Motion & Forces in a Gravitational Field

Set 1

2 a) 18 m N 56° E
2 b) 22 m N 63° W
3 294 N
4 3.8 m s^{-1} at 23° to rip
5 a) 42°
5 b) 3.4 m s^{-1} at 53° to the bank
5 c) 30 m
6 a) 9.2 km
6 b) N 41° W
7 5.5 m s^{-1} away from the player
8 47 m s^{-1} toward the opponent
9 32 m s^{-1} at 51° to the final velocity
10 212 N in the forward direction
11 42 m s^{-1} at 45° to both initial and final velocities
12 a) Position 1: 427 N toward the Earth
12 b) Position 2: 359 N at 2.10° to the line joining the Earth and the asteroid
13 43 m s^{-1}
14 1.78 m s^{-1} N 38.2° E
15 a) 1.17×10^3 N
15 b) 125 N
16 14 m s^{-1}, 20 m s^{-1}
17 4.14 m s^{-2} down the slope
18 2.5 s
19 177 N perpendicular to, and toward, the path of the boat
20 a) 3.5 s
20 b) 30 m
21 b) 32.6°
22 716 N at 2.7° to the left of the boat's path

Set 2

6 5 points
7 3.48 m
9 1.04 s
10 1.16 m
11 a) 2.1 s
11 b) 31 m
12 78.8 m
13 0.81 m
14 285 m
15 a) vertical = 9.0 m s^{-1} upward; horizontal = 9.1 m s^{-1}
15 b) 6.5 m
15 c) 18.9 m
16 a) vertical = 29.0 m s^{-1}; horizontal = 7.76 m s^{-1}
16 b) No
16 c) 29.0 m s^{-1} to the right
16 d) Assuming she hits the ramp with her foot already fully down, then at point A; Ignoring air resistance, the speed at point A should equal the speed at point E
16 e) 27.3 m s^{-1}
17 c) Yes, by 9.2 m
18 35.6 m
19 8.10 m s^{-1}
20 a) no
20 b) yes

Set 3	5	0.82 m s^{-2} toward the centre of the circle
	6	61.9 N
	7 a)	1.54 m s^{-2}
	7 b)	17.5 N
	8	17.6°
	9 a)	691 N
	9 b)	3.55 s
	10 a)	yes
	10 b)	3.09 kN
	10 c)	15.3°
	11	15.8 m s^{-1}
	12 a)	37.8 m s^{-1}
	12 b)	1.90 x 10^{4} m s^{-2}
	12 c)	17.7 kHz
	13 b)	2.59 × 10^{-16} N
	13 d)	5.53 × 10^{8} m
	13 e)	it would drop 30.6 m
	16 a)	88.5 m s^{-1}
	b)	198 m s^{-1}
	17	87.4 m s^{-1}
	18 a)	180 N upward (b) 20.4 N downward
	19 a)	20 m
	20 b)	4.32 m s^{-1}
	c)	2.00 × 10^{3} N
	21 b)	5.94 m s^{-1}
	c)	at top, 0; at bottom, 1176 N upward
	d)	at top, 441 N upward; at bottom, 735 N upward
	22 a)	at A: 8.30 m s^{-1}; at B: 12.1 m s^{-1}
	b)	at A: 61.6 N; at B: 208 N
Set 4	6	6 × 10^{24} kg
	7	1.72 × 10^{-6} N
	8 a)	2.64 × 10^{6} m
	8 b)	8.16 m s^{-2} toward the Earth
	8 c)	7.55 × 10^{3} m s^{-1}
	9	3.80 × 10^{8} m
	11 b)	2.38 × 10^{20} N toward the Sun
	18	5.74 × 10^{3} s (1.59 hours)
	19 a)	1.37 × 10^{4} m s^{-1}
	19 b)	1.90 × 10^{27} kg
	20	5.97 × 10^{24} kg
	21	3.59 × 10^{7} m
	22	3.05 × (radius of Moon's orbit around Earth)
	23 a)	2.07 × 10^{22} N; 9.20 × 10^{21} N
	23 b)	5.37 × 10^{4} m s^{-1}; 4.39 × 10^{4} m s^{-1}
Set 5	2	120 N m
	3	220 N
	6 b)	18 kg
	8 a)	94 N
	8 b)	447 N
	9	46 kg
	10 a)	630 N
	10 b)	0.75 m toward Q
	11	1.5 m from the front wheels
	12 a)	18 kN
	12 b)	0.375 × length of log from the heavier end

14 a) 383 mm from the balcony
15 1.86×10^5 N; 1.95×10^5 N
20 7.76 kg; 2.57 m from the T_1 end.
21 60 cm
23 a) 137 N
b) lower hinge 172 N toward the door at 36.9° above the horizontal
upper hinge 172 N toward the wall at 36.9° above the horizontal
24 a) 1.95×10^3 N
b) vertical = 109 N upward, horizontal = 1.83×10^3 N out from wall
c) 1.84×10^3 N out from wall at 3.40° above the horizontal
25 tension = 1.09×10^3 N; force at hinge = 551 N out from the wall and 10.1° below the horizontal
26 2.07 m from P
27 a) 156 N
b) vertical component = 147 N, horizontal component = 156 N
c) 214 N to right and 43.3° below the horizontal
28 a) 2.39×10^5 N
b) 2.97×10^5 N
29 a) 18.4 kg
b) 144 N at 26.9° above the horizontal

Electricity and Magnetism

Set 6 5 0.042 N m
10 2.4 N
12 0.075 N downward

Set 7 1 0.57 V
2 a) 2.3 A
5 a) 0.21 mV
5 b) 2.1×10^{-4} Wb s^{-1}
7 7.1 mV
8 a) 39 mV
8 d) 7.9 mA
9 a) 8.0×10^{-4} V
11 225 turns
12 a) 2.5 m s^{-1}
12 b) 1.0×10^{-4} N
13 a) 83 mT

Set 8 1 a) 60 kW
1 b) 300 J
1 c) 150 Ω
2 a) 14.6 m^2
2 b) 1.25 Ω
3 a) 83 A
3 b) 18 Ω
6 a) 0.0200 times
6 b) 10 000 turns
6 c) 0.0196 times
7 a) 23 Ω
7 b) 1.3×10^3 C
8 a) 100 A
10 a) 31.3 kW
10 b) 0.31 kW
12 a) 2.00 kW
12 b) 0.125 m
13 a) 6.25 kW
15 35 km

Particles, Waves and Quanta

Set 9	1	5 °C
	2	420 m
	3	82 m
	4 a)	50 mm
	4 b)	0.4 m s^{-1}
	4 c)	8.4 Hz
	5 a)	0.5 Hz
	5 b)	2 s
	6 a)	10 mm
	6 b)	8 ?s
	6 c)	125 kHz
	9 a)	1.3 m
	9 b)	17 mm
	9 c)	4.9 mm
	9 d)	3.4 km
	13 b)	too short
	13 c)	0.29 s
	14 a)	George
	14 b)	Jane
	14 c)	George
Set 10	3 c)	34 Hz to 17 kHz
	5 a)	1.9 mm in air; 8.1 mm in water
	6	72.8 m
	7 a)	100
	7 b)	0.8°
	7 c)	10 scans
	12	708 Hz
	13 a)	512 m s^{-1}
	13 c)	84 Hz, 168 Hz, 262 Hz
	18 a)	0.64 m
	18 b)	328 m s^{-1}
	18 c)	closed
	19 a)	violin
	19 b)	double bass
Set 11	1 a)	3.0 GHz
	1 b)	10cm
	2	red: 4.41 × 10^{14} Hz; 2.92 × 10^{-19} J orange: 5.17 × 10^{14} Hz; 3.43 × 10^{-19} J green: 6.00 × 10^{14} Hz; 3.98 x 10^{-19} J
	3	0.001:1; 1000:1
	4 a)	red
	4 b)	2.87 × 10^{-19} J per photon
	4 c)	1.00 × 10^{5} W m^{-2}
	4 d)	100:1
	5	7.5 × 10^{25} photons per second
	6	5.1 × 10^{10} photons per second
	7 a)	420 m
	7 b)	4.3 x 10^{9} J
Set 12	3	E_1 = -13.6 eV E_2 = -3.4 eV E_3 = -1.5 eV E_4 = -0.85 eV E_5 = -0.54 eV

	4 a)	(i) 2.4×10^{15} Hz; UV
		(ii) 6.14×10^{14} Hz; visible
		(iii) 4.56×10^{14} Hz; visible
		(iv) 2.32×10^{14} Hz; IR
	4 b)	4.58×10^{-19} J; E_5 to E_2
	5 a)	45 keV
	5 c)	30 keV; 40 keV
	5 e)	2.0×10^{-16} J
	7 a)	5.13 eV
	7 b)	2.11 eV; E_2 to E_1
	7 c)	0.002 eV
	11 a)	60 keV (9.6×10^{-15} J)
	11 b)	1.45×10^{8} m s^{-1}
	11 c)	2.07×10^{-11} m
	12	12.4 kV
	13	3.71×10^{-11} m
	14 b)	4.14×10^{-11} m; 7.24×10^{18} Hz

Motion and Forces in Electric and Magnetic Fields

Set 13	1	4.5×10^{6} N C^{-1}
	3 b)	2.94×10^{7} m s^{-1}, deflected by 8.9°
	3 e)	2.9×10^{-16} J
	3 f)	6.0×10^{4} V m^{-1}
	5 a)	3.3×10^{-7} J
	5 b)	66 V
	6	100 V m^{-1}
	7 a)	5.00 keV
	7 b)	8.00×10^{-16} J
	8 a)	10.0 keV
	8 b)	1.6×10^{-15} J
	9 a)	5.6×10^{7} V m^{-1}
	9 b)	2.4×10^{-15} J
	10 b)	3.6×10^{-5} N
	10 c)	10 mm; 0.090 V
	13	3.91×10^{5} m s^{-1}
	14 b)	2500 eV (4.00×10^{-16} J)
	14 c)	2.96×10^{7} m s^{-1}
	14 e)	same
	14 f)	less
	15 a)	4000 eV; 3.75×10^{7} m s^{-1}
	15 b)	2000 V m^{-1}; 3.20×10^{-16} N
	16 b)	7.02×10^{15} m s^{-2}
Set 14	7	1.58×10^{-26} kg to 1.62×10^{-26} kg
	8 a)	41.8 m
	8 b)	6.28×10^{-3} s
	9 b)	2.4×10^{-14} N
	10 b)	6.3×10^{7} C kg^{-1}; 4.8×10^{7} C kg^{-1}
Set 15	3 a)	1.10×10^{5} V m^{-1}
	3 b)	Yes
	4 c)	They accelerate in a straight line at 1.76×10^{14} m s^{-2}
	5 a)	7.26×10^{7} m s^{-1}
	5 b)	1.76×10^{-4} m
	5 c)	1.52×10^{-11} s

6 a) 7.19×10^{6} m s^{-1}

6 b) 2.29×10^{7} Hz; 4.38×10^{-8} s

6 c) 270 kV

7 c) 1.00×10^{5} m s^{-1}

8 a) 3.75×10^{13} m s^{-2} at right angles to the field

8 c) 3.92×10^{5} N C^{-1}

9 a) 3.04×10^{-6} m

9 b) 480 N C^{-1}

10 b) 2.87×10^{7} m s^{-1}; 5.75×10^{7} m s^{-1}