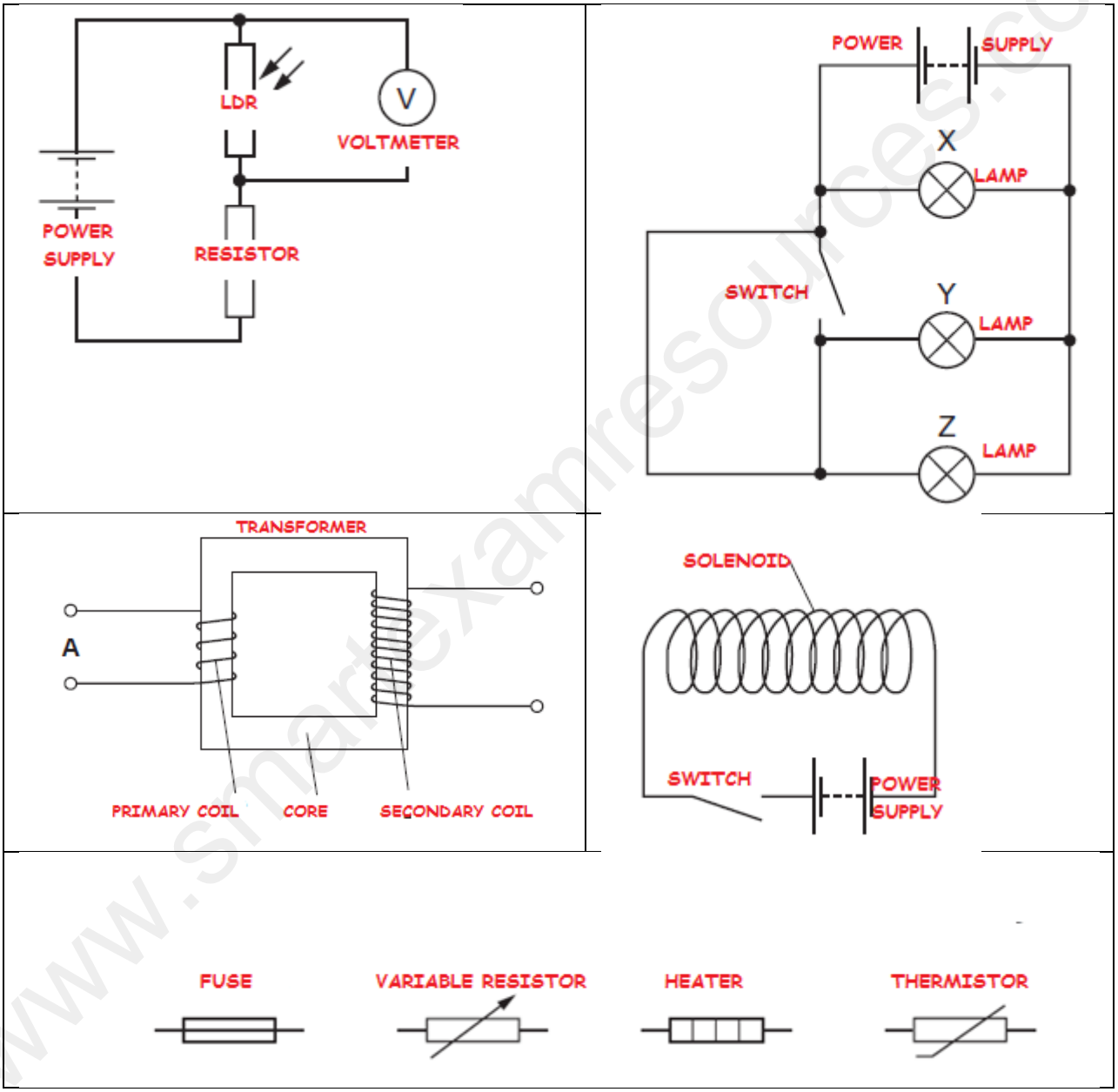
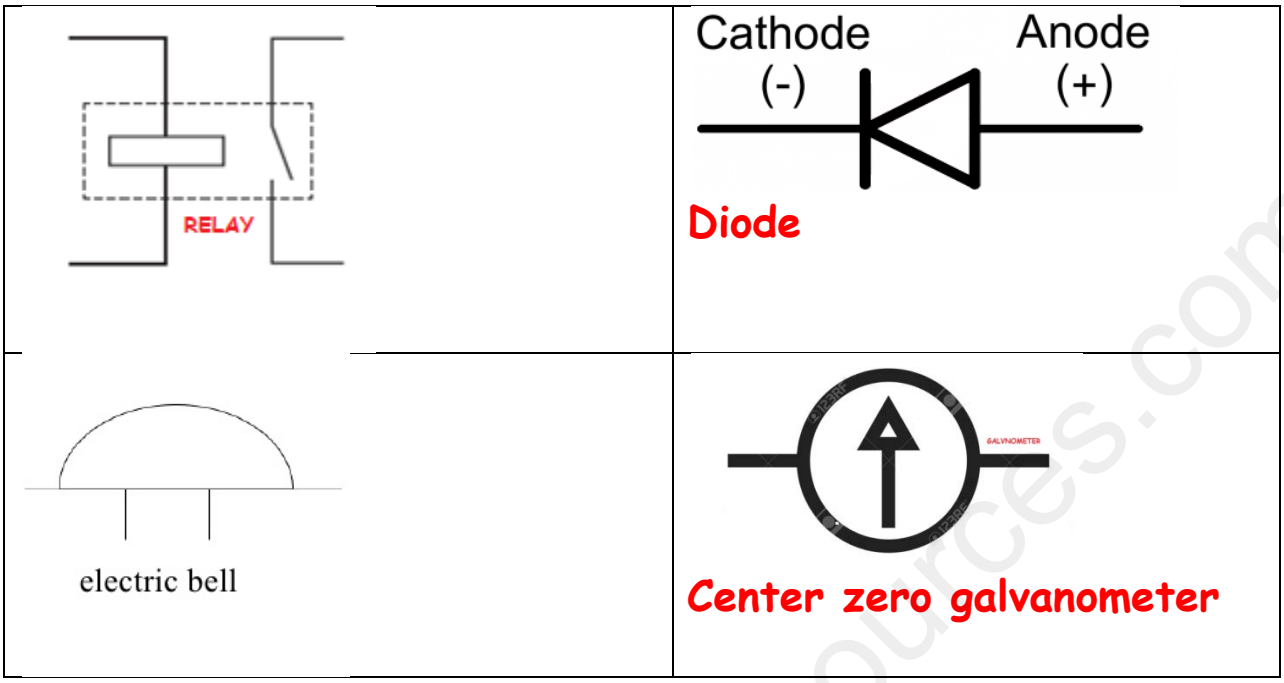
Electric circuits

KNOW THE ELECTRICAL COMPONENTS:





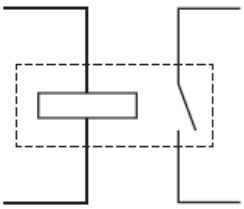
APPLICATION BASED QUESTIONS:

MCQ:

30 What is the circuit symbol for a variable resistor? 0625/11/O/N/15

A B C D

31 Which component is represented by this circuit symbol? 0625/13/M/J/15



A a bell

B a fuse

C a relay

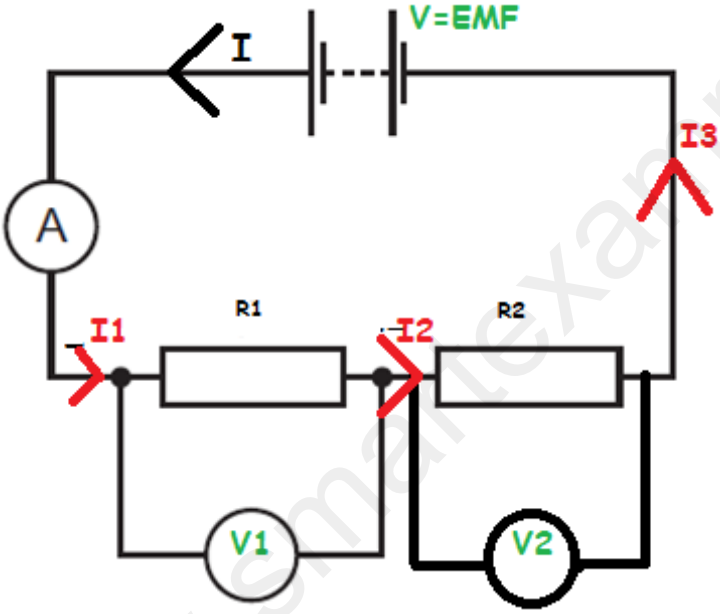
D a transformer

27 Which symbols are used for the units of current and of resistance?

	unit of current	unit of resistance
A	A	W
B	A	Ω
C	C	W
D	C	Ω

0625/11/O/N/11

Series circuits



Currrent: Current at every point in a series circuit is the same.

$I=I_1=I_2=I_3$

Potential difference:

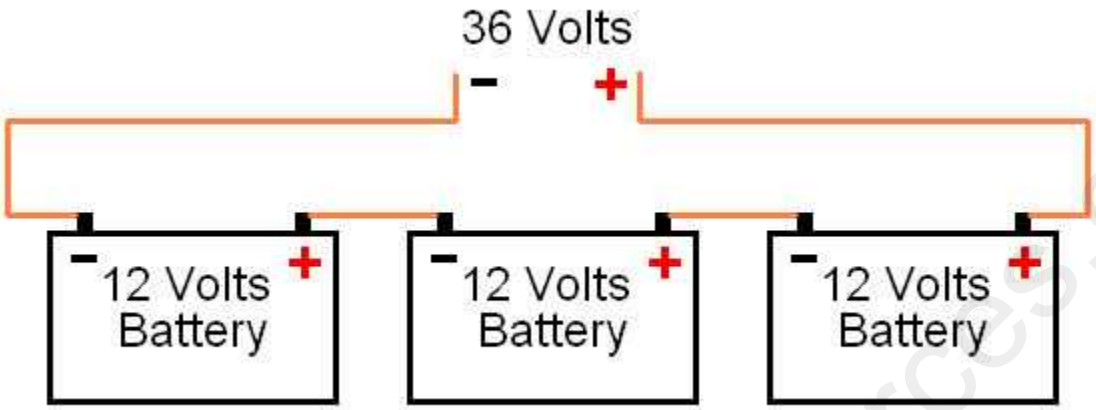
Sum of the pd's across the components in a series circuit is equal to the total pd(emf) across the

$V=V_1+V_2$

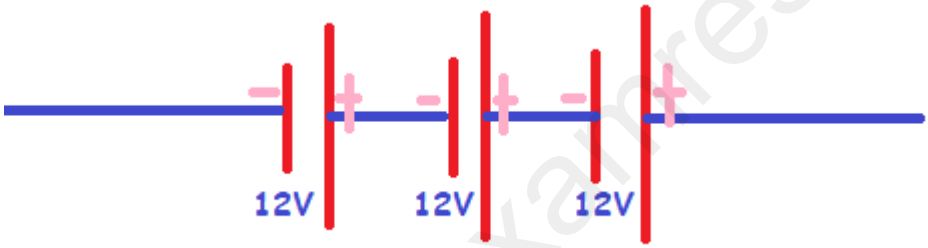
Combined resistance : Combined resistance of two resistors in parallel is less than either of the resistors itself.

$R=R_1+R_2$

Combined emf of several sources in series:

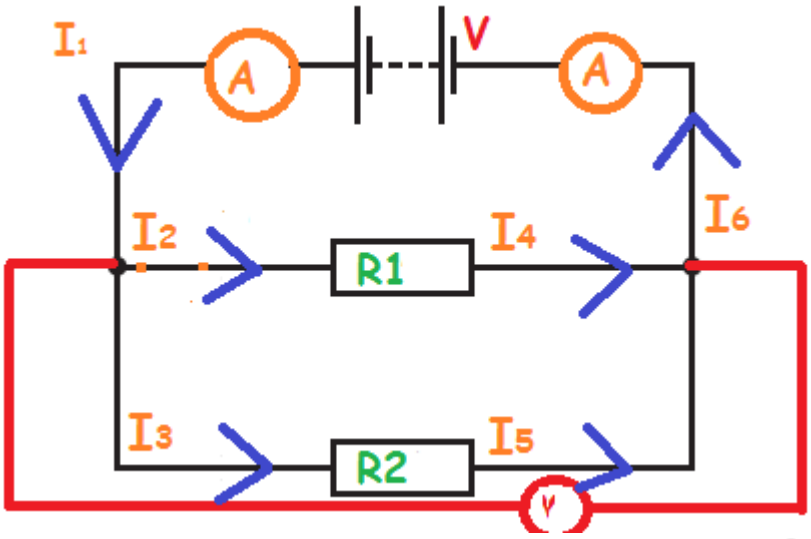


The above diagram can be represented as:



The combined emf= 36V

Parallel circuits



Current:

$I_1 = I_2 + I_3$

$I_1 = I_6$

$I_6 = I_4 + I_5$

$I_2 + I_3 = I_4 + I_5$

$I_2 = I_4$

$I_3 = I_5$

Voltage:

The voltage across the power supply is the same as the voltage across each branch in a parallel circuit.

Hence :

The voltage across Resistor R_1 = The voltage across Resistor R_2
= Emf of the power supply

Resistance:

The total resistance (R) in a parallel circuit is given by:

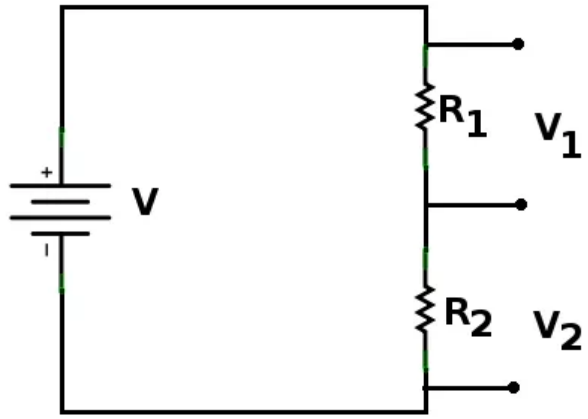
$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

Advantages of connecting lamps in parallel in a lighting circuit:

- All lamps will work at the same brightness.
- If one lamp breaks, the others will continue to light.

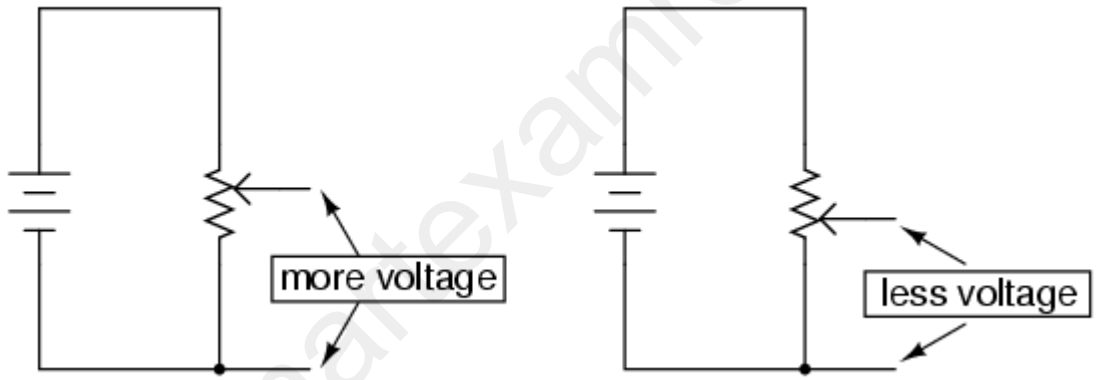
Action and use of circuit components:

Action of a potential divider: *A potential divider consists of 2 or more resistors connected in series across a power supply.*



Because the resistors are in series so the same current flows through them. The emf of the power source is shared between the two resistors R_1 and R_2.

Action of a variable potential divider-potentiometer:



A potentiometer is a kind of potential divider. There is a sliding contact that can help to change the potential.

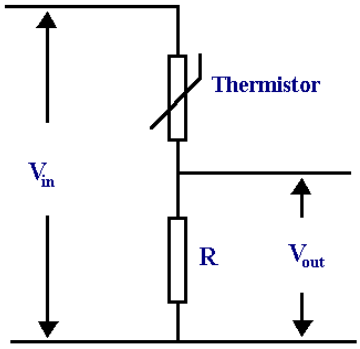
- The voltmeter reading increases when more wires are brought in contact.
- The voltmeter reading decreases when less wires are brought in contact.
- Thus the pd between the sliding contact and either fixed contact depends on the position of the sliding contact.

Action of Thermistors (TDR) and light dependent resistors (LDR) and their use as input transducers

Transducers: A sensor circuit is also called as a transducer.LDR and TDR are used in sensor circuits

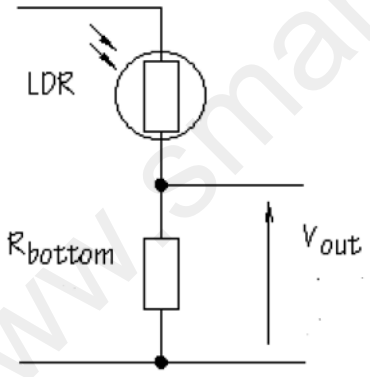
Thermistor:

- A thermistor is a temperature dependent resistor.
- Its resistance decreases as its temperature increases.



When the temperature of the thermistor increases, its resistance decreases, so its share of battery pd decreases. as a result its share of battery pd across resistor R increases so the output pd increases.

Light dependent resistor:



When the brightness of the incident light increases, its resistance decreases, so its share of battery pd decreases. as a result its share of battery pd across resistor R inc

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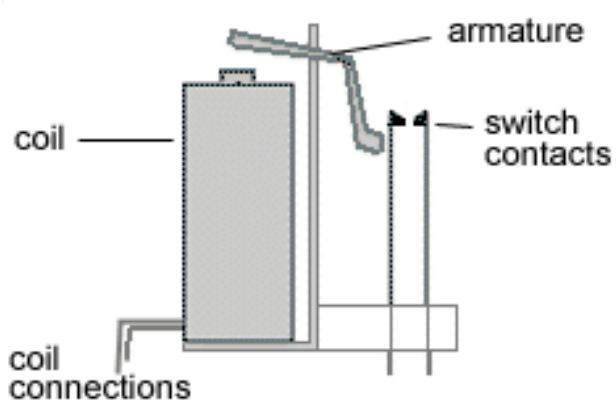
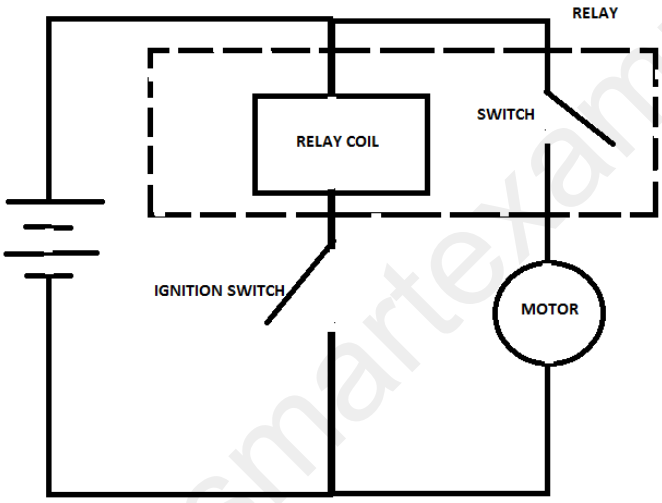
Action of relay and their use in switching circuits:

Relay:

A relay is a special type of switch turned on and off by an electromagnet.



When a current flows through the coil an electro-magnetic field is set up. The field attracts an iron armature, whose other end pushes the contacts together, completing the circuit. When the current is switched off, the contacts open again, switching the circuit off.



When the ignition car switch is turned on, a small current passes through the coil of the electromagnet and the iron armature is attracted to the electromagnet. The armature turns about the pivot and closes the gap. This allows a much larger current to pass through the car motor.

Working of diode and its use as a rectifier:

A diode allows the current to flow in one direction only. This direction is referred to as the forward direction. Its resistance in the forward direction is very low. Its resistance in the reverse direction is very high.

Solved Examples:

8 **(a)** A piece of wire has a resistance of 0.45 Ω. O/N/13-P32

Calculate the resistance of another piece of wire of the same material with a third of the length and half the cross-sectional area.

the resistance of another piece of wire of the same material with a third of the length and half the cross-sectional area.

=(0.45 × 2/3)

= 0.3(0) Ω

(b) Fig. 8.1 shows a circuit with three resistors, a power supply and four voltmeters.

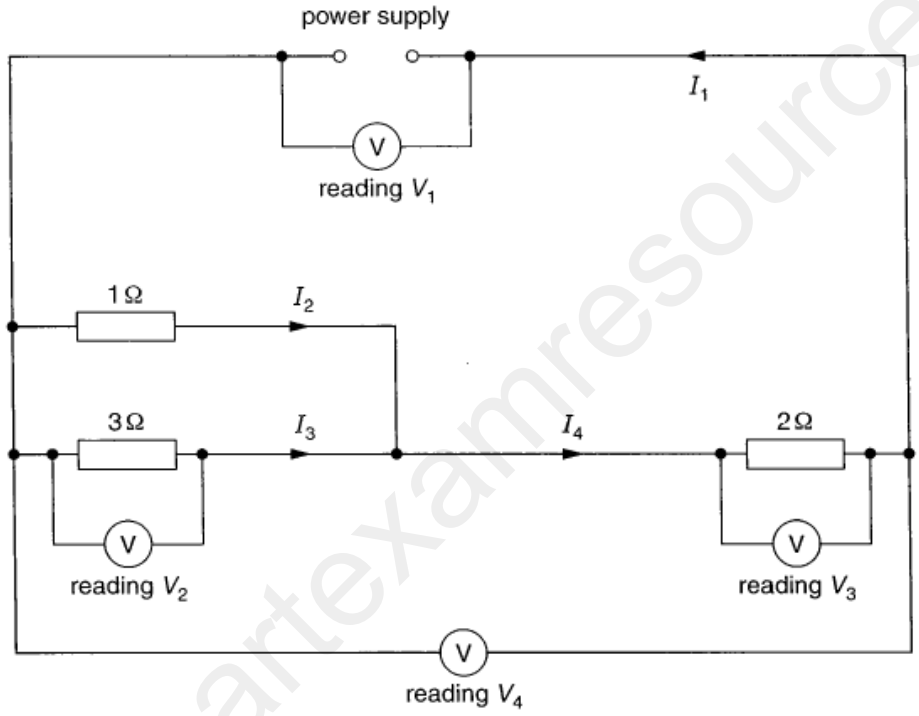


Fig. 8.1

(i) Calculate the combined resistance of the three resistors.

combined reisistance= 1/{(1/1+ 1/3)}+ 2

=2.75ohm

(ii) Write down **two** relationships for the currents in the circuit.

$I_1 = I_4$ *and* $I_1 = I_2 + I_3$

(iii) Write down **two** relationships for the voltmeter readings in the circuit.

$V_1 = V_4$ *and* $V_1 = V_2 + V_3$

10 The circuit shown in Fig. 10.1 uses a 12V battery. A and B are identical lamps, each designed to work from a 6V supply. 16

M/J/2009-P32

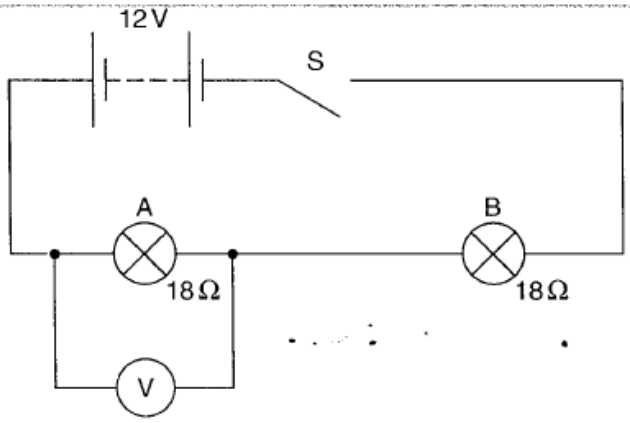


Fig. 10.1

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

(i) State the value of

1. the potential difference (p.d.) across S,

12V

2. the reading on the voltmeter.

0V

(ii) Comment on the brightness of the two lamps.

Both lamps off

(b) Switch S is now closed.

(i) State the new reading on the voltmeter.

6V

(ii) Comment on the brightness of the two lamps.

Normal brightness

(iii) Under these conditions, each lamp has a resistance of 18Ω.

Calculate the current in each lamp.

$V = IR \Rightarrow I = \frac{6}{18} = \frac{1}{3} = 0.3A$

$6 = I \times 18$

(c) With switch S open, lamp B is connected in parallel with lamp A. With no current, each lamp has a resistance of 1.8 Ω.

(i) Calculate the value of the combined resistance of A and B.

$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \therefore \frac{1}{R} = \frac{1}{1.8} + \frac{1}{1.8} \Rightarrow \frac{1}{R} = \frac{2}{1.8} \Rightarrow R = \frac{1.8}{2}$

$= 0.9\Omega$

(ii) State why it would not be wise to close S when A and B are connected in parallel.

Because the lamps would blow off due to too much voltage.

APPLICATION ABSED QUESTIONS:

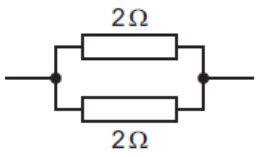
MCQ:

32 A student connects various resistors in parallel pairs. **0625/11/O/N/13**

Underneath each diagram is a statement about the total resistance of each pair of resistors.

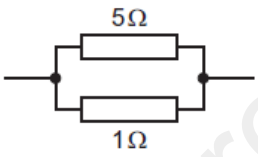
Which statement is correct?

A



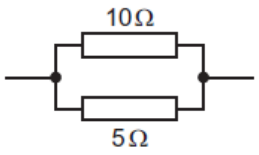
The total resistance is 4Ω.

B



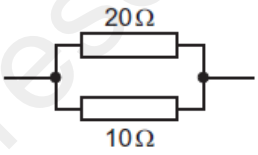
The total resistance is between 1Ω and 5Ω.

C



The total resistance is less than 5Ω.

D



The total resistance is more than 20Ω.

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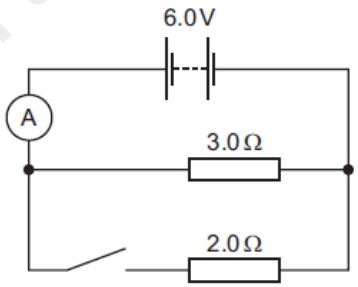
30 The diagram shows a circuit with a 3.0Ω resistor and a 2.0Ω resistor connected in parallel.

0625/11/O/N/14



The switch is open, and the ammeter reads 2.0A.

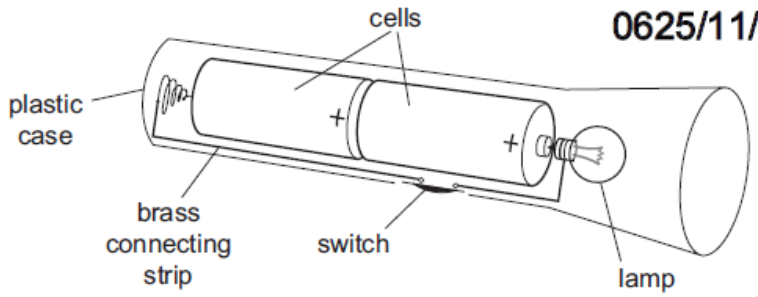
The switch is now closed and the ammeter reads the total current in both resistors.

What is the ammeter reading with the switch closed?

A 1.2A **B** 3.0A **C** 4.0A **D** 5.0A

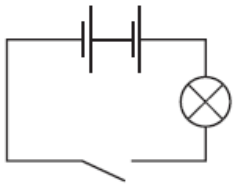
31 The diagram shows a torch containing two cells, a switch and a lamp.

0625/11/O/N/14

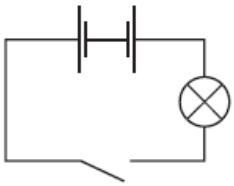


Which is the circuit diagram for the torch?

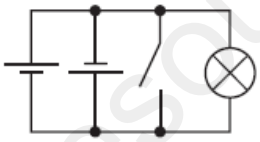
A



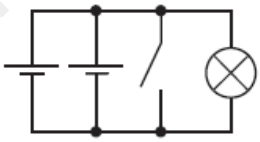
B



C

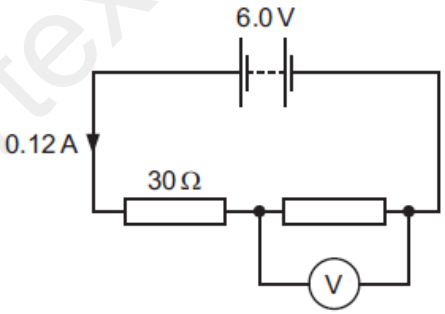


D



29 A 30 Ω resistor is connected in series with another resistor and a 6.0 V battery. The current in the circuit is 0.12 A. A voltmeter is connected across the other resistor.

0625/13/O/N/14



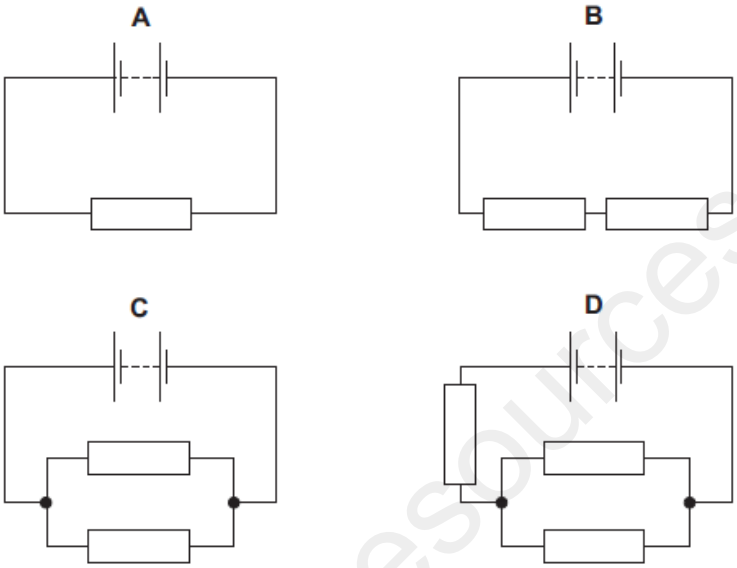
What is the reading on the voltmeter?

A 2.4 V **B** 3.6 V **C** 6.0 V **D** 9.6 V

30 In the circuits shown, all the resistors are identical.

0625/11/M/J/09

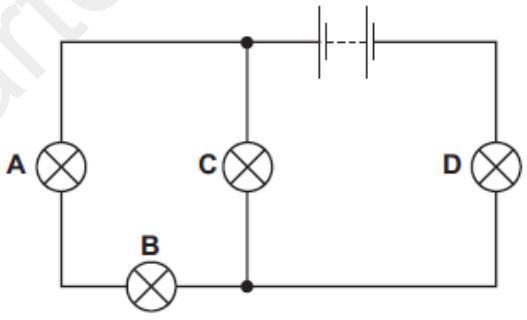
Which circuit has the **least** resistance?



31 In the circuit below, one of the lamps breaks, causing all the other lamps to go out.

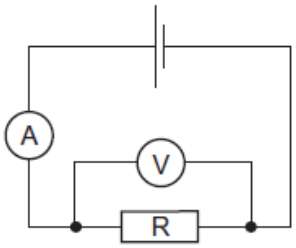
Which lamp breaks?

0625/11/M/J/09



29 A circuit is set up to measure the resistance of a resistor R. The meter readings are 2.0 A and 3.0 V.

0625/11/M/J/10



What is the resistance of the resistor R?

A 0.67 Ω **B** 1.5 Ω **C** 5.0 Ω **D** 6.0 Ω

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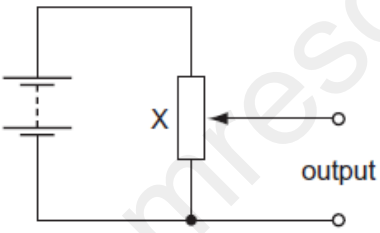
30 The circuit shown is a potential divider.



0625/11/M/J/10

What is component X?

A a light-dependent resistor

B a relay

C a thermistor

D a variable resistor

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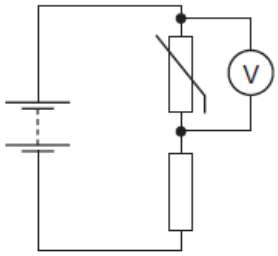
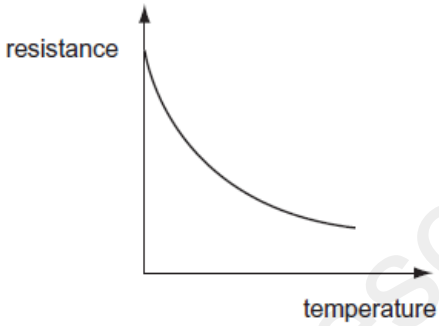
31 The diagram shows a thermistor in a potential divider. A voltmeter is connected across the thermistor.

0625/11/M/J/11



The graph shows how the resistance of the thermistor changes with temperature.



As the thermistor becomes warmer, what happens to its resistance and what happens to the reading on the voltmeter?

0625/11/M/J/11

	resistance	voltmeter reading
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

---

36 An electric current can produce a heating effect and a magnetic effect.

0625/13/M/J/13

Which row shows the effect that a relay uses, together with one application of a relay?

	effect used by a relay	one application of a relay
A	heating effect	allowing a small current to switch on a large current
B	heating effect	changing the voltage of an alternating current
C	magnetic effect	allowing a small current to switch on a large current
D	magnetic effect	changing the voltage of an alternating current

---

27 A thermistor is used in a circuit to control a piece of equipment automatically.

What might this circuit be used for?

0625/13/M/J/12

A lighting an electric lamp as it becomes darker

B ringing an alarm bell if a locked door is opened

C switching on a water heater at a pre-determined time

D turning on an air conditioner when the temperature rises

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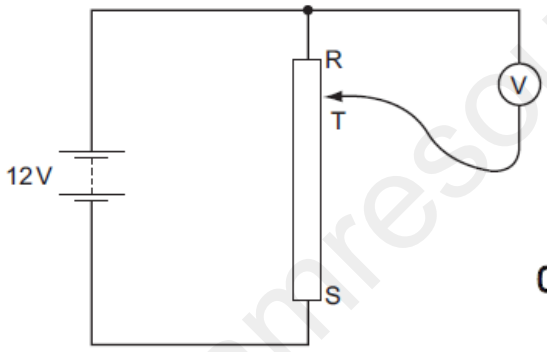
32 A student connects a variable potential divider (potentiometer) circuit.



0625/13/M/J/12

What happens to the reading on the voltmeter as the sliding terminal T is moved from R to S?

A It decreases from 12 V to 0 V.

B It increases from 0 V to 12 V.

C It remains at 0 V.

D It remains at 12 V.

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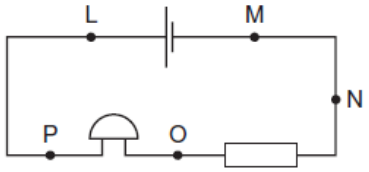
31 The diagram shows an electrical circuit.

0625/11/M/J/13



Between which two points must a voltmeter be connected to find the potential difference across the bell?

A L and M **B** M and N **C** N and O **D** O and P

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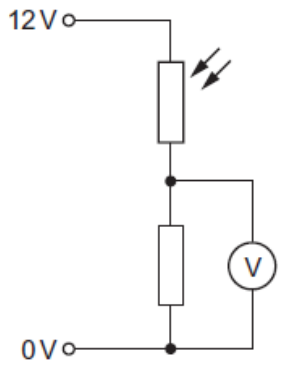
31 The diagram shows part of an electric circuit.



The light falling on the light-dependent resistor (LDR) increases in brightness.

What happens to the resistance of the LDR and what happens to the reading on the voltmeter?

	resistance of LDR	reading on voltmeter
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

0625/11/M/J/14

APPLICATION BASED QUESTIONS-EXTENDED THEORY

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

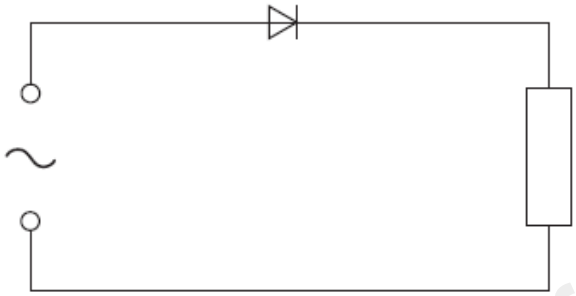


Fig. 9.1

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

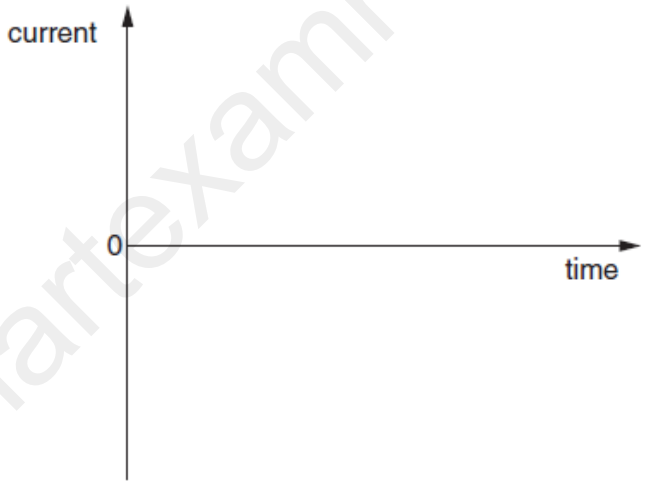


Fig. 9.2

(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.

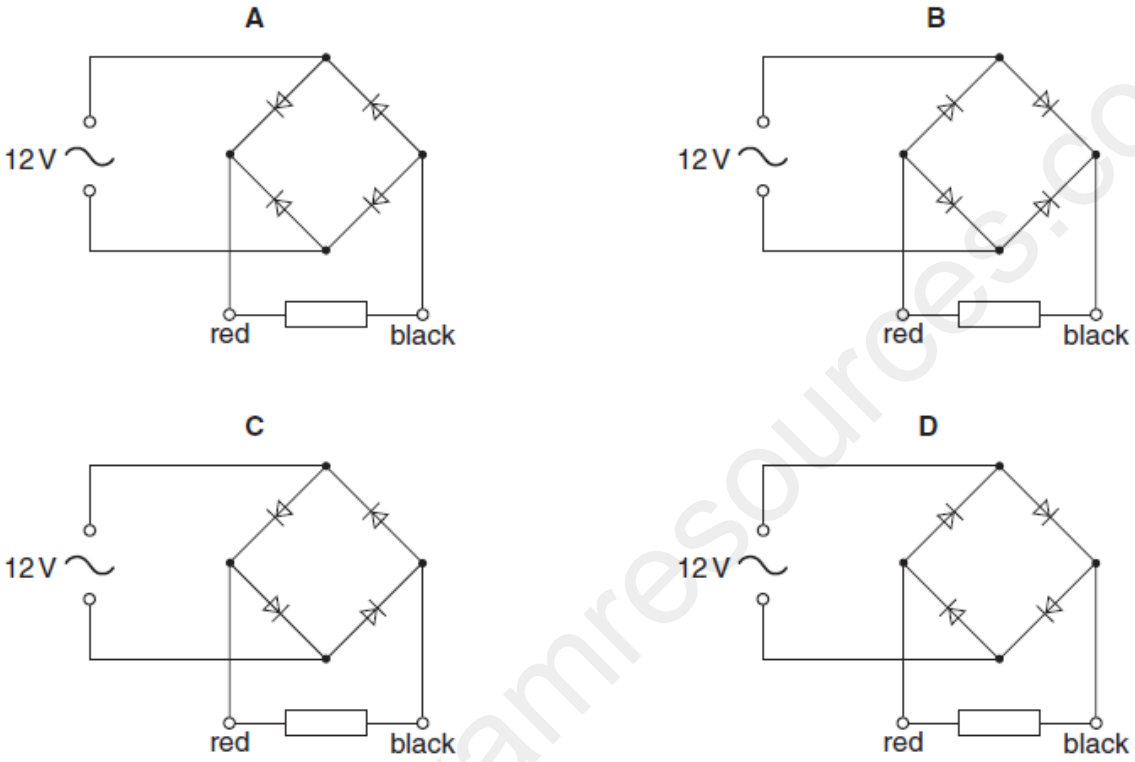


Fig. 9.3

(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]

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

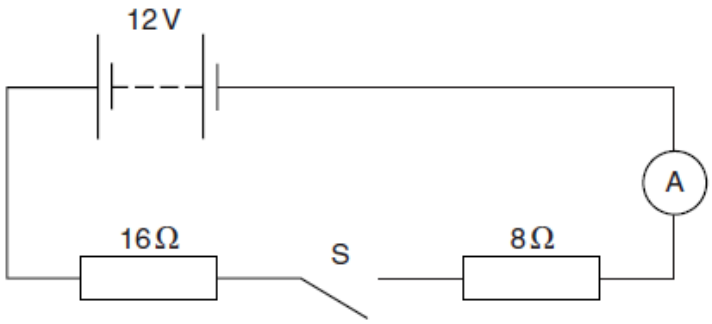


Fig. 10.1

(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 8 Ω 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]

(b) The output of Q is connected to the rectifier circuit.

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State

(i) the name of the circuit component that is used in a rectifier circuit to rectify the a.c. (alternating current),

..... [1]

(ii) the property of this component that is used to rectify the current.

..... [1]
