

Answers, Even-Numbered Problems, Chapter 7

- 7.2** (a) 49.0 N.
(b) 735 J. This work becomes potential energy.

- 7.4**
(a). 7.98 m/s.
(b) 8.36 m/s.
(c) $v_1 = 2.5$ m/s and $v_2 = 8.36$ m/s, the same as in part (b).

Note that kinetic energy depends only on the speed, not on the direction of the velocity.

- 7.6.**
(a) $v_2 = \sqrt{2gd \sin \alpha}$.
(b) $v_2 = \sqrt{2gd \sin \alpha}$, the same as in part (a).
(c) The normal force is perpendicular to the displacement and does no work.

- 7.8**
The speed is v and the kinetic energy is $4K$. The work done by friction is proportional to the normal force, and hence to the mass, and so each term in Eq. (7.7) is proportional to the total mass of the crate, and the speed at the bottom is the same for any mass. The kinetic energy is proportional to the mass, and for the same speed but four times the mass, the kinetic energy is quadrupled.

- 7.12** 7.9 m/s = 28.4 km/hr: Let your experience guide you for the rest!

- 7.14**
(a) 2.1 m/s.
(b) 0.83 N.
(c) 1.9 N

- 7.16**
The spring could be either stretched 9.52 cm or compressed 9.52 cm. If it were stretched, the total length of the spring would be 12.00 cm + 9.52 cm = 21.52 cm. If it were compressed, the total length of the spring would be 12.00 cm - 9.52 cm = 2.48 cm.

- 7.18**
(a); 2.16 J
(b) 8.8 m.
(c) The lack of air resistance and no deformation of the rubber band are two possible assumptions.

- 7.20** 1.72 m

- 7.22** (a) 0.500 m/s
(b) 0.500 m

- 7.24.** (a) 23.6 m/s

(b) 69.2 m/s^2

7.26

(a) -5100 J .

(b) $+5100 \text{ J}$.

(c) $\phi = 90^\circ$ in each case and $W_{\text{grav}} = 0$ in each case.

(d) 0 .

(e) Gravity is a conservative force since the total work done for a round trip is zero.

7.28

(a) 0

(b) -0.10 J

(c) $+0.10 \text{ J}$

(d) The force is conservative. $U = \frac{1}{3}\alpha x^3$. This does correspond to $U = 0$ when $x = 0$.

7.30

(a) -59 J

(b) -42 J

(c) -59 J .

(d) Parts (a) and (b) show that for two different paths between you and Carlos, the work done by friction is different. Part (c) shows that when the starting and ending points are the same, the total work is not zero. Both these results show that the friction force is nonconservative.

7.32

$$F_x = -\frac{6C}{x^7}$$

7.34

$F_x(x) = -\frac{Gm_1m_2}{x^2}$. The force on m_2 is in the $-x$ -direction. This is toward m_1 , so the force is attractive.

7.36

$$\vec{F} = -\alpha \left(\frac{-2}{x^3} \hat{i} + \frac{-2}{y^3} \hat{j} \right) = 2\alpha \left(\frac{\vec{i}}{x^3} + \frac{\vec{j}}{y^3} \right).$$

7.38

(a) Considering only forces in the x -direction, $F_x = -\frac{dU}{dx}$ and so the force is zero when the slope of the U vs x graph is zero, at points b and d .

(b) Point b is at a potential minimum; to move it away from b would require an input of energy, so this point is stable.

(c) Moving away from point d involves a decrease of potential energy, hence an increase in kinetic energy, and the marble tends to move further away, and so d is an unstable point.

7.40 4.6 kg .

7.42

(a) 3.11 m/s.

(b), 0.821 m.

7.44 3.04 m/s .

7.46

(a) $h > \frac{5}{2}R$.

(b) 31.3 m/s. The radial acceleration is 49.0 m/s^2 . $a_{\text{tan}} = g = 9.80 \text{ m/s}^2$.

7.48

(a) $h = 9.3 \text{ m}$.

(b) the rock will slide down.

(c) 11.8 m/s .

7.50 42 m/s .

7.52 50.5 m.

7.54 $k = 2440 \text{ N/m}$.

7.56 142 m .

7.58 1.83 m/s.

7.60

(a) -80.0 J .

(b) -31.3 J .

(c) The ball is moving slower on the way down, and does not go as far (in the x -direction), and so the work done by the air is smaller in magnitude.

7.62

(a) 30.4 m/s .

(b) 12.9 m/s

(c) 2000 N .

7.66

Denote the distance the truck moves up the ramp by x .

$$x = \frac{K_1 + mgL \sin \alpha}{mg(\sin \beta + \mu_r \cos \beta)} = \frac{(v_0^2/2g) + L \sin \alpha}{\sin \beta + \mu_r \cos \beta} .$$

7.68 $mga \sin \theta + \frac{1}{2}k(a\theta)^2$.

7.70

- (a) 5.81 m/s.
- (b) 15.0 cm.

7.72 2d.

7.74

- (a) 7.30 m/s.
- (b) 1.06 m .
- (c) 1.32 m .

7.76

- (a) 3.13 m/s
- (b) 1.40 m
- (c) No

7.78

- (a) 0.053 gallons .
- (b) 19 accelerations

7.80 9.2×10^7 kWh

7.82

- (a) The force is conservative.
- (b) The force is not conservative.

7.84

- (a) The path is sketched in Figure 7.84.
- (b) The work done in moving around the closed path is 3.38 J.
- (c) The work done in moving around a closed path is not zero, and the force is not conservative.

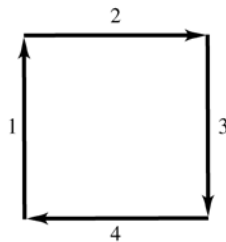


Figure 7.84

7.86

- (a) The slope of the U vs. x curve is negative at point A, so F_x is positive (Eq. (7.16)).
- (b) The slope of the curve at point B is positive, so the force is negative.
- (c) The kinetic energy is a maximum when the potential energy is a minimum, and that figures to be at around 0.75 m.

- (d) The curve at point C looks pretty close to flat, so the force is zero.
- (e) The object had zero kinetic energy at point A , and in order to reach a point with more potential energy than $U(A)$, the kinetic energy would need to be negative. Kinetic energy is never negative, so the object can never be at any point where the potential energy is larger than $U(A)$. On the graph, that looks to be at about 2.2 m.
- (f) The point of minimum potential (found in part (c)) is a stable point, as is the relative minimum near 1.9 m.
- (g) The only potential maximum, and hence the only point of unstable equilibrium, is at point C .