PS # 1

1) a) Generally, it looks like the US's CO_2 emissions increase exponentially beginning in the 1840s. India does not appear until 1850s and does not increase significantly at all; there is a very slight linear incline. For China, it starts off with a slight linear incline for CO_2 emissions but then begins to grow exponentially in the 2000s. The US ends 2012 with a downward incline while China ends 2012 with exponential incline, however India remains at a slight linear incline.

A

b) Generally it seemed like CO_2 emissions increased with per capita income except for certain instances. For China + India there were times when income would decrease while CO_2 emissions remained low. However, as they began to increase their GDP, CO_2 emissions steadily rose.

A

c) The CO_2 emissions of the US definitely began to increase exponentially with the start of the Industrial Revolution. Following major world wars our CO_2 emissions and GDP would decrease. I also found it interesting how the US's emissions dropped drastically in the 80's, perhaps with the rising awareness for the environment.

A

2) (see graph)

3) a) $(1s) 1\ W = 1\ J/s\ (1\ s) \Rightarrow 1\ J = 1\ W\cdot s$ A

b) $kWhr = 10^3(J/s)(1\ hr)\left(\frac{60\ m}{1\ hr}\right)\left(\frac{60\ s}{1\ m}\right) = 3600\times10^3\ J = \boxed{3.6\times10^6\ J = kWh}$ A

c) a) $t = E/P = \frac{3.6\times10^6\ J}{100\ W} = \boxed{3.6\times10^4\ s}$

b) $t = E/P = \frac{3.6\times10^6\ J}{30\ W} = \boxed{1.2\times10^5\ s}$ A

c) $t = E/P = \frac{3.6\times10^6\ J}{10\ W} = \boxed{3.6\times10^5\ s}$

d) $E = mc\Delta T$

$3.6\times10^6\ J = (1\times10^6\ g)(4.2\ J/g°C)\Delta T$

$\boxed{\Delta T = 0.86\ °C}$ A

e) $\boxed{15.34¢ / kWh}$ A

f) it varies → between what & what ~20kg?

touché

6

4) Sun → Solar PV → battery → electric scooter → riding to VA
radiant energy — PE — PE — KE

Sun → plants → coal → burn → boil H_2O → fan → electricity
photo-synthesis — life — combustion — convection — pressure — KE — PE
IR radiation ← Q ← brake ← scooter ← battery
friction — KE — PE

5) EXERCISE

Sun → plants → Food → ATP → KE → Heat → IR
photo-synthesis — digestion (U_c) — friction

(6) a) $42 \text{ mi/gal} \left(\frac{1 \text{ hr}}{65 \text{ mi}}\right) = .65 \text{ hr/gal} \left(\frac{60 \text{ m}}{\text{hr}}\right)\left(\frac{60 \text{ s}}{\text{m}}\right) = \boxed{2322 \text{ s/gal}}$

b) $1 \text{ gal} = 33.4 \text{ kWh/gal} = 120.3 \times 10^6 \text{ J} = \boxed{1.203 \times 10^8 \text{ J}}$

c) $\frac{1.203 \times 10^8 \text{ J}}{2322 \text{ s}} = \frac{x \text{ J}}{1 \text{ s}} = \boxed{5.18 \times 10^4 \text{ J/s}}$

d) Sun → plants → fossil fuel → gas → KE → Q → IR
photo-synthesis — life — combustion — friction

7) a) U_c in candle → (combustion) Q → (conduction) KE in water → (radiation) Q → IR
Q → (radiation) environment

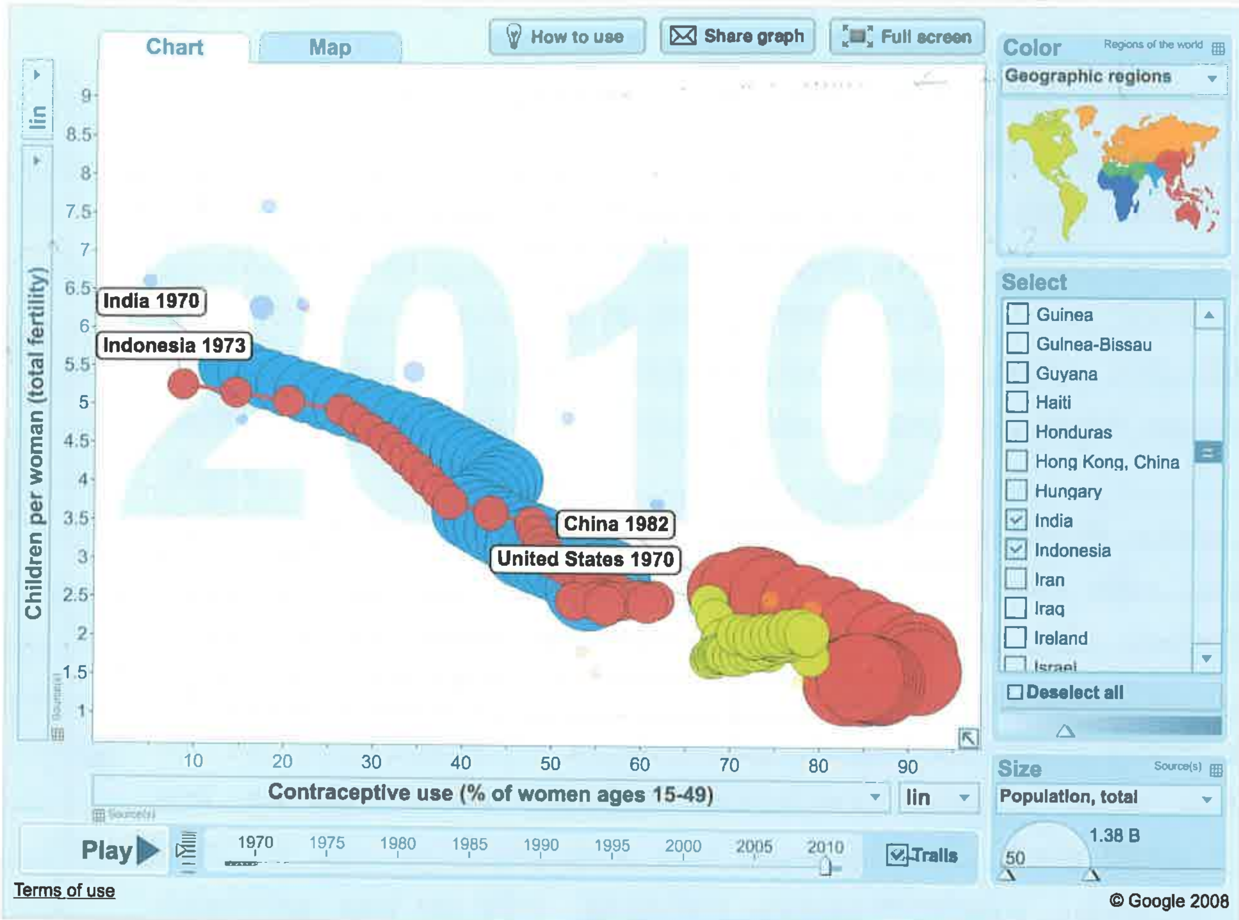
b) input energy: $E = m\Delta e = 0.1 \text{ g} \times 43100 \text{ J/g} = \boxed{4310 \text{ J}}$
output energy: $E = mc\Delta T = 10 \text{ g} \times 4.2 \text{ J/g°C} (11.5°\text{C}) = \boxed{483 \text{ J}}$

c) input power: $\frac{4310 \text{ J}}{48.66 \text{ s}} = 88.57 \text{ J/s} = \boxed{88.57 \text{ W}}$
output power: $\frac{483 \text{ J}}{48.66 \text{ s}} = 9.926 \text{ J/s} = \boxed{9.926 \text{ W}}$

d) efficiency $= \frac{9.926 \text{ W}}{88.57 \text{ W}} \times 100 = \boxed{11.2\%}$

e) We could make it more efficient by holding the test tube closer to the candle's flame so that not as much heat is lost to the environment.

f) N/A



From 1970 onward in places like the US, many women had jobs and were not at home very often. Because of this the increased use of contraceptives did not have very much impact. In third world countries such as India and Indonesia however, many women were not educated and did not have jobs that kept them away from the house. Therefore, without the use of contraceptives women had high fertility rates, whereas when contraceptives were introduced they were able to control how many children they had.