Energy Matters HW1

1. (a) potential to kinetic
   (b) chemical to heat
   (c) nuclear to heat
   (d) light to electrical
   (e) kinetic to potential

2. (a) $E_p = mgh = 25 \times 10 \times 6 = 1500J$

   (b) $E_p = mgh = 2 \times 10 \times 70 = 1400J$

   <u>(a) has gained more potential energy</u>

3.

(a) Water from the dam moves down the pipes towards the turbine/generator house. The potential energy stored in the water is transformed to kinetic energy. When the water reaches the turbine, kinetic energy is transferred to the turbine. The turbine passes the kinetic energy to the generator, where the energy changes from kinetic to electrical energy.

(b) A lot of water is required to keep the hydroelectric power station running. It is not always possible to keep the water in the dam at a high enough level, e.g. during summer when rainfall is lower. Instead, water from the loch can be pumped back up into the dam overnight using electricity from the National Grid that is not required by consumers. This ensures that water is available for use next day and also prevents wastage of the base electricity load during periods of low demand.

(c)

1. $E_p = mgh = 1 \times 10^{10}kg \times 10N/kg \times 400m$

   $= 4 \times 10^{13}J$

   $= \underline{40\ 000\ 000\ MJ}$

(c)

2. Steps to solve this problem are:
   - Calculate the potential energy stored in one minute
   - Find the work done in one minute
   - Calculate the power needed to do the work (be careful with time units!)

Potential energy stored in one minute

Ep = mgh

= 60,000kg x 10N/kg x 400m

= 240,000,000J

WD = energy transformed

= 240,000,000J (or 240MJ)

$$\text{Power} = \frac{\text{W.D.}}{\text{time}} = \frac{240{,}000{,}000}{60\text{s}} = 4{,}000{,}000\text{W}$$

<u>so the minimum power requirement is 4MW</u>

3. In reality, the pump will require more power than this as some of the input energy will be lost as heat and sound while the pump operates. Energy will also be lost as friction as the water is pumped back up to the dam.

4.

(a) The engine is petrol-driven so the input energy is chemical energy.

(b) Ep = mgh = 1500kg x 10N/kg x 20m

so

= <u>300,000J</u>

(c) energy used by the engine = 20MJ x 0.75 = <u>15MJ</u>.

(d) $$\text{efficiency} = \frac{\text{output}}{\text{input}} \text{x} 100\% = \frac{300{,}000\text{J}}{15{,}000{,}000\text{J}} \text{x} 100\% = 2\%$$