Core 1

Fig. 1 shows a battery, a switch and a bell connected so that the bell rings when the switch is pushed.

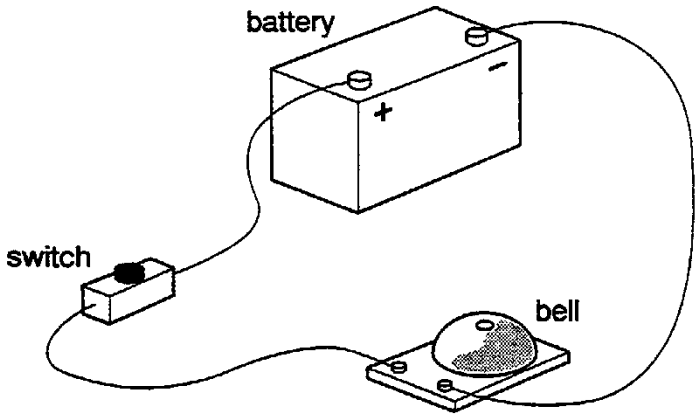

Fig 1

(a) Draw the circuit diagram for this arrangement. Use standard circuit symbols.

[3]

(b) A second bell is now connected in parallel with the first bell.

(i) Copy your circuit diagram from **(a)** and add the second bell.

(ii) Why will the battery run out more quickly when the switch has been pushed?

.....

.....

[2]

(a) **(i)** Copper is an electrical conductor. What is meant by a *conductor*?

.....

(ii) Ebonite, glass and polythene are electrical insulators. What is meant by an *insulator*?

.....

[2]

(b) Polythene is easily given a negative charge by rubbing it with a dry woollen cloth.

(i) Fig. 2 shows a charged polythene rod being held close to a suspended charged polythene rod.

Complete the phrase,

"like charges .....".

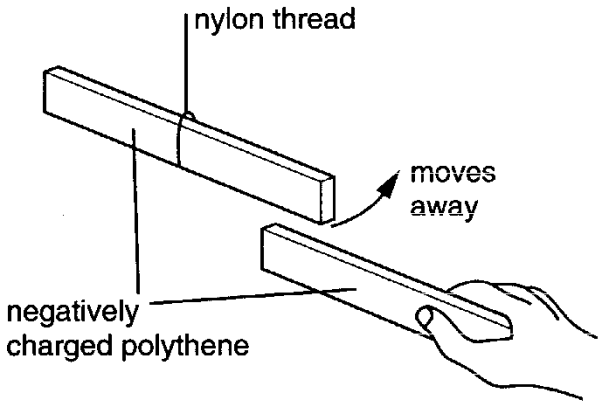

Fig 2

(ii) Fig. 3 shows rod X being held near the suspended charged polythene rod.

Tick **any** of the following which might correctly describe rod X.

positively charged glass ☐

negatively charged ebonite ☐

uncharged copper ☐

negatively charged polythene ☐

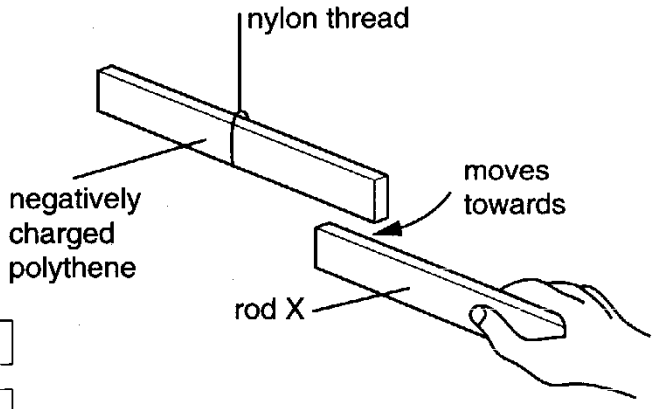

Fig. 3

[3]

Core 3

The circuit in Fig. 4 is connected up.

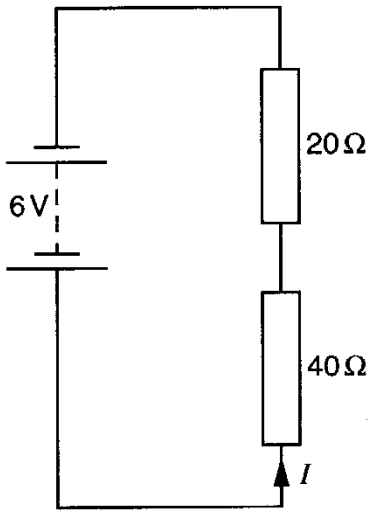

Fig 4

(a) Calculate the combined resistance of the two resistors in Fig. 4

combined resistance = ... Ω [2]

(b) **(i)** State the relationship between resistance, p.d. and current by completing the following equation.

resistance = ——————————

(ii) Calculate the current, I, in Fig. 4 . State the unit in your answer.

(c) Use your answer to **(b)(ii)** to calculate the p.d. across the 40 Ω resistor.
State the unit in your answer.

p.d. = ... [3]

(d) The circuit is now used as a potential divider, as shown in Fig. 5

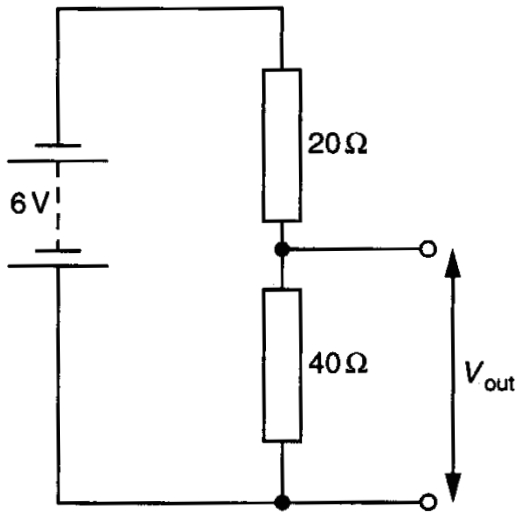

Fig. 5

Use your answer to **(c)** to state the value of V_{out} , the output voltage of the potential divider.

V_{out} = ... V [1]

Extension 1

Fig. 6 shows an uncharged metal plate held in a wooden clamp and stand.

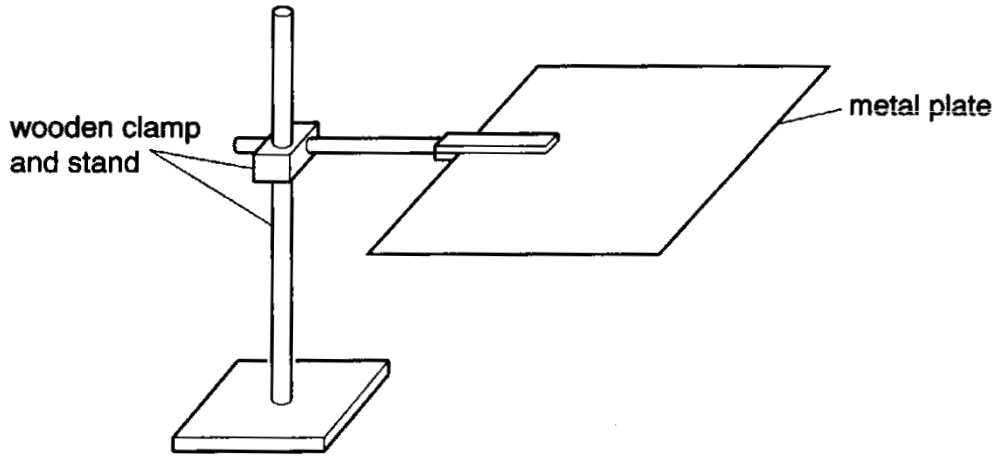

Fig. 6

(a) A polythene rod is charged negatively by rubbing it with a duster.

Suggest, in terms of the movement of electrons,

(i) how the polythene becomes negatively charged,

.....

.....

.....

(ii) how the metal plate can be positively charged without the polythene touching the plate.

.....

.....

.....

.....

[4]

(b) A strong α-particle emitting source is brought close to, but not touching, the positively charged metal plate.

Explain why the plate rapidly loses its charge.

.....

.....

.....

.....[2]

Extension 2

Fig. 7 is a block diagram of an electrical generating and distribution system.

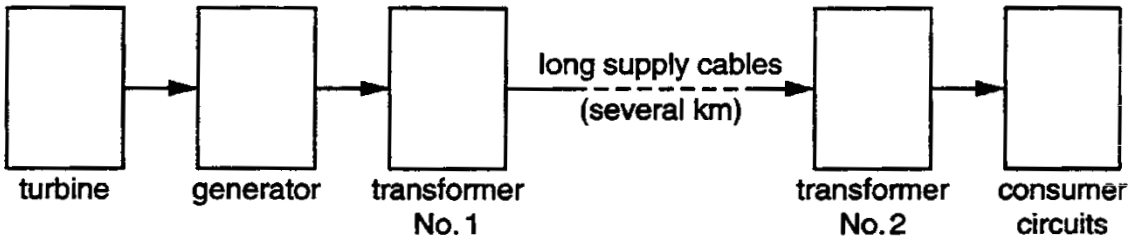

Fig 7

(a) The generator produces an e.m.f. by a process called electromagnetic induction.

(i) Name two factors and state how they are changed in order to increase the output e.m.f. of the generator.

1. .....

.....

2. .....

.....

(ii) Explain what is meant by the statement 'the induced e.m.f. acts in such a direction as to produce effects to oppose the change causing it'.

.....

.....

.....

.....

[6]

(b) (i) Fig. 8 shows the basic parts of transformer No. 1 which is 100% efficient.

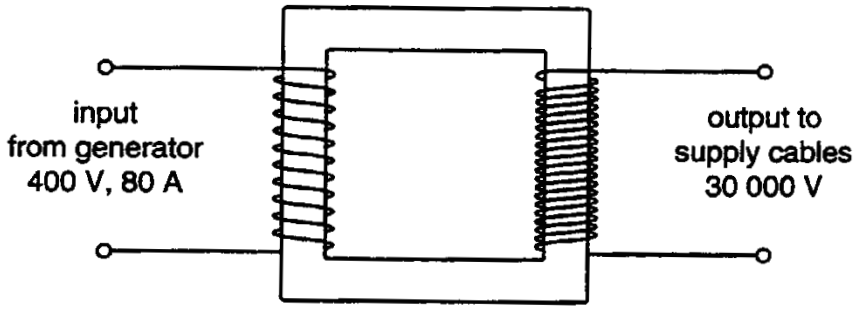

Fig. 8

Using the information on Fig. 8 calculate the current in the supply cables.

current = ...

(ii) Describe the function of transformer No. 2.

.....

.....

(iii) Explain why the use of the two transformers results in a big reduction in power loss in the supply cables.

.....

.....

.....

(c) Fig. 9 shows one of the consumer circuits with three electrical appliances R, S and T, connected into the circuit.

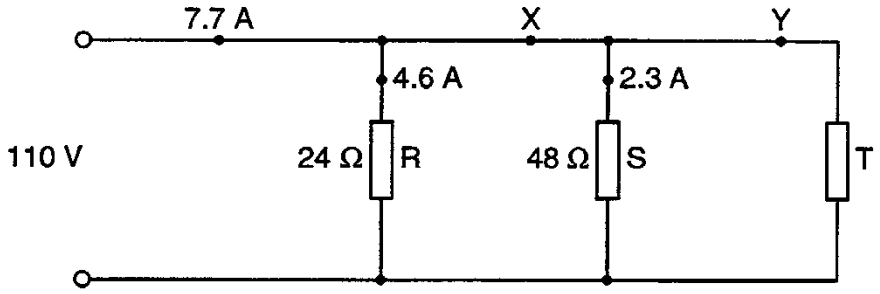

Fig. 9

Using the current, voltage and resistance values shown on Fig. 9 , calculate

(i) the current at point X and at point Y,

current at X = ...

current at Y = ...

(ii) the resistance of appliance T,

resistance = ...

(iii) the combined resistance of appliances R and S,

resistance = ...

(iv) the power developed in appliance R,

power = ...

(v) the energy converted by the appliance S in 2 minutes (120 s).

energy converted = ...

[10]

Core 1

a a series circuit using symbols
correct symbols for switch and cell
correct symbol for battery (group of cells)

b(i) second bell in parallel with the first (any recognisable symbol may be used)

(ii) more current / amps / energy / charge / electricity from the battery

Core 2

a(i) passes a current / charge / electricity
some electrons are free to move about

(ii) does not pass a current or does not conduct electricity or all charge / electrons fixed or bad conductor

b(i) repel or move away

(ii) first and third boxes ticked

Core 3

a R = R_1 + R_2
= 60 Ω

b(i) P.D./current or voltage /current or volts/amps or V/I or 6/I

(ii) current = 6/60

= 0.1 A / amps

c 0.1 x 40 = 4 V / volts

d 4 V

Extension 1

a(i) electrons move from the duster to the rod

(ii) hold the rod close to the plate
touch the plate to earth it
remove the rod leaving the plate positively charged

b alpha particles ionise the air
electrons are conducted by the ionised air to the plate

Extension 2

a(i) any two from

speed of rotation of the coil / magnet	faster
number of turns of the coil on the generator	greater
strength of the magnet / magnetic field	stronger

(ii) induced emf / current produced by a conductor cutting a magnetic field
induced emf/current also interacts with the magnetic field
this produces a force which slows the moving conductor

b(i) power input = power output
$400 \times 80 = 30\,000 \times I$
$I = 1.1$ A

(ii) to reduce the voltage

(iii) current in the cables is much reduced
because the voltage is increased
heat = $I^2 Rt$ or power = $I^2 R$ or the heat in the cables is less

c(i) current at X = 3.1 A
current at Y = 0.8 A

(ii) resistance of T = 110/0.8
= 138 Ω

(iii) $\frac{1}{R} = \frac{1}{24} + \frac{1}{48}$
$R = 16\ \Omega$

(iv) power = 110×4.6 or $4.6^2 \times 24$
= 506 W

(v) energy converted = $I^2 Rt$ or VIt
= 30 000 J