KE + PE Extra Practice Problems KEY

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*Remember to check: • units • significant figures.

Practice Questions: (Your solutions should be organized similar to the example problem. Show all your steps please)

1. A cheetah can run briefly with a speed of 31.0 m/s. Suppose a cheetah with a mass of 47.0 kg runs at this speed. What is the cheetah's kinetic energy?

3s.f. 3s.f.

$v = 31.0\ \frac{m}{s}$
$m = 47.0\ kg$
$E_K = ?$

$E_K = \frac{1}{2}mv^2$
$= \frac{1}{2}(47.0)(31.0)^2 =$
$= 22584\ J$

$22.6\ kJ$ (3s.f.)

2. A ping pong ball has a mass of about 2.45 grams. Suppose that Forrest Gump hits the ball across the table with a speed of about 4.00 m/s. What is the ball's E_k?

$m = 2.45\ g = 0.00245\ kg$
$v = 4.00\ m/s$
$E_K = ?$

$E_K = \frac{1}{2}mv^2$
$= \frac{1}{2}(0.00245)(4.00)^2$
$= 0.0196\ J = $

$1.96 \times 10^{-2}\ J$ or $19.6\ mJ$

$\boxed{1000\ mJ = 1\ J}$

3. The largest land predator is the male polar bear, which has a mass of around 500.0 kg. If the top speed of a male polar bear is 11.0 m/s, how much E_k does it have?

4sf. 3s.f.

$\boxed{1000\ J = 1\ kJ}$

$m = 500.0\ kg$
$v = 11.0\ \frac{m}{s}$
$E_K = ?$

$E_K = \frac{1}{2}mv^2$
$= \frac{1}{2}(500.0)(11.0)^2 =$
$= 30\,250\ J$

$30.3\ kJ$

$\boxed{3.03 \times 10^4\ J}$

4. Though slow on land, the leatherback turtle holds the record for the fastest water speed of any reptile. The largest leatherback yet discovered could swim at a speed of 9.78 m/s. If its E_k was 60,800 J, what was its mass?

3s.f. 3s.f.

$v = 9.78\ m/s$
$E_K = 60\,800\ J$
$m = ?$

$E_K = \frac{1}{2}mv^2$
$m = \frac{2E_K}{v^2} = \frac{2(60\,800)}{9.78^2} = 1271\ kg$

$\boxed{1.27\ kg}$

5. What is the E_k of a 1.00 kg hammer swinging at 20.0 m/s?

3s.f. 3s.f.

$m = 1.00\ kg$
$v = 20.0\ m/s$
$E_K = ?$

$E_K = \frac{1}{2}mv^2$
$= \frac{1}{2}(1.00)(20.0)^2$
$= 200\ J$

need 3s.f.

$\boxed{= 2.00 \times 10^2\ J}$

6. Japan's fasted high speed "bullet" trains, also known as the Shinkansen, travel at a speed of 88.9 m/s. It has an estimated mass of 480,000 kg. What is the maximum E_k of this train?

3 s.f. 2 s.f.

$v = 88.9\ m/s$

$m = 480\ 000\ kg$

$E_K = ?$

$E_K = \frac{1}{2}mv^2$

$= \frac{1}{2}(480\ 000)(88.9)^2$

round up.

$= 1\ 896\ 770\ 400\ J = 1.9\ GJ$

$\boxed{= 1.9 \times 10 \times 10^8\ J}$

$1\ GJ = 1\ 000\ 000\ 000\ J$

7. If a falling snowflake has a speed of 0.92 m/s, and has 1.27 mJ of kinetic energy, what is its mass?

2 s.f. 3 s.f.

$v = 0.92\ \frac{m}{s}$

$1000\ mJ = 1\ J$

$E_K = 1.27\ mJ = 0.00127\ J$

$m = ?$

$E_K = \frac{1}{2}mv^2$

$m = \frac{2E_K}{v^2}$

$= \frac{2(0.00127)}{0.92^2}$

$= 0.00300\ kg = 3.0\ g$

$\boxed{3.0 \times 10^{-3}\ kg}$

8. The spring of a dart gun exerts a force on a 0.020 kg dart as it is launched from the gun with 4.00 J of E_k. At what velocity does the dart come out of the gun?

2 s.f. 3 s.f.

$m = 0.020\ kg$

$E_K = 4.00\ J$

$v = ?$

$E_K = \frac{1}{2}mv^2$

$\therefore v = \sqrt{\frac{2E_K}{m}}$

$= \sqrt{\frac{2(4.00)}{0.020}} = 20\ \frac{m}{s}$

$\boxed{= 2.0 \times 10^{-2}\ m/s}$

9. What would happen to the amount of E_k if the mass of an object were to double, but its speed stayed the same?

"velocity is constant" <=

$E_K = \frac{1}{2}mv^2$

IF $m \rightarrow 2m$, $E_K = \frac{1}{2} \cdot 2mv^2$

YOU GET 2x THE ENERGY

10. What would happen to the amount of E_k if the mass of an object were to stay the same, but its speed doubled?

"mass is constant"

IF $v \rightarrow 2v$ THEN $E_K = \frac{1}{2}m(2v)^2$

$= \frac{1}{2}m(4)v^2$

$= 4\left(\frac{1}{2}mv^2\right)$

YOU GET 4x THE ENERGY.

SC 10 POTENTIAL ENERGY PROBLEMS

KEY

Practice Questions: (Your solutions should be organized similar to the example problem. Show all your steps please)

1. A goat jumps up in the air and reaches a height of 39.0 m above the surface of the Earth. How much potential energy will the 31.0 kg goat have at this height?

3 s.f. 3 s.f.

$h = 39.0\ m$
$m = 31.0\ kg$
$g = 9.80\ N/kg$
$E_p = ?$

$E_p = mgh$
$= (31.0)(9.80)(39.0)$
$= 11848.2\ J = \boxed{1.18 \times 10^4\ J}$

$11\,800\ J$
$11.8\ kJ$

2. If a rock has 250 MJ of potential energy while sitting on the edge of a cliff 42.0 m above the valley floor, what is its mass?

2 s.f. 3 s.f.

$E_p = 250\ MJ$ $\times 1\,000\,000$
$\boxed{1\,000\,000\ J = 1MJ}$ $= 250\,000\,000\ J$
$h = 42.0\ m$
$g = 9.80$
$m = ?$

$E_p = mgh$
$\therefore m = \frac{E_p}{gh} = \frac{250\,000\,000}{9.8(42.0)}$
round up
$= 607\,000\ kg$ $\boxed{= 6.1 \times 10^5\ kg}$

3. The International Space Station is 405 km above the Earth's surface and has a mass of 419 000 kg. If the gravitational field strength is only 8.72 N/kg at this altitude, how much potential energy does the ISS have?

$h = 405\ km = 405\,000\ m$
$m = 419\,000\ kg$
$g = 8.72\ N/kg$
$E_p = ?$

$E_p = mgh$
$= (419\,000)(8.72)(405\,000)$
$\boxed{= 1.48 \times 10^{12}\ J}$ $= 1.48\ TJ$
$(1\,480\,000\,000\,000\ J)$

4. If you had a job lifting books from the floor up onto a bookshelf (h = 1.70 m), and the average book had a mass of 1.20 kg, and you had 1000 books to put away, how much extra potential energy would all those books have when you were done? Where did this energy come from?

3 s.f. 3 s.f.

counting number, doesn't count for sig. figs. (tricky!)

$h = 1.70\ m$
$m = 1.20\ kg$
$\times 1000$
$g = 9.80\ N/kg$
$E_p = ?$

$E_p = mgh$
$= (1.20)(1000)(9.8)(1.70)$
round up!
$= 19992\ J = 1.9992 \times 10^4\ J$
3 s.f.
$= 20.0\ kJ$ $= \boxed{2.00 \times 10^4\ J}$

5. If 9.75 kJ of E_p was given to a lemon while lifting it, and the lemon had a mass of 218 g, how high was it lifted?

3sf.   3sf.

$\boxed{1000 J = 1 kJ}$

$E_p = 9.75 \text{ kJ} = 9750 \text{ J}$

$m = 218 \text{ g} = 0.218 \text{ kg}$

$g = 9.80$

$h = ?$

$E_p = mgh$

$h = \frac{E_p}{mg} = \frac{9750}{0.218(9.80)} = 4563 \text{ m}$

$\boxed{= 4.56 \times 10^3 \text{ m}}$

$= 4.56 \text{ km}$

6. How high could a 60.0 kg pole vaulter get above the ground if she could convert 2975 J of energy into E_p?

3sf.   4sf.

$m = 60.0 \text{ kg}$

$E_p = 2975 \text{ J}$

$g = 9.80 \text{ N/kg}$

$E_p = mgh$

$\therefore h = \frac{E_p}{mg} = \frac{2975}{(60.0)(9.80)} = 5.0595 \text{ m}$

3sf.

$\boxed{= 5.06 \text{ m}}$

7. What is the mass of one chocolate chip if throwing it 2.10 m vertically into the air requires 68.5 mJ of energy? (ignoring energy lost to friction)

3sf.   3sf.

$h = 2.10 \text{ m}$

$E_p = 68.5 \text{ mJ}$

$\boxed{1000 mJ = 1 J}$ $= 0.0685 \text{ J}$

$g = 9.80$

$E_p = mgh$

$\therefore m = \frac{E_p}{gh} = \frac{0.0685}{(9.80)(2.10)} = 0.003328 \text{ kg}$

round up.

$\boxed{3.33 \times 10^{-3} \text{ kg}}$

3.33 g

8. An astronaut jumping on the moon could get his 140 kg of mass (body plus space suit) to a height of 1.73 m above the surface (measured to his center of mass). At this point, his E_p was only 412 J. What must the gravitational field strength be on the moon?

2sf.   3sf.   3sf.

← you are solving for "g"... not the same as on Earth.

$m = 140 \text{ kg}$

$h = 1.73 \text{ m}$

$E_p = 412 \text{ J}$

$g = ?$

$E_p = mgh$

$\therefore g = \frac{E_p}{mh} = \frac{412}{140(1.73)} = 1.7010 \text{ N/kg}$

answer needs 2sf.

$= 1.7\cancel{0} \text{ N/kg}$ $\boxed{= 1.7 \text{ m/s}^2}$

9. If the mass of an object were to suddenly double, what would happen to it's E_p?

$E_p = mgh$ DOUBLES

10. If the height of an object were to suddenly double, what would happen to it's E_p?

$E_p = mgh$ DOUBLES