

Answers

Exercise 2.1

1. (a) (i) 79 (ii) 997.07 (iii) -238
(iv) 79 631 (v) -102 643 (vi) 8.373592
- (b) (i) -54 758 (ii) -0.0099 (iii) -2.69793
(iv) 75 (v) -4 205 (vi) -643
- (c) (i) 110.5 (ii) -1 950 (iii) 1.2015
(iv) 612 (v) 0.000066768 (vi) 472 926
- (d) (i) -0.6793 (4 s.f.) (ii) 0.2635 (4 s.f.)
(iii) 4.824 (4 s.f.) (iv) 3.25 (v) 6.731 (4 s.f.)
(vi) 92 051
- (e) (i) 7 921 (ii) 36.036009 (iii) 50.2681
(iv) 121 801 (v) 2 116 (vi) 184 041
- (f) (i) 29.47880595 (ii) 298.9331029
(iii) 26.94438717 (iv) 0.09591663 (v) 0.056302753
(vi) 9.055385138
- (g) (i) 314 432 (ii) -39651821
(iii) 0.000323818 (iv) 4 665 834 711
(v) $6.1489559 \times 10^{-11}$ (vi) 2 197
- (h) (i) 3.732511157 (ii) 8.845085422
(iii) -8.763380887 (iv) 0.201652967
(v) 0.193987741 (vi) -0.147514601

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|-----|-------|-------------|------|-------------|
| (i) | (i) | 0.693465572 | (ii) | 0.125534728 |
| | (iii) | 378.8501611 | (iv) | 0.569078797 |

Exercise 2.2

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|----|------|-------|--------|------|---------|-------|----------------|
| 1. | (a) | (i) | 80 000 | (ii) | 65 000 | (iii) | 67 000 |
| | | (iv) | 4 000 | (v) | 380 000 | (vi) | 13 000 |
| | (b) | (i) | 79 500 | (ii) | 65 300 | (iii) | 67 200 |
| | | (iv) | 4 000 | (v) | 379 900 | (vi) | 13 200 |
| | (c) | (i) | 79 550 | (ii) | 65 320 | (iii) | 67 240 |
| | | (iv) | 4 030 | (v) | 379 880 | (vi) | 13 190 |
| 2. | (a) | (i) | 7.6 | (ii) | 8.0 | (iii) | 17.4 |
| | | (iv) | 0.1 | (v) | 4.2 | (vi) | 0 |
| | (b) | (i) | 7.6 | (ii) | 8.0 | (iii) | 17 |
| | | (iv) | 0 | | | | |
| 3. | (a) | (i) | 67.2 | (ii) | 1.3 | (iii) | 0 |
| | | (iv) | 0 | (v) | 32.9 | (vi) | 9.5 |
| | (b) | (i) | 67.25 | (ii) | 1.26 | (iii) | 0.04 |
| | | (iv) | 0.04 | (v) | 32.93 | (vi) | 9.54 |
| | (c) | (i) | 67.46 | (ii) | 1.258 | (iii) | 0.0379 |
| | | (iv) | 0.037 | (v) | 32.926 | (vi) | 9.540 |
| 4. | (a) | 709.3 | | (b) | 3.3 | (c) | 16 980 |
| | (d) | 56 | | (c) | 0.062 | (f) | 56.60 |
| 5. | (a) | (i) | 420 | (ii) | 10 190 | (iii) | 11 |
| | (b) | (i) | 1 | (ii) | 320 | (iii) | 4 500 |
| | (c) | (i) | 3 | (ii) | 12 000 | (iii) | 48 000 000 |
| | (d) | (i) | 12.5 | (ii) | 2 | (iii) | $8\frac{1}{3}$ |
| | (e) | (i) | 143 | (ii) | 700 | (iii) | 0.9286 |
| 6. | 190 | | | | | | |
| 7. | 40 h | | | | | | |

Exercise 2.3

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|----|-----|--|-----|--|
| 1. | (a) | 25.5 – 26.5 cm | (b) | 25.95 – 26.05 cm |
| | (c) | 26.065 – 26.075 cm | | |
| 2. | (a) | Lower; 1.0245 kg
Upper; 1.0255 kg
Absolute error = 0.005 | (b) | L; 2.495 m
U; 2.505 m
Absolute error = 0.005 |

- (c) L; 157.5 km
U; 158.5 km
Absolute error = 0.05
- (d) L ; 12.095 s
U; 12.105s
Absolute error = 0.05
- (e) L; 12.05 s
U; 12.15 s
Absolute error = 0.5
- (f) L; 11.5 s
U; 12.5 s
Absolute error = 0.5
3. (a) ± 0.5 (b) ± 0.05 (c) ± 0.005
(d) ± 0.05 (e) ± 0.5
4. (a) 0.05 (b) $\frac{0.05}{29.5} = \frac{1}{590}$ (or 0.0017)
- (c) $\frac{10}{59} = \%$ or 0.1695%
5. (a) 40.5° (b) 39.5° (c) $\frac{0.5}{40} \times 100 = 1.25\%$
6. 10.65 – 10.75 s
7. (a) Absolute error = 0.005; Absolute error = $\frac{0.005}{45.38} = 0.0001$
Percentage error = $\frac{1}{9076} \times 100$
 $= 0.011\%$
- (b) Absolute error = 0.005; Relative error = $\frac{0.005}{0.45} = 0.0111$
Percentage error = $\frac{10}{9}\%$
 $= 1.11\%$
- (c) Absolute error = 0.005 ; Relative error = $\frac{0.005}{7.62}$
 $= 0.0007$
Percentage error = $\frac{25}{381}\%$
 $= 0.066$
- (d) Absolute error = 0.0005 ; Relative error = $\frac{0.0005}{12.004} = 0.00004$
Percentage error = $\frac{25}{6002}\%$
 $= 0.0042$
- (e) Absolute error = 0.5 ; Relative error = $\frac{0.5}{2505} = 0.0002$

$$\begin{aligned}\text{Percentage error} &= \frac{10}{501} \% \\ &= 0.02\%\end{aligned}$$

8. (a) $2.45 - 2.55$

(b) $\frac{0.05}{2.5} = 0.02$

9. $\text{Percentage error} = \frac{0.01}{8.0} \times 100\%$
 $= 0.125\%$

10. (a) $\frac{67}{100} - \frac{2}{3} \times 100\% = 0.5\%$

(b) $\left(\frac{2}{3} - \frac{66}{100} \right) \times 100\% = 1\%$

11. (a) (i) $0.33 ; 0.9\%$

(ii) $4.1 ; 1.23\%$

(iii) $2.7 ; 0.66\%$

(iv) $3.1 ; 1.27\%$

(v) $10 ; 3.47\%$

(vi) $400 ; 1.27\%$

(b) (i) $0.32 ; 2.1\%$

(ii) $4.0 ; 1.23\%$

(iii) $2.7 ; 0.66\%$

(iv) $3.1 ; 1.27\%$

(v) $10 ; 3.47\%$

(iv) $390 ; 1.27\%$

12. (a) L; -186.005

(b) L; $7\,950$

U; -185.995

U; $8\,050$

(c) L; $-43\,500$

(d) L; 693.95

U; $-42\,500$

U; 694.05

Exercise 2.4

1. (a) Min = 11.170 cm

(b) Min = 12.140 l

Max = 11.190 cm

Max = 12.160 l

(c) Min = 482.435 m

Max = 483.545 m

2. (a) Min. per = 7

(b) Min per = 143.90 m

Max per = 71.80 cm

Max per = 146.10 m

3. Min = 0.10 s

Max = 0.30 s

4. $0.655 - 0.865\text{ m}$

5. 74.75 cm

6. (a) Min = 11.7 cm

(b) Min = 0.0075 km

Max = 11.9 cm

Max = 0.0185 km

- (c) Min = 2.18 g
Max = 2.20 g
- (d) Min = 2.19 l
Max = 2.21 l
7. 0.5
8. (a) Min = 28.00 cm³
Max = 31.33 cm³
- (b) Min = 64.435 cm²
Max = 68.635 cm²
9. (a) $\frac{10}{61}$
- (b) $\frac{1}{68}$
- (c) $\frac{3}{182}$
- (d) $\frac{125}{5292} \approx 0.02$
- (e) $\frac{862}{22491} \approx 0.038$ (2 s.f.)
- (f) 0.023 (2 s.f.)
- (g) 0.015 (2 s.f.)
- (h) 0.024 (2 s.f.)
- (i) 0.023 (2 s.f.)
- (j) 0.040 (2 s.f.)
- (k) 0.024 (2 s.f.)
- (l) -0.068
10. $161.4\pi \text{ cm}^3 - 170.8\pi \text{ cm}^3$
11. $33.75 \text{ cm}^2 - 46.75 \text{ cm}^2$
12. Min = 330 kg
Max = 390 kg
13. Least = 71.25 cm²
Max = 236.25 cm²
14. 4.66 h
15. 3.06 %
16. (a) 0.14 (2 s.f.) (b) 0.092 (2 s.f.)
(c) 0.69 (2 s.f.)