(ii)



(c) (i)



(ii)



3. (a) 197 s

(b) 12 s

(c) $c \approx 191$, $d \approx 203$

4. (a) 53%

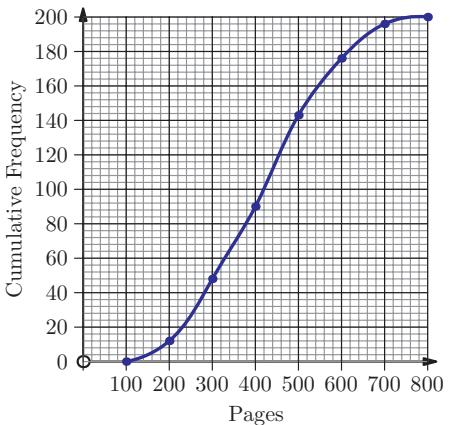
(b) 28

5. Median = 12, IQR = 9

6. (a) 417 pages

(b) 90, 143, 176, 196

(c)



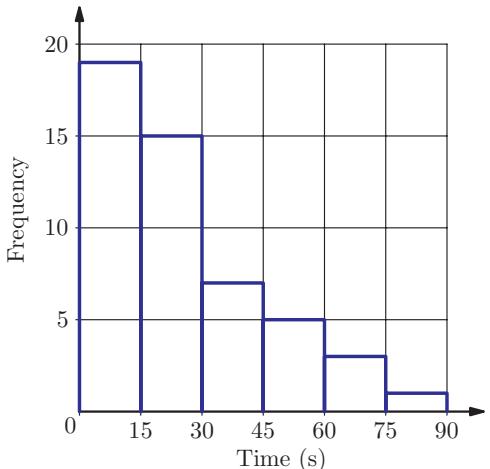
(d) 420 pages

(e) 210 pages

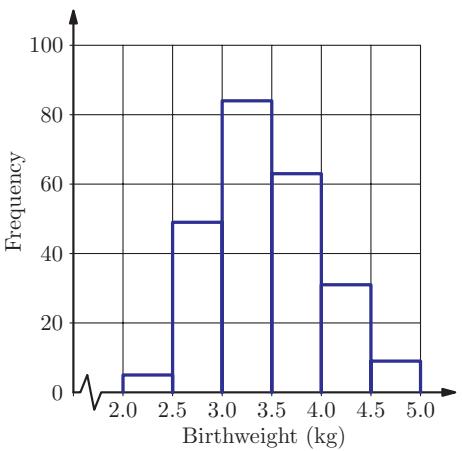
(f) 43%

Exercise 16E

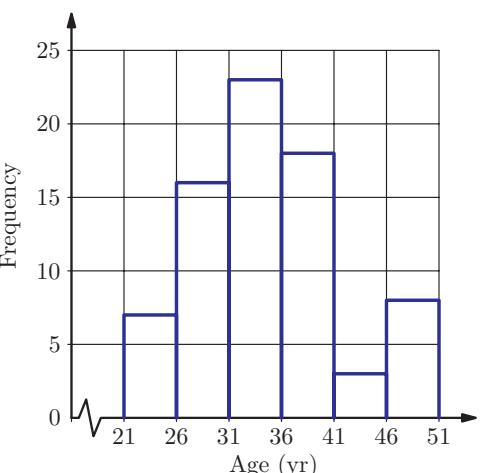
1. (a) (i)



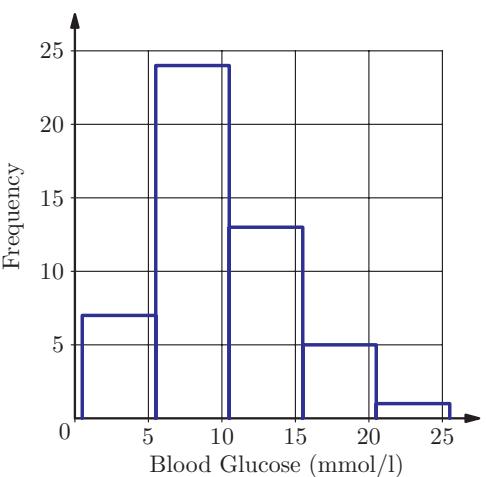
(ii)



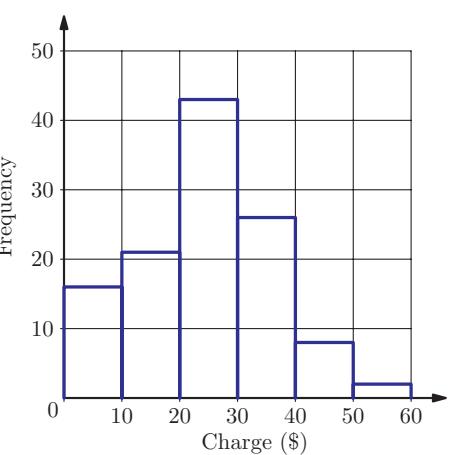
(c) (i)



(b) (i)



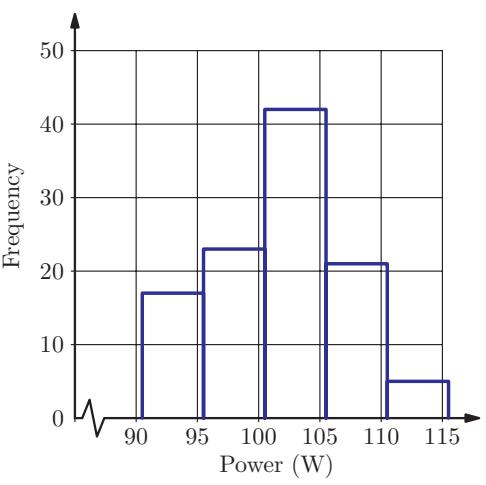
(ii)



2. A3, B2, C1

3. $\bar{x} = 10, \sigma = 6.71$

(ii)

**Exercise 16F**1. (a) (i) $\bar{y} = 3, \sigma_y = 14$ (ii) $\bar{y} = 17, \sigma_y = 3$ (b) (i) $\bar{y} = 18.6, \sigma_y = 4.8$ (ii) $\bar{y} = 7, \sigma_y = 2$ (c) (i) $\bar{y} = -2, \sigma_y = 5$ (ii) $\bar{y} = 34, \sigma_y = 30$ (d) (i) $\bar{y} = 7, \sigma_y = 12$ (ii) $\bar{y} = 44, \sigma_y = 12$

2. (a) (i) Median 6.3, IQR 2.4

(ii) Median 4.1, IQR 2

(b) (i) Median 22.5, IQR 7.5

(ii) Median 9.6, IQR 7.2

(c) (i) Median 54.6, IQR 16.8

(ii) Median 86, IQR 72

3. (a) $x+1$
(b) $x-5$

4. Median 11.328 kpl, variance 7.52 kpl²

5. (a) 39.2°F
(b) 1.11°C

6. $b = 10a$

7. Multiply or divide by $|x|$

Exercise 16C

1. (a) (i) 0.802
(b) (i) -0.942 (ii) 0.770
 (ii) -0.949

6. (a) (i) -0.328
 (b) $y = 1.11x^2 - 3.55$ (ii) 0.996

Exercise 16G

1. (a) (i) 0.802 (ii) 0.770
(b) (i) -0.942 (ii) -0.949
(c) (i) 0.194 (ii) 0.441
(d) (i) 1 (ii) -1

2. A: 1
B: 4
C: 2
D: 3

3. (a) 0.990
(b) There is a strong positive linear relationship.
(c) No

4. (a) 0.876
(b) There is a positive correlation.
(c) Yes, since the claim does not relate to causation.

5. (a) 0.162
(b) No, e.g. weak correlation, cannot talk about causation, small sample.

6. (a) -0.996
(b) -0.996

Exercise 16H

1. (a) (i) $y = 2.27x - 6$
 (ii) $y = 1.48x + 0$
 (b) (i) $y = -0.258x + 1$
 (ii) $y = -0.557x + 1$
 (c) (i) $y = 0.155x + 1$
 (ii) $y = 1.09x - 5$
 (d) (i) $y = 2x + 1$
 (ii) $y = -x + 10$

2. (a) 400
 (b) Cannot be found

3. (a) 0.962

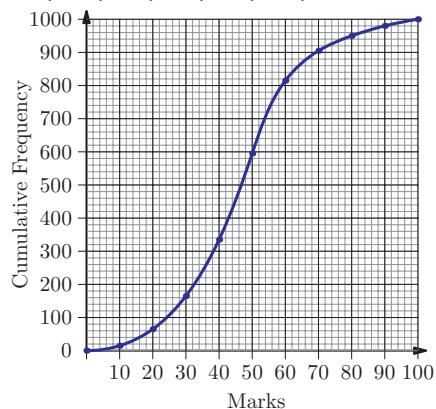
Mixed examination practice 16

Short questions

Long questions

1. (a) 11 cm
(b) 8, 5, 4
(c) 11.8 cm

2. (a) 165 335 595 815 950 980 1000



- (c) (i) 46
 (ii) 240
 (iii) 63
3. (a) -0.660
 (d) $y = -19.0x + 617$
 (e) £617
 (f) Extrapolation
4. (a) 0.945
 (b) 37
 (c) Extrapolation; dependent variable (ice creams sold) should not be used to predict the independent variable (temperature)

Chapter 17

Exercise 17A

1. (a) (i) 0.667
 (b) (i) 0.571
 (c) (i) 0.429
 (ii) 0.150
 (ii) 0.400
 (ii) 0.100
2. (a) 5
 (b) 75
 (c) 0.672
4. No; it is true only if the same number of bulbs were tested in each study.

Exercise 17B

1. (a) 1, 2, 3, 4, 5, 6
 (b) RED, RDE, ERD, EDR, DRE, DER
 (c) BBB, BBG, BGB, GBB, BGG, GBG, GGB, GGB
 (B = boy, G = girl)
 (d) 1, 1, 1, 2, 3, 4
2. (a) (i) $\frac{1}{2}$
 (b) (i) $\frac{1}{13}$
 (c) (i) $\frac{18}{52}$
 (d) (i) $\frac{3}{4}$
 (e) (i) $\frac{25}{52}$
 (f) (i) $\frac{10}{52}$
 (ii) $\frac{1}{4}$
 (ii) $\frac{4}{13}$
 (ii) $\frac{4}{52}$
 (ii) $\frac{9}{13}$
 (ii) $\frac{44}{52}$
 (ii) $\frac{12}{52}$
3. (a) (i) $\frac{6}{15}$
 (b) (i) $\frac{11}{15}$
 (ii) $\frac{5}{15}$
 (ii) $\frac{9}{15}$

- (c) (i) $\frac{9}{15}$
 (ii) $\frac{10}{15}$
 (d) (i) 0
 (ii) 1
 (e) (i) $\frac{4}{15}$
 (ii) $\frac{6}{15}$
 (f) (i) $\frac{6}{15}$
 (ii) $\frac{11}{15}$
 (g) (i) 0
 (ii) 0
5. (a) $\frac{5}{36}$
 (b) $\frac{22}{36}$
 (c) $\frac{6}{36}$
 (d) $\frac{7}{36}$
 (e) $\frac{12}{36}$
 (f) $\frac{14}{36}$
6. (a) $\frac{4}{32}$
 (b) $\frac{19}{32}$
 (c) $\frac{5}{32}$
 (d) $\frac{7}{32}$
 (e) $\frac{14}{32}$
 (f) $\frac{16}{32}$
7. 115
 8. $\frac{10}{216}$

Exercise 17C

1. (a) (i) 0.5
 (b) (i) $\frac{1}{6}$
 (c) (i) $\frac{4}{15}$
 (d) (i) 0.7
 (ii) 1
 (ii) 0.05
 (ii) 0.2
 (ii) 0.11
2. (a) (i) $\frac{7}{20}$
 (b) (i) 27.5%
 (c) (i) 55%
 (ii) 100%
 (ii) $\frac{7}{30}$
 (ii) 18.3%
3. (a) $P(x > 4)$
 (b) $P(y \leq 3)$
 (c) 0
 (d) 1
 (e) $P(\text{fruit})$
 (f) $P(\text{apple})$
 (g) $P(\text{multiple of 4})$
 (h) $P(\text{rectangle})$
 (i) $P(\text{blue})$
 (j) $P(\text{blue} \cap \text{red})$

4. 5%
 5. 0.4
 6. 0.3
 7. (a) 0.166
 (b) 0.041

Exercise 17D

1. (a) (i) 0.12 (ii) 0
 (b) (i) 0.24 (ii) 0.24
 (c) (i) $\frac{13}{20}$ (ii) $\frac{3}{4}$
 2. $\frac{15}{91}$
 3. $\frac{1}{6}$
 4. (a) $\frac{19}{27}$
 (b) $\frac{25}{27}$
 5. 0.048
 6. $\frac{69}{110}$
 7. 15 or 21

Exercise 17E

1. (a) (i) 0.21 (ii) $\frac{1}{15}$
 (b) (i) $\frac{15}{28}$ (ii) $\frac{5}{9}$
 (c) (i) 0.496 (ii) 0.4
 (d) (i) $\frac{1}{3}$ (ii) $\frac{4}{9}$
 2. (a) (i) Yes (ii) No
 (b) (i) Yes (ii) No
 3. (a) 0.3
 (b) 0.54
 4. (a) 62.6%
 (b) 2.56%
 (c) 97.4%
 5. (a) 0.410
 (b) 0.684

ANSWER HINT

(b) Did you consider the complement?

6. $\frac{14}{15}$

Exercise 17F

1. (a) P(prime \cap odd)
 (b) P(Senegal \cup Taiwan)
 (c) P(French|IB)
 (d) P(heart|red)
 (e) P(lives in Munich|German)
 (f) P(not black \cap not white)
 (g) P(potato|not cabbage)
 (h) P(red|red \cup blue)

2. (a) (i) $\frac{2}{3}$ (ii) $\frac{15}{28}$
 (b) (i) $\frac{5}{14}$ (ii) $\frac{5}{6}$

3. (a) (i) 0.1
 (b) $\frac{1}{6}$

4. (a) $\frac{1}{3}$
 (b) $\frac{7}{15}$

5. (a) $\frac{149}{240} = 0.621$
 (b) $\frac{125}{149} = 0.839$

6. (a) $\frac{64}{75} = 0.853$
 (b) $\frac{5}{32} = 0.156$

7. (a) $\frac{72}{160} = 0.45$
 (b) $\frac{9}{44} = 0.205$

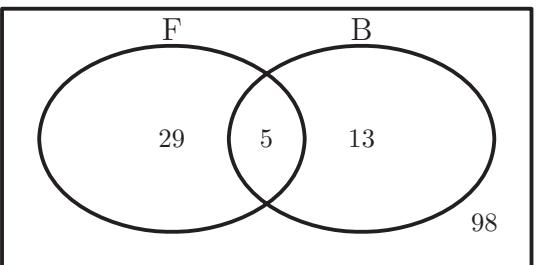
8. (a) $\frac{2}{3}$
 (b) $\frac{4}{5}$

9. $\frac{4}{9}$

10. $\frac{1}{6}$

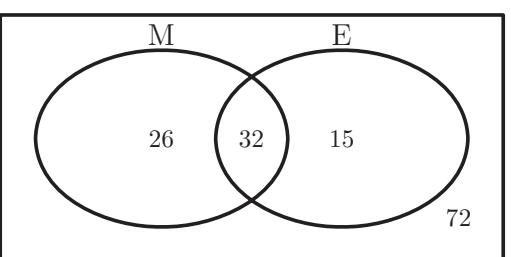
Exercise 17G

1. (a)



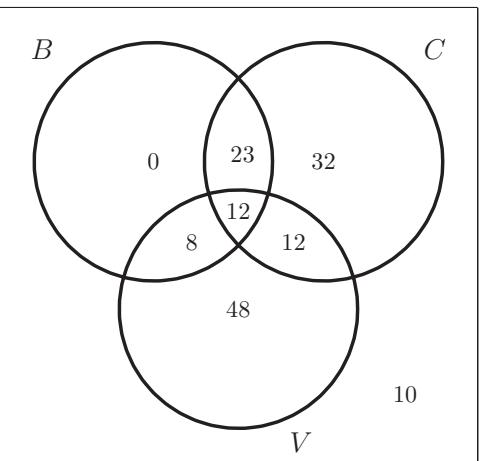
- (b) 98
 (c) $\frac{18}{145}$
 (d) $\frac{5}{34}$

2. (a)



- (b) 32
 (c) $\frac{16}{29}$

3. (a) where C = chilli con carne, V = vegetable curry, B = spaghetti bolognese



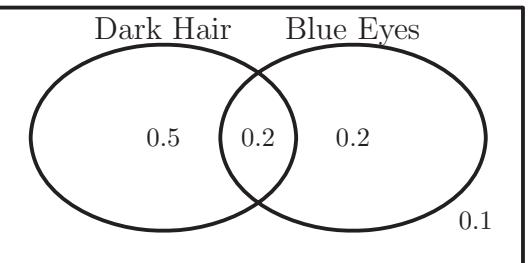
- (b) 0
 (c) 79

(d) $\frac{16}{29}$

(e) $\frac{3}{5}$

(f) $\frac{11}{29}$

4. (a)



(b) 0.1

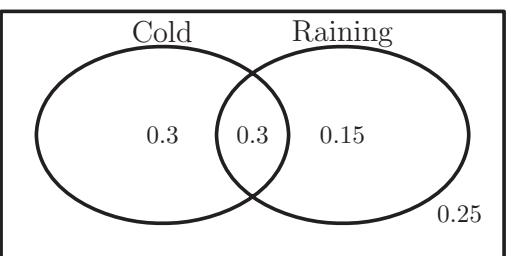
(c) $\frac{2}{7}$

(d) $\frac{2}{3}$

(e) No: $P(B \cap D) = 0.2, P(B)P(D) = 0.28$

5. (a) 0.3

(b)



(c) $\frac{1}{3}$

(d) $\frac{3}{8}$

(e) No: $P(R \cap C) = 0.3, P(C)P(R) = 0.27$

Exercise 17H

1. $\frac{5}{14}$

2. 0.580

3. $\frac{9}{25}$

4. $\frac{5}{9}$

5. Without, because $\frac{13}{25} > \frac{1}{2}$
 6. (b) 18

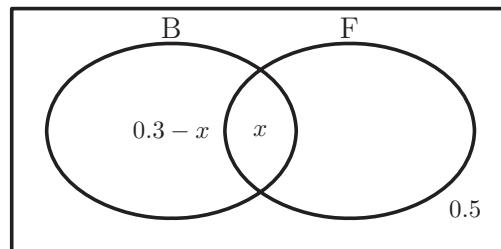
Mixed examination practice 17

Short questions

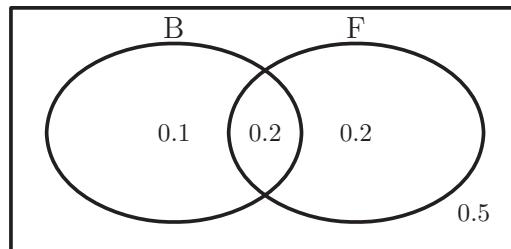
1. 0.320
2. 0.8
3. $\frac{1}{9} = 0.111$
4. $\frac{1}{3}$

Long questions

1. (a) $\frac{14}{95}$
 (c) 0.138
 (d) 0.356
2. (a) $0 \leq P(X) \leq 1$
 (b) $P(A) - P(B|A)P(A)$
3. (a)



- (b) 0.2
 (c) 0.2
 (d) 0.1



- (e) $\frac{1}{3}$
4. (a) (i) $\frac{5}{36}$ (ii) $\frac{25}{216}$ (iii) $\left(\frac{1}{6}\right)\left(\frac{5}{6}\right)^{2(n-1)}$
 (c) $\frac{5}{11}$
 (d) 0.432

Chapter 18

Exercise 18A

1. (a)

w	0	1	2	3	4
$P(W=w)$	$\frac{1}{16}$	$\frac{4}{16}$	$\frac{6}{16}$	$\frac{4}{16}$	$\frac{1}{16}$

(b)

d	0	1	2	3	4	5
$P(D=d)$	$\frac{6}{36}$	$\frac{10}{36}$	$\frac{8}{36}$	$\frac{6}{36}$	$\frac{4}{36}$	$\frac{2}{36}$

(c)

x	1	2	3	4	6
$P(X=x)$	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$

(d)

g	1	2	3
$P(G=g)$	$\frac{6}{72}$	$\frac{36}{72}$	$\frac{30}{72}$

(e)

c	1	2	3	4
$P(C=c)$	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{9}{64}$	$\frac{27}{64}$

(f)

x	1	2	3	4	6	8	9	12	16
$P(X=x)$	$\frac{1}{16}$	$\frac{2}{16}$	$\frac{2}{16}$	$\frac{3}{16}$	$\frac{2}{16}$	$\frac{2}{16}$	$\frac{1}{16}$	$\frac{2}{16}$	$\frac{1}{16}$

2. (a) (i) $\frac{1}{8}$ (ii) 0
 (b) (i) $\frac{1}{10}$ (ii) $\frac{12}{25}$
 (c) (i) $\frac{9}{10}$ (ii) $\frac{1}{10}$

3. 0.207

Exercise 18B

1. (a) (i) 2 (ii) 9
 (b) (i) $\frac{36}{14} = 2.57$ (ii) 3

2. (b) 4.4

3. 14

4. (b) $\frac{32}{18}$

5. (a) $\frac{1}{10}$

(b) 2

6. $\frac{13}{6}$

7. $p = 0.5, q = 0.2$

8. 40

9. (a)

Profit (\$)	$-n$	$1-n$	$2n$	$3n$
Probability	$\frac{27}{64}$	$\frac{27}{64}$	$\frac{9}{64}$	$\frac{1}{64}$

(b) \$0.82

Exercise 18C

1. (a) (i) 0.147 (ii) 0.0459
 (b) (i) 0.944 (ii) 0.797
 (c) (i) 0.0563 (ii) 0.0104
 (d) (i) 0.990 (ii) 0.797
 (e) (i) 0.203 (ii) 0.832
 (f) (i) 0.0562 (ii) 0.776

2. (a) (i) $\frac{5}{32}$ (ii) $\frac{1}{32}$
 (b) (i) $\frac{31}{32}$ (ii) $\frac{6}{32}$
 (c) (i) $\frac{1}{32}$ (ii) $\frac{26}{32}$

3. (a) (i) $E(Y) = 10, \text{Var}(Y) = 9$
 (ii) $E(X) = 8, \text{Var}(X) = 4$
 (b) (i) $E(X) = 4.5, \text{Var}(X) = 3.15$
 (ii) $E(Y) = 7, \text{Var}(Y) = 4.55$

(c) (i) $E(Z) = \frac{n-1}{n}, \text{Var}(Z) = \left(\frac{n-1}{n}\right)^2$

(ii) $E(X) = 2, \text{Var}(X) = \frac{2(n-2)}{n}$

4. (a) 0.238

(b) 0.181

(c) 0.5

5. (a) The students in the sample may not be independent of each other (e.g. siblings) or sampling without replacement.

(b) 0.103

6. 2700

7. (a) 0.0231

(b) 2

(c) 1.5

(d) 0.0273

8. (a) 0.108

(b) 0.0267

(c) e.g. The probability that a person going to the doctor has the virus is the same as for the general population of the country.

9. 0.4

10. The second (because $0.0165 > 0.0154$)

12. (a) $0.16 \binom{n}{2} (0.6)^{n-2}$

(b) 10

ANSWER HINT 12(b)

To solve this, you need to try some values of n or use tables on your calculator.

13. 0.14, 0.20

14. 0.494, 0.700

Exercise 18D

1. (a) (i) 0.885 (ii) 0.212
 (b) (i) 0.401 (ii) 0.878
 (c) (i) 0.743 (ii) 0.191
 (d) (i) 0.807 (ii) 0.748
 (e) (i) 0.451 (ii) 0.689

2. (a) (i) 0.5 (ii) 1

(b) (i) -1.67 (ii) -0.4

3. (a) (i) $P(Z < 1.6)$ (ii) $P(Z < 1.28)$

(b) (i) $P(Z \geq -0.68)$ (ii) $P(Z \geq -2.96)$

- (c) (i) $P(-1.4 < Z < 0.2)$
(ii) $P(-2.36 \leq Z \leq -0.2)$
4. (a) 1.16
(b) 0.123
5. 1547
6. (a) 0.278
(b) (i) 0.127 (ii) 0.334
7. (a) 0.160 (b) 0.171 (c) 0.727
8. (a) 0.707 (b) 0.663
9. (a) 0.673 (b) 0.314
10. (a) 0.952 (b) 0.838
11. (a) 0.841 (b) 0.811
12. 0.640

Exercise 18E

1. (a) (i) 19.9 (ii) 13.3
(b) (i) 32.4 (ii) 37.3
(c) (i) 2.34 (ii) 4.44
2. (a) (i) 5.68 (ii) 7.32
(b) (i) 43.4 (ii) 15.3
3. (a) (i) $\mu = 8.91, \sigma = 2.27$
(ii) $\mu = 129.8, \sigma = 38.6$
(b) (i) $\mu = -0.201, \sigma = 1.19$
(ii) $\mu = 870, \sigma = 202$
4. 141
5. 3.61 kg
6. 1.97 cm
7. (a) 0.691
(b) 39.7
(c) 0.240
8. 99.7%
9. (a) $\mu = 1.29$ mm, $\sigma = 0.554$ cm
(b) $\mu = 1.36$ mm, $\sigma = 0.764$ cm

Mixed examination practice 18

Short questions

1. 0.261
2. 55
3. (a) 6.68%
(b) 82

4. (a) 4.8
(b) 0.0834
5. 0.149
6. (a) 0.232
(b) 0.894
7. (a) 0.0296
(b) 0.000244
8. $\mu = 31.4^\circ, \sigma = 4.52^\circ$
9. (a) 15
(b) 0.273

Long questions

1. (a) 2.5
(b) 0.0162
(c) 0.756
(d) 2
(e) It stays constant at 0.25

2. (a) 0.460
(b) $1 - (0.95)^n$
(c) 32

3. (a) (i) $\frac{1}{9}$ (ii) $\frac{1}{81}$
(b) (i) 0.113 (ii) 0.444
(c) (ii)

x	3	4	5
$P(X = x)$	$\frac{65}{1296}$	$\frac{175}{1296}$	$\frac{369}{1296}$

$$\text{(iii)} \frac{6797}{1296} = 5.24$$

[13 marks]

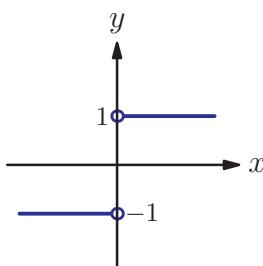
Chapter 19

Short questions

1. $\frac{5}{36}$

2. 4

- 3.



4. $\frac{1}{3}x^3 + x^2 + C$

5. $\frac{a(r^n - 1)}{n(r-1)}$

6. $\frac{11}{12}$

7. $\frac{\sqrt[10]{e}}{2\sqrt[10]{27}}$

8. Translation by $\begin{pmatrix} \frac{\pi}{2} \\ 1 \end{pmatrix}$

9. (a) $\frac{1}{k}$ (b) $\begin{pmatrix} 0 \\ \ln k \end{pmatrix}$

10. (a) $\frac{2047}{1024}$ (b) $-55\ln 2$

11. $\frac{3}{64}$

12. $y = 1.86$

13. $-0.618 < x < 1.62$

14. $\sqrt{13}$

15. (b) $\frac{1}{6}\left(\frac{5}{6}\right)^{r-1}$

16. $\ln 2$

17. $\frac{2\pi l^3}{9\sqrt{3}}$

18. (a) $\pi - 2\theta$ (b) $4\cos^2 \theta$

19. (a) $\ln\left(\frac{x-3}{x}\right)$ (b) $\frac{3}{1-e^x}$

20. (a) Vertical stretch with scale factor 2

(b) Vertical stretch with scale factor

$$\frac{1}{\ln 10} (= \log_{10} e)$$

21. $\frac{1}{5}$

22. (b) 0

23. $\frac{\theta}{1-\cos\theta}$

24. (a) $x = \ln\left(\frac{y \pm \sqrt{y^2 - 4}}{2}\right)$

25. $\left(\frac{1}{2}e^2 - 2e + \frac{5}{2}\right)\pi$

26. 3, 11

27. $\frac{3}{2}$

Long questions

1. (a) $\frac{1}{5}$ (b) $\frac{4}{25}$

(c) $\frac{16}{125}$ (e) $\frac{4}{9}$

(f) $\frac{1}{2}$

2. (a) 6 (b) -7

3. (a) $2 + \cos 2x - \frac{1}{\cos^2 x}$

4. (a) $\frac{1}{3}$

(b) $k = 1$

(d) 0.095

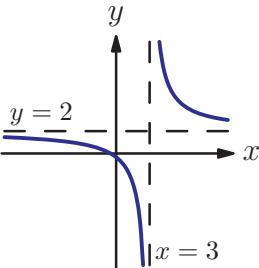
5. (b) $\frac{6}{17}$

(c) 0.443

6. (a) (ii) $x = 3$
(iii) (3, 2)

(b) $\left(-\frac{1}{2}, 0\right), \left(0, -\frac{1}{3}\right)$

(c)



(d) $y = -7x + 37$

(e) (2, -5)

7. (a) $y = \frac{1}{e}x$

8. (a) 2π
(b) $[-0.4, 0.4]$

(c) (i) $2\sin x \cos^2 x - \sin^3 x$

(iii) $\frac{2\sqrt{3}}{9}$

(d) $\frac{\pi}{2}$

(e) (i) $\frac{1}{3}\sin^3 x + c$

(ii) $\frac{1}{3}$

(f) 0.491

9. (a) (i) $10x + 1 - e^{2x}$

(ii) $\frac{\ln 5}{2} = 0.805$

(b) (i) $f^{-1}(x) = \frac{\ln(x-1)}{2}$

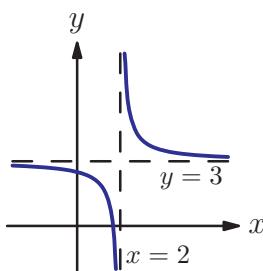
(c) $\int_0^{\ln 2} \pi(1 + e^{2x})^2 dx$

10. (a) $f^{-1}(x) = \frac{x+5}{3}$

(b) $3x - 3$

(c) $x = \frac{3}{2}$

(d) (i)

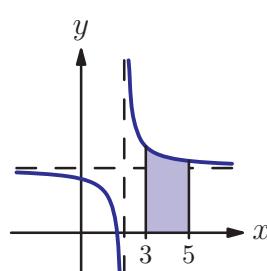


(ii) $x = 2, y = 3$

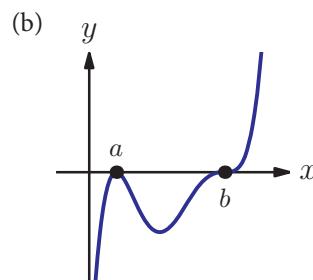
(e) (i) $3x + \ln(x-2) + c$

(ii) $6 + \ln 3$

(f)



11. (a) $\frac{qa+pb}{p+q}$



(c) q should be even