Practice Physics Exam: Chapter 6

IMPORTANT: Except for multiple-choice questions, you will receive no credit if you show only an answer, even if the answer is correct. Always show in the space on your answer sheet some sketches, words, or equations which clearly justify your answer. Show the equations you use and the values substituted into them whenever equations are necessary. If you go from a formula directly to an answer without showing the values used, you will lose points. Points will also be deducted for missing or erroneous units.

Be sure that your calculator is set to the "DEGREES" mode.

1. In the SI system energy is measured in

   (a) $\mathrm{kg}\frac{\mathrm{m}}{\mathrm{s}}$
   (b) $\mathrm{kg}\frac{\mathrm{m}^2}{\mathrm{s}^2}$
   (c) $\mathrm{kg}\frac{\mathrm{m}}{\mathrm{s}^2}$
   (d) $\mathrm{kg}\frac{\mathrm{m}^2}{\mathrm{s}}$
   (e) $\mathrm{kg}^2\frac{\mathrm{m}}{\mathrm{s}}$

2. Which of the following are valid statements about energy?

   i) Energy is a quantity belonging to specific physical systems.
   ii) Energy is a quantity that can be transferred from one system to another by working, heating, or radiation.
   iii) New energy is never produced by any process whatsoever in the entire universe.

   (a) i only
   (b) ii only
   (c) i and ii only
   (d) ii and iii only
   (e) i, ii, and iii

3. Linda drives her 2000. kg limo at 10 m/s. How much kinetic energy does it have?______________________
   $\frac{1}{2}mv^2 = \frac{1}{2}(2000\ \mathrm{kg})(10\frac{\mathrm{m}}{\mathrm{s}})^2 = 100,000\ \mathrm{J}$

4. If Linda's limo doubles its speed to 20 m/s, by what factor does its kinetic energy increase?

   (a) $\frac{1}{4}$
   (b) $\frac{1}{2}$
   (c) 2
   (d) 4

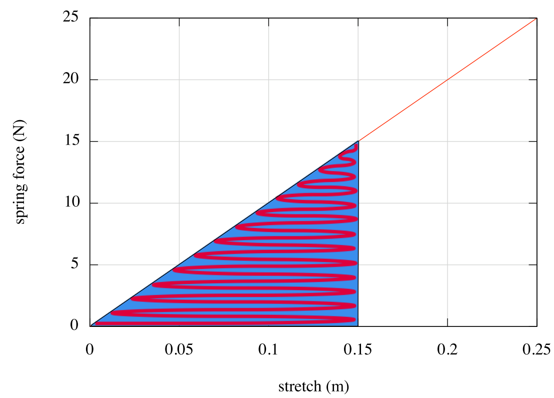
For items 5 and 6

A 20 g steel ball bearing is pushed back to a maximum compression of 0.10 m against a spring. The spring has a spring constant of 50 N/m. The launcher is aimed horizontally.

5. How much elastic potential energy is stored in the spring when compressed as described?
   $\frac{1}{2}kx^2 = \frac{1}{2}\left(50\ \frac{\mathrm{N}}{\mathrm{m}}\right)\left(0.10\frac{\mathrm{m}}{\mathrm{s}}\right)^2 = 0.25\ \mathrm{J}$

6. Assuming that all the energy stored in the spring is transferred to the ball bearing, how fast will the ball bearing be moving when launched? $\mathrm{KE} = 0.25\mathrm{J} = \frac{1}{2}mv^2 = \frac{1}{2}(0.020\ \mathrm{kg})v^2 \implies v = 5\ \mathrm{m/s}$

7. A spring exerts a force as it is stretched according to the graph shown below.



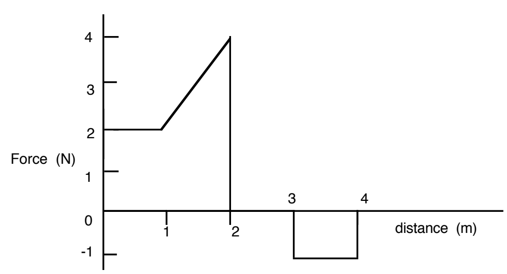
(a) What is the value of the force constant (or "spring" constant) for this spring?
$k = \text{slope} = \text{rise/run} = \dfrac{\Delta F}{\Delta x} = \dfrac{25\ \text{N}}{0.25\ \text{m}} = 100\ \dfrac{\text{N}}{\text{m}}$

(b) How much energy does the spring possess if it is stretched 0.15 m?

$\frac{1}{2}kx^2 = \frac{1}{2}\left(100\ \frac{\text{N}}{\text{m}}\right)(0.15\text{m})^2 = 1.13$ J or calculate area of shaded region in plot above.

For the next two items:

The graph shows the force applied to a 2 kg body initially at rest but free to move along a straight line on a frictionless surface. The force acts along the same straight line.



8. After the body has moved a distance of 1 meter its kinetic energy is

(a) 1 J.
(b) 2 J.
(c) 3 J.
(d) 4 J.
(e) 19.6 J.

9. After the body has moved a distance of 4 meters its kinetic energy is

   (a) 1 J.
   (b) 2 J.
   (c) 4 J.
   (d) 5 J.
   (e) 6 J.

10. Which of the following are classified as mechanical energy?

    i) kinetic energy
    ii) gravitational potential energy
    iii) spring potential energy
    iv) thermal energy

    (a) i only
    (b) ii only
    (c) iv only
    (d) i and ii only
    (e) ii and iii only
    (f) i, ii, and iii only
    (g) i, ii, iii, and iv

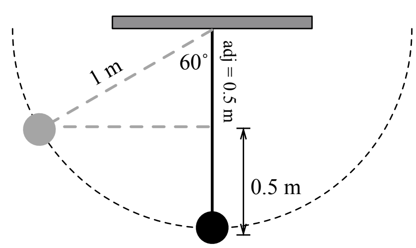
11. An elevator in a tall building has a mass of 2000 kg, including its occupants. It rises 100 m at a steady speed from Ground Floor to 9$^{\text{th}}$ floor in 20 s. How much power is required to accomplish this?

$$P = \frac{\Delta E}{\Delta t} = \frac{\Delta GPE}{\Delta t} = \frac{\Delta mgh}{\Delta t} = \frac{(2000\text{ kg})(9.8\frac{\text{N}}{\text{kg}})(100\text{m} - 0)}{20\text{s}} = 98,000\text{W}$$

12. A 200. g pendulum that is 1.0 m long is released 60° from vertical. What is its speed at the lowest point of its swing?

$$\frac{\text{adj}}{\text{hyp}} = \cos 60^\circ$$

$$\frac{\text{adj}}{1\text{ m}} = 0.5$$



Pendulum bob "falls" 0.5 m. The change in GPE is $\Delta\text{GPE} = 0 - (0.2\text{kg})(9.8\text{N/kg})(0.5\text{m}) = -0.98$ J. The lost GPE from the gravitational field goes to the bob as KE. The bob gains 0.98 J as KE. $\text{KE} = \frac{1}{2}mv^2$. So $v = \sqrt{\frac{2(\text{KE})}{m}}$. I get $v = 3.1$ m/s