Energy Conservation

1.) The driver of a $1200\ kg$ car travelling at $50.\frac{km}{h}$ applies the brakes so that there is a force of friction on the wheels of $1550\ N$, while the car travels a distance of $25\ m$.

a.) What is the original kinetic energy of the car?

b.) How much work is done by the force of friction from the brakes?

c.) How much of the car's kinetic energy is transformed to heat?

d.) What is the car's kinetic energy when the driver takes his foot off the brakes?

e.) What is the car's speed when the driver takes his foot off the brakes?

f.) How much work would the force of friction have had to do to stop the car?

g.) How much farther would the car have travelled with the drivers foot on the brake for the car to stop?

2.) It requires $502\ KJ$ of heat energy to raise the temperature of $1.5\ kg$ of water from $20.\,^{\circ}\mathrm{C}$ to $100.\,^{\circ}\mathrm{C}$. It takes a kettle with a power of $1500\ W$, $6.5\ minutes$ to boil the water.

a.) How much electrical energy is transformed into heat energy by the kettle?

b.) What is the efficiency of the kettle?

3.) A $100.\ W$ incandescent light bulb is only about 21% efficient. How much light energy per second does the bulb supply?

4.) A car of mass $1250\ kg$ travels up a hill $250\ m$ long and $18.0\ m$ high. Starting with a speed of $50.\frac{km}{h}$ and ending with a speed of $70.\frac{km}{h}$. The force of friction on the car is $550\ N$.

a.) How much potential energy does the car have at the bottom of the hill?

b.) What is the car's kinetic energy at the bottom of the hill?

c.) What is the car's total energy at the bottom of the hill?

d.) What is the potential energy of the car at the top of the hill?

e.) How much does the car's total energy increase as it climbs the hill?

f.) How much chemical energy does the car use?

5.) What is the mass of an object travelling at $20.\frac{m}{s}$ with a kinetic energy of $4000.J$?

6.) How much time is required to raise the temperature of $1.50\ kg$ of water ($c = 4180\frac{J}{kg}°C$) from $10.0°C$ to $90.0°C$, using $1.50 \times 10^3 W$ electric kettle that is 75.0% efficient?

7.) What is the final temperature of a $2.0\ kg$ block of copper ($c = 430\frac{J}{kg}°C$) if it's original temperature was $23°C$, and it absorbs $50\ 000.J$ of heat energy?

8.) If it takes $2.4 \times 10^5 J$ to raise the temperature of a $6.0\ kg$ mass up $15°C$, what is it's specific heat capacity?

9.) A $15\ g$ bullet travelling at $400.\frac{m}{s}$ hits a block of wood and penetrates it a distance of $20.\,cm$ before stopping. How much work is done in stopping the bullet?

10.) How much work must be done to stop a $1000.\,kg$ car travelling $100.\frac{km}{h}$?

11.) Tarzan is running at a top speed of $8.0\frac{m}{s}$ and grabs a vine hanging vertically from a tall tree in the jungle. How high can he swing upwards? Does the length of the vine affect your answer?

12.) A flea should be able to jump to a height of $5.0\ cm$, but because of air resistance it only reaches $3.5\ cm$. What fraction of its energy is lost to air resistance?

13.) A $0.25\ kg$ pine cone falls from a branch $20.\,m$ above the ground.

a.) With what speed would it hit the ground if air resistance could be ignored?

b.) If it actually hits the ground with a speed of $9.0\frac{m}{s}$, what was the average force of air resistance on it?

<u>Answers</u> – 1a.) $1.2 \times 10^5\ J$ b.) $3.9 \times 10^4\ J$ c.) $3.9 \times 10^4\ J$ d.) $8.1 \times 10^4\ J$ e.) $12\frac{m}{s}$ f.) $8.1 \times 10^4\ J$ g.) $d = 52\ m$

2a.) $585\ 000\ J$ b.) 85.8% 3.) $21\ J$ 4a.) $zero$ b.) $1.2 \times 10^5 J$ c.) $1.2 \times 10^5 J$ d.) $2.2 \times 10^5\ J$

e.) $3.36 \times 10^5\ J$ f.) $4.74 \times 10^5\ J$ 5.) $20.\,kg$ 6.) $7\ \text{min}\ 26\ s$ 7.) $81°\text{C}$ 8.) $2.7 \times 10^3\ \frac{J}{kg}°\text{C}$ 9.) $1200\ J$

10.) $3.86 \times 10^5 J$ 11.) $h = 3.3\ m$ No, the vine length has no impact on height.

12.) $30.\,\%$ 13a.) $-20.\frac{m}{s}$ b.) $+2.0\ N$