Worksheet 2.3: Energy & Charge (E = Q V)

PhysicsSheets

Specification: GCSE Physics (AQA / Edexcel / OCR Gateway)

Core Equation: $E = Q \times V$

Rearranged Forms: $Q = \frac{E}{V}$ | $V = \frac{E}{Q}$

Units: E (Energy transferred, Joules, J) | Q (Charge flow, Coulombs, C) | V (Potential difference, Volts, V)

Section A: Units, Rearranging & Conversions

1. Complete the table below with the correct SI unit and symbol for each variable in the equation $E = Q \times V$.

Variable	SI Unit Name	SI Unit Symbol
Energy transferred (E)	_____	_____
Charge flow (Q)	_____	_____
Potential difference (V)	_____	_____

2. Rearrange the equation $E = Q \times V$ to make:

a) Charge flow (Q) the subject: $Q =$ _____

b) Potential difference (V) the subject: $V =$ _____

3. Perform the following unit conversions. Show your working where appropriate.

a) Convert 3500 J to kilojoules (kJ).

b) Convert 0.025 C to millicoulombs (mC).

c) Convert 2.5 kV to volts (V).

d) Convert 15 kJ to joules (J).

e) Convert 120 mC to coulombs (C).

f) Convert 0.05 V to millivolts (mV).

Section B: Practice Calculations

4. Answer the following questions, showing all your working and stating the correct units.

a) A charge of 3.0 C flows through a component with a potential difference of 9.0 V across it. Calculate the energy transferred.

b) A 12 V car battery transfers 50 C of charge when starting the engine. How much energy is transferred from the battery?

c) An electric heater transfers 4800 J of energy when 400 C of charge flows through it. What is the potential difference across the heater?

d) A light bulb transfers 150 J of energy when connected to a 6.0 V power supply. Calculate the amount of charge that flows through the bulb.

Section C: Challenge Context & Multi-step Problems

5. Answer the following multi-step problems, ensuring you show all working, including unit conversions, and state final answers with appropriate units.

a) A portable charger has a potential difference of 5.0 V. If it transfers 1200 C of charge to a phone battery, calculate the energy transferred. Give your answer in kilojoules (kJ).

b) A car battery with a potential difference of 12 V delivers an average power of 60 W to the car's headlights for 25 minutes.

(i) Calculate the total energy transferred by the battery during this time.

(ii) Calculate the total charge that flows through the headlights.

(iii) Explain why it is important to show all steps of your working, including unit conversions, in multi-step calculations like this.