S4 Dynamics and Space

Solutions to Problems

Distance and Displacement

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

Speed and Velocity

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

Combining Velocities

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°

Combining Forces

1.
(a) 3.7 x 10^3 N @ 125°
(b) 0.25 ms^{-2}
2.
(a) 510N
(b) 11°
3.
(a) 666kN@ 086°
(b) 1.61 ms^{-2}
(c) 4.03MN
(d) 4.03MN

Velocity-Time Graphs

1.
(a) (i)
(ii) 0.67 ms^{-2}
(b) 3m
2.
(a) 4s, 5.6s
(b) 50m
(c) 10m
(d) 18m
(e) 12.5 ms^{-2}

Projectiles

1.
(a) 40 m
(b) 19.6 ms^{-1}
(c) 19.6 m
2.
(a) 1 200 m
(b) 118 ms^{-1}
(c) 706 m
3.
(a) 300 m
(b) 98 ms^{-1}
4.
(a) 8 x 10^7 m
(b) 1960 ms^{-1}
(c) 196 km
5.
(a) 0.5 s
(b) 4.9 ms^{-1}
(c) 1.23 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) 23.5 ms^{-1}
(c) 28.2 m

Satellites

1.
(a) 4 x 10^9 Hz
(b) 1.1 x 10^{10} Hz
(c) 1.4 x 10^{10} Hz
(d) 6.5 x 10^9 Hz
2.
(a) 0.05 m
(b) 0.07 s
3.
(a) 1.5 x 10^{10} Hz
(b) 0.12 s
4.
(a) 1.2 x 10^9 Hz
(b) 0.07 s
5.
(a) 0.03 m
(b) 4.5 x 10^7 m
6.
(a) 1.07 x 10^{-3} s
7. Early Bird
8.
(a) 24 hours
(b) 0.075 m
9.
(a) 1 x 10^{10} Hz
(b) 1.5 x 10^7 m
10.
(a) 0.02 m
(b) 0.17 s
(c) 0.03 m
(d) 0.33 s

Work Done

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 x 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

Potential Energy

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

Kinetic Energy

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) 1 440 000 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 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

Conservation of Energy

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

Energy Transformations

1. 80 000 J
2. 12 600 000 J
3.
(a) 800 000 J
(b) 800 000 J
(c) 800 000 W
4.
(a) $2{\cdot}25 \times 10^{6}$ J
(b) $2{\cdot}25 \times 10^{6}$ J
(c) 1875 kg
5.
(a) $1{\cdot}10 \times 10^{6}$ J
(b) $1{\cdot}10 \times 10^{6}$ J
(c) 367 m
6.
(a) 3×10^{8} J
(b) 83 333 W
7. 125 000 W
8.
(a) $6{\cdot}4 \times 10^{8}$ J
(b) $6{\cdot}4 \times 10^{8}$ J
(c) 29 630 W
9.
(a) 24 J
(b) 24 J
(c) 2·4 kg
10.
(a) 14 000 J
(b) 14 000 J
(c) 20·3 s
11. 11 704 s
12. 100·32 s
13. 117·19 ^{0}C
14. 836 W
15. 0·04 kg
16. $22{\cdot}8 \times 10^{5}$ J
17.
(a) 65 ^{0}C
(b) 300 s
18.
(a) 10 000 J