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?

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

$E_p = mgh$
$= (31.0)(9.80)(39.0)$
$= 11848.2\ J$ = 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?

$E_p = 250\ MJ$
$= 250\ 000\ 000\ J$
$h = 42.0\ m$
$g = 9.80$
$m = ?$

$E_p = mgh$
$\therefore m = \frac{E_p}{gh} = \frac{250\ 000\ 000}{9.8(42.0)}$
$= 607\ 000\ kg$

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?

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

$E_p = mgh$
$= (419\ 000)(8.72)(405\ 000)$
$= 1.48 \times 10^{12}\ J$ = 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 <u>1000 books</u> to put away, how much extra potential energy would all those books have when you were done? Where did this energy come from?

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

$E_p = mgh$
$= (1.20)(1000)(9.8)(1.70)$
$= 19992\ J$
$= 20.0\ kJ$

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?

$E_p = 9.75\ kJ = 9750\ J$

$m = 218\ g = 0.218\ kg$

$g = 9.80$

$h = ?$

$E_p = mgh$

$h = \frac{E_p}{mg} = \frac{9750}{0.218(9.80)} = 4563\ m = 4.56\ km$

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

$m = 60.0\ kg$

$E_p = 2975\ J$

$g = 9.80\ N/kg$

$E_p = mgh$

$\therefore h = \frac{E_p}{mg} = \frac{2975}{(60.0)(9.80)} = 5.0595\ m = 5.06\ m$

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)

$h = 2.10\ m$

$E_p = 68.5\ mJ = 0.0685\ J$

$g = 9.80$

$E_p = mgh$

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

$3.33\ g$

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?

$m = 140\ kg$

$h = 1.73\ m$

$E_p = 412\ J$

$g = ?$

$E_p = mgh$

$\therefore g = \frac{E_p}{mh} = \frac{412}{140(1.73)} = 1.7010\ \frac{N}{kg} = 1.70\ N/kg$

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