Revision Sheet

A-Level Physics · Unit 9 Electricity

10 vocabulary items · 28 marks of exam questions (14 questions)

Part 1 · Vocabulary review (10 items). The terms this unit is examined on most. Mark it yourself from the answer key.

Section A · Chinese to English

Write the English word.

1. _____ [1]

2. _____ [1]

3. _____ [1]

4. _____ [1]

5. _____ [1]

6. _____ [1]

7. _____ [1]

8. _____ [1]

9. _____ [1]

10. _____ [1]

Part 2 · Exam questions (28 marks, 14 questions) begins on the next page. They are ordered easy to difficult and none of them has been set before.

11 A piece of wire X has resistivity ρ, length L and cross-sectional area A. Wire X has a resistance R.

A second piece of wire Y is made of a different metal. It has the same resistance as X but has twice the length of X.

Which row gives possible values for the resistivity and the cross-sectional area of Y?

	resistivity	cross-sectional area
A	$\frac{1}{2}\rho$	$\frac{1}{2}A$
B	$\frac{1}{2}\rho$	A
C	ρ	$\frac{1}{2}A$
D	2ρ	A

12 A sample of material has cross-sectional area A and length L. The temperatures at the two sides of the sample are T_1 and T_2. Thermal energy Q is transferred through the sample in time t.

These quantities are related by

$$\frac{Q}{t} = \frac{k \times A \times (T_1 - T_2)}{L}$$

where k is a constant.

What are the SI base units of k?

A $\mathrm{kg\,m\,s^{-3}\,°C^{-1}}$ **B** $\mathrm{kg\,m\,s^{-3}\,K^{-1}}$ **C** $\mathrm{kg\,m\,s^{-1}\,°C^{-1}}$ **D** $\mathrm{kg\,m\,s^{-1}\,K^{-1}}$

13 A wire of diameter d is connected into an electric circuit. There is a current I in the wire and the charge carriers have an average drift speed v.

The wire is replaced with a new wire of the same material but with a diameter $0.5d$.

The current is adjusted so that the charge carriers in the new wire have an average drift speed $3v$.

What is the current in the new wire?

A $0.75I$ **B** $1.5I$ **C** $6I$ **D** $12I$

14 What is the definition of potential difference across a component?

A energy transferred per unit charge

B energy transferred per unit current

C energy transferred per unit distance

D energy transferred per unit time

15 A radioactive source produces a beam of α-particles in a vacuum. The average current caused by the α-particles in the beam is 1.5×10^{-9} A.

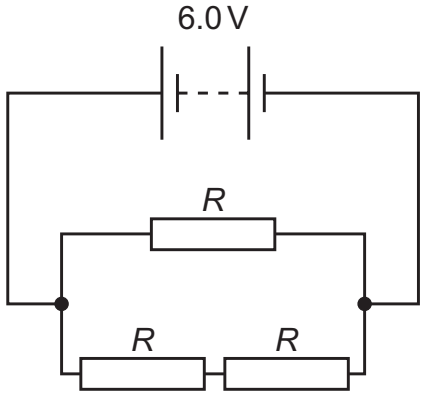
The beam is incident on a metal target.

What is the average number of α-particles hitting the metal target in a time of 3.0 s?

A 4.7×10^{9} **B** 9.4×10^{9} **C** 1.4×10^{10} **D** 2.8×10^{10}

16 In the circuit shown, the battery has an electromotive force (e.m.f.) of 6.0 V and negligible internal resistance.

The three resistors each have resistance *R*.

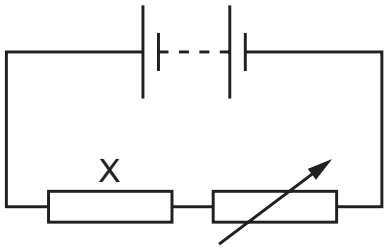


The total power dissipated in the resistor network is 24 W.

What is the value of *R*?

A 0.50 Ω **B** 1.0 Ω **C** 1.5 Ω **D** 2.3 Ω

17 In the circuit shown, a fixed resistor X is connected in series with a battery and a variable resistor.



The power dissipated in resistor X is 7.2 W when a current of 3.0 A passes through it.

The variable resistor is adjusted so that the power dissipated in X increases by 50%.

What is the new current in the circuit?

A 2.4 A **B** 3.7 A **C** 4.5 A **D** 14 A

18 A power supply is connected to a component by connecting wires of total resistance 4.9 Ω.

The power supply has an output power of 3.6 W and a terminal potential difference of 12 V.

How much thermal energy is dissipated in the connecting wires in a time of 1.0 hour?

A 0.44 J **B** 29 J **C** 1.6 kJ **D** 11 kJ

19 What is the definition of the potential difference (p.d.) across a component?

A the electrical power supplied to the component

B the energy transferred to the component per unit charge

C the product of the current in the component and its resistance

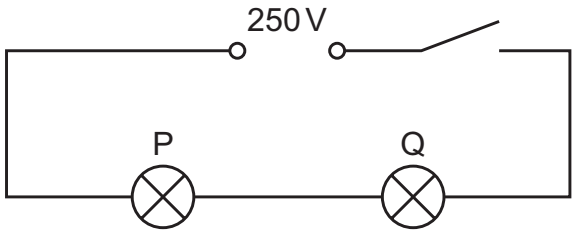
D the voltage across the component

20 A resistor has resistance R. When the potential difference (p.d.) across the resistor is V, the current in the resistor is I. The power dissipated in the resistor is P. Work W is done when charge Q flows through the resistor.

What is **not** a valid relationship between these variables?

A $I = \frac{P}{V}$ **B** $Q = \frac{W}{V}$ **C** $R = \frac{P}{I^2}$ **D** $R = \frac{V}{P}$

21 In the circuit shown, lamp P is rated 250 V, 50 W and lamp Q is rated 250 V, 200 W. The two lamps are connected in series to a 250 V power supply.



Assume that the resistance of each lamp remains constant.

Which statement most accurately describes what happens when the switch is closed?

A Lamp P emits four times as much power as lamp Q.

B Lamp P emits twice as much power as lamp Q.

C Lamp Q emits four times as much power as lamp P.

D Lamp Q emits twice as much power as lamp P.

22 Which values of current and resistance will produce a rate of energy transfer of $16\,J\,s^{-1}$?

	current / A	resistance / Ω
A	1	4
B	2	2
C	2	8
D	4	1

23 **(a)** The current in a filament lamp decreases.

State and explain how the resistance of the lamp changes.

.....

..... [1]

(b) A cylindrical wire has length *L* and resistance *R*. The **total** number of free electrons (charge carriers) contained in the volume of the wire is *N*. Each free electron has charge *e*. The potential difference between the ends of the wire is *V*.

Determine expressions, in terms of some or all of the symbols *e*, *L*, *N*, *R* and *V* for:

(i) the current in the wire

current = ... [1]

(ii) the average drift speed of the free electrons

average drift speed = ... [2]

(iii) the average time taken for a free electron to move along the full length of the wire.

time taken = ... [1]

[Total: 5]

24 **(a)** State Kirchhoff's second law.

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..... [2]

(b) A battery has electromotive force (e.m.f.) 4.0 V and internal resistance 0.35 Ω. The battery is connected to a uniform resistance wire XY and a fixed resistor of resistance *R*, as shown in Fig. 5.1.

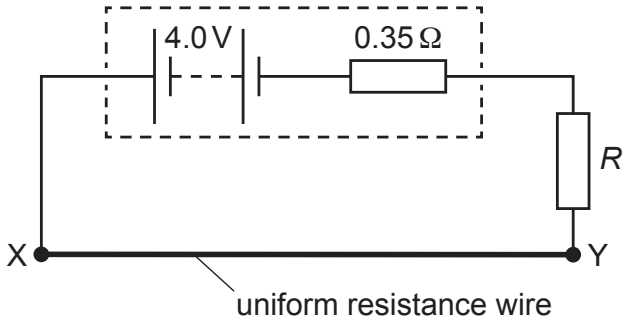

Fig. 5.1

Wire XY has resistance 0.90 Ω. The potential difference across wire XY is 1.8 V.

Calculate:

(i) the current in wire XY

current = ... A [1]

(ii) the number of free electrons that pass a point in the battery in a time of 45 s

number = ... [2]

(iii) resistance *R*.

R = ... Ω [2]

(c) A cell of e.m.f. 1.2 V is connected to the circuit in **(b)**, as shown in Fig. 5.2.

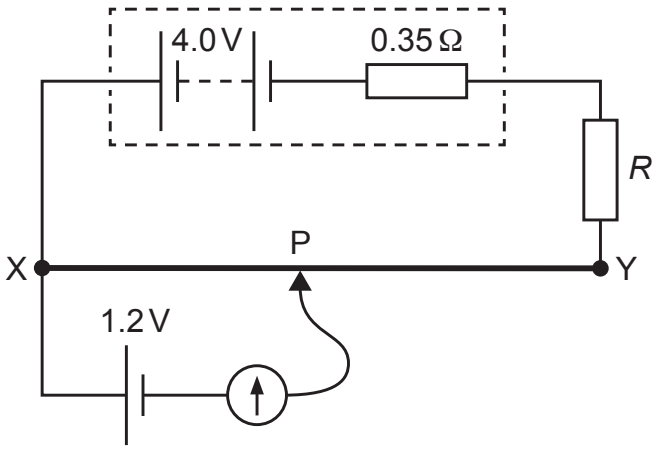

Fig. 5.2

The connection P is moved along the wire XY. The galvanometer reading is zero when distance XP is 0.30 m.

(i) Calculate the total length *L* of wire XY.

L = ... m [2]

(ii) The fixed resistor is replaced by a different fixed resistor of resistance greater than *R*.

State and explain the change, if any, that must be made to the position of P on wire XY so that the galvanometer reading is zero.

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..... [2]

[Total: 11]