6.2 The motor effect and electrical energy (P)

Name: _____ Class: _____ Date: _____ **Total: 25 marks**

KEY WORDS motor effect • kilowatt-hour

Objective

Build the skills to answer exam questions on **the motor effect and electrical energy** : the force on a wire in a magnetic field, Fleming's left-hand rule, electric motors, electrical power and energy, and the cost of electricity.

You must be able to:

- describe the force on a current-carrying wire in a magnetic field
- use Fleming's left-hand rule and explain how a motor works
- use $P = IV$, $P = I^2R$, $E = Pt$ and $E = VQ$
- calculate energy in kWh and the cost of electricity

1 Key knowledge and worked examples

Motor effect and electrical energy

idea	equation or rule
motor effect	a wire with a current in a magnetic field feels a force; biggest when the wire is at 90° to the field; bigger with more current or a stronger magnet
Fleming's left-hand rule	First finger: Field (N to S); seCond finger: Current; thuMb: Motion (force)
electric motor	forces on the two sides of the coil are in opposite directions, so the coil turns; a split-ring commutator reverses the current every half turn
power	$P = IV$ or $P = I^2R$ (W)
energy	$E = Pt$ or $E = VQ$ (J)
cost	energy in kWh = power in kW × time in hours; cost = kWh × price per kWh

Worked example 1: power. A heater takes 4.0 A from the 230 V mains. Find its power.

1. Known: $I = 4.0$ A, $V = 230$ V.
2. Rule: $P = IV$.
3. Numbers: 4.0×230.
4. Result: $P = 920$ **W**.

Worked example 2: the cost of electricity. A 2.0 kW heater runs for 3.0 hours. Electricity costs 0.60 yuan per kWh. Find the cost.

1. Known: $P = 2.0$ kW, $t = 3.0$ h.
2. Rule: kWh = kW × h; cost = kWh × price.
3. Numbers: $2.0 \times 3.0 = 6.0$ kWh; 6.0×0.60.
4. Result: 3.6 **yuan**.

Answer shapes: use W and s for joules, but kW and hours for kWh.

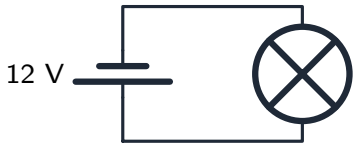
2 Practice

2.1 A wire carries a current into the page between two magnets. Use Fleming's left-hand rule to find the direction of the force on the wire. [2]

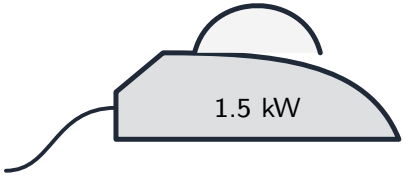


current into the page

2.2 A charge of 50 C passes through a 12 V lamp. Calculate the energy transferred. [2]

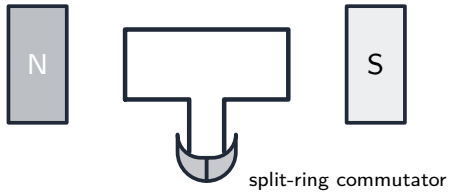


2.3 A 1.5 kW iron is used for 2.0 hours. Electricity costs 0.50 yuan per kWh. Calculate the energy in kWh and the cost. [2]

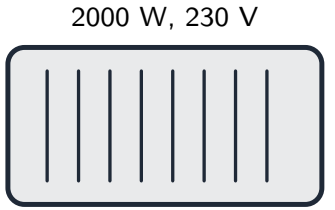


3 Exam-style questions

3.1 The diagram shows a simple electric motor. Explain why the coil turns. Explain why the motor needs a split-ring commutator. [3]



3.2 A heater has a power of 2000 W on the 230 V mains. Calculate the current and the resistance of the heater. [3]



3.3 A family records how they use some appliances each day. Electricity costs 0.60 yuan per kWh.

appliance	power / kW	hours each day
kettle	2.2	0.5
TV	0.10	5
fridge	0.15	8
6 LED lamps	0.010 each	6

(a) Calculate the energy used each day by the kettle and by the TV, in kWh. [2]

(b) Calculate the energy used each day by the TV in joules. [2]

(c) Calculate the total energy used by all the appliances each day. Calculate the cost for 30 days. [3]

(d) Suggest and explain ways the family can use less electricity. Use the data in your answer. [6]