WHA

CP9 Calculations

EXAM BOOKLET

MCKELVIE. S

(b) A transformer is 100% efficient.

It has 200 turns on the primary coil and 3000 turns on the secondary coil.
The input voltage is 55 V.

(i) Show that the output voltage is about 800 V.

(3)

(ii) Calculate the current in the secondary coil when the current in the primary coil is 0.50 A.

(2)

current in secondary coil = ... A

5 A windfarm generates electrical power from the wind.

(a) State **one** disadvantage of using the wind to generate electrical power.

(1)

.....

.....

(b) A windfarm generates 322 MW of electrical power.

The windfarm is connected to a transmission line at a potential difference of 132 kV.

(i) Calculate the current from the windfarm.

(3)

current = ... A

(ii) The windfarm produces 322 MW of power.
The windfarm is to be extended by adding 75 improved turbines.
The extended windfarm will then produce a total of 539 MW.

Calculate the power produced by each improved turbine.

(2)

power = ... MW

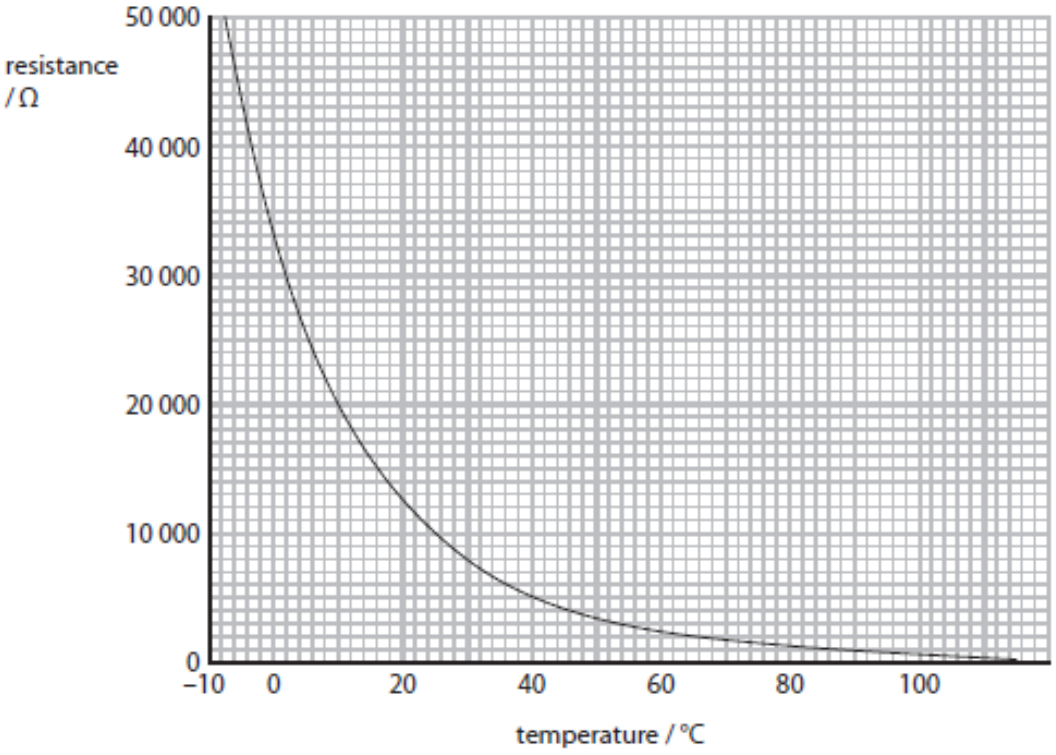
(b) This label is attached to the heater.

230 V 500 W 50 Hz

Use this information to calculate the expected current in the heater.

(3)

current = ... A



When the temperature is 10 °C, the current in the thermistor is 0.60 mA.

Calculate the potential difference across the thermistor at 10 °C.

(3)

potential difference = ... V

(b) The students use the electric motor to lift a weight.
The current in the motor is 0.5 A.
The potential difference (voltage) across the motor is 6 V.

Calculate the input power to the motor.
State the unit.

(3)

input power = ... unit = ...

(d) A homeowner fits a solar panel to her roof.
The cost of the solar panel is £4800.
The solar panel supplies an average of 800 kW h of electrical energy to the National Grid each year.
The homeowner is paid 40p for each kW h of energy supplied to the National Grid.

Calculate the payback time for the solar panels by selling energy to the National Grid.

(3)

payback time = ... years

(ii) A large solar farm has 21 700 solar panels and generates 5.0 MW of power.

$1.0\ \text{MW} = 1.0 \times 10^6\ \text{W}$

Calculate the average power each panel produces.

(2)

average power produced by each panel = ... W

(iii) The solar farm receives 25 MW of power from the Sun to generate 5 MW of electrical power.

Calculate the efficiency of the solar farm.

(2)

efficiency = ...

4 A small notebook computer has a power rating of 40 W.
The computer is connected to the mains supply through a step-down transformer.
The mains supply is a.c.

(a) (i) How much energy is supplied to the computer each second?

Put a cross (☒) in the box next to your answer.

(1)

- ☐ **A** 0.025 J
- ☐ **B** 4.0 J
- ☐ **C** 40 J
- ☐ **D** 240 J

(b) The step-down transformer has:

- 2400 turns on the primary coil
- 200 turns on the secondary coil
- a primary voltage of 230 V.

Calculate the voltage output of the secondary coil.

(3)

secondary voltage = ... V

(ii) One of the components being investigated is a 12 ohm resistor.
When it is in the circuit, the ammeter reading is 0.50 A.

Calculate the voltmeter reading.

(2)

voltmeter reading = ... V

(b) During the lightning flash a total charge of 52 C flows.
The average current is 2600 A.

Calculate the duration of the flash in seconds.

(3)

duration of flash = ... s

(c) A LED lamp has a power rating of 3 W.
The voltage across the lamp is 12 V.
Calculate the current in the lamp.

(3)

current in the lamp = ... A

(iii) The supply voltage is 12 V.
At 20 °C the current is 0.047 A.

Calculate the resistance of the thermistor at this temperature.

(3)

resistance = ... Ω

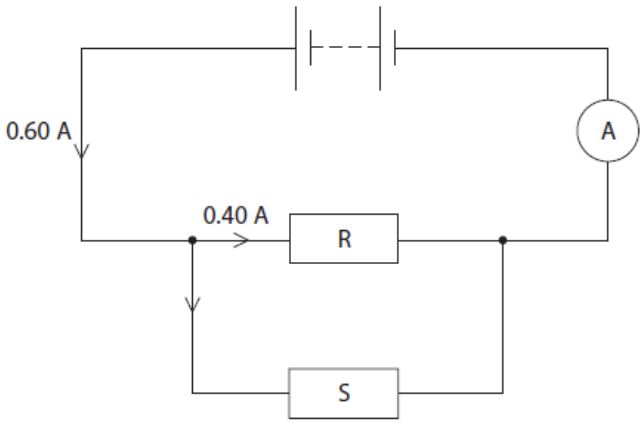
(b) The current in a wire is 3.7 A.

Calculate the charge that flows into the wire in 13 s.

(2)

charge = ... C

5 (a) The diagram shows an electric circuit with two resistors, R and S.



(i) R has a resistance of 11 ohms.

Calculate the potential difference across R.

(2)

(ii) Use information from the diagram to calculate the current in S.

(1)

current = ... A

(c) A transformer has 2400 turns on the primary coil and 100 turns on the secondary coil.

Calculate the secondary voltage if the primary voltage is 12 V.

(3)

secondary voltage = ... V

(b) The power of the kettle when it is heating water is 1.8 kW.
The mains voltage is 230 V.

(i) Calculate the current in the kettle.

(3)

current = ... A

(ii) The kettle is switched on for 2 minutes.

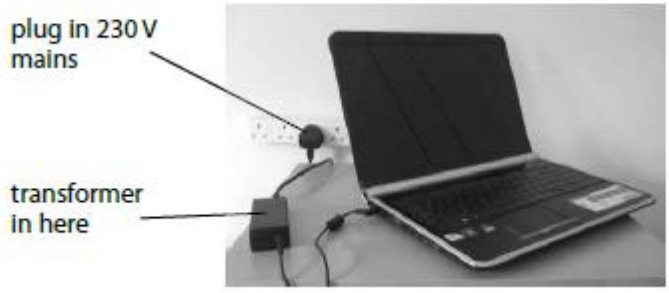
Calculate the total amount of energy transferred by the kettle in this time.

(2)

energy transferred = ... J

Power

3 The photograph shows a laptop computer plugged into the 230 V mains.



(b) When the laptop is in normal use, its power consumption from the mains is 97 W.

Calculate the current drawn from the mains.

(3)

current = ... A

(c) The transformer shown in the photograph steps down the mains voltage of 230 V to 9.2 V.

The primary coil of the transformer has 4700 turns.

(i) Calculate the number of turns on the secondary coil.

(3)

number of turns = ...

(c) An electric torch is switched on for 90 s.

The current in the torch is 70 mA.

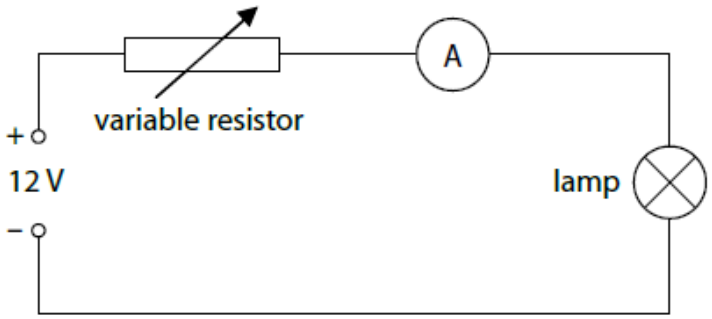
Calculate the amount of charge flowing from the torch battery during this time.

(2)

charge = ... C

Electrical resistance

5 A student uses this circuit to investigate how the current in a filament lamp varies with the potential difference (voltage) across the lamp.



(a) Add a voltmeter to the circuit that can be used to measure the potential difference (voltage) across the lamp.

(1)

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

The 12 V electrical supply transfers

(1)

☐ **A** 12 joules per coulomb

☐ **B** 12 coulombs per joule

☐ **C** 12 joules per ohm

☐ **D** 12 volts per amp

(c) When the variable resistor is at the half-way position, the ammeter reads 0.37 A and the voltmeter reads 4.0 V.

Show that the resistance of the filament in the lamp is about 11 Ω.

(2)

1 (b) (i) A single wind turbine has a maximum power output of 2 000 000 W.

The wind turbine operated continuously at maximum power for 6 hours.

Calculate the energy output in kilowatt-hours of the wind turbine.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

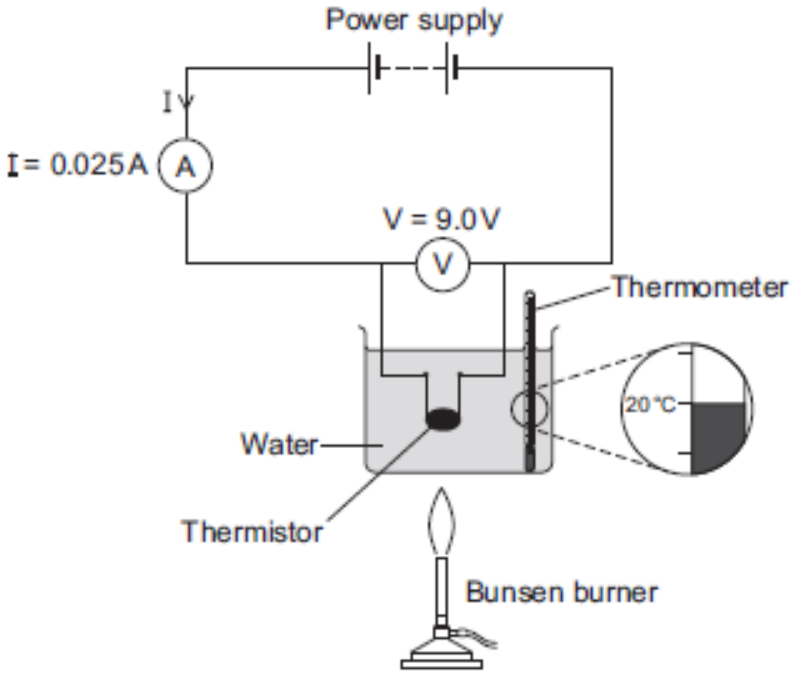
.....

.....

.....

4 (a) **Figure 4** shows the apparatus used to obtain the data needed to calculate the resistance of a thermistor at different temperatures.

Figure 4



4 (a) (i) In the box below, draw the circuit symbol for a thermistor.

[1 mark]

4 (a) (ii) Use the data given in **Figure 4** to calculate the resistance of the thermistor at 20 °C.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

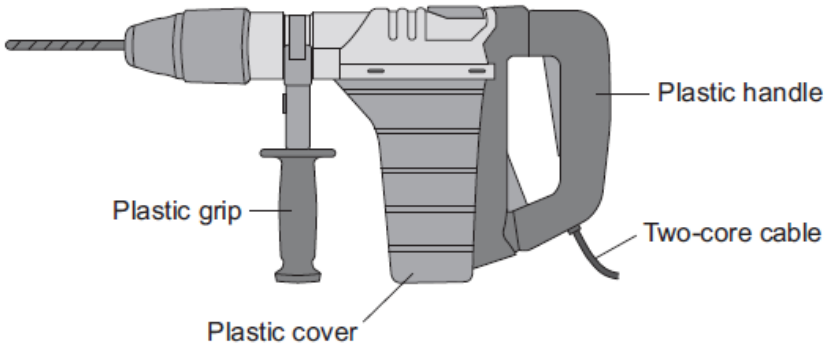
.....

.....

Resistance = ... ohms

7 **Figure 8** shows an electric drill.

Figure 8



The information in the box is taken from the booklet supplied with the drill.

- This drill is fitted with a two-core cable
- Power supply: 230 V a.c. 50 Hz
- Power input: 1012 W
- Mass: 6 kg

7 (b) Calculate the current drawn from the mains electricity supply by the drill.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Current = ... A

5 (b) (ii) The solar storage power station can store a maximum of 2 200 000 kWh of energy.
The solar storage power station can supply a town with a maximum electrical power of 140 000 kW.

Calculate for how many hours the energy stored by the solar storage power station can supply the town with electrical power.

Give your answer to 2 significant figures.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

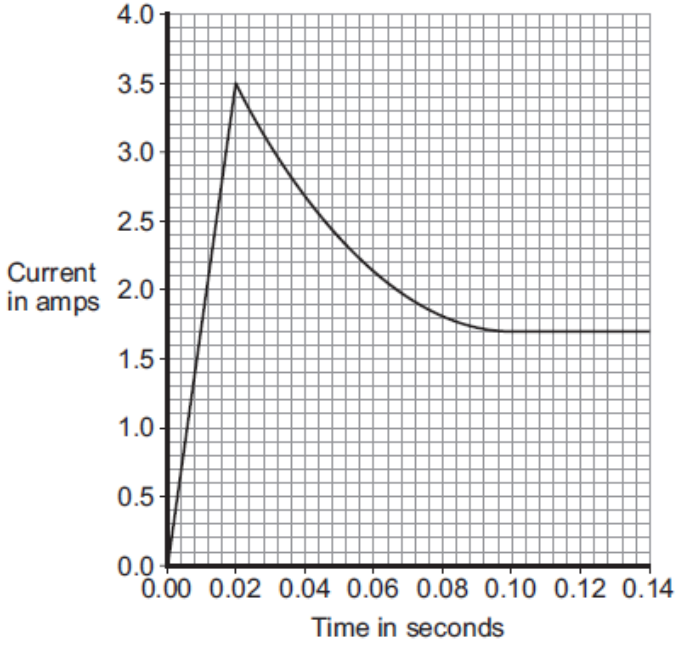
.....

.....

.....

Time = ... hours

Figure 6



5 (a) (i) After 0.10 seconds, the bulb works at its normal brightness.

What is the current through the bulb when it is working at normal brightness?

[1 mark]

Current = ... A

5 (a) (ii) The bulb works at normal brightness for 30 seconds before it is switched off.

Calculate the charge that flows through the bulb in the 30 seconds before it is switched off. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

Charge = ... unit .....

5 (a) (iii) Calculate the energy transferred by the 12 V bulb when it is working at normal brightness for 30 seconds.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

Energy transferred = ... J

8 (b) When the toothbrush is being charged, the p.d. across the primary coil in the charging base is 230 V.

The charging p.d. across the secondary coil in the toothbrush is 7.2 V.

The primary coil in the charging base has 575 turns of wire on its coil.

Calculate the number of turns on the secondary coil inside the toothbrush.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

.....

Number of turns on the secondary coil = ...

8 An electric vehicle has a rechargeable battery.

The battery is recharged by connecting it to a charging station.

© Epattloamer

(a) The battery voltage is 385 V.

(i) State the amount of energy transferred when one coulomb of charge passes through a potential difference of 385 V.

(1)

energy transferred = ... J

(ii) Show that, when a charge of 180000 C passes through the battery, the total amount of energy transferred to the battery is about 70 MJ.

(2)

(b) Charging takes 110 minutes and causes a total charge of 180000 C to pass through the battery.

(i) State the equation linking charge, current and time.

(1)

(ii) Calculate the average charging current in the battery.

(3)

current = ... A

(d) (i) State the equation linking voltage, current and resistance.

(1)

(ii) At room temperature the thermistor has a resistance of 680 Ω.

The voltage across it is 5.9 V.

Show that the current in the thermistor is about 8.5 mA.

(3)

There is a warning label on the reel.

WARNING
maximum allowable power
when cable fully extended – 2400 W, 240 V
when cable coiled up – 700 W, 240 V

(a) (i) State the equation linking power, current and voltage.

(1)

(ii) Complete the table by inserting the missing value.

(1)

Power in W	Voltage in V	Current in A
700	240	
2400	240	10

(b) It takes 3.5 hours to recharge the battery fully.

The average current supplied by the charger is 400 mA.

(i) State the equation linking charge, current and time.

(1)

(ii) Calculate the amount of charge needed to recharge the battery fully, and give the unit.

(3)

charge = ... unit .....

(b) The student uses voltmeter and ammeter readings to find the resistance at each temperature.

One set of readings is shown below.

temperature in °C	voltmeter reading in V	ammeter reading in mA
80	13.2	2.60

(i) State the equation linking voltage, current and resistance.

(1)

(ii) Show that the resistance of the thermistor at 80 °C is about 5000 Ω.

(3)

(b) The generator in the wind turbine transfers 39 MJ of energy in 1 minute.

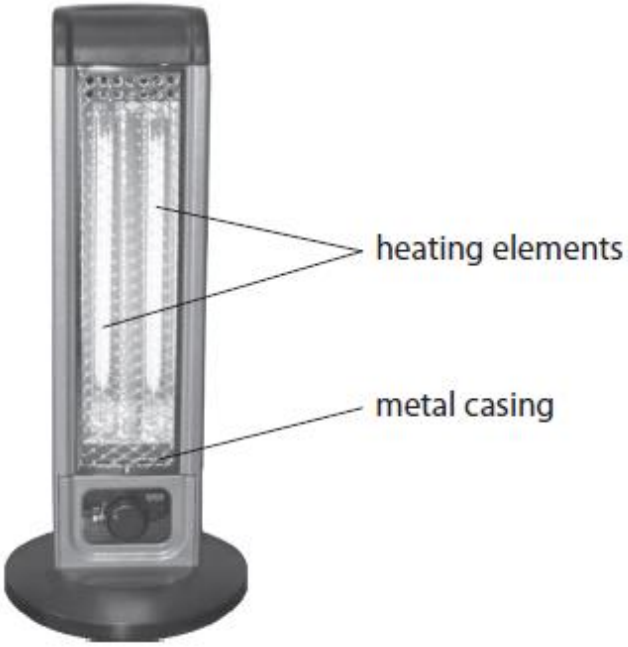
The generator current is 490 A.

(i) Calculate the output voltage of the generator.

(3)

Voltage = ... V

6 The photograph shows an electric heater.



(a) The power of the heater is 2000 W.

The heater is connected to a 230 V mains supply.

(i) State the equation linking power, current and voltage.

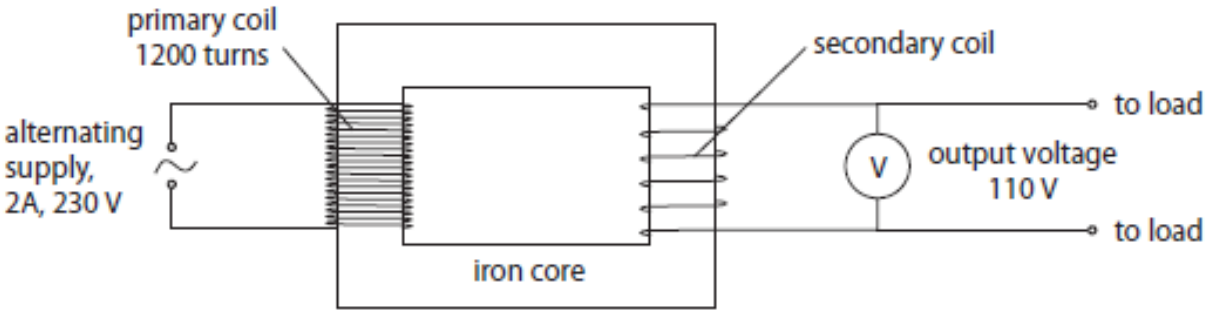
(1)

(ii) Calculate the current in the heater.

(2)

current = ... A

7 The diagram shows a transformer that is 100% efficient.



(a) (i) State the equation linking input power and output power for the transformer.

(1)

(ii) Calculate the output current of the transformer.

(2)

output current = ... A

(b) (i) State the equation linking input voltage, output voltage and turns ratio for the transformer.

(1)

(ii) Calculate the number of turns on the secondary coil of the transformer.

(2)

number of turns = ...

(c) Lamp Y is removed and replaced with a low-energy lamp.

When the low-energy lamp is connected to a 230 V supply, the current in it is 0.12 A.

(i) Calculate the amount of energy transferred by the low-energy lamp in 7 hours.

(3)

energy transferred = ... J

2 An electric kettle is connected to the 230 V mains supply.

The power of the kettle is 960 W.

(a) (i) A power of 960 watts is the same as

(1)

☒ **A** 960 joules per coulomb

☒ **B** 960 joules per second

☒ **C** 960 newtons per metre

☒ **D** 960 newtons per second

(ii) State the equation linking power, current and voltage.

(1)

(iii) Show that the current in the kettle is about 4 A.

(2)

(b) (i) State the equation linking the input (primary) and output (secondary) voltages and the turns ratio of a transformer.

(1)

(ii) The transformer has 520 primary turns and 30 secondary turns.

The input voltage to the transformer is 44 V.

Calculate the output voltage.

(2)

output voltage = ... V

(b) The photograph shows a machine at a coal mine.

© Andrew Curtis

The machine lifts up containers of coal from the mine and lowers empty containers down.

The machine uses an electric motor connected to a 600 V d.c. supply.

The maximum current in the motor is 4000 A.

(i) State the equation linking power, current and voltage.

(1)

(ii) Calculate the maximum power available from the motor.

(2)

maximum power = ... MW

(c) The machine lifts a load weighing 400 000 N through 190 m.

(i) State the relationship between work done, force and distance moved.

(1)

(ii) Calculate the work done on the load.

(2)

work done on load = ... J

(d) The machine uses an average (mean) power of 1.9 MW to do 67 MJ of work.

(i) Calculate the time needed to do this work.

(3)

time = ... s

(b) The man presses a metal button to operate the lift.

There is a spark and the man receives an electric shock.

The spark lasts for 75 ms and 0.0017 C of charge passes.

(i) State the equation linking charge, current and time.

(1)

(ii) Calculate the average current in the spark.

Give the unit.

(3)

current = ... unit .....