Chapter 16

Exercise 62 (page 118)

1. (a) 0.1653 (b) 0.4584 (c) 22030
2. (a) 5.0988 (b) 0.064037 (c) 40.446
3. (a) 4.55848 (b) 2.40444 (c) 8.05124
4. (a) 48.04106 (b) 4.07482 (c) −0.08286
5. 2.739 **6.** 120.7 m

Exercise 63 (page 120)

1. 2.0601 **2.** (a) 7.389 (b) 0.7408
3. $1-2x^2-\frac{8}{3}x^3-2x^4$
4. $2x^{1/2}+2x^{5/2}+x^{9/2}+\frac{1}{3}x^{13/2}+\frac{1}{12}x^{17/2}+\frac{1}{60}x^{21/2}$

Exercise 64 (page 122)

1. 3.95, 2.05 **2.** 1.65, −1.30
3. (a) 28 cm^3 (b) 116 min **4.** (a) 70°C (b) 5 minutes

Exercise 65 (page 124)

1. (a) 0.55547 (b) 0.91374 (c) 8.8941
2. (a) 2.2293 (b) −0.33154 (c) 0.13087
3. −0.4904 **4.** −0.5822 **5.** 2.197 **6.** 816.2
7. 0.8274 **8.** 11.02 **9.** 1.522 **10.** 1.485
11. 1.962 **12.** 3 **13.** 4
14. 147.9 **15.** 4.901 **16.** 3.095
17. $t=e^{b+a\ln D}=e^b e^{a\ln D}=e^b e^{\ln D^a}$ i.e. $t=e^b D^a$
18. 500 **19.** $W=PV\ln\left(\frac{U_2}{U_1}\right)$

Exercise 66 (page 127)

1. (a) 150°C (b) 100.5°C **2.** 99.21 kPa
3. (a) 29.32 volts (b) 71.31×10^{-6} s
4. (a) 1.993 m (b) 2.293 m **5.** (a) 50°C (b) 55.45 s
6. 30.37 N **7.** (a) 3.04 A (b) 1.46 s
8. 2.45 mol/cm^3 **9.** (a) 7.07 A (b) 0.966 s
10. £2424

Chapter 17

Exercise 67 (page 134)

1. (a) Horizontal axis: 1 cm = 4 V (or 1 cm = 5 V), vertical axis: 1 cm = 10 Ω
(b) Horizontal axis: 1 cm = 5 m, vertical axis: 1 cm = 0.1 V
(c) Horizontal axis: 1 cm = 10 N, vertical axis: 1 cm = 0.2 mm
2. (a) −1 (b) −8 (c) −1.5 (d) 5 **3.** 14.5
4. (a) −1.1 (b) −1.4
5. The 1010 rev/min reading should be 1070 rev/min; (a) 1000 rev/min (b) 167 V

Exercise 68 (page 140)

1. Missing values: −0.75, 0.25, 0.75, 2.25, 2.75; Gradient $=\frac{1}{2}$
2. (a) 4, −2 (b) −1, 0 (c) −3, −4 (d) 0, 4
3. (a) 2, $\frac{1}{2}$ (b) 3, $2\frac{1}{2}$ (c) $\frac{1}{24}$, $\frac{1}{2}$
4. (a) 3, −3 (b) −2, 4 (c) 3, 0 (d) 0, 7
5. (a) 2, $-\frac{1}{2}$ (b) $-\frac{2}{3}$, $-1\frac{2}{3}$ (c) $\frac{1}{18}$, 2 (d) 10, $-4\frac{2}{3}$
6. (a) $\frac{3}{5}$ (b) −4 (c) $-1\frac{5}{6}$
7. (a) and (c), (b) and (e)
8. (2, 1) **9.** (1.5, 6) **10.** (1, 2)
11. (a) 89 cm (b) 11 N (c) 2.4 (d) $l=2.4W+48$
12. $P=0.15W+3.5$ **13.** $a=-20, b=412$

Exercise 69 (page 144)

1. (a) 40°C (b) 128 Ω
2. (a) 850 rev/min (b) 77.5 V
3. (a) 0.25 (b) 12 (c) $F=0.25L+12$
(d) 89.5 N (e) 592 N (f) 212 N
4. −0.003, 8.73
5. (a) 22.5 m/s (b) 6.43 s (c) $v=0.7t+15.5$
6. $m=26.9L-0.63$
7. (a) $1.31t$ (b) 22.89% (c) $F=-0.09W+2.21$
8. (a) 96×10^9 Pa (b) 0.00022 (c) 28.8×10^6 Pa

9. (a) $\frac{1}{5}$ (b) 6 (c) $E = \frac{1}{5}L + 6$ (d) 12 N (e) 65 N

10. $a = 0.85, b = 12$, 254.3 kPa, 275.5 kPa, 280 K

Chapter 18

Exercise 70 (page 149)

1. (a) y (b) x^2 (c) c (d) d **2.** (a) y (b) $\sqrt{x}$ (c) b (d) a

3. (a) y (b) $\frac{1}{x}$ (c) f (d) e **4.** (a) $\frac{y}{x}$ (b) x (c) b (d) c

5. (a) $\frac{y}{x}$ (b) $\frac{1}{x^2}$ (c) a (d) b

6. $a = 1.5, b = 0.4$, 11.78 mm^2 **7.** $y = 2x^2 + 7$, 5.15

8. (a) 950 (b) 317 kN

9. $a = 0.4, b = 8.6$ (i) 94.4 (ii) 11.2

Exercise 71 (page 154)

1. (a) $\lg y$ (b) x (c) $\lg a$ (d) $\lg b$

2. (a) $\lg y$ (b) $\lg x$ (c) L (d) $\lg k$

3. (a) $\ln y$ (b) x (c) n (d) $\ln m$

4. $I = 0.0012\,V^2$, 6.75 candelas

5. $a = 3.0, b = 0.5$

6. $a = 5.7, b = 2.6$, 38.53, 3.0

7. $R_0 = 26.0, c = 1.42$ **8.** $y = 0.08e^{0.24x}$

9. $T_0 = 35.4$ N, $\mu = 0.27$, 65.0 N, 1.28 radians

Chapter 19

Exercise 72 (page 156)

1. $x = 2, y = 4$ **2.** $x = 1, y = 1$

3. $x = 3.5, y = 1.5$ **4.** $x = -1, y = 2$

5. $x = 2.3, y = -1.2$ **6.** $x = -2, y = -3$

7. $a = 0.4, b = 1.6$

Exercise 73 (page 160)

1. (a) Minimum (0, 0) (b) Minimum (0, −1)
(c) Maximum (0, 3) (d) Maximum (0, −1)

2. −0.4 or 0.6 **3.** −3.9 or 6.9

4. −1.1 or 4.1 **5.** −1.8 or 2.2

6. $x = -1.5$ or −2, Minimum at (−1.75, −0.1)

7. $x = -0.7$ or 1.6 **8.** (a) ± 1.63 (b) 1 or −0.3

9. (−2.6, 13.2), (0.6, 0.8); $x = -2.6$ or 0.6

10. $x = -1.2$ or 2.5 (a) −30 (b) 2.75 and −1.50
(c) 2.3 or −0.8

Exercise 74 (page 161)

1. $x = 4, y = 8$ and $x = -0.5, y = -5.5$

2. (a) $x = -1.5$ or 3.5 (b) $x = -1.24$ or 3.24
(c) $x = -1.5$ or 3.0

Exercise 75 (page 162)

1. $x = -2.0, -0.5$ or 1.5

2. $x = -2$, 1 or 3, Minimum at (2.1, −4.1),
Maximum at (−0.8, 8.2)

3. $x = 1$ **4.** $x = -2.0$, 0.4 or 2.6

5. $x = 0.7$ or 2.5

6. $x = -2.3$, 1.0 or 1.8 **7.** [illegible]

Chapter 20

Exercise 76 (page 167)

1. 22.2′ **2.** 27°54′ **3.** 51°11′ **4.** 100°6′52″

5. 15°44′17″ **6.** 86°49′1″ **7.** 72.55° **8.** 27.754°

9. 37°57′ **10.** 58°22′52″

Exercise 77 (page 169)

1. reflex **2.** obtuse **3.** acute **4.** right angle

5. (a) 21° (b) 62°23′ (c) 48°56′17″

6. (a) 102° (b) 165° (c) 10°18′49″

7. (a) 60° (b) 110° (c) 75° (d) 143° (e) 140°
(f) 20° (g) 129.3° (h) 79° (i) 54°

8. Transversal (a) 1 & 3, 2 & 4, 5 & 7, 6 & 8
(b) 1 & 2, 2 & 3, 3 & 4, 4 & 1, 5 & 6, 6 & 7,
7 & 8, 8 & 5, 3 & 8, 1 & 6, 4 & 7 or 2 & 5
(c) 1 & 5, 2 & 6, 4 & 8, 3 & 7 (d) 3 & 5 or 2 & 8

9. 59°20′ **10.** $a = 69°, b = 21°, c = 82°$ **11.** 51°

12. 1.326 rad **13.** 0.605 rad **14.** 40°55′

Exercise 78 (page 173)

1. (a) acute-angled scalene triangle
(b) isosceles triangle (c) right-angled triangle
(d) obtuse-angled scalene triangle
(e) equilateral triangle (f) right-angled triangle

Exercise 121 (page 284)

1. $11.11\sin(\omega t + 0.324)$ **2.** $8.73\sin(\omega t - 0.173)$
3. $i = 21.79\sin(\omega t - 0.639)$
4. $v = 5.695\sin(\omega t + 0.670)$
5. $x = 14.38\sin(\omega t + 1.444)$
6. (a) $305.3\sin(314.2t - 0.233)$ V (b) 50 Hz
7. (a) $10.21\sin(628.3t + 0.818)$ V (b) 100 Hz (c) 10 ms
8. (a) $79.83\sin(300\pi t + 0.352)$ V (b) 150 Hz (c) 6.667 ms

Chapter 31

Exercise 122 (page 288)

1. (a) continuous (b) continuous (c) discrete (d) continuous
2. (a) discrete (b) continuous (c) discrete (d) discrete

Exercise 123 (page 292)

1. If one symbol is used to represent 10 vehicles, working correct to the nearest 5 vehicles, gives 3.5, 4.5, 6, 7, 5 and 4 symbols respectively.
2. If one symbol represents 200 components, working correct to the nearest 100 components gives: Mon 8, Tues 11, Wed 5, Thurs 12 and Fri 6.5.
3. 6 equally spaced horizontal rectangles, whose lengths are proportional to 35, 44, 62, 68, 49 and 41, respectively.
4. 5 equally spaced horizontal rectangles, whose lengths are proportional to 1580, 2190, 1840, 2385 and 1280 units, respectively.
5. 6 equally spaced vertical rectangles, whose heights are proportional to 35, 44, 62, 68, 49 and 41 units, respectively.
6. 5 equally spaced vertical rectangles, whose heights are proportional to 1580, 2190, 1840, 2385 and 1280 units, respectively.
7. Three rectangles of equal height, subdivided in the percentages shown in the columns of the question. P increases by 20% at the expense of Q and R.
8. Four rectangles of equal height, subdivided as follows: week 1: 18%, 7%, 35%, 12%, 28%; week 2: 20%, 8%, 32%, 13%, 27%; week 3: 22%, 10%, 29%, 14%, 25%; week 4: 20%, 9%, 27%, 19%, 25%. Little change in centres A and B, a reduction of about 8% in C, an increase of about 7% in D and a reduction of about 3% in E.
9. A circle of any radius, subdivided into sectors having angles of 7.5°, 22.5°, 52.5°, 167.5° and 110°, respectively.
10. A circle of any radius, subdivided into sectors having angles of 107°, 156°, 29° and 68°, respectively.
11. (a) £495 (b) 88 **12.** (a) £16 450 (b) 138

Exercise 124 (page 297)

1. There is no unique solution, but one solution is:
39.3–39.4 1; 39.5–39.6 5; 39.7–39.8 9; 39.9–40.0 17; 40.1–40.2 15; 40.3–40.4 7; 40.5–40.6 4; 40.7–40.8 2.
2. Rectangles, touching one another, having midpoints of 39.35, 39.55, 39.75, 39.95, ... and heights of 1, 5, 9, 17, ...
3. There is no unique solution, but one solution is:
20.5–20.9 3; 21.0–21.4 10; 21.5–21.9 11; 22.0–22.4 13; 22.5–22.9 9; 23.0–23.4 2.
4. There is no unique solution, but one solution is:
1–10 3; 11–19 7; 20–22 12; 23–25 11; 26–28 10; 29–38 5; 39–48 2.
5. 20.95 3; 21.45 13; 21.95 24; 22.45 37; 22.95 46; 23.45 48
6. Rectangles, touching one another, having midpoints of 5.5, 15, 21, 24, 27, 33.5 and 43.5. The heights of the rectangles (frequency per unit class range) are 0.3, 0.78, 4, 4.67, 2.33, 0.5 and 0.2.
7. (10.95 2), (11.45 9), (11.95 19), (12.45 31), (12.95 42), (13.45, 50)
8. A graph of cumulative frequency against upper class boundary having co-ordinates given in the answer to problem 7.
9. (a) There is no unique solution, but one solution is:
2.05–2.09 3; 2.10–2.14 10; 2.15–2.19 11; 2.20–2.24 13; 2.25–2.29 9; 2.30–2.34 2.
(b) Rectangles, touching one another, having midpoints of 2.07, 2.12, ... and heights of 3, 10, ...
(c) Using the frequency distribution given in the solution to part (a) gives 2.095 3; 2.145 13; 2.195 24; 2.245 37; 2.295 46; 2.345 48.
(d) A graph of cumulative frequency against upper class boundary having the co-ordinates given in part (c).

Chapter 32

Exercise 125 (page 300)

1. Mean 7.33, median 8, mode 8
2. Mean 27.25, median 27, mode 26

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