

National 4&5 Dynamics & Space Problems

Answers to Numerical Questions

Average Speed (p.2)

1.
 - (a) 5 ms^{-1}
 - (b) 5 ms^{-1}
 - (c) 12.5 m
 - (d) 880 m
 - (e) 0.05 s
 - (f) 200 s
2. 12.5 ms^{-1}
3. 2400 m
4. 6.67 s
5. 1.92 ms^{-1}
6. 780 m
7. 57.14 s
8. 120000 m
9. 55.56 m
10. 555.56 s
11. 20625 s (5.73 h)
12. 10.42 ms^{-1}
13. 70 km
14. 285.71 ms^{-1}
15.
 - (a) 75 ms^{-1}
 - (b) 212.5 kmh^{-1}
16.
 - (a) 23.28 ms^{-1}
 - (b) Perth & Dundee
17.
 - (a) 3 ms^{-1}
 - (b) 0.05 s
18.
 - (a) 70 kmh^{-1}
 - (b) $1 \text{ h } 40 \text{ min}$
 - (c) 82.5 kmh^{-1}
19.
 - (a) 480 m
 - (b) 13.71 s
 - (c) After 15s cheetah is still 5 m behind antelope. Antelope escapes!
20.
 - (a) Donald
 - (b) Mickey's- 82.95 ms^{-1}
 - (c) Mickey- 78.35 ms^{-1}
Donald- 77.84 ms^{-1}
Goofy- 80.00 ms^{-1}

Instantaneous Speed (p.6)

1.
 - (a) 2 ms^{-1}
 - (b) 1 ms^{-1}
 - (c) 2 ms^{-1}
 - (d) 0.7 ms^{-1}
 - (e) 0.5 ms^{-1}
 - (f) 0.75 ms^{-1}
2. 1.46 ms^{-1}

3.
 - A – 8.00 ms^{-1}
 - B – 7.69 ms^{-1}
 - C – 6.67 ms^{-1}
 - D – 6.90 ms^{-1}
 - E – 8.00 ms^{-1}
 - F – 8.33 ms^{-1}
- (a) F
- (b) C
4. 105.63 ms^{-1}
5.
 - (a) 0.5 ms^{-1}
 - (b) 0.63 ms^{-1}
 - (c) 0.56 ms^{-1}
- (b) $11 \text{ km @ } 45^\circ \text{ S of E}$
Or ... $11 \text{ km @ } 135^\circ$
12.
 - (a) 17 km
 - (b) $5 \text{ km @ } 37^\circ \text{ S of W}$
Or ... $5 \text{ km @ } 233^\circ$

Speed and Velocity (p.12)

Distance and Displacement (p.9)

1.
 - (a) 150 m
 - (b) 150 m, East
2.
 - (a) 150 m
 - (b) 50 m, East
3.
 - (a) 180 km
 - (b) 20 km, South
4.
 - (a) 80 m
 - (b) 40 m, South
5.
 - (a) 3.6 km
 - (b) 2 km, West
6.
 - (a) $40 \text{ m @ } 45^\circ \text{ S of E}$
 $40 \text{ m @ } 135^\circ$
 - (b) $60 \text{ m @ } 30^\circ \text{ N of E}$
 $60 \text{ m @ } 060^\circ$
 - (c) $25 \text{ m @ } 50^\circ \text{ S of W}$
 $25 \text{ m @ } 220^\circ$
 - (d) $80 \text{ m @ } 75^\circ \text{ N of W}$
 $80 \text{ m @ } 345^\circ$
7.
 - (a) 70 m
 - (b) 50 m
 - (c) 53° W of N
 - (d) 307°
8.
 - (a) 1700 m
 - (b) $1300 \text{ m @ } 67^\circ \text{ W of N}$
Or ... $1300 \text{ m @ } 293^\circ$
9.
 - (a) 460 m
 - (b) 0 m
10.
 - (a) 8 km
 - (b) $5.8 \text{ km @ } 31^\circ \text{ N of W}$
Or ... $5.8 \text{ km @ } 301^\circ$
11.
 - (a) 16 km

1.
 - (a) 400 m
 - (b) 0 m
 - (c) 8.3 ms^{-1}
 - (d) 0 ms^{-1}
2.
 - (a) 250 m
 - (b) 150 m, West
 - (c) 5 ms^{-1}
 - (d) $3 \text{ ms}^{-1}, \text{ West}$
3.
 - (a) 1.2 ms^{-1}
 - (b) $0.7 \text{ ms}^{-1} @ 085^\circ$
4.
 - (a) 3.6 km h^{-1}
 - (b) $2 \text{ km h}^{-1}, \text{ West}$
5.
 - (a) 100 km
 - (b) 60 km, North
 - (c) 50 km h^{-1}
 - (d) $30 \text{ km h}^{-1}, \text{ North}$
6.
 - (a) 140 km
 - (b) $100 \text{ km @ } 053^\circ$
 - (c) 70 km h^{-1}
 - (d) $50 \text{ km h}^{-1} @ 053^\circ$
7.
 - (a) 50 m
 - (b) $36 \text{ m @ } 056^\circ$
 - (c) 0.83 ms^{-1}
 - (d) $0.6 \text{ ms}^{-1} @ 056^\circ$
8.
 - (a) 1100 m
 - (b) $781 \text{ m @ } 220^\circ$
 - (c) 10 ms^{-1}
 - (d) $7.1 \text{ ms}^{-1} @ 220^\circ$
9.
 - (a) 1200 m
 - (b) $894 \text{ m @ } 063^\circ$
 - (c) 100 s
 - (d) $8.94 \text{ ms}^{-1} @ 063^\circ$
10.
 - (a) 8 m
 - (b) $5.8 \text{ m @ } 149^\circ$
 - (c) 40 s
 - (d) $0.15 \text{ ms}^{-1} @ 149^\circ$
11.
 - (a) 12 m
 - (b) $8.5 \text{ m @ } 045^\circ$
 - (c) 6 s

National 4&5 Dynamics & Space Problems

Answers to Numerical Questions

- (d) 1.4 ms^{-1} @ 045°
 12.
 (a) 11 km
 (b) 5 km @ 233°
 (c) 3.7 km h^{-1}
 (d) 1.7 km h^{-1} @ 233°

Combining Velocities (p. 15)

1.
 (a) 5 ms^{-1} @ 053°
 (b) 7.2 ms^{-1} @ 214°
 (c) 5.4 ms^{-1} @ 338°
 2. 8.9 ms^{-1} @ 246°
 3. 6.7 ms^{-1} @ 063°
 4. 108 kmh^{-1} @ 248°
 5.
 (b) 187 kmh^{-1} @ 16° S of E
 6. 900 kmh^{-1} , North
 7.
 (a) 804 kmh^{-1} @ 5.7° E of N
 (b) 804 kmh^{-1} @ 5.7° W of N
 8. 26 ms^{-1} @ 023°
 9. 4.5 ms^{-1} @ 063°
 10. 6 ms^{-1} @ 323°

Acceleration(p.18)

1.
 (a) 2 ms^{-2}
 (b) 4 ms^{-2}
 (c) 0.05 ms^{-2}
 (d) 0.4 ms^{-2}
 (e) 3 ms^{-2}
 (f) 5 ms^{-2}
 2. 0.5 ms^{-2}
 3. 0.875 ms^{-2}
 4. 10 ms^{-2}
 5. 0.25 ms^{-2}
 6. 1.25 ms^{-2}
 7. $0.4 \text{ km h}^{-1} \text{ s}^{-1}$
 8. 0.5 ms^{-2}
 9. $3 \text{ km h}^{-1} \text{ s}^{-1}$
 10. 1 ms^{-2}
 11. 1.5 ms^{-2}
 12. 0.5 ms^{-2}
 13. 0.75 ms^{-2}
 14. 0.4 ms^{-2}
 15.
 (a) 8 ms^{-1}
 (b) 28 ms^{-1}
 16. 3.2 ms^{-1}
 17. 0.2 ms^{-1}
 18. 9.5 s
 19. 30 s
 20. $0.9 \text{ km h}^{-1} \text{ s}^{-1}$
 21.
 (a) 2 ms^{-1}
 (b) 3.6 ms^{-1}

22. A - 4 ms^{-1}
 B - 5 ms^{-1}
 23. 13.5 ms^{-1}
 24.
 (a) 0 m/s
 (b) Earth - 0.64 s
 Moon - 4 s
 25. 15.2 ms^{-1}

Velocity-Time Graphs (p.22)

1.
 (a) 0.3 ms^{-2}
 (b) 10 ms^{-2}
 (c) 0.24 ms^{-2}
 (d) 0.5 ms^{-2}
 (e) 5 ms^{-2}
 (f) 0.2 ms^{-2}
 2.
 (a) 2.5 ms^{-2}
 (b) 1 ms^{-2}
 3.
 (a) 0.56 ms^{-2}
 (b) 0 ms^{-2}
 4. Gear 4- 2 ms^{-2}
 Gear 3- 0.75 ms^{-2}
 Gear 2- 0.5 ms^{-2}
 5.
 (a) 50 - 70 s
 (b) 0 s, 50 s and 100 s
 (c) 0.83 ms^{-2}
 7.
 (a) 250 m
 (b) 180 m
 (c) 650 m
 (d) 300 m
 (e) 550 m
 (f) 300 m
 (g) 693 m
 (h) 4 000 m
 (i) 220 m
 8.
 (a) 8 s after seeing
 accident
 (b) 200 m
 (c) 250 m
 9.
 (a) 0.5 ms^{-2}
 (b) 1 700 m
 10.
 (a) 0.5 ms^{-2}
 (b) 1 100 m
 11.
 (a) at 10 seconds
 (b) 160 m
 12.

- (a) 500 m
 (b) deceleration for
 560m so rocket
 reaches a point 20 m
 above Moon and
 hovers.
 13.
 (a) at 5 s
 (b) 125 m
 14. 202.5 m
 15.
 (a) 2 ms^{-2}
 (b) 120 m
 (c) 5.45 ms^{-1}

Mass and Weight(p.27)

1.
 (a) 3 000 N
 (b) 2.22 N
 (c) 2.34 N
 (d) 23 kg
 2.
 (a) 500 N
 (b) 200 N
 (c) 90 N
 (d) 5 N
 3.
 (a) 75 kg
 (b) 0.45 kg
 (c) 35 kg
 (d) 4 kg
 (e) $1.4 \times 10^3 \text{ kg}$
 (f) $3 \times 10^{-5} \text{ kg}$
 4. 0.3 N
 5. 0.02 N
 6.
 (a) 4.9 N
 (b) 0.8 N
 (c) 0 N
 7.
 (a) 82 kg
 (b) 82 kg
 (c) 82 kg
 8.
 (a) Nicola
 (b) The force due to
 gravity acting on each
 kg of an object.
 9.
 (a) 9 000 N
 (b) 918 kg
 10.
 (a) $2.2 \times 10^7 \text{ N}$
 (b) $1.96 \times 10^7 \text{ N}$
 11.
 (a) 0.098 N
 (b) 9.8 Nkg^{-1}
 12.

National 4&5 Dynamics & Space Problems

Answers to Numerical Questions

- (a) 1 300 kg
 (b) 13 kN
 13.
 (a) 2.94 N
 (b) 300 g
 14. 857 N
 15. 0.05 kg
 16. 2.9 kg
 17. 2 kg stone on Neptune
 18. 60 N
 19. 0.44 kg
 20. Jupiter

Newton's First Law(p.32)

1. (b), (c), (d) and (f)
 2. 16 000 N
 3. 2 N
 4. 550 N
 5.
 (a) 7 500 N
 (b) 7 500 N
 6.
 (a) 85 500 N
 (b) 8 550 kg
 7.
 (a) 953 kg
 (b) 9 530 N
 (c) 9 530 N
 (d) 9 530 N
 (e) 1 640 kg
 (f) 12 people
 8.
 (a) 3 000 N to the right
 (b) 12
 (c) 2 750 N
 9.
 (a) 6 - 9 minutes
 (b) 9 minutes
 (d) 74.5 kg
 (e) 745 N
 10.
 (a) 2 400 N
 (b) 580 000 N

Newton's Second Law (p.35)

1.
 (a) 8 N
 (b) 18 N
 (c) 100 ms^{-2}
 (d) 90 kg
 (e) 8.23 kg
 (f) 22.5 ms^{-2}
 2. 24 N
 3. 5 000 N
 4. 25 ms^{-2}
 5. 1 ms^{-2}

6. 43.33 kg
 7. 2 000 kg
 8. 1.18 ms^{-2}
 9. 0.6 ms^{-2}
 10. 4.5 N
 11. 15 ms^{-2}
 12. 0.32 ms^{-2}
 13. $3 \times 10^8 \text{ N}$
 14.
 (a) 200 N
 (b) 2.86 ms^{-2}
 15.
 (a) 2 000 N
 (b) 0.44 ms^{-2}
 16.
 (a) 306 000 kg
 (b) 4 500 kN
 (c) 15 ms^{-2}
 17.
 (a) 3600N
 (b) 200 N
 18.
 (a) 0.11 ms^{-2}
 (b) 0.13 ms^{-2}
 19.
 (a) 6 100 N
 (b) 0.12 ms^{-2}
 20. 917 kg
 21.
 (a) 1 ms^{-2}
 (b) 1 200 N
 22.
 (a) 36.7 ms^{-2}
 (b) 275 000 N
 (c) 349 000 N
 23. 320 kg
 24. 250 200 N
 25. 120 N
 26. 0.75 ms^{-2}
 27. $4.2 \times 10^6 \text{ N}$
 28.
 (a) 30.6 ; 10.2
 (b) 19 000 ; 95
 (c) 14700;5300; 3.5
 (d) 490000;
 60000;1.2
 (e) 686 000;
 154 000; 2.2
 (f) 745 000;
 151 800; 2.0
 29.
 (a) 7.84 N
 (b) 5.2 ms^{-2}
 (c) 13.4 ms^{-2}
 30.

- (a) $1.84 \times 10^6 \text{ kg}$
 (b) 1.47 ms^{-2}
 (c) no;thrust is less than weight
 (d) 4.9 ms^{-2}
 (e) 5.7 ms^{-2}
 (f) $5.7 \times 10^7 \text{ N}$

Projectiles (p. 44)

1.
 (a) 40 m
 (b) 20 ms^{-1}
 (c) 20 m
 2.
 (a) 1 200 m
 (b) 120 ms^{-1}
 (c) 720 m
 3.
 (a) 300 m
 (b) 100 ms^{-1}
 4.
 (a) $8 \times 10^7 \text{ m}$
 (b) $2 000 \text{ ms}^{-1}$
 (c) 20 000 m
 5.
 (a) 0.5 s
 (b) 5 ms^{-1}
 (c) 1.25 m
 6.
 (a) 0 ms^{-1}
 (b) 100 ms^{-1}
 7.
 (a) 0 ms^{-1}
 (b) 12.5 s
 8. h.dist. = 1200 m
 v.dist = 1 350 m
 9.
 (a) 200 m
 (b) 0.75 ms^{-2}
 (c) 150 m
 10.
 (a) 84 m
 (b) 24 ms^{-1}
 (c) 28.8 m

Satellites (p.48)

1.
 (a) $4 \times 10^9 \text{ Hz}$
 (b) $1.1 \times 10^{10} \text{ Hz}$
 (c) $1.4 \times 10^{10} \text{ Hz}$
 (d) $6.5 \times 10^9 \text{ Hz}$
 2.
 (a) 0.05 m
 (b) 0.07 s
 3.
 (a) $1.5 \times 10^{10} \text{ Hz}$
 (b) 0.12 s
 4.

National 4&5 Dynamics & Space Problems
Answers to Numerical Questions

- (a) 1.2×10^9 Hz
 (b) 0.07 s
 5.
 (a) 0.03 m
 (b) 4.5×10^7 m
 6.
 (a) 1.07×10^{-3} s
 7. Early Bird
 8.
 (a) 24 hours
 (b) 0.075 m
 9.
 (a) 1×10^{10} Hz
 (b) 1.5×10^7 m
 10.
 (a) 0.02 m
 (b) 0.17 s
 (c) 0.03 m
 (d) 0.33 s

Work Done (p.51)

1.
 (a) 3 750 J
 (b) 2 080 000 J
 (c) 125 N
 (d) 271 m
 2. 5 000 J
 3. 200 m
 4. 30 N
 5. 133 N
 6. 3 400 m
 7. 6 500 000 J
 8. 1 818 m
 9. 7.5×10^7 J
 10.
 (a) 433 N
 (b) 54 N
 11. 4 750 m
 12.
 (a) 52 500 J
 (b) 52 500 J
 (c) (i) Peter - 8,
 John - 4
 (ii) Peter
 13. 60 J
 14. 4 800 J
 15. 690 000 J
 16.
 (a) 16 250 N
 (b) 1 660 kg
 17.
 (a) 40 N
 (b) 4 kg
 (c) 10 books
 18.
 (a) 735 N
 (b) 110 000 J

Kinetic Energy (p.54)

1.
 (a) 9 J
 (b) 56.25 J
 (c) 36 J
 (d) 50 J
 (e) 12 J
 (f) 400 000 J
 2. 135 000 J
 3. 2.25 J
 4. 19.36 J
 5.
 (a) 250 000 J
 (b) 440 000 J
 6. 1 021 J
 7. 1.82×10^{-16} J
 8.
 (a) 20 ms^{-1}
 (b) 1×10^7 J
 9. 3.75×10^{-3} J
 10. 8.09×10^{10} J
 11. 10 ms^{-1}
 12. 0.125 kg
 13. 22 ms^{-1}
 14.
 (a) $5 000 \text{ ms}^{-1}$
 (b) 4 800 kg
 15.
 (a) 226 625 J
 (b) 9.52 ms^{-1}
 16.
 (a) 0.53 ms^{-1}
 (b) 0.11 J
 17. 4 people
 18.
 (a) 140 000 J
 (b) 18 ms^{-1}
 (c) 313 600 J

Potential Energy(p.57)

1.
 (a) 3675 J
 (b) 13 200 J
 (c) 1.3 m
 (d) 3.6 m
 (e) 2.4 kg
 (f) 10.7 kg
 2.
 (a) 2 350 J
 (b) 147 000 J
 (c) 3 680 J
 3.
 (a) 1.36 kg
 (b) 7.85 kg
 (c) 19.1 kg
 4. 3 m
 5. 41 200 J
 6. 470 000 J

7. 66 kg
 8. 0.6 J
 9. 102 m
 10.
 (a) 366 500 J
 (b) 158 000 J
 11. 1 000 J
 12. 540 000 J
 13. 120 000 J
 14. 21.25 m
 15. 100 N

Specific Heat Capacity (p.60)

1.
 (a) 546 000 J
 (b) 74 415 J
 (c) $3.89 \text{ }^\circ\text{C}$
 (d) $500 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$
 (e) $533.3 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$
 (f) 192 J
 2. 27 060 J
 3. $5.86 \text{ }^\circ\text{C}$
 4. 2.5 kg
 5. $9 200 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$
 6. 211 500 J
 7. 3 667 J
 8. $2 400 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$
 9. B
 10. 0.05 kg
 11. $846.15 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$
 12. $80.58 \text{ }^\circ\text{C}$
 13. $11.65 \text{ }^\circ\text{C}$
 14. $93.73 \text{ }^\circ\text{C}$
 15. $21.56 \text{ }^\circ\text{C}$

Specific Latent Heat (p.62)

1.
 (a) 198 000 J
 (b) 29 465 000 J
 (c) $180 000 \text{ Jkg}^{-1}$
 (d) 0.36 kg
 (e) 1 kg
 (f) $334 000 \text{ Jkg}^{-1}$
 2. 668 000 J
 3. 10 080 000 J
 4. 3.2 kg
 5. 0.58 kg
 6. $3.95 \times 10^5 \text{ Jkg}^{-1}$
 7. 7.2×10^6 J
 8. 1.36×10^6 J
 9. 910 J
 10. 0.01 kg
 11. 560 000 J
 12. $0.25 \times 10^5 \text{ Jkg}^{-1}$
 13. 10 kg
 14. 4.42 kg
 15.

National 4&5 Dynamics & Space Problems
Answers to Numerical Questions

- (a) BC
- (b) 45 200 J
- (c) 8 360 J
- (d) 6 680 J

Re-entry (p.65)

- 1. 1.6×10^7 J
- 2. 8.1×10^9 J
- 3.
- (a) 6.4×10^{13} J
- (b) 6.4×10^{13} J
- 4. 2.4×10^8 J
- 5. 8.75×10^8 J
- 6.
- (a) 6.32×10^8 J
- (b) 6.32×10^8 J
- (c) $1806 \text{ J kg}^{-1} \text{ } ^\circ\text{C}^{-1}$
- 7.
- (a) 4.8×10^{10} J
- (b) 4.8×10^{10} J
- 8.
- (a) 3.45×10^{11} J
- (b) 3.45×10^{11} J
- (c) 34 500 N
- 9.
- (a) 1.2×10^{14} J
- (b) 1.2×10^{14} J
- (c) 3×10^6 N
- 10.
- (a) 8.1×10^9 J
- (b) 8.1×10^9 J
- (c) 2 025 m

Cosmology and The Light Year (p.68)

- 1. 9.47×10^{15} m
- 2. 2.56×10^{17} m
- 3. 40 light years
- 4. 300 years
- 5. 19 210 s
- 6. 9.47×10^{20} m
- 7. 4.2 light years
- 8. 7×10^{13} s
(≈ 2.2 million years)
- 9. 1.49×10^{11} m
- 10. 9 570 s

Conservation of Energy (p.72)

- 1.
- (a) 60 J
- (b) 60 J
- (c) 7.75 ms^{-1}
- 2.
- (a) 4 J
- (b) 4 J
- (c) 4 ms^{-1}
- 3.

- (a) 0.9 J
- (b) 0.9 J
- (c) 3 ms^{-1}
- 4.
- (a) 0.6 J
- (b) 0.6 J
- (c) 0.2 m
- 5.
- (a) 812.5 J
- (b) 812.5 J
- (c) 1.25 m
- 6.
- (a) 1 600 J
- (b) 20 ms^{-1}
- 7. 15 ms^{-1}
- 8. 14.14 ms^{-1}
- 9. 320 m
- 10. 2 ms^{-1}
- 11.
- (a) 164 640 J
- (b) 4 200 J
- (c) 168 840 J
- (d) 28.35 ms^{-1}
- 12. 1 125 m
- 13.
- (a) 1 920 J
- (c) 1 500 J
- (d) 420 J
- 14.
- (a) 300 000 J
- (c) 243 000 J
- (d) 57 000 J
- 15.
- (a) 450 000 J
- (b) 96 000 J
- (c) 348 000 J
- (d) 11.6 m