※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Please describe and explain (a) Carnot engine, (b) Coulomb's law, (c) electric potential, (d) inelastic collision, (e) Faraday's law. **(20%)**

2. Two identical bar magnets are placed north pole to north pole as shown in the diagram:

| S　　　　　N | | N　　　　　S |

(a) Draw a diagram showing the magnetic field lines.

(b) If a small iron particle was placed exactly between the two magnets, would a magnetic force be exerted on it? What would happen if it moved slightly closer to one magnet? **(20%)**

3. Two resistors, with resistances of 100 Ω and 400 Ω, are connected to a 6V power supply:

If the resistors are connected in parallel: (a) Draw a circuit diagram for this circuit. (b) What is the total resistance in the circuit? (c) What is the total current in the circuit? (d) Why is the total resistance less than both $R1$ and $R2$? **If the resistors are connected in series:** (e) Draw a circuit diagram for this circuit. (f) What is the total resistance in the circuit? (g) What is the total current in the circuit? **(20%)**

4. In a photoelectric effect experiment, it is found that metal X (an unknown) produces photo-electrons only if exposed to light of wavelength less than 380 nm. (a) Calculate the work function of this metal, in eV. (b) Now light at wavelength 240 nm shines on metal X. What is the maximum kinetic energy, in eV, of the photo-electrons that are being produced? (c) What stopping potential, in volts, would prevent the flow of the photo-current? Planck's constant h = 6.626×10^{-34} J·s. speed of light c = 2.9979×10^{8} m/s, **(15%)**

5. 2.0 litres of water is heated from an initial temperature of 20°C until it is completely boiled away. (a) How much heat is required to raise the temperature of the water to 100°C? (b) How much heat is required to completely boil the water after the temperature has reached 100°C? (c) What happens to the heat in parts a and b? Where does the energy go? **(15%)**

6. A flashlight uses two 1.5-volt batteries in series to produce a current of 500 mA through a light bulb. The flashlight is turned on for 6.0 minutes. (a) What quantity of charge flowed through the lightbulb? (b) How much energy did the battery supply during the 6.0 minutes? **(10%)**