



Electricity 2 Questions – NAT 5

- 1) a) A 25W lamp is designed to be used with the mains voltage.

Calculate the resistance of the lamp.

- b) Four of the lamps are connected in parallel.

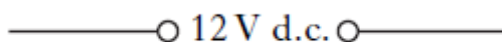
Calculate the total resistance of the lamps.

- 2) Two groups of pupils are investigating the electrical properties of a lamp.

- a) **Group 1** is given the following equipment:

ammeter; voltmeter; 12V dc supply ; lamp; connecting wires.

Complete the circuit diagram to show how this equipment is used to measure the **current through** and the **voltage across** the lamp.



- b) **Group 2** uses the same lamp and is only given the following equipment:

lamp; ohmmeter ; connecting wires.

What property of the lamp is measured by the ohmmeter?

- c) The results of both groups are combined and recorded in the table below.

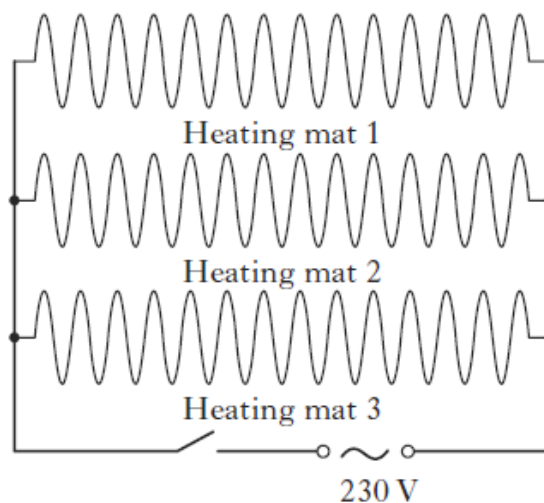
I(A)	V(V)	R(Ω)	IV	I ² R
2	12	6		

- i) Use these results to complete the last two columns of the table.
- ii) What quantity is represented by the last two columns of the table?
- iii) What is the unit of this quantity?

3) A house owner installs a heating system under the floor of a new conservatory.

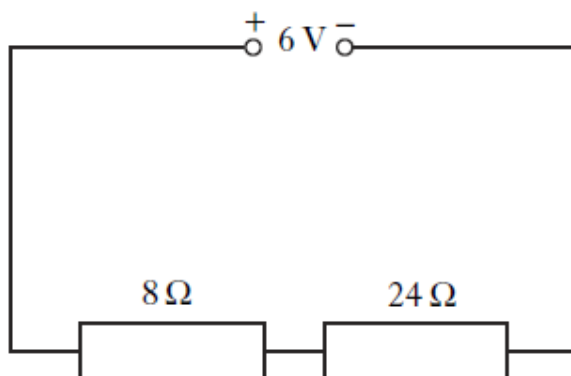
The heating mats are fitted. The mats contain resistance wires and are laid underneath the floor.

Each mat is designed to operate at 230V and has a power of 300W.



- State how the three mats are connected together to operate at their correct voltage.
- Calculate the current in each heating mat when switched on.
- Calculate the total resistance of the heating system when all three mats are switched on.

4) A student sets up the following circuit.

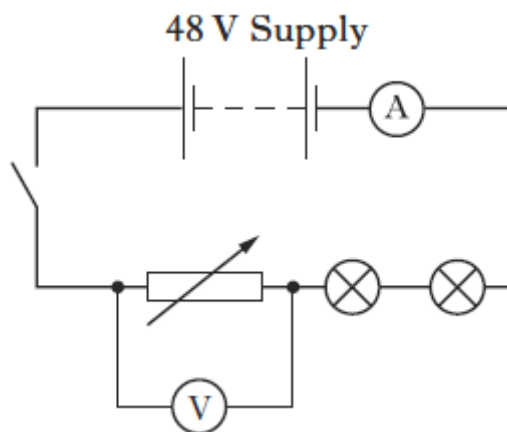


- Calculate the current in the 8Ω resistor.
- Calculate the voltage across the 8Ω resistor.
- The 24Ω resistor is replaced by one of **greater** resistance.

How will this affect the voltage across the 8Ω resistor?

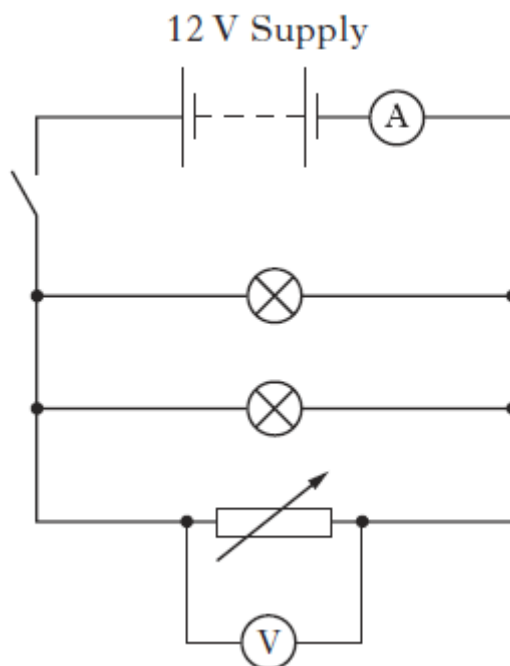
Explain your answer.

5) A student sets up the circuit to operate two identical 12V, 36W lamps from a 48V supply.



- a) i) Calculate the reading on the ammeter.
ii) Calculate the reading on the voltmeter.
iii) Calculate the resistance of the variable resistor.

- b) The student sets up a second circuit using a 12V supply and the same lamps.
Each lamp has a resistance of 4Ω . The resistance of the variable resistor is set at 6Ω .

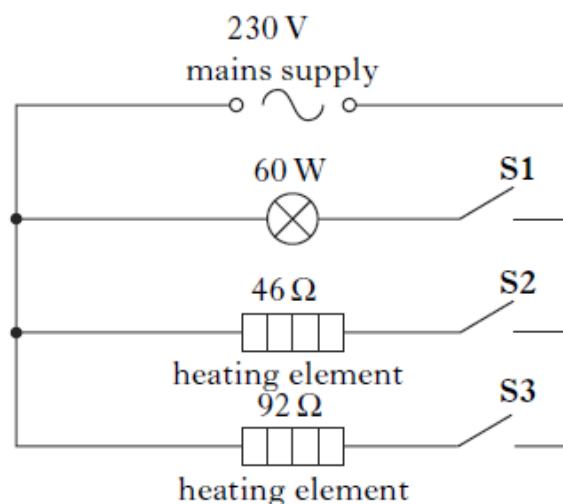


- i) Calculate the total resistance of this circuit.
ii) The variable resistor is now removed from the circuit.
A) What happens to the reading on the ammeter?
B) Justify your answer.

- 6) A mains electric fire has two heating elements which can be switched on and off separately. The heating elements can be switched on to produce three different heat settings: **LOW**, **MEDIUM** and **HIGH**. The fire also has an interior lamp which can be switched on to give a log-burning effect.



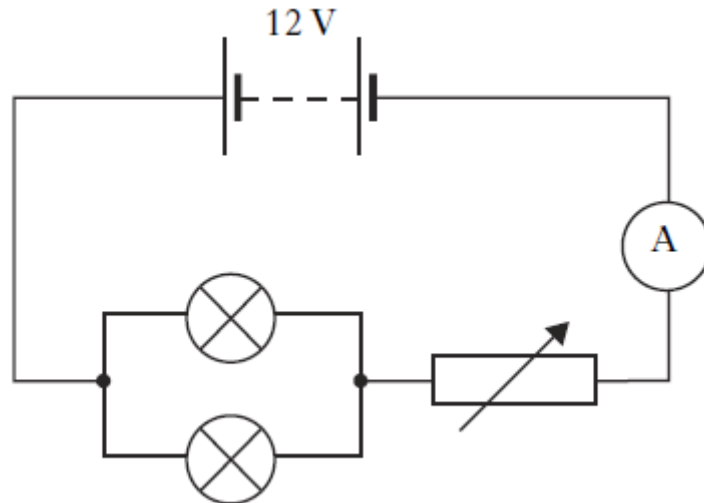
The circuit diagram for the fire is shown.



- a) When **S1** is closed, the lamp operates at its stated rating of 60W.
Calculate the current in the lamp.
- b) Switch **S1** is opened and switches **S2** and **S3** are closed.
- i) Calculate the combined resistance of both heating elements.
 - ii) Calculate the total power developed in the heating elements when **S2** and **S3** are closed.
 - iii) State and explain which switch or switches would have to be closed to produce the LOW heat setting.

7) The circuit shown is used to control the brightness of **two identical** lamps.

The variable resistor is adjusted until the lamps operate at their correct voltage of 3V.



a) When the lamps operate at their correct voltage, the reading on the ammeter is 1.2A.

Calculate the current in **one** lamp.

b) Calculate the resistance of **one** lamp.

c) Calculate the combined resistance of the two lamps in this circuit.

d) When the lamps operate at their correct voltage the resistance of the variable resistor is 7.5Ω .

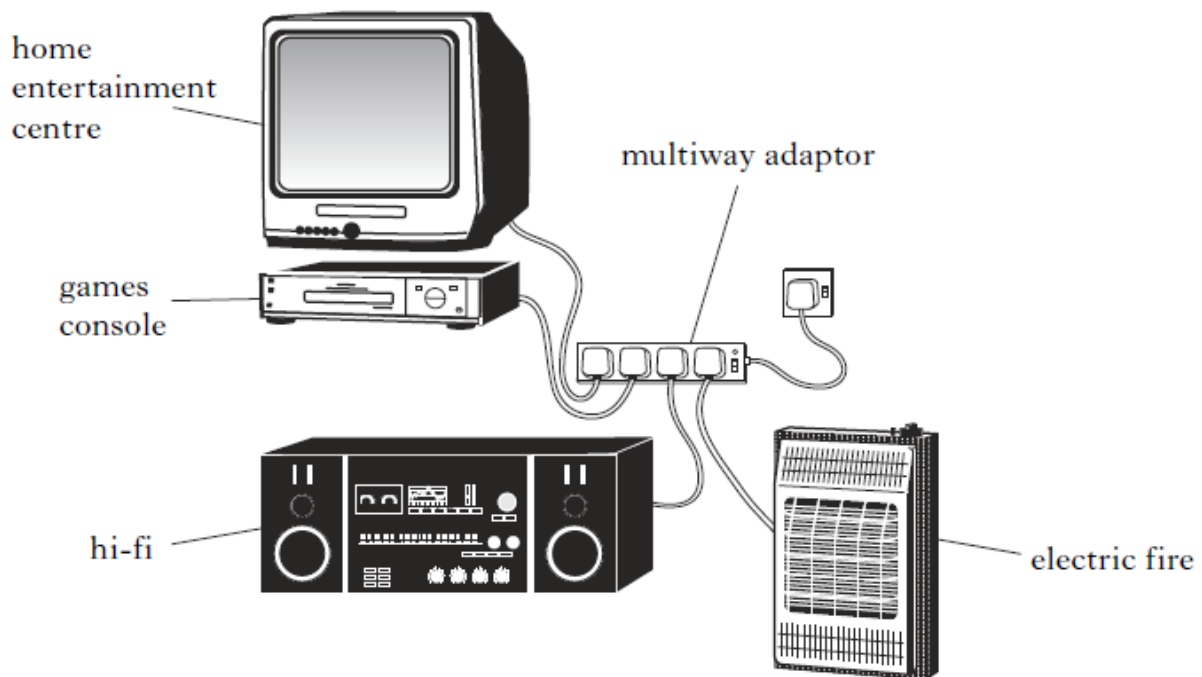
Calculate the total resistance in the circuit.

e) One of the lamps is removed.

i) What happens to the reading on the ammeter?

ii) Justify your answer.

- 8) A householder plugs a home entertainment centre, a hi-fi, a games console and an Electric fire into a multiway adaptor connected to the mains.



The householder goes on holiday for **14 days** with the electric fire unplugged.

All the other appliances are left on standby.

On standby, these appliances operate at 9% of their power rating listed in the table.

<i>Appliance</i>	<i>Power rating (W)</i>
home entertainment centre	350
hi-fi	150
games console	300
electric fire	2080

- a) Calculate the total power consumption in watts of all the appliances left on standby.
- b) i) Calculate the number of kilowatt-hours used by these appliances during the 14 days on standby.
- ii) Calculate how much this will cost if it is 15p per unit of electrical energy used.

9) An overhead projector contains a lamp and a motor that operates a cooling fan.

A technician has a choice of two lamps to fit in the projector.

Lamp A: rated 24.0 V , $2.5\ \Omega$

Lamp B: rated 24.0 V , $5.4\ \Omega$



a) Which lamp gives a brighter light when operating at the correct voltage?

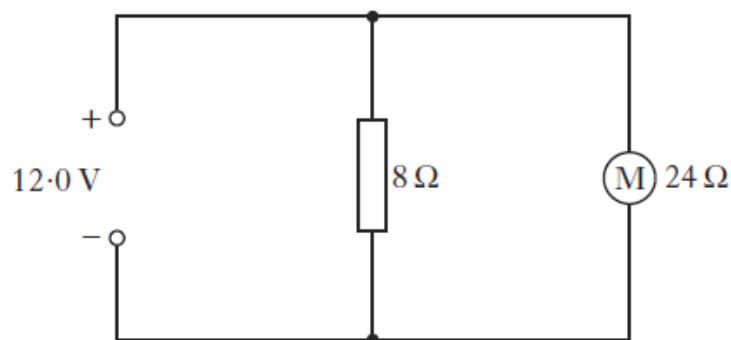
Explain your answer.

b) Calculate the power developed by **lamp A** when it is operating normally.

c) The overhead projector plug contains a fuse.

Draw the circuit symbol for a fuse.

d) The technician builds a test circuit containing a resistor and a motor, as show in **Circuit 1** below.



Circuit 1

i) State the voltage across the motor.

ii) Calculate the combined resistance of the resistor and the motor.

10) A resistor is labelled: " $10\Omega \pm 10\%$, 3W".



This means that the resistance value could actually be between 9Ω and 11Ω .

a) A student decides to check the value of resistance.

Draw a circuit diagram, including a 6V battery, a voltmeter and an ammeter, for a circuit that could be used to determine resistance.

b) Readings from the circuit give the voltage across the resistor as 5.7V and the current through the resistor as 0.60A.

Use these values to calculate the resistance.

c) During the experiment, the resistor becomes very hot and gives off smoke.

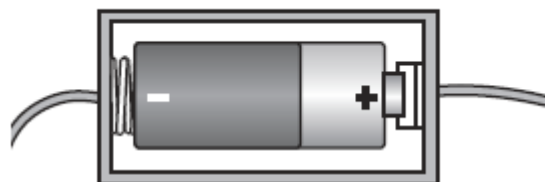
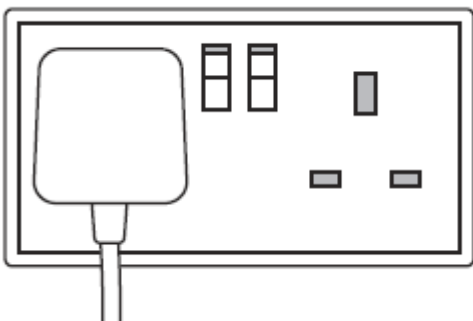
Explain why this happens.

d) The student states that two of these resistors would not have overheated if they were connected together in parallel with the battery.

Is the student correct?

Explain your answer.

11) A student has two electrical power supplies. One is ac and the other is a dc supply.



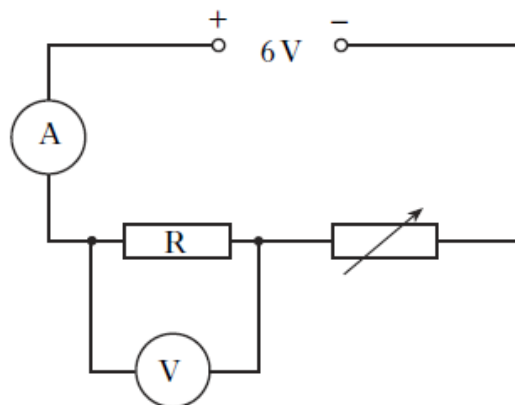
a) Explain ac and dc in terms of electron flow in a circuit.

b) i) Which power supply should be used to operate a transformer?

ii) A transformer with an efficiency of 30% is used in a computer.

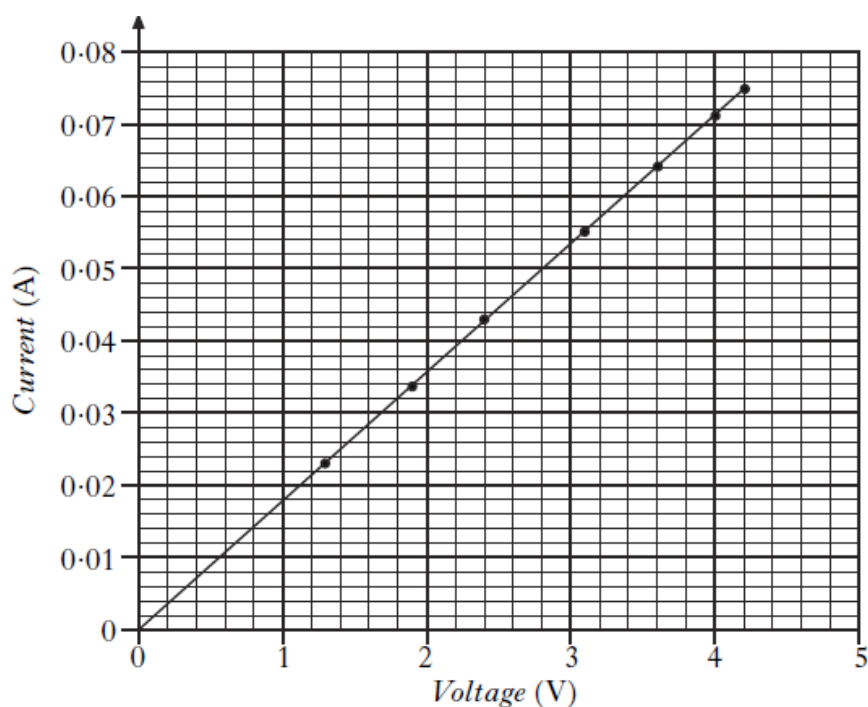
Calculate the power output when the input power is 50W.

12) A student sets up the following circuit to investigate the resistance of resistor R.



The variable resistor is adjusted and the voltmeter and ammeter readings are noted.

The following graph is obtained from the experimental results.



- a) i) Calculate the value of resistor when the reading on the voltmeter is 4.2V.
ii) Using the information from the graph, state whether the resistance of resistor R, **increases, stays the same** or **decreases** as the voltage increases.

Justify your answer.

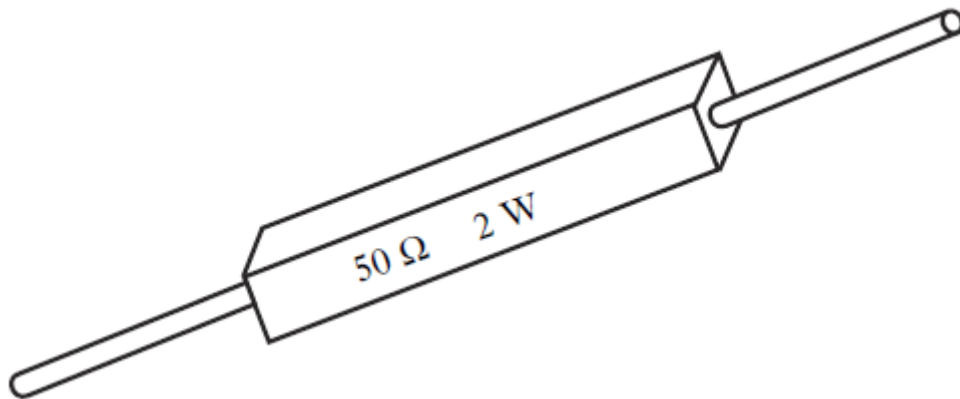
- b) The student is given a task to combine **two** resistors from a pack containing one each of 33Ω, 56Ω, 82Ω, 150Ω, 270Ω and 390Ω.

Show by calculation which **two resistors** should be used to give:

- i) The largest combined resistance:
ii) The smallest combined resistance.

13) Some resistors are labelled with a power rating as well as their resistance value.

This is the maximum power at which they can operate without overheating.

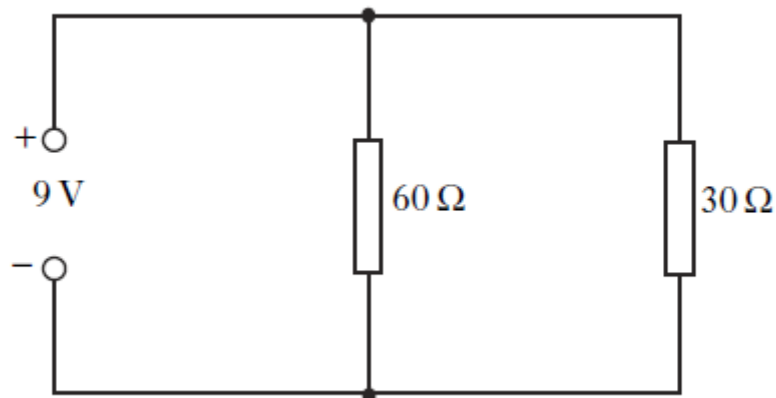


a) A resistor is labelled 50Ω , $2W$.

Calculate the maximum operating current for this resistor.

b) Two resistors, each rated at $2W$, are connected in parallel to a $9V$ dc supply.

They have resistances 60Ω and 30Ω .



i) Calculate the total resistance of the circuit.

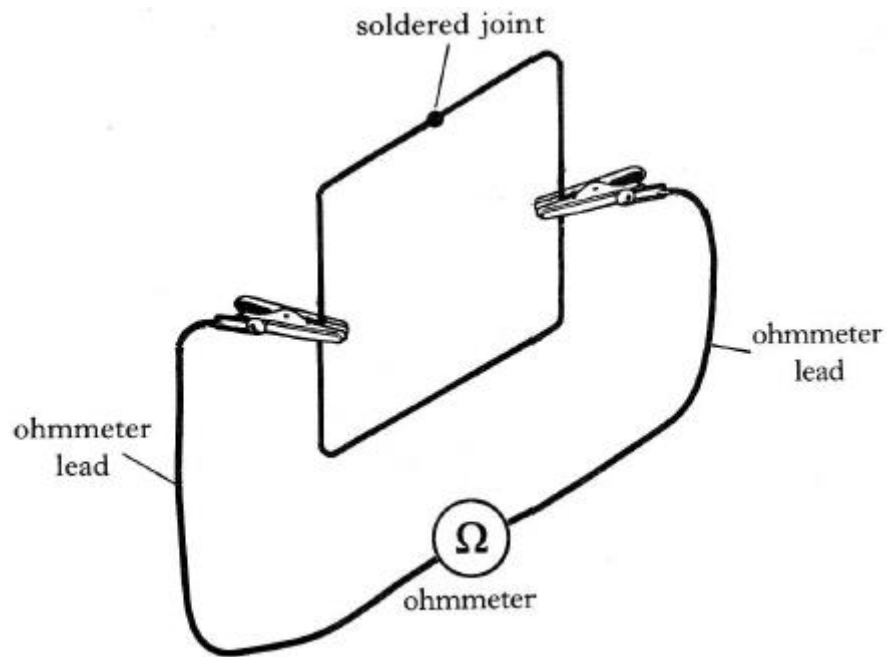
ii) Calculate the power produced in each resistor.

iii) State which, if any, of the resistors will overheat.

c) The **9V dc** supply is replaced by a **9V ac** supply.

What affect, if any, would this have on the answers to part b) ii)?

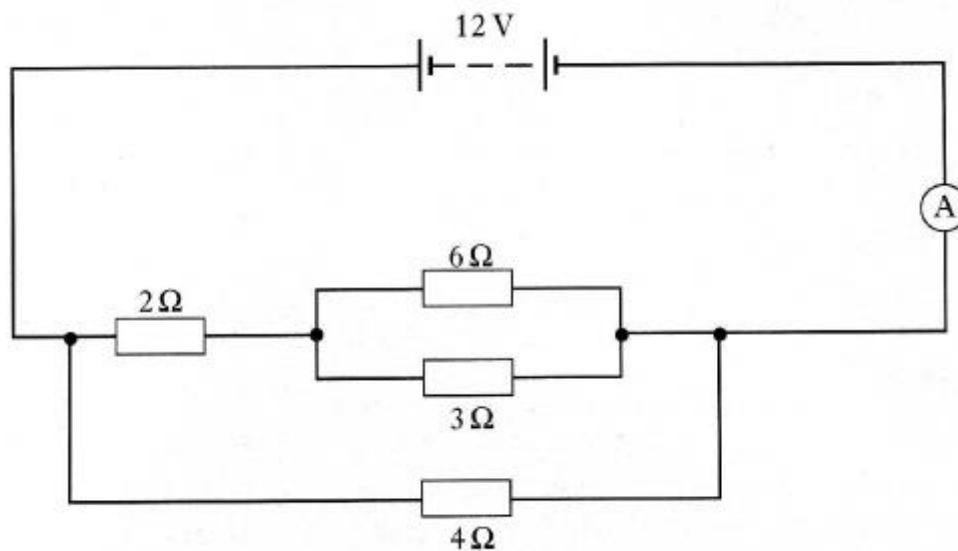
- 14) The resistance of a length of bare uniform wire is 30Ω . The length of wire is folded into the shape of a square and the ends soldered together as shown below.



What value of resistance would the ohmmeter read if it is connected as shown at the mid-points of opposite sides of the square?

(You may ignore the resistance of the ohmmeter leads.)

- 15) A student sets up the circuit below.



- Calculate the total resistance in the circuit.
- Calculate the current reading show on the ammeter.