Chapter 7

Problem 7: Insert the word “gravitational” in front of “potential energy” in the second sentence.

Problem 9. Move “Ignore air resistance” to the second sentence position. Then the third sentence should read: “The work done on the object by all forces acting on it is”

Problem 12: Insert “of angle θ” after the word “incline”.

Problem 16: Answer b. change “laying” to “Lying”.

delete problem 23

Problem 28. change the second sentence to “What is the magnitude of the change in potential energy….”

Problem 62: delete the word “in” just before the last word “is” in the problem statement.

Problem 65: Add as the second sentence: “At maximum compression, the spring is reduced in length by x_{max}.” Then change each “h” in the answers to “$(h + x)$”.

New problems:

1. A mechanism catches a train car initially moving at speed v_0 at the instant when it has compressed a heavy horizontal spring of spring constant k to maximum compression x_{max}. At that instant the total mechanical energy of the system of train plus spring is

   a. $\frac{1}{2}kx_{\max}^2$.
   b. $\frac{1}{2}mv_0^2 - \frac{1}{2}kx_{\max}^2$.
   c. $\frac{1}{2}kx_{\max}^2 - \frac{1}{2}mv_0^2$.
   d. $\frac{1}{2}mv_0^2 + \frac{1}{2}kx_{\max}^2$.
   e. a quantity that cannot be determined from the information given.
   Answer: a

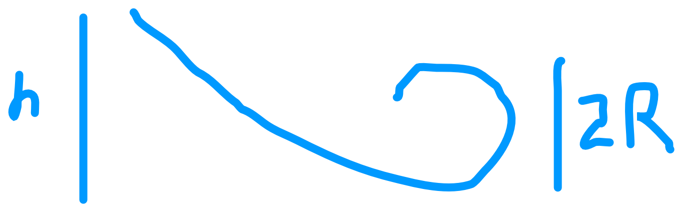
2. A toy car of total mass m but with wheels of negligible mass, is started up an inclined plane of angle θ with initial velocity v_0. it travels a distance x up the plane before starting to roll down again. assuming its initial gravitational potential energy is 0, we can find its gravitational potential energy at the highest poit where the vertical displacement is h, by using

   a. $h = x$.

b. $h = x\cos\theta$.
c. $h = x\sin\theta$.
d. $h = x\tan\theta$.
e. $h = x\csc\theta$.
Answer: c

3. A car starts at height h above ground and rolls around the loop-the-loop of radius R. we want to calculate h in terms of R for the car just to make it around without losing contact with the track. Assume the track is frictionless. Which equation below must be one of the equations we use to solve this problem? (Use v_{top} as the speed at the top of the loop and v_{bottom} as the speed at the bottom of the loop.)

a. $v_{bottom}^2 = v_{top}^2 + mgR$.
b. $v_{bottom}^2 = v_{top}^2 + 2mgR$.
c. $v_{bottom}^2 = v_{top}^2 - mgR$.
d. $v_{bottom}^2 = v_{top}^2 - 2mgR$.
e. $v_{bottom}^2 = v_{top}^2 + 5mgR$.



Answer: b
For this problem you need to copy the figure in problem 29, but change the height at the left from a number to "h".

4. A pendulum of mass m and length L is raised to a point that is $L/3$ higher than its initial position. It is then allowed to fall and strike a spring of spring constant k that is located at the pendulum's lowest position. If the spring were to absorb all the pendulum's kinetic energy, it would have compression x_{max} such that

a. $x = \sqrt{\frac{1}{3}\frac{mgL}{k}}$.
b. $x = \sqrt{\frac{2}{3}\frac{mgL}{k}}$.
c. $x = \sqrt{\frac{3}{2}\frac{mgL}{k}}$.
d. $x = \sqrt{\frac{3mgL}{k}}$.
e. $x = L$.
Answer: b

5. When the gravitational potential energy of a body of mass m initially moving at speed v_0 changes by $\Delta U = -J$, the final velocity of the body, v_f, can be found from

a. $\frac{1}{2}mv_f^2 + J = \frac{1}{2}mv_0^2$.

b. $\frac{1}{2}mv_f^2 + \frac{1}{2}mv_0^2 = -J$.
c. $\frac{1}{2}mv_f^2 - \frac{1}{2}mv_0^2 = +J$.
d. $\frac{1}{2}mv_f^2 + \frac{1}{2}mv_0^2 = +J$.
e. $\frac{1}{2}mv_f^2 - \frac{1}{2}mv_0^2 + J = 0$.
Answer: c

6. When the gravitational potential energy of a body of mass m initially moving at speed v_0 changes by $\Delta U = +J$, the final velocity of the body, v_f, can be found from

a. $\frac{1}{2}mv_f^2 + J = \frac{1}{2}mv_0^2$.
b. $\frac{1}{2}mv_f^2 + \frac{1}{2}mv_0^2 = -J$.
c. $\frac{1}{2}mv_f^2 - \frac{1}{2}mv_0^2 = +J$.
d. $\frac{1}{2}mv_f^2 + \frac{1}{2}mv_0^2 = +J$.
e. $\frac{1}{2}mv_f^2 - \frac{1}{2}mv_0^2 + J = 0$.
Answer: e

7. A light string suspended over a frictionless pulley of negligible mass connects a 20 kg and a 12 kg mass as shown below. When they are released from rest, and the 20 kg mass has fallen 1.0 m, the speed of the 12 kg mass, in m/s, is

   a. 1.1.
   b. 1.6.
   c. 2.2.
   d. 3.1.
   e. 4.9.
   Answer: c

8. A 70 kg person who runs up a 10-story flight of stairs to a point 25 m above his starting point in 5.0 minutes has a power expenditure of
   a. 29 W.
   b. 57 W.
   c. 570 W.
   d. 3400 W.
   e. 17, 100 W.
   Answer: b

9. For a 70 kg person to match the 100 W power expenditure of champion athletes when running up a 10 story flight of stairs to a point 25 m above his starting point, he has to reach the top in
   a. 60 s.
   b. 86 s.
   c. 100 s.
   d. 172 s.
   e. 300 s.

   Answer: d