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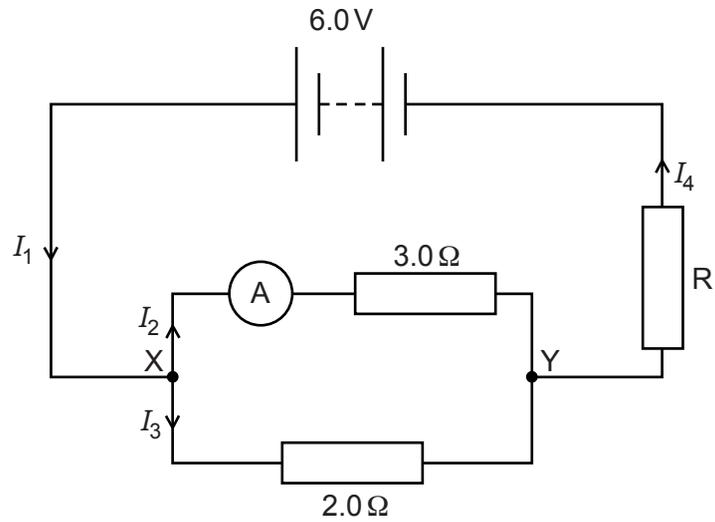

Fig. 9.1

(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,

<div align="right">p.d. = ... [1]</div>

(ii) the current I_3,

current = ... [2]

(iii) the resistance of R.

resistance = ... [4]

[Total: 9]

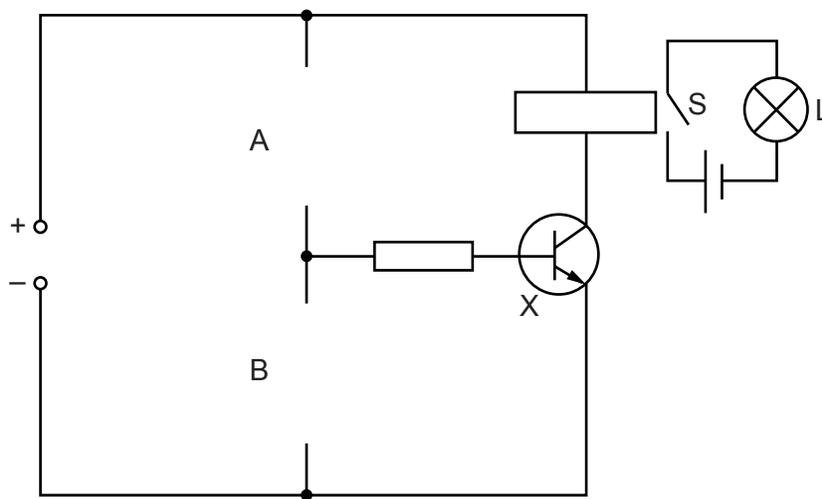**2** Fig. 11.1 shows part of a circuit designed to switch on a security lamp when it gets dark.

Fig. 11.1

When there is a current in the relay coil, switch S closes and the lamp L comes on.

(a) Write down the name of the component X. .... [1]

(b) The circuit has gaps at A and at B.

State the components that need to be connected into these gaps for the circuit to perform its required function.

gap A ....

gap B ....
[3]

(c) The circuit in Fig. 11.1 is modified. The function of lamp L is now to give a warning when the temperature becomes too high.

State any necessary changes of components in the circuit.

....

....

.... [2]

[Total: 6]

3 40 lamps, each of resistance 8.0 Ω, are connected in series to a 240 V supply in order to decorate a tree.

(a) Calculate

(i) the current in each lamp,

current = ... [2]

(ii) the power dissipated in each lamp.

power = ... [2]

(b) The lamps are designed to "fail-short". If a filament fails, the lamp shorts so that it has no resistance. The other lamps continue to light and the current increases.

The lamps are connected through a fuse that blows when the current rises above 0.9 A. At this current, the resistance of each lamp is 5% greater than its normal working resistance.

Calculate the maximum number of lamps that can fail before the fuse blows.

number of lamps = ... [4]

[Total: 8]

4 **(a)** Determine which **one** of the following resistors, connected in parallel with a 24.0 Ω resistor, would give a total resistance of 8.0 Ω. Show your working.

Available resistors: 2.0 Ω, 4.0 Ω, 6.0 Ω, 8.0 Ω, 12.0 Ω, 16.0 Ω, 18.0 Ω, 32.0 Ω

value of resistor = ... [3]

(b) **(i)** In the space below, draw the parallel combination of resistors from **(a)** connected in a circuit with a 6.0 V battery. The circuit should also include an ammeter to measure the current in the 24.0 Ω resistor.

[2]

(ii) Calculate the current in each of the resistors when connected as in **(b)(i)**. Show your working.

current in 24.0 Ω resistor = ... [3]

current in the other resistor = ... [Total: 8]

5 An electric heater is connected to a 230V mains supply. The heater circuit includes two resistors R_1 and R_2, and two switches S_1 and S_2. Fig. 8.1 is the circuit diagram.
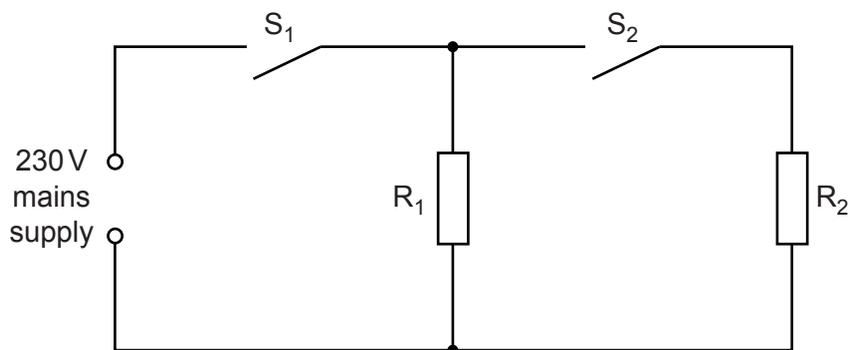

Fig. 8.1

The resistance of R_1 is 46 Ω and the resistance of R_2 is also 46 Ω.

Switch S_1 is closed and switch S_2 remains open.

(a) Calculate

   (i) the current from the mains supply,

current = ... [2]

   (ii) the power dissipated in the heater.

power = ... [2]

(b) Switch S_2 is now closed.

State the current in R_2.

current = ... [1]

[Total: 5]

6 A warning bell is fitted in a photographic dark room. In the dark, the bell is silent but in bright light, it rings. Two circuits linked by a relay R control the bell B. Fig. 10.1 is the circuit diagram for the arrangement.
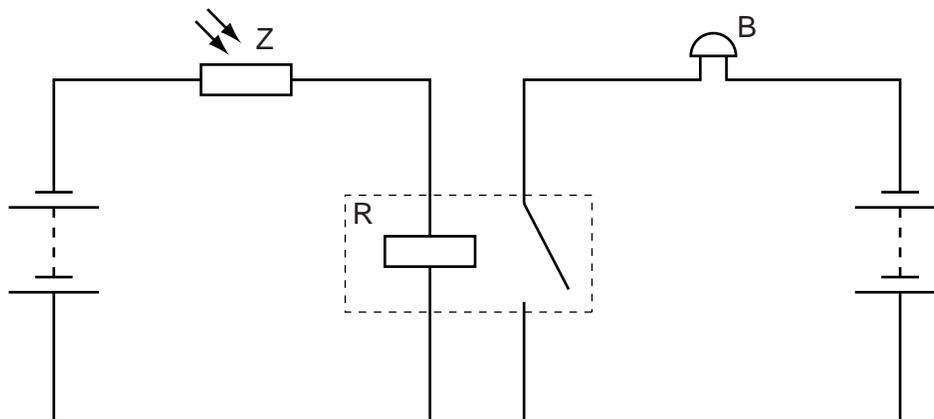

Fig. 10.1

(a) (i) State the name of component Z.

.... [1]

(ii) Explain why B rings in bright light.

....

....

....

....

....

....

.... [4]

(b) A change is made to one of the circuits so that B starts to ring when the temperature in the room rises.

State the change made.

....

.... [1]

[Total: 6]