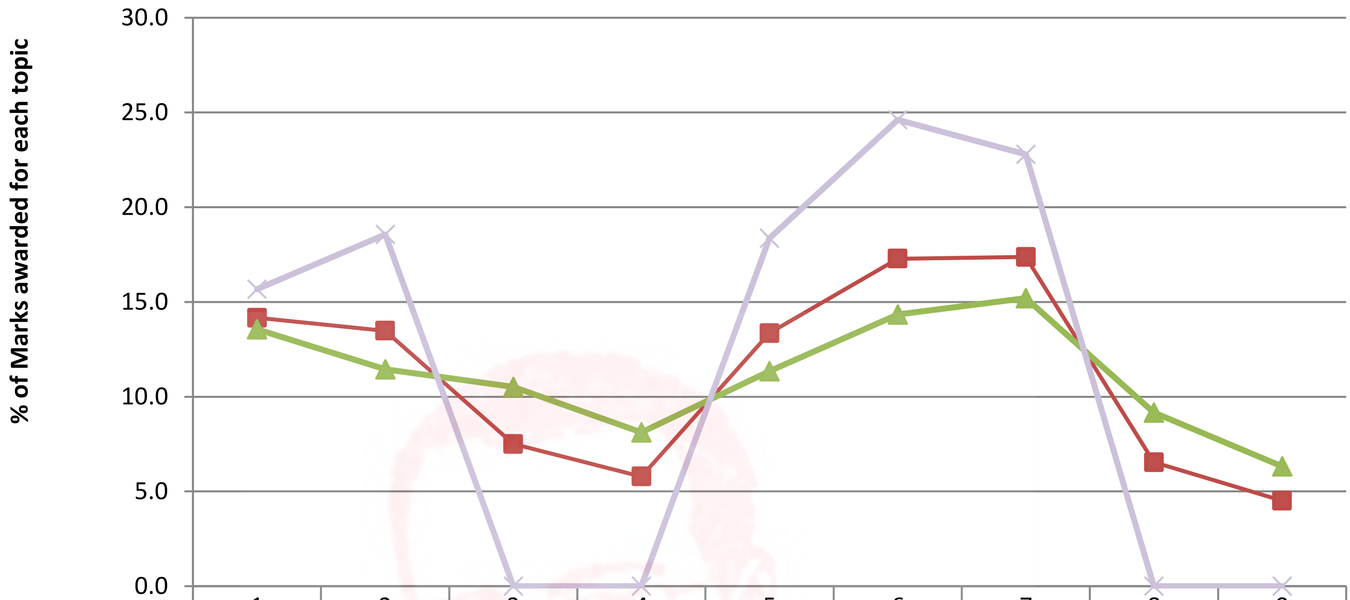
Name

iG Phx 7 EQ 14w to 02w P3 4Students 315marks

For these stats only papers 3 (which after 2016 became paper 4) and paper 6 were used to examine the topics.

iG Phx CIE 0625 PAPERS 3 and 6

Percentage of all WEIGHTED marks awarded for P3 & 6 each topic from s2002 to w2014 (red squares) and % of Paper 3 marks (green triangles) and paper 6 (purple crosses)



	1	2	3	4	5	6	7	8	9
PhxBoth P3&6	14.2	13.5	7.5	5.8	13.4	17.3	17.4	6.5	4.5
PhxP3	13.6	11.4	10.5	8.1	11.3	14.3	15.2	9.2	6.3
PhxP6	15.7	18.6	0.0	0.0	18.4	24.6	22.8	0.0	0.0

Papers 3 and 6 Topic Number

PAPER 3

Percentage of all marks awarded for each topic from s2002 to w2014 in Paper 3 (red squares) and marks per topic for papers 3 and 6 (green triangles)

	1	2	3	4	5	6	7	8	9
ALL P3 %	13.6	11.4	10.5	8.1	11.3	14.3	15.2	9.2	6.3
P3 & 6	14.2	13.5	7.5	5.8	13.4	17.3	17.4	6.5	4.5

Paper 3 Topic Number

Papers covered in this sample

	1st Paper	Last Paper	Marks/ paper	Theor. All Papers	Actual All Marks	Difference	Difference %	Weight per paper	Weight per mark
Paper 3	2002w	2014w	80	2000	2072	72	3.6	50	0.63
Paper 6	2002s	2015w	40	1120	1040	-80	-7.1	20	0.50

There are a few missing:

Got all Paper 31s (except 2014w Paper 31), and got 2014w 33

So papers in time zones 2 and 3 are not covered.

All topics ranked by frequency of marks in exams (P3 and 6 only)

Topic	PhxBoth P3&6	PhxP3	PhxP6
7	17.4	15.2	22.8
6	17.3	14.3	24.6
1	14.2	13.6	15.7
2	13.5	11.4	18.6
5	13.4	11.3	18.4
3	7.5	10.5	0.0
8	6.5	9.2	0.0
4	5.8	8.1	0.0
9	4.5	6.3	0.0

Other statistics that might be of interest:

	Topics:	1	2	3	4	5	6	7	8	9
P3/4 marks	2072	281	237	218	168	235	297	315	190	131
P3/4 %		13.6	11.4	10.5	8.1	11.3	14.3	15.2	9.2	6.3
P6	1040	163	193	0	0	191	256	237	0	0
P6 %		15.7	18.6	0.0	0.0	18.4	24.6	22.8	0.0	0.0
Total Marks (WIEGHTED)	1815	257	245	136	105	242	314	315	119	82
% of Marks (Weighted)	1815	14.2	13.5	7.5	5.8	13.4	17.3	17.4	6.5	4.5
# of Questions		63	64	35	16	63	74	70	26	20
Average marks per Q		**4.1**	**3.8**	**3.9**	**6.6**	**3.8**	**4.2**	**4.5**	**4.6**	**4.1**

Final note:

My iG and IB chemistry papers were broken down more carefully than these were, so there may be a mark or two in the wrong topic especially in topics 3 to 5, but if you learnt or taught these topics in sequence than you shouldn't have a problem with seeing material from an earlier topic.

Defining the Topics: Why not use the units given in the syllabus?

Artificial topics have been created for the physics syllabus by me so that each topic is roughly the same size. Topics go in syllabus order. I have decided to use the number of marks allocated in previous exams to each syllabus point to determine how many go into each topic.

1. General physics

Topic 1

1.1 Length and time
1.2 Motion
1.3 Mass and weight
1.4 Density

Topic 2

1.5 Forces
1.6 Momentum (Extended candidates only)

Topic 3

1.7 Energy, work and power
1.8 Pressure

2. Thermal physics

Topic 4

2.1 Simple kinetic molecular model of matter

Topic 5

2.2 Thermal properties and temperature
2.3 Thermal processes

3. Properties of waves, including light and sound

Topic 6

3.1 General wave properties
3.2 Light
3.3 Electromagnetic spectrum
3.4 Sound

4. Electricity and magnetism

Topic 7

4.1 Simple phenomena of magnetism
4.2 Electrical quantities
4.3 Electric circuits
4.4 Digital electronics (Extended candidates only)
4.5 Dangers of electricity

Topic 8

4.6 Electromagnetic effects

5. Atomic physics

Topic 9

5.1 The nuclear atom
5.2 Radioactivity

8 A student sets up a circuit containing three identical cells. Each cell has an e.m.f. (electromotive force) of 2.0 V.

Fig. 8.1 shows the cells in series with a length of uniform metal wire connected between two terminals K and L, an ammeter and a resistor X.

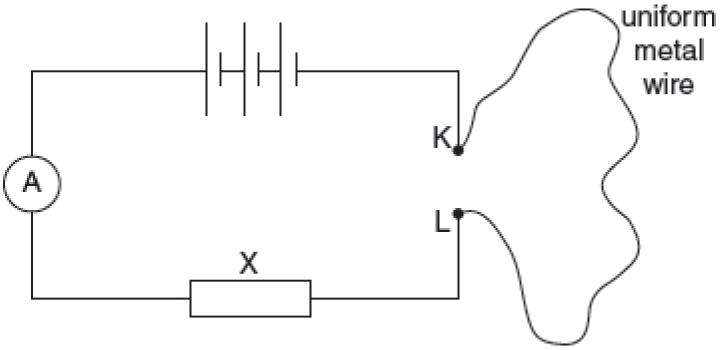


Fig. 8.1

(a) State the total e.m.f. of the three cells in series.

total e.m.f. = ... [1]

(b) The ammeter reading is 0.25 A.

(i) State the name of the unit in which electric charge is measured.

....[1]

(ii) Calculate the charge that flows through the circuit in twelve minutes.

charge = ... [2]

(iii) The metal wire has a resistance of 16 Ω.

Calculate the resistance of resistor X.

resistance = ... [2]

(c) The student removes the 16 Ω wire from the circuit and cuts it into two equal lengths.

He then connects the two lengths in parallel between K and L, as shown in Fig. 8.2.

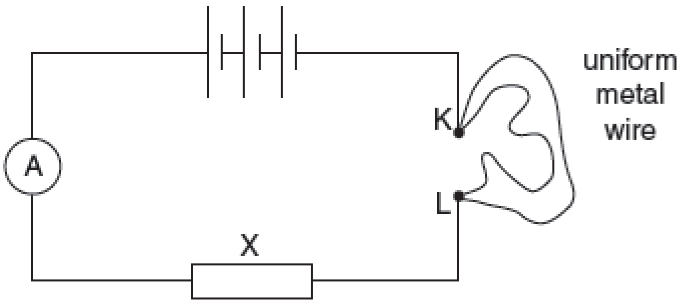


Fig. 8.2

Calculate the resistance of the two lengths of wire in parallel.

resistance = ... [3]

[Total: 9]

6 (a) Explain why

(i) metals are good conductors of electricity,

....

....

(ii) insulators do not conduct electricity.

....

....
[3]

(b) The battery of an electric car supplies a current of 96 A at 120 V to the motor which drives the car.

(i) State the useful energy change that takes place in the battery.

....[1]

(ii) Calculate the energy delivered to the motor in 10 minutes.

energy = ... [2]

(iii) The motor operates with an efficiency of 88 %.

Calculate the power output of the motor.

power = ... [2]

[Total: 8]

Q# 3/ iG Phx/2014/s/Paper 31/ NOT with Q b(i)

7 (a) The following are three statements about boiling.

- A liquid boils at a fixed temperature.
- During boiling, vapour can form at any point within the liquid.
- Without a supply of thermal energy, boiling stops.

The answer to question Q(b)(i) is amount of energy that was calculated from the measured temperature change

(ii) The hot-plate operates at 240 V, 0.65 A.

Calculate the energy supplied to the hot-plate in 20 minutes.

energy = ... [2]

(iii) Suggest why the answers to **(b)(i)** and **(b)(ii)** are not the same.

....

.... [1]

[Total: 8]

9 In the circuit shown in Fig. 9.1, resistors can be connected between terminals P and Q. The e.m.f. of the battery is 6.0V.

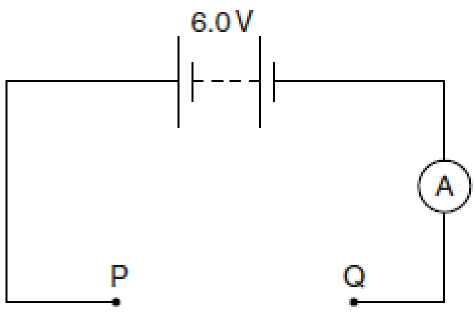


Fig. 9.1

(a) Calculate the current shown by the ammeter when a 12.0 Ω resistor and a 4.0 Ω resistor are

(i) connected in series between P and Q,

current = ... [2]

(ii) connected in parallel between P and Q.

current = ... [3]

(b) State the relationship between

(i) the resistance *R* and the length *l* of a wire of constant cross-sectional area,

....

(ii) the resistance *R* and the cross-sectional area *A* of a wire of constant length.

....
[2]

(c) The 12.0 Ω and 4.0 Ω resistors in **(a)** are wires of the same length and are made of the same alloy.

Calculate the ratio: $\dfrac{\text{cross-sectional area of } 12.0\,\Omega \text{ resistor}}{\text{cross-sectional area of } 4.0\,\Omega \text{ resistor}}$

ratio = ... [1]

[Total: 8]

9 **(a)** State the relationship between

(i) the resistance *R* and the length *L* of a wire of constant cross-sectional area,

....

(ii) the resistance *R* and the cross-sectional area *A* of a wire of constant length.

....
[1]

(b) A 60W filament lamp X is connected to a 230V supply, as shown in Fig. 9.1.

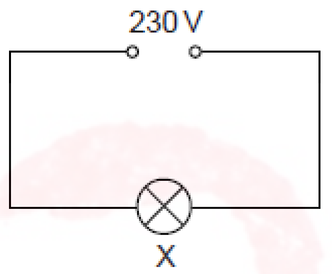


Fig. 9.1

Calculate the current in the filament.

current = ... [2]

(c) Lamp Y has a filament made of the same metal as the filament of lamp X in **(b)**.

This filament has half the length and one-third of the cross-sectional area of the filament of X.

Lamp Y is also connected to a 230V supply.

Calculate the ratio $\frac{\text{current in filament of Y}}{\text{current in filament of X}}$. Show your working.

ratio = ... [4]

[Total: 7]

11 **(a)** Describe the action of

(i) a NOT gate,

.... [1]

(ii) a thermistor.

.... [1]

(b) Fig. 11.1 shows a circuit that switches on a warning lamp when the temperature in an oven falls below a set value.

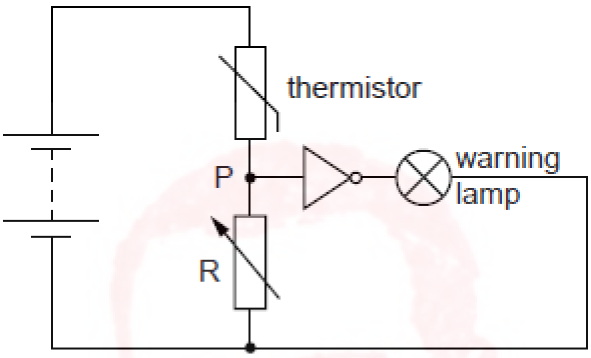


Fig. 11.1

Explain, with reference to the components in the circuit and point P,

(i) why the warning lamp is on when the temperature in the oven is below the set value,

....

....

....

....

....

....

.... [4]

(ii) the effect of changing the resistance of R.

....

.... [1]

[Total: 7]

9 Fig. 9.1 shows the circuit that operates the two headlights and the two sidelights of a car.

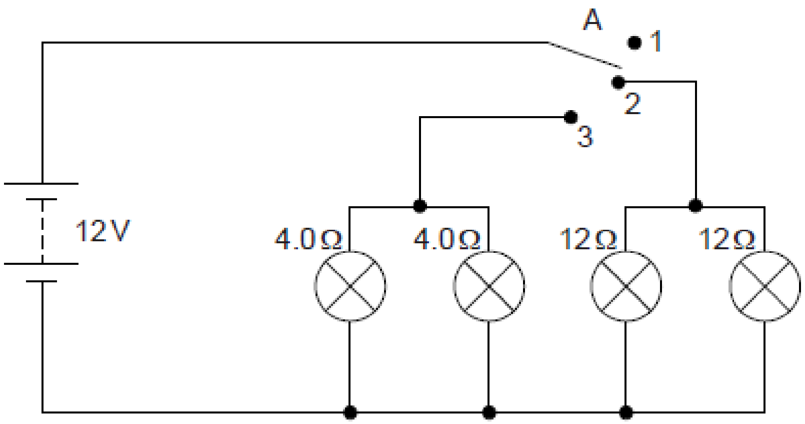


Fig. 9.1

Two of the lamps have resistances of 4.0 Ω when lit. The other two lamps have resistances of 12 Ω when lit. Switch A can be connected to positions 1, 2 or 3.

(a) State what happens when switch A is connected to

(i) position 1, ...

(ii) position 2, ...

(iii) position 3. .... [1]

(b) **(i)** State the potential difference across each lamp when lit.

potential difference = ... [1]

(ii) Calculate the current in each 12 Ω lamp when lit.

current = ... [2]

(c) Show, with reasons for your answer, which type of lamp, 4.0 Ω or 12 Ω, has the higher power.

....

....

....

.... [3]

[Total: 7]

10 **(a)** State the electrical quantity that has the same value for each of two resistors connected to a battery

(i) when they are in series, ...

(ii) when they are in parallel. ....
[1]

(b) Fig. 10.1 shows a circuit with a 1.2 kΩ resistor and a thermistor in series. There is no current in the voltmeter.

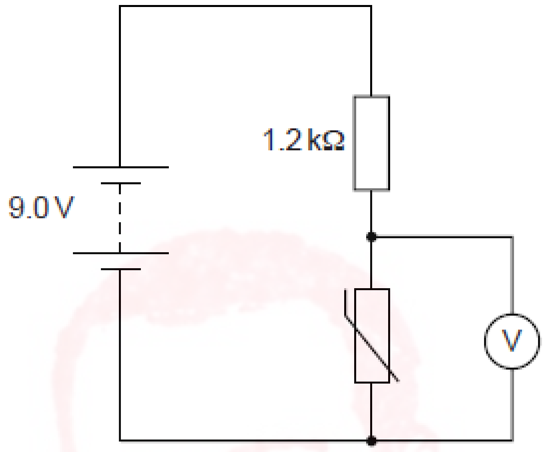


Fig. 10.1

Calculate the voltmeter reading when the resistance of the thermistor is 3.6 kΩ.

voltmeter reading = ... [3]

(c) Fig. 10.2 shows a fire-alarm circuit. The circuit is designed to close switch S and ring bell B if there is a fire.

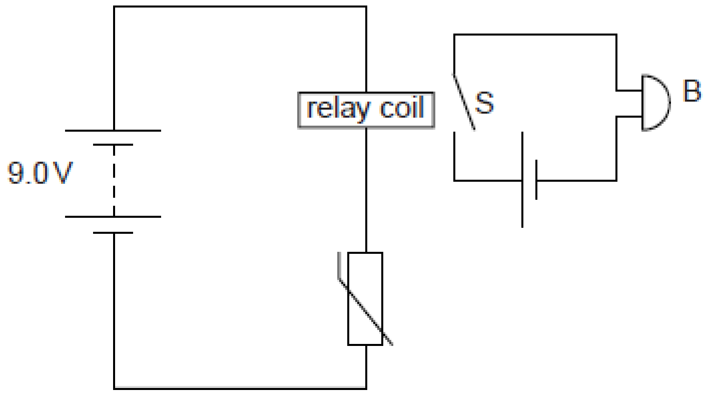


Fig. 10.2

Explain the operation of the circuit.

....

....

....

....

....

....

.... [3]

[Total: 7]

8 **(a)** In Fig. 8.1, S is a metal sphere standing on an insulating base. R is a negatively charged rod placed close to S.

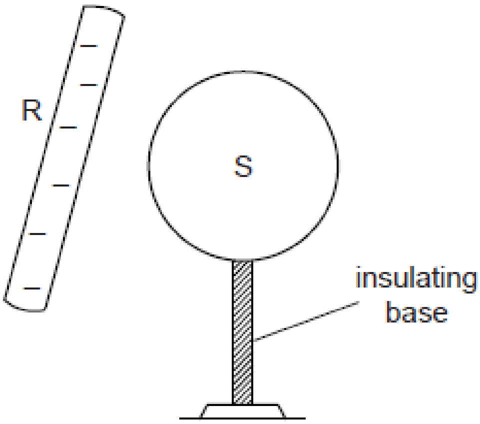


Fig. 8.1

(i) Name the particles in S that move when R is brought close to S.

.... [1]

(ii) On Fig. 8.1, add + signs and – signs to suggest the result of this movement. [1]

(iii) Describe the actions which now need to take place so that S becomes positively charged with the charge distributed evenly over its surface. A positively charged object is **not** available.

....

....

.... [3]

(b) During a thunderstorm, the potential difference between thunderclouds and the ground builds up to 1.5×10^6 V. In each stroke of lightning, 30 C of charge passes between the thunderclouds and the ground. Lightning strokes to the ground occur, on average, at 2 minute intervals.

Calculate

(i) the average current between the thunderclouds and the ground,

average current = ... [2]

(ii) the energy transferred in each stroke of lightning.

energy = ... [2]

[Total: 9]

9 This question refers to quantities and data shown on the circuit diagram of Fig. 9.1.

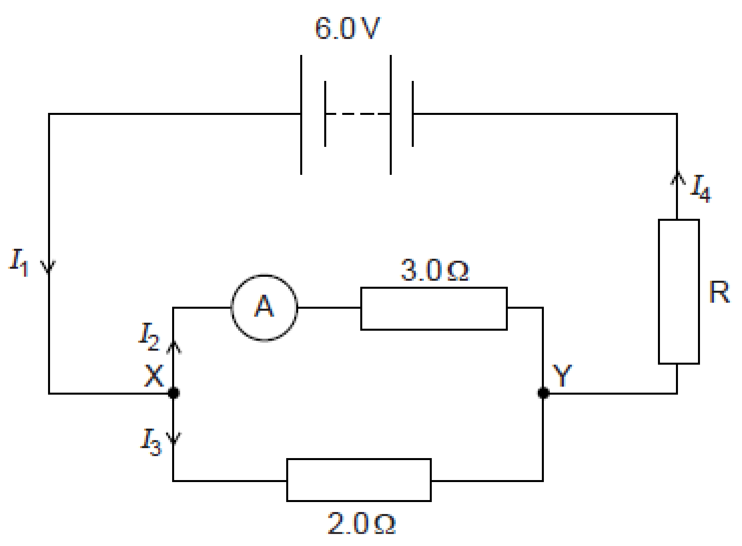


Fig. 9.1

(a) State the relationship between

(i) the currents I_1, I_2 and I_3, ... [1]

(ii) the currents I_1 and I_4. .... [1]

(b) The ammeter reads 0.80 A. Assume it has zero resistance.

Calculate

(i) the potential difference between X and Y,

p.d. = ... [1]

(ii) the current I_3,

current = ... [2]

(iii) the resistance of R.

resistance = ... [4]

[Total: 9]

9 The graphs in Fig. 9.1 show the relation between the current I and the potential difference V for a resistor and a lamp.

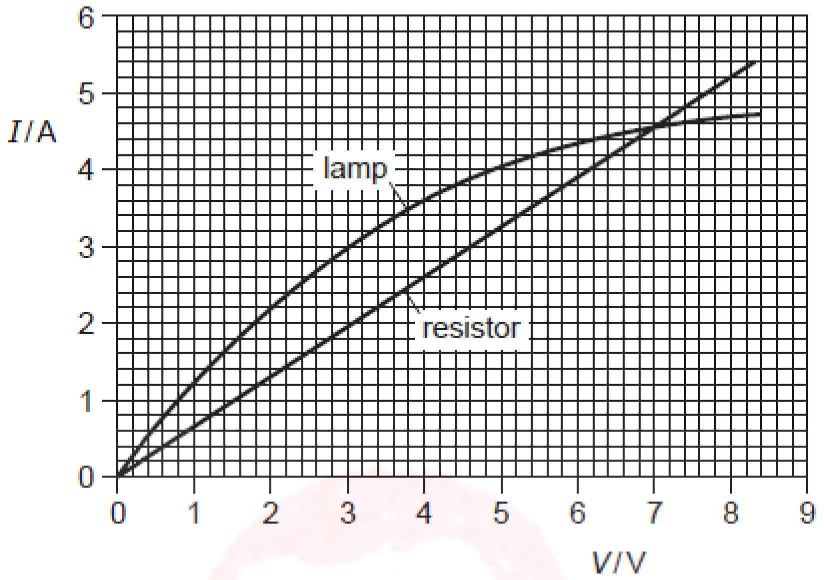


Fig. 9.1

(a) **(i)** Describe how, if at all, the resistance varies as the current increases in

1. the resistor, ...

2. the lamp. ....[2]

(ii) State the value of the potential difference when the resistor and the lamp have the same resistance.

potential difference = ...[1]

(b) The two components are connected **in parallel** to a supply of e.m.f. 4.0V. Calculate the total resistance of the circuit.

total resistance = ...[4]

[Total: 7]

5 The manufacturer's label on an electric heater is as shown in Fig. 5.1.

C.I.E. Electrical Company
Suitable for use on 110 V, 60 Hz supply
1 kW/2 kW
This appliance must be earthed when in use

Fig. 5.1

(a) State what electrical quantity is represented by

(i) 110V, ...

(ii) 60 Hz, ...

(iii) 1 kW. .... [1]

(b) (i) Which part of the electric heater must be earthed?

....[1]

(ii) Explain what the hazard might be if the heater is not earthed.

....

....

....[2]

(c) The heater has two 110V heating elements, with two switches, so that either one or both elements may be switched on.

In the space below, draw a circuit diagram showing how the heating elements and switches are connected to the mains supply.
Use the symbol ─□□□□─ for each heating element.

[2]

[Total: 6]

4 The circuit of Fig. 4.1 is set up to run a small immersion heater from a 6.0V battery.

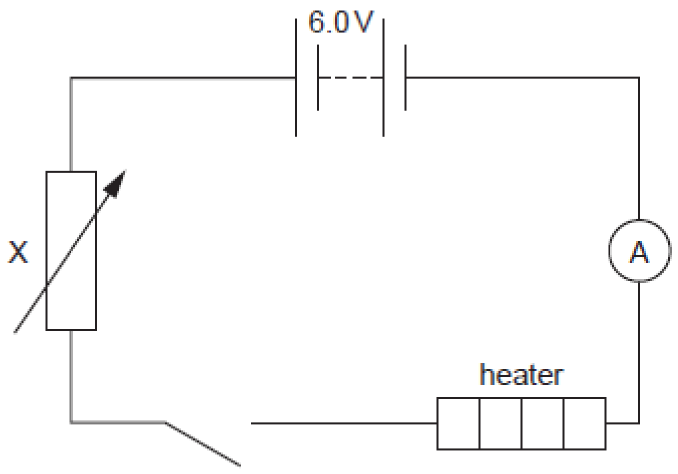


Fig. 4.1

(a) State the name and purpose of component X.

name ....

purpose ....[1]

(b) The heater is designed to work from a 3.6V supply. It has a power rating of 4.5W at this voltage.

(i) Calculate the current in the heater when it has the correct potential difference across it.

current = ...[2]

(ii) Calculate the resistance of component X if there is to be the correct potential difference across the heater. The battery and the ammeter both have zero resistance.

resistance = ...[3]

(c) Some time after the heater is switched on, the ammeter reading is seen to have decreased.

Suggest why this happens.

....

....[1]

(d) As an alternative to running the heater from a battery, it is decided to construct a circuit to enable it to be operated from the a.c. mains supply.

Name the electrical component needed to

(i) reduce the potential difference from that of the mains supply down to a potential difference suitable for the heater,

....[1]

(ii) change the current from a.c. to a current which has only one direction.

....[1]

[Total: 9]

9 In Fig. 9.1, A and B are two conductors on insulating stands. Both A and B were initially uncharged.

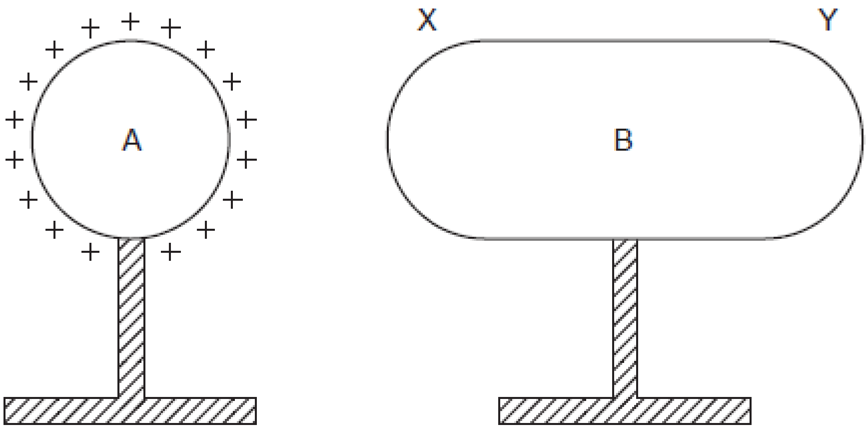


Fig. 9.1

(a) Conductor A is given the positive charge shown on Fig. 9.1.

(i) On Fig. 9.1, mark the signs of the charges induced at end X and at end Y of conductor B. [1]

(ii) Explain how these charges are induced.

....

....

.... [3]

(iii) Explain why the charges at X and at Y are equal in magnitude.

....

....

.... [1]

(b) B is now connected to earth by a length of wire.

Explain what happens, if anything, to

(i) the charge at X,

....

.... [1]

(ii) the charge at Y.

....

.... [2]

[Total: 8]

8 The circuit in Fig. 8.1 contains a 2.0V cell, whose resistance you should ignore.
There are also three resistors, a 3-position switch, an ammeter and another component, P.

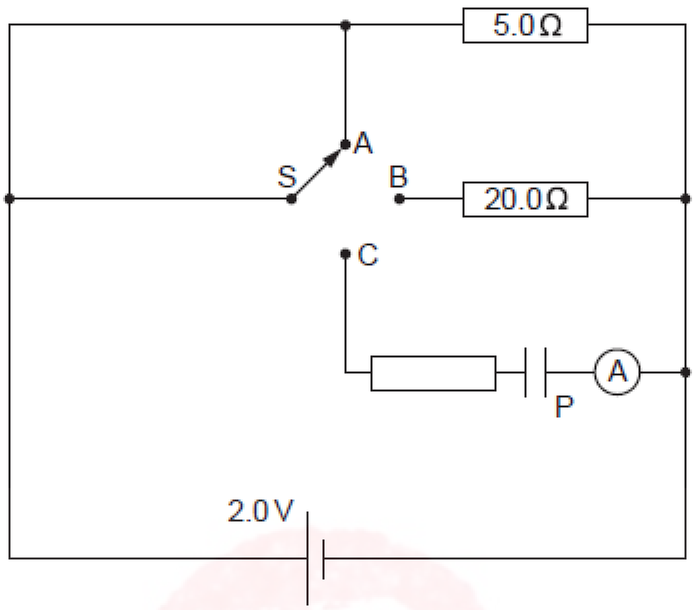


Fig. 8.1

(a) State the name of component P. .... [1]

(b) Deduce the resistance of the circuit when switch S is

(i) in position A,

resistance = ... [1]

(ii) in position B.

resistance = ... [3]

(c) Describe and explain what is seen on the ammeter when S is moved to position C.

....

....

....

.... [2]

(d) With S in position A, calculate how long it takes for the circuit to transfer 320 J of electrical energy to other forms.

time taken = ... [3]

[Total: 10]

11 **(a)** A coil of wire is connected into a circuit containing a variable resistor and a battery.

The variable resistor is adjusted until the potential difference across the coil is 1.8V.

In this condition, the current in the circuit is 0.45A.

Calculate

(i) the resistance of the coil,

resistance = ... [1]

(ii) the thermal energy released from this coil in 9 minutes.

energy released = ... [3]

(b) The coil in part **(a)** is replaced by one made of wire which has half the diameter of that in **(a)**.

When the potential difference across the coil is again adjusted to 1.8V, the current is only 0.30A.

Calculate how the length of wire in the second coil compares with the length of wire in the first coil.

length of wire in second coil is .... the length of wire in first coil [4]

[Total: 8]

11 Fig. 11.1 is a schematic diagram of an electronic circuit controlling a lamp.

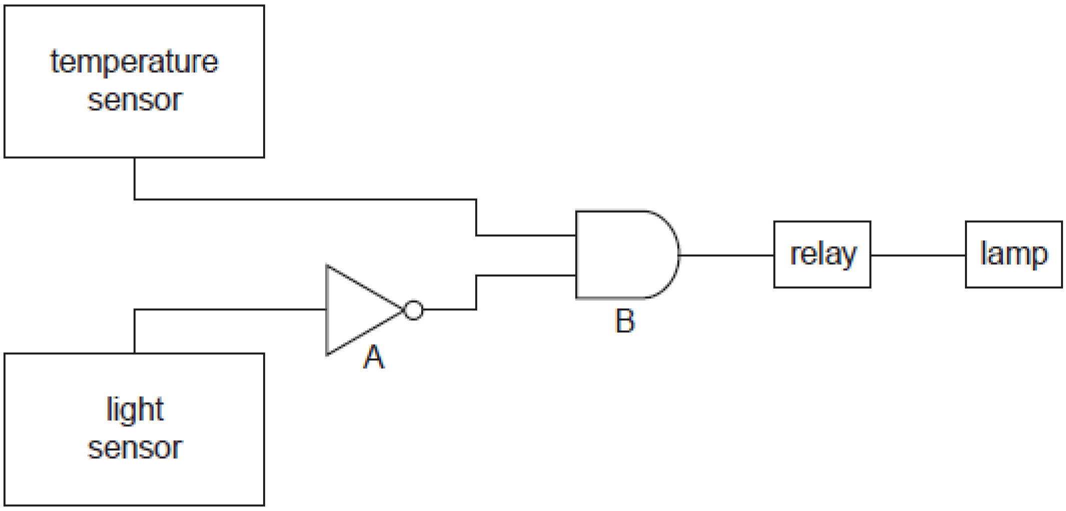


Fig. 11.1

(a) State the names of the logic gates A and B.

A .... B .... [2]

(b) The output of the temperature sensor is high (logic 1) when it detects raised temperature. The output of the light sensor is high (logic 1) when it detects raised light levels.

State the outputs of A and B when the surroundings are

(i) dark and cold, output of A = ...

output of B = ... [1]

(ii) dark and warm, output of A = ...

output of B = ... [1]

(iii) bright and warm. output of A = ...

output of B = ... [1]

(c) **(i)** Suggest why B is connected to a relay, rather than directly to the lamp.

.... [1]

(ii) The relay switches on when its input is high. In which of the three combinations in **(b)** will the lamp light up?

.... [1]

(iii) Suggest a practical use for this circuit.

.... [1]

[Total: 8]

10 Alternating current electricity is delivered at 22 000 V to a pair of transmission lines. The transmission lines carry the electricity to the customer at the receiving end, where the potential difference is *V*. This is shown in Fig. 10.1. Each transmission line has a resistance of 3 Ω.

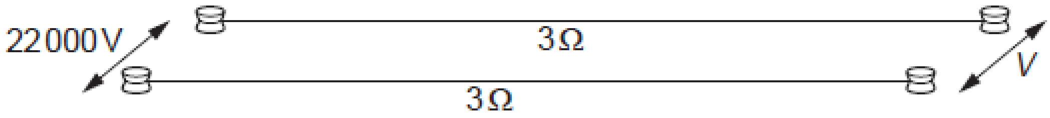


Fig. 10.1

(a) The a.c. generator actually generates at a much lower voltage than 22 000 V.

(ii) State one advantage of delivering electrical energy at high voltage.

.... [1]

(b) The power delivered by the generator is 55 kW. Calculate the current in the transmission lines.

current = ... [2]

(c) Calculate the rate of loss of energy from one of the 3 Ω transmission lines.

rate of energy loss = ... [2]

(d) Calculate the voltage drop across one of the transmission lines.

voltage drop = ... [2]

(e) Calculate the potential difference *V* at the receiving end of the transmission lines.

V = ... [2]

[Total: 10]

10 The circuit shown in Fig. 10.1 uses a 12V battery.

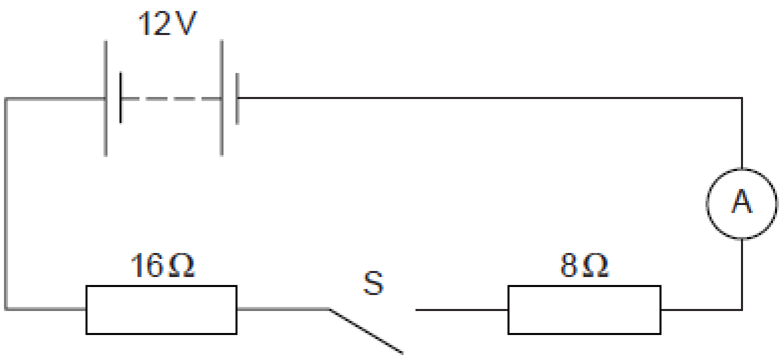


Fig. 10.1

(a) Switch S is open, as shown in Fig. 10.1.

State the value of

(i) the reading on the ammeter,

reading = ... [1]

(ii) the potential difference (p.d.) across S.

p.d. = ... [1]

(b) Switch S is now closed.

(i) Calculate the current in the ammeter.

current = ... [2]

(ii) Calculate the p.d. across the 8Ω resistor.

p.d. = ... [2]

(c) The two resistors are now connected in parallel.

Calculate the new reading on the ammeter when S is closed, stating clearly any equations that you use.

reading = ... [4]

[Total: 10]

9 **(a)** Fig. 9.1 shows an a.c. supply connected in series to a diode and a resistor.

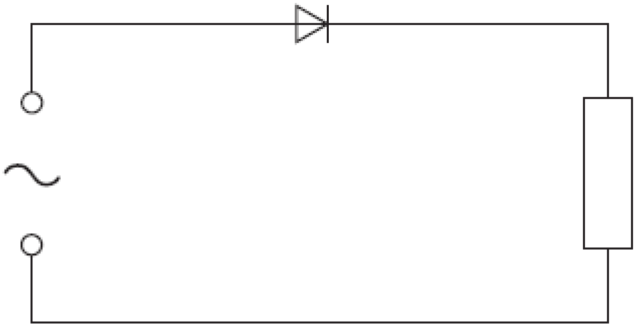


Fig. 9.1

On the axes of Fig. 9.2, draw a graph showing the variation of the current in the resistor. [1]

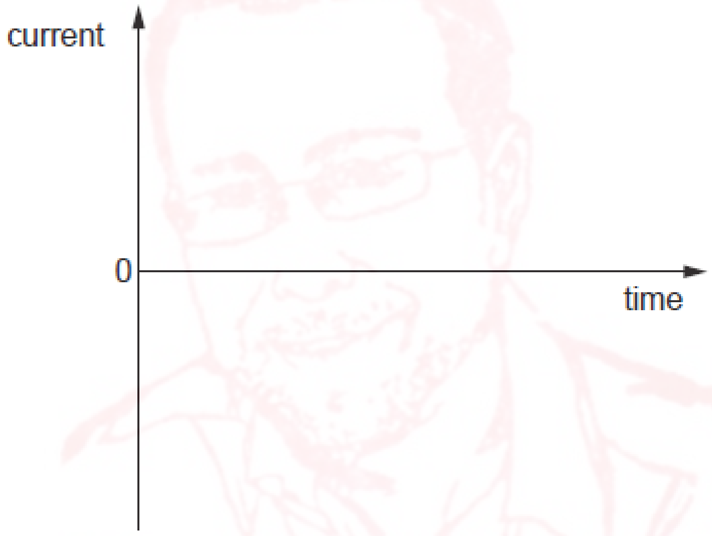


Fig. 9.2

(b) Fig. 9.3 shows four attempts, **A**, **B**, **C** and **D**, to connect a circuit known as a bridge rectifier.

The circuit is connected to a 12V a.c. supply.

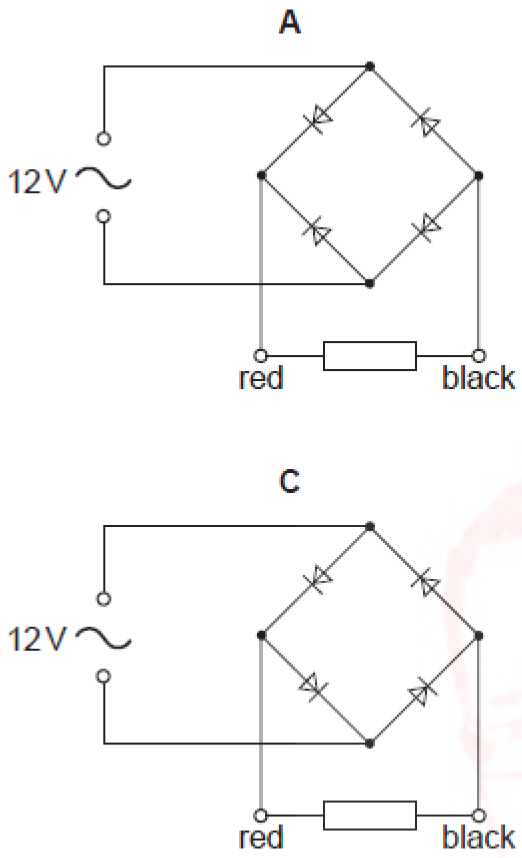


Fig. 9.3

(i) In which circuit will the direction of the conventional current in the resistor always be from red to black?

.... [1]

(ii) On the circuit you chose in **(b)(i)**, clearly indicate with arrows the path of the conventional current in the circuit when the upper terminal of the a.c. supply is positive with respect to the lower terminal. [2]

[Total: 4]

8 Fig. 8.1 shows a car battery being charged from a 200V a.c. mains supply.

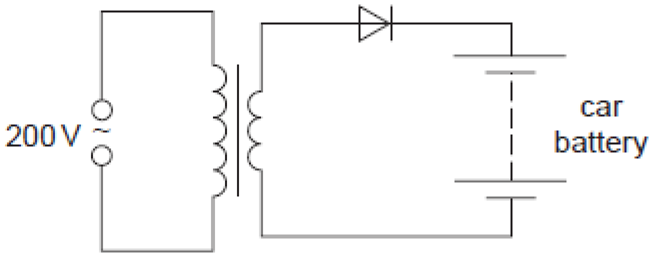


Fig. 8.1

(a) State the function of the diode.

....

.... [1]

(b) The average charging current is 2.0 A and the battery takes 12 hours to charge fully.

Calculate the charge that the battery stores when fully charged.

charge stored .... [2]

(c) The battery has an electromotive force (e.m.f.) of 12V and, when connected to a circuit, supplies energy to the circuit components.

State what is meant by an *electromotive force of 12 V*.

....

....

.... [2]

(d) **(i)** In the space below, draw a circuit diagram to show how two 6.0V lamps should be connected to a 12V battery so that both lamps glow with normal brightness. [1]

(ii) The power of each lamp is 8.0W. Calculate the current in the circuit.

current = ... [2]

(iii) Calculate the energy used by the two lamps when both are lit for one hour.

energy = ... [2]

[Total: 10]

10 (a) In the space below, draw the symbol for a NOR gate.

[1]

(b) Describe the action of a NOR gate in terms of its inputs and output.

....

....

....

....

.... [2]

(c) A chemical process requires heating at low pressure to work correctly.

When the heater is working, the output of a temperature sensor is high.

When the pressure is low enough, a pressure sensor has a low output.

Both outputs are fed into a NOR gate. A high output from the gate switches on an indicator lamp.

(i) Explain why the indicator lamp is off when the process is working correctly.

....

....

.... [1]

(ii) State whether the lamp is on or off in the following situations.

1. The pressure is low enough, but the heater stops working. ....

2. The heater is working, but the pressure rises too high. .... [2]

[Total: 6]

8 Fig. 8.1 is the plan of a small apartment that has four lamps as shown.

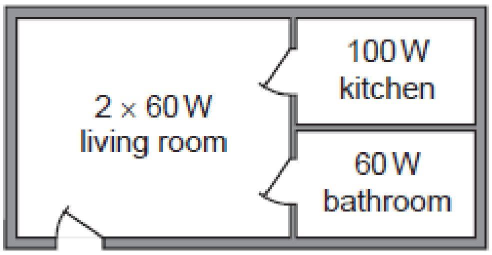


Fig. 8.1

Power for the lamps is supplied at 200 V a.c. and the lamps are all in parallel.

(a) In the space below, draw a lighting circuit diagram so that there is one switch for each room and one master switch that will turn off all the lamps. Label the lamps as 60 W or 100 W.

[3]

(b) The 100 W lamp is switched on. Calculate

(i) the current in the lamp,

current = ... [2]

(ii) the charge passing through the lamp in one minute.

charge = ... [2]

(c) The three 60W lamps are replaced by three energy-saving ones, that give the same light output but are rated at only 15W each.

Calculate

(i) the total reduction in power,

reduction in power = ... [1]

(ii) the energy saved when the lamps are lit for one hour.

energy saved = ... [2]

[Total: 10]

10 **(a)** Fig. 10.1 shows an AND gate with two inputs A and B and one output.

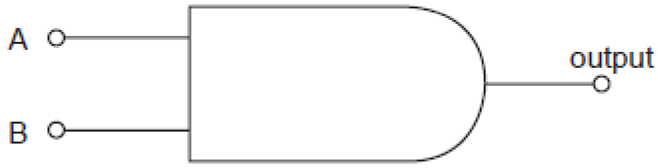


Fig. 10.1

State the output when

(i) A is high and B is low,

.... [1]

(ii) both A and B are low.

.... [1]

(b) An electrical thermometer in a greenhouse gives a low output if the temperature is too low.

A humidity sensor in the same greenhouse gives a high output if the humidity in the greenhouse is too high.

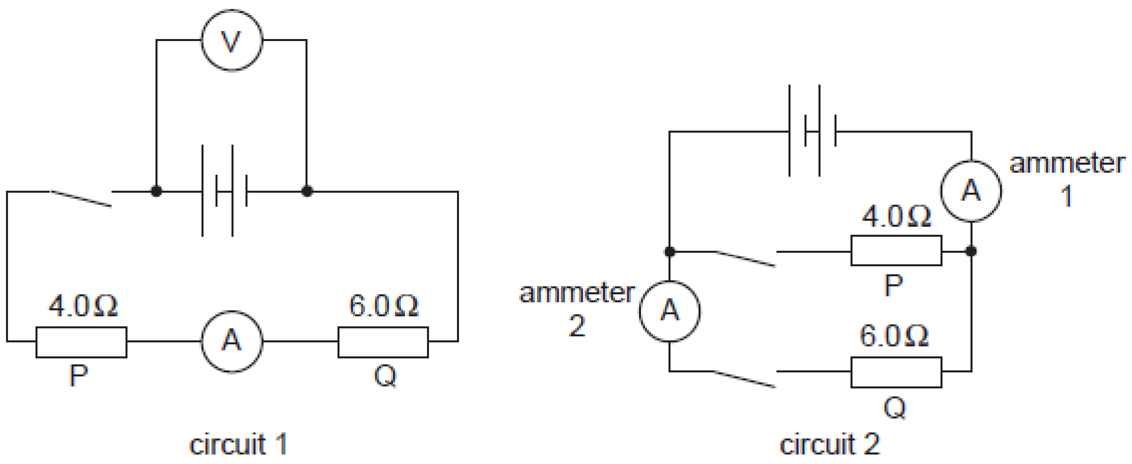
An alarm sounds when both the temperature is too low and the humidity is too high.

(i) Complete the diagram below to show how a NOT gate and an AND gate may be used to provide the required output to the alarm. [2]

(ii) On your diagram, use either 'high' or 'low' to indicate the level of the inputs and outputs of both gates when the alarm sounds. [2]

[Total: 6]

8 Fig. 8.1 shows two electrical circuits.



The batteries in circuit 1 and circuit 2 are identical.

Fig. 8.1

(a) Put ticks in the table below to describe the connections of the two resistors P and Q.

	series	parallel
circuit 1		
circuit 2		

[1]

(b) The resistors P and Q are used as small electrical heaters.

State two advantages of connecting them as shown in circuit 2.

advantage 1 ....

advantage 2 .... [2]

(c) In circuit 1, the ammeter reads 1.2 A when the switch is closed.

Calculate the reading of the voltmeter in this circuit.

voltmeter reading = ... [2]

(d) The two switches in circuit 2 are closed. Calculate the combined resistance of the two resistors in this circuit.

combined resistance = ... [2]

(e) When the switches are closed in circuit 2, ammeter 1 reads 5 A and ammeter 2 reads 2 A.

Calculate

(i) the current in resistor P,

current = ... [1]

(ii) the power supplied to resistor Q,

power = ... [1]

(iii) the energy transformed in resistor Q in 300 s.

energy = ... [1]

[Total: 10]

Q# 26/ iG Phx/2007/s/Paper 31/ www.SmashingScience.org

8 Fig. 8.1 shows part of a low-voltage lighting circuit containing five identical lamps.

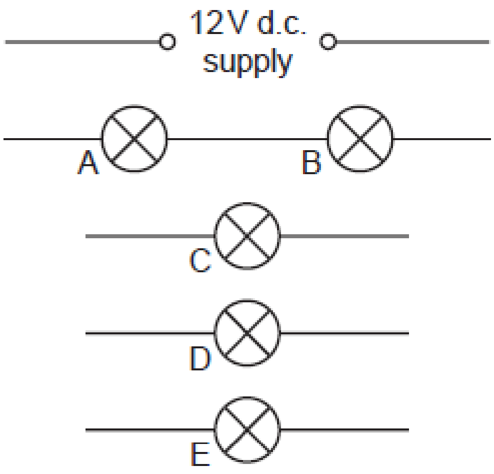


Fig. 8.1

(a) Complete the circuit, by the addition of components as necessary, so that

(i) the total current from the supply can be measured,

(ii) the brightness of lamp E only can be varied,

(iii) lamps C and D may be switched on and off together whilst lamps A, B and E remain on. [4]

(b) All five lamps are marked 12V, 36W. Assume that the resistance of each lamp is the same fixed value regardless of how it is connected in the circuit.

Calculate

(i) the current in one lamp when operating at normal brightness,

current = ... [1]

(ii) the resistance of one lamp when operating at normal brightness,

resistance = ... [1]

(iii) the combined resistance of two lamps connected in parallel with the 12V supply,

resistance = ... [1]

(iv) the energy used by one lamp in 30 s when operating at normal brightness.

energy = ... [1]

(c) The whole circuit is switched on. Explain why the brightness of lamps A and B is much less than that of one lamp operating at normal brightness.

....

....

.... [2]

[Total: 10]

Q# 27/ iG Phx/2006/w/Paper 31/ www.SmashingScience.org

9 **(a)** Fig. 9.1 shows how a beam of electrons would be deflected by an electric field produced between two metal plates.
The connections of the source of high potential difference are not shown.

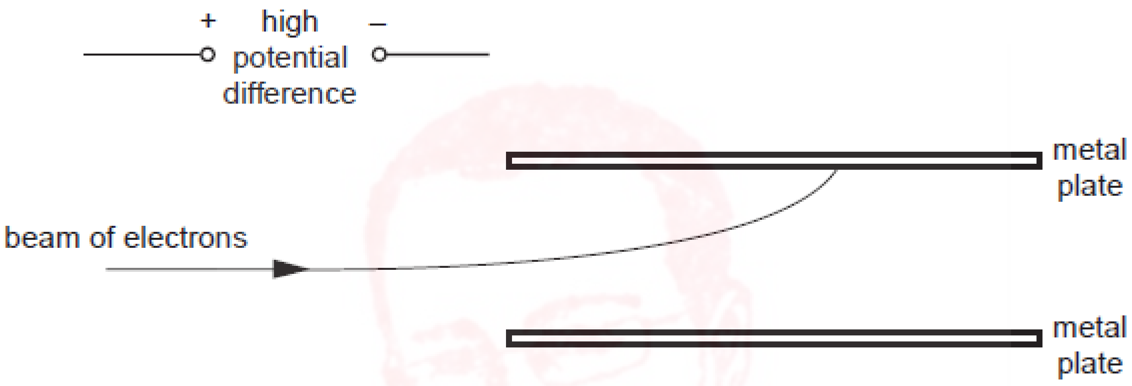


Fig. 9.1

(i) On Fig. 9.1, draw in the missing connections.

(ii) Explain why the beam of electrons is deflected in the direction shown. In your answer, consider all the charges involved and their effect on each other.

....

....

....

....

[5]

8 Fig. 8.1 shows a low-voltage lighting circuit.

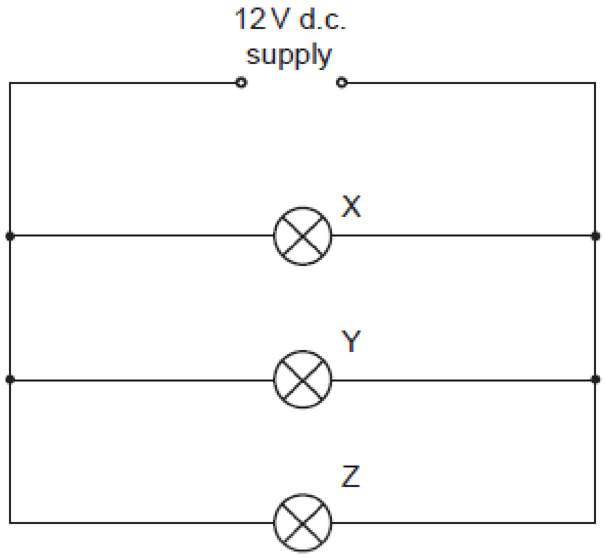


Fig. 8.1

(a) On Fig. 8.1, indicate with a dot and the letter S, a point in the circuit where a switch could be placed that would turn off lamps Y and Z at the same time but would leave lamp X still lit. [1]

(b) (i) In the space below, draw the circuit symbol for a component that would vary the brightness of lamp X.

(ii) On Fig. 8.1, mark with a dot and the letter R where this component should be placed.

[2]

(c) Calculate the current in lamp Y.

current = ...[2]

(d) The current in lamp Z is 3.0 A. Calculate the resistance of this lamp.

resistance = ...[2]

(e) The lamp Y is removed.

(i) Why do lamps X and Z still work normally?

....

....

(ii) The current in lamp X is 1.0 A. Calculate the current supplied by the battery with lamp Y removed.

current = ...

[2]

10 **(a)** Fig. 10.1 shows a positively charged plastic rod, a metal plate resting on an insulator, and a lead connected to earth.

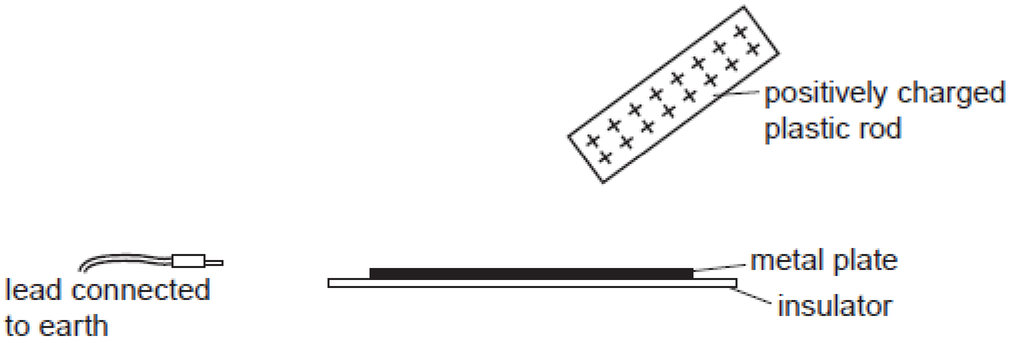


Fig. 10.1

Describe how the metal plate may be charged by induction.

....

....

....[3]

(b) An electrostatic generator sets up a current of 20 mA in a circuit.

Calculate

(i) the charge flowing through the circuit in 15 s,

charge = ...

(ii) the potential difference across a 10 kΩ resistor in the circuit.

potential difference = ...
[3]

8 Fig. 8.1 shows an electrical circuit.

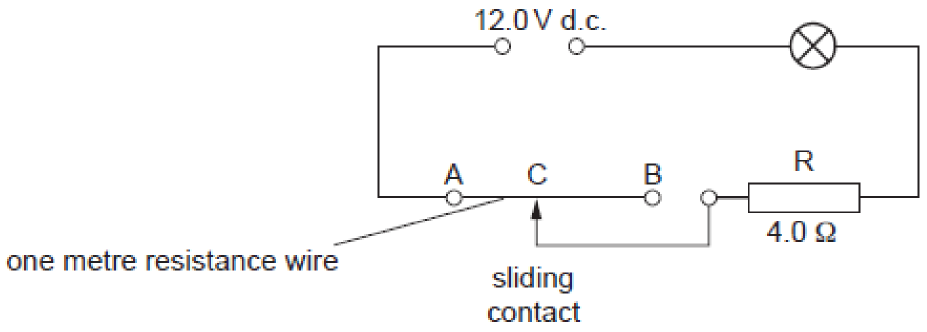


Fig. 8.1

The resistance of the lamp is 4.0 Ω when it is at its normal brightness.

(a) The lamp is rated at 6.0V, 9.0W.
Calculate the current in the lamp when it is at its normal brightness.

current = ...[2]

(b) The sliding contact C is moved to A. The lamp lights at its normal brightness.
Calculate

(i) the total circuit resistance,

resistance = ...[1]

(ii) the potential difference across the 4.0 Ω resistor R.

potential difference = ...[1]

(c) The sliding contact C is moved from A to B.

(i) Describe any change that occurs in the brightness of the lamp.

....[1]

(ii) Explain your answer to **(i)**.

....

....[2]

(d) The 1 m wire between A and B, as shown in Fig. 8.1, has a resistance of 2.0 Ω.
Calculate the resistance between A and B when

(i) the 1 m length is replaced by a 2 m length of the same wire,

resistance = ...[1]

(ii) the 1 m length is replaced by a 1 m length of a wire of the same material but of only half the cross-sectional area.

resistance = ...[1]

9 **(a)** In the space provided, draw the symbol for a NOR gate. Label the inputs and the output.

[2]

(b) State whether the output of a NOR gate will be high (ON) or low (OFF) when

(i) one input is high and one input is low,

....

(ii) both inputs are high.

....

[1]

(c) Fig. 9.1 shows a digital circuit made from three NOT gates and one NAND gate.

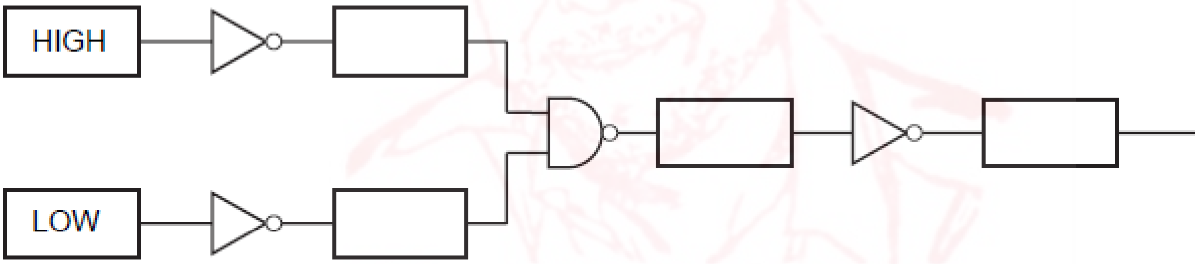


Fig. 9.1

(i) Write HIGH or LOW in each of the boxes on Fig. 9.1. [2]

(ii) State the effect on the output of changing both of the inputs.

....

.... [1]

8 Fig. 8.1 shows a high-voltage supply connected across two metal plates.

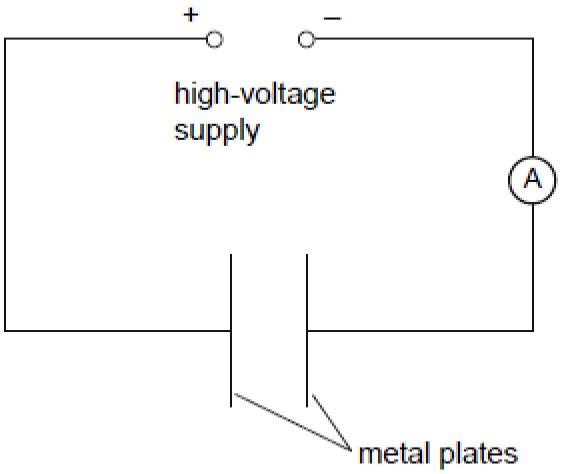


Fig. 8.1

When the supply is switched on, an electric field is present between the plates.

(a) Explain what is meant by an *electric field* .

.... [2]

(b) On Fig. 8.1, draw the electric field lines between the plates and indicate their direction by arrows. [2]

(c) The metal plates are now joined by a high-resistance wire. A charge of 0.060 C passes along the wire in 30 s.
Calculate the reading on the ammeter.

ammeter reading = ... [2]

(d) The potential difference of the supply is re-set to 1500 V and the ammeter reading changes to 0.0080 A. Calculate the energy supplied in 10 s. Show your working.

energy = ... [3]

9 **(a)** Fig. 9.1 shows an a.c. supply connected to a resistor and a diode.

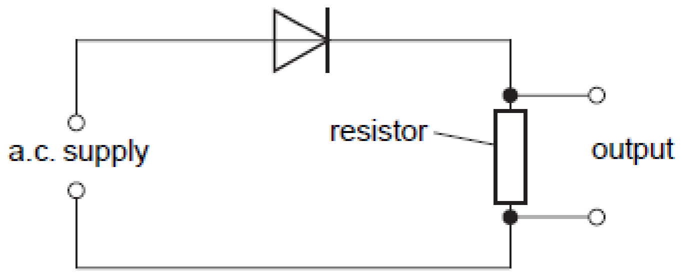


Fig. 9.1

(i) State the effect of fitting the diode in the circuit.

....

.... [1]

(ii) On Fig. 9.2, sketch graphs to show the variation of the a.c. supply voltage and the output voltage with time.

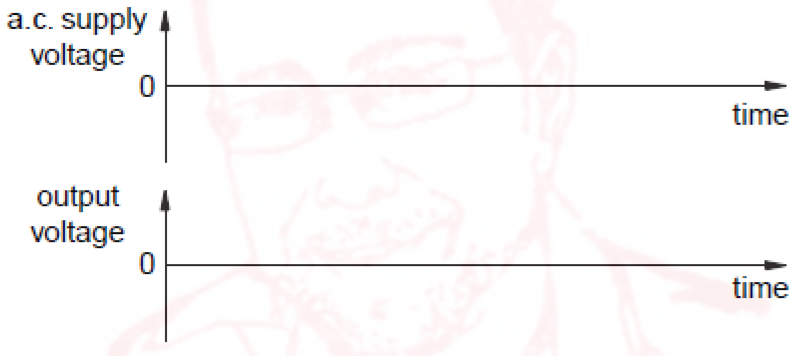


Fig. 9.2

[2]

(b) **(i)** In the space below, draw the symbol for a NOT gate.

[1]

(ii) State the action of a NOT gate.

....

....

.... [2]

8 A student has a power supply, a resistor, a voltmeter, an ammeter and a variable resistor.

(a) The student obtains five sets of readings from which he determines an average value for the resistance of the resistor.

In the space below, draw a labelled diagram of a circuit that he could use.

[3]

(b) Describe how the circuit should be used to obtain the five sets of readings.

....

....

.... [2]

(c) Fig. 8.1 shows another circuit.

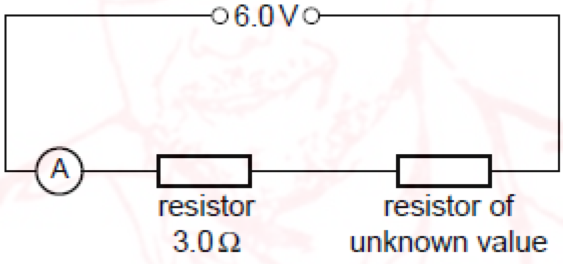


Fig. 8.1

When the circuit is switched on, the ammeter reads 0.50 A.

(i) Calculate the value of the unknown resistor.

resistance = ... [2]

(ii) Calculate the charge passing through the 3.0 Ω resistor in 120 s.

charge = ... [1]

(iii) Calculate the power dissipated in the 3.0 Ω resistor.

power = ... [2]

7 Fig. 7.1 shows a 12 V battery connected to a number of resistors.

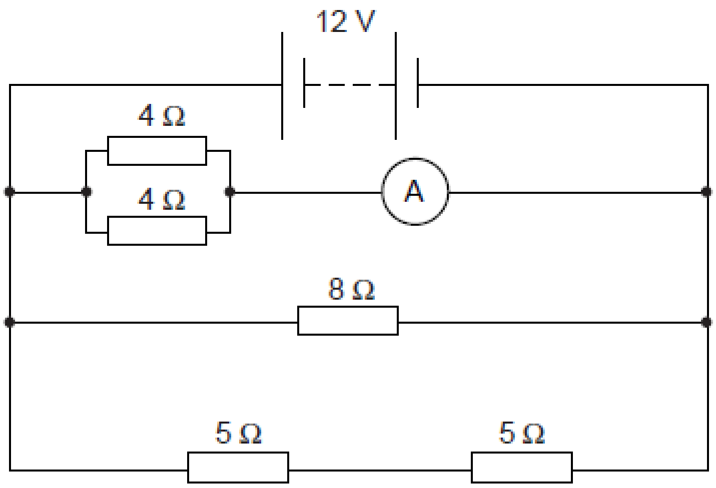


Fig. 7.1

(a) Calculate the current in the 8 Ω resistor.

current = ...[2]

(b) Calculate, for the resistors connected in the circuit, the combined resistance of

(i) the two 5 Ω resistors,

resistance = ...

(ii) the two 4 Ω resistors.

resistance = ...
[2]

(c) The total current in the two 4 Ω resistors is 6 A.
Calculate the total power dissipated in the two resistors.

power = ...[2]

(d) What will be the reading on a voltmeter connected across

(i) the two 4 Ω resistors,

reading = ...

(ii) one 5 Ω resistor?

reading = ...
[2]

(e) The 8 Ω resistor is made from a length of resistance wire of uniform cross-sectional area. State the effect on the resistance of the wire of using

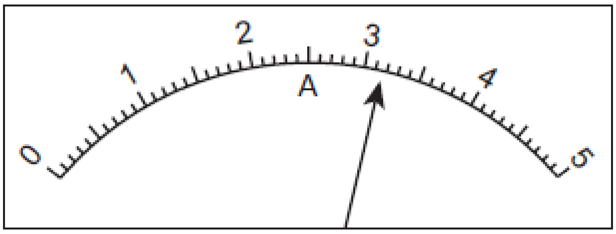
(i) the same length of the same material with a greater cross-sectional area,

....

(ii) a smaller length of the same material with the same cross-sectional area.

....
[2]

10 **(a)** Fig. 10.1 shows the faces of two ammeters. One has an analogue display and the other a digital display.



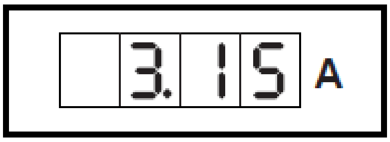


Fig. 10.1

State what is meant by the terms *analogue* and *digital*.

....

....

....[2]

(b) **(i)** Name the components from which logic gates are made.

....[1]

(ii) In the space below, draw the symbol for an AND gate.
Label the inputs and the output. [1]

(iii) Describe the action of an AND gate with two inputs. [2]

8 Fig. 8.1 shows a 240 V a.c. mains circuit to which a number of appliances are connected and switched on.

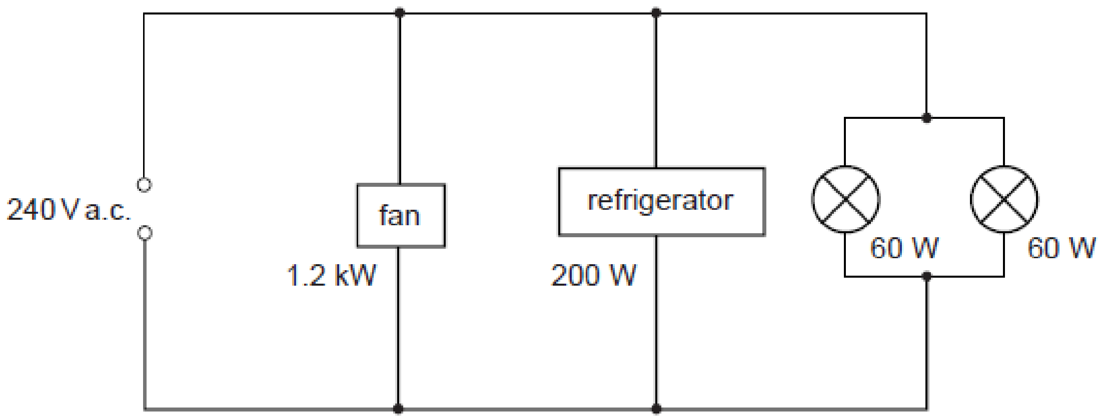


Fig. 8.1

(a) Calculate the power supplied to the circuit.

power = ...[1]

(b) The appliances are connected in parallel.

(i) Explain what connected *in parallel* means.

....

....

(ii) State two advantages of connecting the appliances in parallel rather than in series.

advantage 1 ....

advantage 2 ....

[3]

(c) Calculate

(i) the current in the refrigerator,

current = ...

(ii) the energy used by the fan in 3 hours,

energy = ...

(iii) the resistance of the filament of one lamp.

resistance = ...

[7]

10 Fig. 10.1 shows a battery with an e.m.f of 12 V supplying power to two lamps.

The total power supplied is 150 W when both lamps are on.

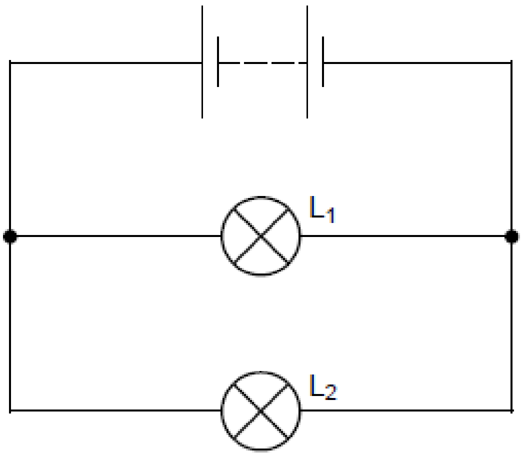


Fig. 10.1

(a) Calculate the current supplied by the battery when both lamps are on.

current = ... [2]

(b) The current in lamp L_2 is 5.0 A.

Calculate

(i) the current in lamp L_1,

current = ...

(ii) the power of lamp L_1,

power = ...

(iii) the resistance of lamp L_1.

resistance = ...

[6]

11 **(a)** A sodium nucleus decays by the emission of a β-particle to form magnesium.

(i) Complete the decay equation below.

$$^{24}_{11}Na \longrightarrow \quad Mg \; +$$

(ii) Fig. 11.1 shows β-particles from sodium nuclei moving into the space between the poles of a magnet.

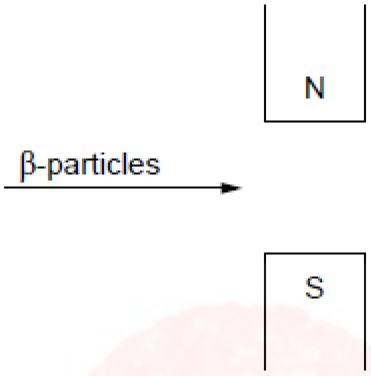


Fig. 11.1

Describe the path of the β-particles between the magnetic poles.

....

....

....

[5]

(b) Very small quantities of a radioactive isotope are used to check the circulation of blood by injecting the isotope into the bloodstream.

(i) Describe how the results are obtained.

....

....

....

....

(ii) Explain why a γ-emitting isotope is used for this purpose rather than one that emits either α-particles or β-particles.

....

....

....

[4]

8 Fig. 8.1 shows a battery with a resistor connected across its terminals. The e.m.f. of the battery is 6.0 V.

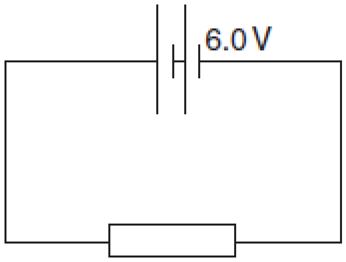


Fig. 8.1

The battery causes 90 C of charge to flow through the circuit in 45 s.

(a) Calculate

(i) the current in the circuit,

current = ...

(ii) the resistance of the circuit,

resistance = ...

(iii) the electrical energy transformed in the circuit in 45 s.

energy = ...
[6]

(b) Explain what is meant by the term *e.m.f. of the battery*.

....

....

....[2]

Q# 41/_iG Phx/2002/w/Paper 3/ www.SmashingScience.org

9 Fig. 9.1 shows a beam of electrons, two charged plates and a screen. These components are inside an electron tube, the outline of which is not shown.

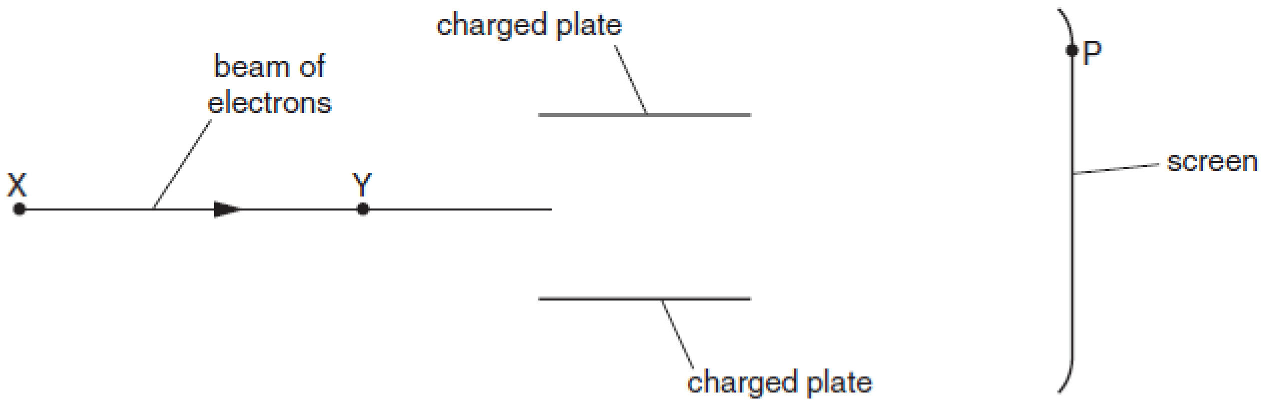


Fig. 9.1

The beam of electrons hits the screen at the point P.

(a) On Fig. 9.1,

(i) complete the path of the electron beam,

(ii) mark the charges on both plates,

(iii) mark with an arrow and the letter C the direction of the conventional current in the electron beam.

[4]

Mark Scheme

Q# 1/_iG Phx/2014/w/Paper 33/ www.SmashingScience.org

8 **(a)** 6.0 V B1

(b) **(i)** coulomb (**IGNORE** C) B1

(ii) $(Q =) It$
OR 0.25 × 12 × 60 **OR** 0.25 × 720 **OR** 0.25 × 12 **OR** 3.0 **OR** 0.25 × 60 **OR** 15 C1
180 (C) A1

(iii) $(R =) V / I$ or 6.0 / 0.25 or 24.0 e.c.f. from **(a)**
OR
$(V =) IR$ **OR** 0.25 × 16 **OR** 4.0 e.c.f. from **(a)** C1

8.0 Ω A1

(c) $R \propto l$ **OR** 8.0 **OR** 16 / 2 C1
$R_1R_2 / (R_1 + R_2)$ **OR** $1 / R = 1 / R_1 + 1 / R_2$ **OR** 64 / 16 **OR** $1 / R = 1 / 8 + 1 / 8$ C1
4.0 Ω A1

[Total: 9]

Q# 2/ iG Phx/2014/w/Paper 33/ www.SmashingScience.org

6	(a)	mark **(i)** and **(ii)** together:	
		mention of free electrons	B1
		(current is) flow/movement of free electrons	B1
		insulators contain no free electrons / metals contain many free electrons	B1
	(b) (i)	chemical (energy) to electrical (energy) (**IGNORE** heat)	B1
	(ii)	(energy =) VIt **OR** 120 × 96 × 10 (**OR** × 60 **OR** × 10 × 60)	
		OR 11 520 × 10 (**OR** × 60 **OR** × 10 × 60)	C1
		6.9×10^6 J	A1
	(iii)	96 × 120 **OR** $1.2/1.15(2) \times 10^4$ **OR** 12 000 / 11 500 / 11 520	C1
		1.0×10^4 W	A1
			[Total: 8]

Q# 3/ iG Phx/2014/s/Paper 31/ www.SmashingScience.org

(ii)	(E =) VIt OR 240 × 0.65 × (20 × 60)	C1
	OR $P = IV$ <u>and</u> $P = E/t$ OR energy / time	
	1.9×10^5 J	A1

Q# 4/ iG Phx/2014/s/Paper 31/ www.SmashingScience.org

9	(a) (i)	(I =) V/R OR 6 / (12 + 4) OR 6 / 16	C1
		0.38 A / 0.37 A	A1
	(ii)	$1/R = 1/R_1 + 1/R_2$	
		OR (R =) $R_1 R_2/(R_1 + R_2)$	
		OR above with numbers substituted	C1
		R = 3 (Ω)	C1
		(I = 6 / 3 =) 2(.0) A	A1
		OR ALTERNATIVE METHOD:	
		6 / 12	(C1)
		+ 6 / 4	(C1)
		2(.0) A	(A1)
	(b) (i)	$R \propto l$ (in words or symbols)	
		OR directly proportional OR e.g. R doubles when l doubles	B1
	(ii)	$R \propto 1/A$ (or with words)	
		OR inversely proportional OR e.g. R doubles when A halves	B1
	(c)	4 / 12 OR 4:12 OR 1 / 3 OR 1:3 OR 0.33	B1
			[Total: 8]

Q# 5/ iG Phx/2013/w/Paper 31/ www.SmashingScience.org

9 (a)(i)(ii) $R \propto L$ in words or symbols

(ii) AND $R \propto 1/A$ in words or symbols B1

(b) $P = IV$ OR $(I =) P/V$ OR 60/230 C1
0.26 A A1

(c) length change divides resistance by 2/multiplies current by 2 C1
cross-section change multiplies resistance by 3/divides current by 3 C1
(overall) resistance of Y is 3/2 times bigger/3/2 × 885 Ω / 1327 Ω
OR current in Y 2/3 of 0.26 A = 0.17 A C1
current in Y/Current in X = 2/3 A1

[Total: 7]

Q# 6/ iG Phx/2013/w/Paper 31/ www.SmashingScience.org

11 (a) (i) input high/on/1, output low/off/0
input low/off/0, output high/on/1
OR reverses/inverts state of input OR output opposite to input B1

(a) (ii) resistance changes as temperature changes B1

(i) at low temperature resistance of thermistor is high
OR when temperature falls resistance of thermistor rises B1
p.d. across thermistor is high OR p.d. across R is low B1
(voltage) input to gate is low B1
output of gate is high (and warning light is on) B1

(ii) changes the temperature/set value at which the lamp comes on B1

[Total: 7]

Q# 7/ iG Phx/2013/s/Paper 31/ www.SmashingScience.org

9 **(a)** **(i)** all lamps off

(ii) 12 Ω lamps (only) on — B1

(iii) 4 Ω lamps (only) on

(b) **(i)** 12 V — B1

(ii) $I = V/R$ in any form OR V/R OR 12/12 — C1
1.0 A OR 1 A — A1
e.c.f. from **(b)(i)**

(c) current in 4 Ω lamp = 3 (A) (current in 12 Ω lamp is in **(b)(ii)**) — C1
(P =) IV OR I^2R — C1
(P =) 36 W for 4 Ω lamp; P = 12 W for 12 Ω lamp — A1
e.c.f. from **(b)(ii)**
OR
(P =) V^2/R — (C1)
(P =) $12^2/4$ = 36 W for 4 Ω lamp OR $12^2/12$ = 12 W for 12 Ω lamp — (C1)
(P =) $12^2/4$ = 36 W for 4 Ω lamp AND $12^2/12$ = 12 W for 12 Ω lamp — (A1)
OR
(P =) V^2/R — (B1)
Same V for all lamps — (M1)
4 Ω lamp has higher power / 12 Ω has lower power — (A1)

[Total 7]

Q# 8/ iG Phx/2012/w/Paper 31/ www.SmashingScience.org

10 **(a)** **(i)** current

(ii) p.d. OR potential difference OR voltage — B1

Both required

(b) $R = R_1 + R_2$ OR 1.2 + 3.6 OR 4.8 (k Ω) — C1
I = 9.0 / 4.8 = 1.875 (mA) OR 9.0/4800 = 1.875×10^{-3} (A) — C1
Voltmeter reading = 6.75V *Unit penalty applies — A1
OR
Voltmeter reading = $[R_1 / (R_1 + R_2)]$ V — (C1)
= [3.6 / (1.2 + 3.6)] × 9.0 — (C1)
= 6.75V *Unit penalty applies — (A1)

(c) (In fire) temperature of thermistor rises and its resistance falls — B1
Current (through thermistor and relay coil) rises / flows — B1
OR voltage / p.d. across / of relay coil rises
<u>Magnetic field</u> of relay closes switch (and bell rings) — B1 **[7]**

*Apply unit penalty once only

8	(a)	(i)	Electron(s)	B1
		(ii)	At least 2 + signs on left-hand side of S Same number of – signs on right-hand side of S	B1
		(iii)	Connect S to earth (with rod in place) Remove connection of S to earth Remove R / rod	M1 M1 A1
	(b)	(i)	$Q = It$ OR $I = Q / t$ OR in words OR $I = 30/120$ = 0.25 A or C/s	C1 A1
		(ii)	$E = IVt$ OR in words OR $0.25 \times 1.5 \times 10^6 \times 120$ OR $E = QV$ OR in words OR $30 \times 1.5 \times 10^6$ E = 45000000 J / 4.5×10^7 J / 45 MJ / 12.5 kWh	C1 (C1) A1

[Total: 9]

Q# 10/ iG Phx/2012/s/Paper 31/ www.SmashingScience.org

9	(a)	(i)	$I_1 = I_2 + I_3$	B1
		(ii)	$I_1 = I_4$ OR same	B1
	(b)	(i)	($V = IR = 0.80 \times 3.0 =$) 2.4 V	A1
		(ii)	$I = V/R$ in any algebraic form OR 2.4 / 2 OR **(b)(i)** / 2 OR any voltage divided by 2 ($I_3 = V/R = 2.4 / 2 =$) 1.2 A OR $I_3/I_2 = 3/2$ $I_3 = 3/2 \times 0.8$ A = 1.2 A	 C1 A1 (C1) (A1)
		(iii)	($I_2 + I_3$ OR Current through R = 0.8 + 1.2) = 2.0 (A) OR 6 V / 2 A used Parallel combination formula: $1/r = 1/r_1 + 1/r_2$ OR ($r =$) $r_1r_2/(r_1 + r_2)$ Use of formula: combined resistance = 1.2 (Ω) (R + 1.2 = 6/2 = 3.0 Ω R =) 1.8 Ω OR Current through R = 0.8 + 1.2 = 2.0 (A) P.D. across R = 6.0 – 2.4 = 3.6 (V) R = 3.6 / 2.0 = 1.8 Ω	 C1 C1 C1 A1 (C1) (C1) (C1) (A1)

[Total: 9]

Q# 11/_iG Phx/2011/w/Paper 31/ www.SmashingScience.org

9 (a) (i) 1. resistance is constant / doesn't vary — B1
2. resistance increases — B1

(ii) 7 V — B1

(b) resistance of resistor = 4/2.6 (= 1.54 Ω) — C1
resistance of lamp = 4/3.6 (= 1.11 Ω) — C1
$1/R = 1/R_1 + 1/R_2$ OR $(R =)\ R_1R_2/(R_1 + R_2)$ OR either eq. with numbers — C1
0.645 or 0.65 Ω — A1
OR
current through resistor = 2.6 A — (C1)
current through lamp = 3.6 A — (C1)
total current = 2.6 + 3.6 = 6.2 A — (C1)
0.645 Ω OR 0.65 Ω OR *R* = 4/sum of candidate's currents — (A1) [7]
accept *R* value based on no. of sig. figs. for resistors used by candidate

Q# 12/_iG Phx/2011/s/Paper 31/ www.SmashingScience.org

5 (a) (i) potential difference OR e.m.f. OR voltage ignore volts
(ii) frequency accept cycles/s ignore waves/s
(iii) power accept energy/s
} all 3 — B1

(b) (i) case/frame/outside/base/parts that can be touched ignore metal parts — B1

(ii) electric shock/electrocution/death by electricity o.w.t.t.e. ignore anything else — B1
live wire touches case — B1

(c) heaters in parallel with any supply
(M0 if no supply, clear break in circuit, short across supply or heater) — M1
one switch controlling both heaters <u>and</u> one switch controlling one heater
OR one switch in series with each element — A1

special case: heaters in series with supply and <u>one</u> switch shorting out <u>one</u> resistor AND another switch in series with supply — B2 [6]

Q# 13/ iG Phx/2011/s/Paper 31/ www.SmashingScience.org

4	**(a)** rheostat/variable resistor AND control/vary/change/ limit current /resistance/power/voltage across heater	B1	
	(b) (i) $P = VI$ in any form OR (I=) P/V	C1	
	1.25 A	A1	
	(ii) (R =) V/I in any form words or numbers	C1	
	(voltage across X =) 2.4 (V) OR 6 - 3.6 (V)	C1	
	1.92 Ω e.c.f. from **(b) (i)**	A1	
	(c) battery running down/going flat/energy of battery used up OR V or e.m.f. less OR more/increasing resistance (of heater) NOT resistance of X increases	B1	
	(d) (i) transformer condone step-up OR potential divider/potentiometer NOT extras	B1	
	(ii) diode OR rectifier OR L.E.D. NOT extras	B1	[9]

Q# 14/ iG Phx/2010/w/Paper 31/ www.SmashingScience.org

9	**(a) (i)** negative at LH end **and** positive at RH end	B1
	(ii) (+ve) charge on A attracts electrons/-ve charges/-ve ions OR unlike charges attract (ignore reference to + charges)	B1
	electrons move to end X/towards A	B1
	(unbalanced) +ve charges (left) at end Y NOT repelled to Y	B1
	(iii) idea that each electron leaves behind an equal unbalanced proton in nucleus/B has no net charge/B is neutral/idea that B has not gained or lost any charges	B1
	(b) (i) nothing OR nothing implied	B1
	(ii) +ve charge cancelled/neutralised	B1
	by electrons/negative charges flowing up from earth	B1
		[Total: 8]

Q# 15/ iG Phx/2010/w/Paper 31/ www.SmashingScience.org

8	(a)		capacitor/capacitance/condenser	B1
	(b)	(i)	5 Ω	B1
		(ii)	5 and 20 both used OR 25	C1
			$1/R = 1/R_1 + 1/R_2$ OR $(R =)\ \frac{R_1 R_2}{R_1 + R_2}$ seen or used	C1
			4 Ω	A1

(c)

EITHER	OR	
ammeter reading falls (to zero)	no current/reading	M1
as capacitor charges	P already charged/does not conduct d.c.	A1

(d) Formula for calculation of I ($I = V/R$) OR P ($P = V^2/R$) — C1

Use of energy = power × time in any form — C1

400 s — A1

[Total: 10]

Q# 16/ iG Phx/2010/s/Paper 31/ www.SmashingScience.org

11 (a) (i) 4 Ω — B1

(ii) IVt OR I^2Rt OR V^2t/R in any form or words or numbers

Condone t = 9 if substituted possible ecf from **(i)** — C1

540 (s) — C1

437.4 J possible ecf if 4 Ω from **(i)** used — A1

(b) $R = \rho L/A$ OR $R \propto L/A$ OR $R \propto L$ <u>and</u> $R \propto 1/A$ or $1/d^2$ or $1/r^2$ — C1

$A_2 = \frac{1}{4}A_1$ OR $A_2 = 0.25A_1$ — C1

$R_2 = (0.45/0.3) \times R_1$ OR $(3/2) \times R_1$ — C1

⅜ OR 0.375 OR 37.5 % — A1

OR

$R = \rho L/A$ OR $R \propto L/A$ OR $R \propto L$ <u>and</u> $R \propto 1/A$ or $1/d^2$ or $1/r^2$ — C1

Resistance of thinner wire with same length as thicker wire = 4 × 4 = 16 Ω — C1

Actual resistance of thinner wire = 1.8 /0.3 = 6.0 Ω — C1

Ratio: L of thinner wire / L of thicker wire = 6.0 / 16 = 3/8 = 0.375 = 37.5 % — A1 [8]

Q# 17/_iG Phx/2009/w/Paper 31/ www.SmashingScience.org

11 **(a)** A NOT or inverter — B1
B AND — B1

(b) (accept 1 or ON for HIGH, and 0 or OFF or NOT HIGH for LOW throughout)

(i) A – HIGH and B – LOW (both) no e.c.f. — B1

(ii) A – HIGH and B – HIGH (both) no e.c.f. — B1

(iii) A – LOW and B – LOW (both) no e.c.f. — B1

(c) **(i)** B cannot provide enough power / current for lamp, or equiv.
OR allows remote lamp — B1

(ii) the second one / dark and warm / HIGH, HIGH e.c.f. from **(b)** — B1

(iii) warning if temperature in a closed / dark space (e.g. refrigerator, kiln) reaches too high a value
N.B. "to switch on a lamp when it is dark and warm" not accepted — B1

[8]

Q# 18/_iG Phx/2009/w/Paper 31/ www.SmashingScience.org

10 **(a)** **(i)** step-up transformer — B1

(ii) less heat/energy/power loss (from lines) / thinner wires (possible)
OR lower current NOT more efficient — B1

(b) $P = V \times I$ in any form, figures or symbols / ($P =$) VI — C1
2.5 A — A1

(c) $P = I^2R$ in any form, figures or symbols / ($P =$) I^2R — C1
18.75 W e.c.f. from **(b)** — A1

(d) $V = IR$ in any form, figures or symbols OR ($V =$) IR OR
$P = V^2 / R$ in any form, figures or symbols OR ($P =$) V^2 / R OR $V = (PR)^{1/2}$ — C1

7.5 V e.c.f. from **(b)** or **(c)** — A1

(e) 22,000 – 7.5 – 7.5 OR 22,000 – 7.5 ecf — C1
21,985 V e.c.f. (minimum 4 s.f.in this case) — A1
OR
55,000 – 37.5 = 54962.5 — (C1)
54962.5 / 2.5 = 21985 V (minimum 4 s.f. in this case) — (A1)

[10]

Q# 19/ iG Phx/2009/s/Paper 31/ www.SmashingScience.org

10 (a) (i)	0 (A) / zero Unit penalty if wrong unit	B1
(ii)	12 V	B1
(b) (i)	*V* / *R* OR *V* = *IR* in any form, letters, words or numbers	C1
	0.5 A	A1
(ii)	8 × candidate's **(i)** OR 8/24 × 12	C1
	4 V OR 4.0 V e.c.f.	A1
(c)	$1/R_1 + 1/R_2 = 1/R$ OR $R = R_1R_2 / (R_1 + R_2)$ in any form	B1
	5.3 (Ω) OR 5⅓ (Ω) OR 16/3 (Ω)	C1
	12 / candidate's R	C1
	2.25 A c.a.o.	A1
	Alternatively: 12/16 (= 0.75) OR 12/8 (= 1.5)	C1
	12/16 (= 0.75) AND 12/8 (= 1.5)	C1
	Currents added	C1
	2.25 A c.a.o.	A1 [10]

Q# 20/ iG Phx/2009/s/Paper 31/ www.SmashingScience.org

9 (a)	half-wave rectification clearly indicated (any wave shape, repeated): at least 2 humps with all spaces more than half width of hump, by eye.	B1
(b) (i)	**A** (c.a.o.)	M1
(ii)	For answers **A** and **B** only in **(i)**, not **C** or **D**:	
	Route to resistor: correct arrow on one downwards diode and nothing wrong on this route	B1
	Route from resistor: correct arrow on one downwards diode and nothing wrong on this route	B1 [4]

Q# 21/ iG Phx/2008/w/Paper 31/ www.SmashingScience.org

8 (a)	changes a.c. to d.c. OR rectifies a/c OR allows current to flow one way only OR prevents current flowing backward	B1
(b)	I × t or 2 × 12 or 2 × 12 × 60 × 60 or amps × seconds	C1
	24 Ah or 86 400 C or 86 000 C	A1
(c)	emf = J/C OR energy converted/work done per unit charge/coulomb OR W/A OR volts/p.d. when no current in circuit	C1
	12 J of energy are delivered/needed for every coulomb of charge OR 12 W is the power to drive a current of 1 A	A1
(d) (i)	series connection shown, any recognisable symbols	B1
(ii)	total power = 16 W OR 8/6	C1
	1.33 A accept fraction c.a.o.	A1
(iii)	any power × any time or 16 × 60 × 60 or IVt or 8 × 60 × 60	C1
	57 600 J or 0.016 kWh or 28 800 J or 0.008 kWh	A1 [10]

Q# 22/_iG Phx/2008/s/Paper 31/ www.SmashingScience.org

10 (a) correct symbol, must show 3 connections, condone rounded "nose", ignore width of the shape, allow OR gate followed by NOT gate, correctly drawn B1

(b) if truth table is shown, mark the truth table and ignore the rest
either input 1, output 0 <u>AND</u> both inputs 1, output 0 B1
both inputs 0, output 1 accept high/low, on/off for both B1

(c) (i) one input is high/1 AND output is low/0 B1
IGNORE any reference to 2nd input

(ii) 1. on B1
2. off B1

[6]

Q# 23/_iG Phx/2008/s/Paper 31/ www.SmashingScience.org

8 (a) all 4 lights in parallel with supply and none in series B1
master switch in a place where it will work (cannot score if no supply or if short circuit) B1

one switch for 2 lights in living room AND one for bathroom AND one for bedroom B1

(b) (i) $W = V \times I$ or $100 = 200 \times I$ in any form C1
0.5 A or 0.5 a A1

(ii) $I \times t$ or 0.5×60 e.c.f. C1
30 C or 30 c e.c.f. A1

(c) (i) 135 W B1

(ii) any power × any time (words or symbols or numbers) C1
NOTE: 280 (W) is the total power of lamps in house, so counts as "power"

486 000 J or 486 kJ or 0.135 kWh accept lower case units A1
NOTE: $45 \times 3600 = 162000$ J gets e.c.f. from (i)

[10]

Q# 24/_iG Phx/2007/w/Paper 31/ www.SmashingScience.org

10 (a) (i) low/0/off/no output B1

(ii) low/0/off/no output B1

(b) (i) temp sensor to NOT gate input, correct symbol B1
output of NOT gate (condone incorrect symbol) and humidity sensor to AND inputs (condone labelled box for AND gate) B1

(ii) NOT low in, high out B1
AND both inputs high, high output B1
Note: B0, B0 for states on wrong diagram.

[Total: 6]

Q# 25/_iG Phx/2007/w/Paper 31/ www.SmashingScience.org

8	(a)	circuit 1 series AND circuit 2 parallel	B1
	(b)	switch off each one separately one fails, other works both get full current/voltage/same voltage other good point e.g. more heat in parallel lower resistance) any 2	B1+B1
	(c)	(total R =) 10 (Ω) (V =) 12V	C1 A1
	(d)	1/R = 1/4 + 1/6 (= 5/12) OR $1/R = 1/R_1 + 1/R_2$ 2.4 (Ω)	C1 A1
	(e)	(i) 3(A)	B1
		(ii) 24W	B1
		(iii) 7200J e.c.f. (ii)	B1
			[Total: 10]

Q# 26/_iG Phx/2007/s/Paper 31/ www.SmashingScience.org

Q# 27/_iG Phx/2006/w/Paper 31/ www.SmashingScience.org

9	(a)	(i)	connections one to each plate top one to +ve , bottom one to -ve (New PSU drawn C1)	M1 A1	[2]
		(ii)	electrons negatively charged one plate positively charged, one negatively charged electrons attracted to +/repelled by –	B1 B1 B1	[3]

Q# 28/_iG Phx/2006/w/Paper 31/ www.SmashingScience.org

8	(a)		switch in correct position	B1	[1]
	(b)	(i)	rheostat/variable resistance symbol drawn	B1	
		(ii)	dot and R in line to 12 W lamp	B1	[2]
	(c)		Question deleted		
	(d)		R = V/I or 12/.3 = 4Ω	C1 A1	[2]
	(e)	(i)	parallel circuit/all lamps connected separately across the 12V	B1	
		(ii)	4 A	A1	[2]
					[Total: 7]

Q# 29/_iG Phx/2006/s/Paper 31/ www.SmashingScience.org

10	**(a)**		bring rod close but not touching plate	M1	
			touch metal plate with earth lead	M1	
			remove lead and then rod	A1	**3**
	(b)	**(i)**	Q = 20 (mA) x 15 (s)	C1	
			= 0.30 C	A1	
		(ii)	V = 20 (ma) x 10 (kΩ)	C1	
			= 200 V	A1	**M3**
					[6]

Q# 30/_iG Phx/2006/s/Paper 31/ www.SmashingScience.org

8	**(a)**		I = W/V or 9/6	C1	
			I = 1.5 A	A1	**2**
	(b)	**(i)**	8 ohm	A1	
		(ii)	6 V	A1	**2**
	(c)	**(i)**	brightness decreases/dimmer	B1	
		(ii)	resistance of circuit greater	B1	
			current through lamp falls	B1	**3**
	(d)	**(i)**	4 ohm	A1	
		(ii)	4 ohm	A1	**2**
					[9]

Q# 31/_iG Phx/2005/w/Paper 31/ www.SmashingScience.org

9	(a)	correct symbol correct labels	B1 B1	[2]
	(b) (i)	low, OFF or 0		
	(ii)	low, OFF or 0 need both correct	B1	[1]
	(c) (i)	need 4 boxes correct for 2 marks, -1 for e.e.o.e.	B2	
	(ii)	no change	B1	[3] Total [6]

Q# 32/_iG Phx/2005/w/Paper 31/ www.SmashingScience.org

8	(a)	force is produced on any charge placed in the field	B1 B1	[2]
	(b)	at least 3 parallel, straight lines plate to plate, ignore end effect at least one correct arrow, none wrong	B1 B1	[2]
	(c)	q = It or 0.06 = I x 30 I = 0.002 A or 2 mA	C1 A1	[2]
	(d)	E = Vit = 1500 x 0.008 x 10 = 120 J	C1 C1 A1	[3] Total [9]

Q# 33/_iG Phx/2005/s/ www.SmashingScience.org

9	(a)	(i)	to change a.c. to d.c. or rectify (a.c.)	B1	
		(ii)	full sine wave at least 1.5 full waves	B1	
			half wave rectified at least two d.c. 'bumps'	B1	3
	(b)	(i)	correct symbol	B1	
		(ii)	when input high or 1, output low or 0 or off	B1	
			when input low or 0 or off, output high or 1 or on	B1	3
					[6]

Q# 34/_iG Phx/2005/s/ www.SmashingScience.org

Q# 35/_iG Phx/2004/w/Paper 3/ www.SmashingScience.org

7	(a)		I = V/R or 12/8	1	
			= 1.5 A	1	2
	(b)	(i)	10(Ω)	1	
		(ii)	2(Ω)	1	2
	(c)		power = VI or I^2R or V^2/R	1	
			= 72W	1	2
	(d)	(i)	12(V)	1	
		(ii)	6(V)	1	2
	(e)	(i)	(resistance) less	1	
		(ii)	(resistance) less	1	2
					(10)

Q# 36/_iG Phx/2004/s/ www.SmashingScience.org

10	(a)		Analogue, continuously increasing / decreasing readings	B1	
			Digital, readings increase / decrease by one unit	B1	2
	(b)	(i)	Transistors + other components such as resistors	B1	
		(ii)	Standard symbol, must have labeled inputs and output	B1	
		(iii)	Both inputs 0 (off), or either one input 0 (off), output 0 (off)	B1	
			Both inputs 1 (on), output 1 (on)	B1	4
			OR correct truth table drawn (**C1**)		
			Some explanation of what truth table shows (**A1**)		
					[6]

Q# 37/_iG Phx/2004/s/ www.SmashingScience.org

8	(a)		1.52 kW	A1	1
	(b)	(i)	Each appliance is connected across 240 V supply or equivalent	B1	
		(ii)	Any 2: all work on same voltage or on 240 V or mains OR all have full/stated power OR each can be on or off OR one goes off/breaks others stay on	B2	3
	(c)	(i)	Current = power/voltage or 200/240	C1	
			Current = 0.83 A	A1	
		(ii)	Energy = power x time or 1.2 x 3	C1	
			Energy = 3.6 kWh or 1.3 x 10^7 J	A1	
		(iii)	Current = 60/240	C1	
			R= V/I or 240/0.25	C1	
			R =960Ω	A1	7
					[11]

Q# 38/_iG Phx/2003/w/Paper 3/ www.SmashingScience.org

10 (a)	current = power/voltage or 150/12	C1	
	value is 12.5 A	A1	2
(b) (i)	sum of currents at junction = current after junction/12.5 A = 5.0 A + I	C1	
	value is 7.5 A	A1	
(ii)	power = VI or is 7.5 x 12 e.c.f from (i)	C1	
	value is 90 W	A1	
(iii)	resistance = voltage/current or 12/7.5 e.c.f. from (i) but not from (a)	C1	
	value is 1.6Ω	A1	6
			[8]

Q# 39/_iG Phx/2003/w/Paper 3/ www.SmashingScience.org

11 (a)	top line correct, need 24 and 0	B1	
	bottom line correct, need 12 and –1 (accept β or e for electron	B1	2
(b)	particles take curved path (accept from diagram)	B1	
	move between the poles at right angles to lines of force	B1	
	move out of paper	B1	3
(c) (i)	use detector to pick up radiation (from isotope at points on/in body etc.)	B1	
	high count where circulation good or v.v. explained	B1	
(ii)	alpha particles all absorbed, none detected		
	beta particles may be largely absorbed, not penetrative enough		
	gamma rays reach detector/leave body any two	B2	4
			[9]

Q# 40/_iG Phx/2003/s/ www.SmashingScience.org

6	(a)	(i)	incident ray, refracted ray and normal drawn	C1	
			all correct and meeting at a point	A1	
		(ii)	angle of incidence and refraction correctly identified	B1	
		(iii)	values correct within agreed limits	B1	4
	(b)		use of sini/sinr	C1	
			correct substitution from candidates values	C1	
			value correct within agreed limits from candidate's values	A1	3
					[7]

Q# 41/_iG Phx/2002/w/Paper 3/ www.SmashingScience.org

9	a(i)	curve upwards between plates		C1	
		curve upwards between plates + straight line	2	A1	
	(ii)	top +, bottom -	1	B1	
	(iii)	to left, arrow and C marking any point on the beam between X and P	1	B1	4
mark on diag	b	cathode/heater, labelled		B1	
		anode labelled		B1	
		correct arrangement of cathode with anode cylinder		B1	
		suitable power supplies to heater/ anode-cathode (either to score)	4	B1	4
				QT	8