# Electricity – Exam type questions

The resistance of a certain piece of wire is found to be 0.8 Ω. What would be the resistance of

**Question 11**

a piece of the same wire 3 times as long?

**A** 0.27 Ω **B** 0.8 Ω **C** 2.4 Ω **D** 7.2 Ω

**Question 12**

two pieces of the same wire side by side?

**A** 0.27 Ω **B** 0.2 Ω **C** 0.4 Ω **D** 1.6 Ω

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A battery of emf 6 volt is connected across 0.30 m of resistance wire of diameter 1.0 mm. A current of 0.5 ampere flows through the wire.

**Question 13 (1984 Question 59)**

What current will flow if this wire is replaced by 1.20 m of the same wire?

A circuit consists of a 12 volt battery and two 4 ohm resistors connected in series. Draw the circuit, and use it to answer the following questions.

**Question 17**

How many Coulomb pass through each resistor in a second?

**Question 18**

How many joule of energy is each coulomb of charge given as it passes through the battery?

**Question 19**

How much energy would each coulomb of charge flowing from a 9 V transistor radio battery possess?

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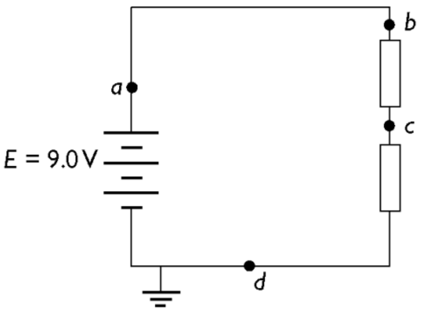
**Question 21**

Find the voltage at point c in the following circuit. The voltage drop $V_{cd}$ is 3.5 V.

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**Question 22**

What is meant by the expression ‘voltage drop’?

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**Question 25**

What is the voltage drop across a 330 Ω resistor if it carries a current of 4.0 A?

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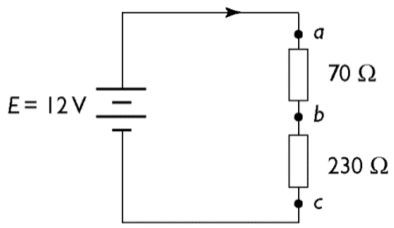
**Questions 31 to 33** refer to the following circuit.




**Question 31**

What is the effective resistance of this circuit?

**Question 32**

What is the magnitude of the current at point b?

**Question 33**

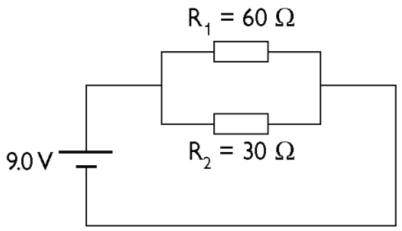
Calculate the voltage drop $V_{ab}$.

**Question 34**

What is the effective resistance of two resistors connected in parallel if their values are 20 Ω and 5.0 Ω?

**Questions 35 to 38** refer to the following information.

Consider the circuit below.




**Question 35**

What is the effective resistance of this circuit?

**Question 36**

What is the voltage drop across the 60 Ω resistor?

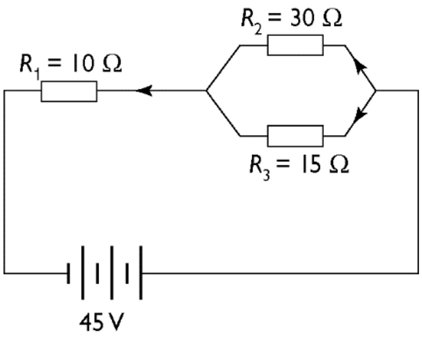
**Question 37**

Calculate the current flowing through the 60 Ω resistor.

**Question 38**

Calculate the current flowing through the source of emf in this circuit.

**Questions 39 to 41** refer to the following circuit diagram.




**Question 39**

Find the effective resistance of this circuit.

**Question 40**

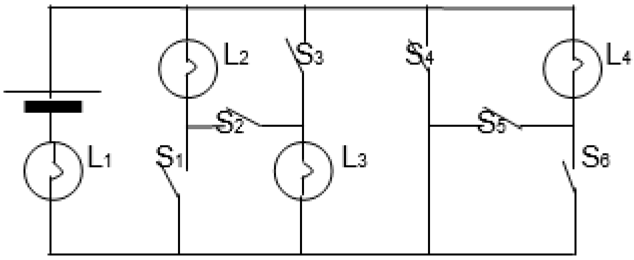
What is the voltage drop across the 15 Ω resistor?

**Question 41**

What current flows through the 30 Ω resistor?

**Questions 43 to 45** refer to the following information.

A battery, 4 light globes ($L_1$, $L_2$, $L_{3,}$, $L_4$) and 6 switches ($S_1$, $S_2$, $S_3$, $S_4$, $S_5$, $S_6$) are connected as shown




**Question 43**

Which one of the following best describes the situation if switch $S_2$ only is closed?

**A** $L_1$ only would light

**B** $L_1$ and $L_2$ only would light

**C** $L_1$, $L_2$, and $L_3$ only would light

**D** $L_1$, $L_2$, $L_3$ and $L_4$ would light.

**Question 44**

Which one of the following best describes the situation if switch $S_5$ only is closed?

**A** $L_4$ only would light

**B** $L_1$ and $L_3$ only would light

**C** $L_1$, and $L_4$ only would light

**D** No globes would light.

**Question 45**

Which one of the following best describes the situation if switches $S_3$ and $S_4$ only are closed?

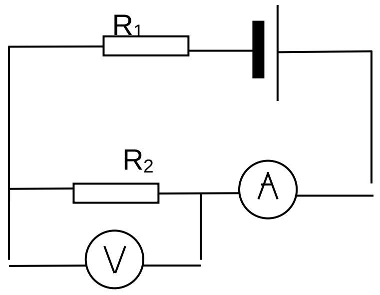
**A** $L_1$ only would light

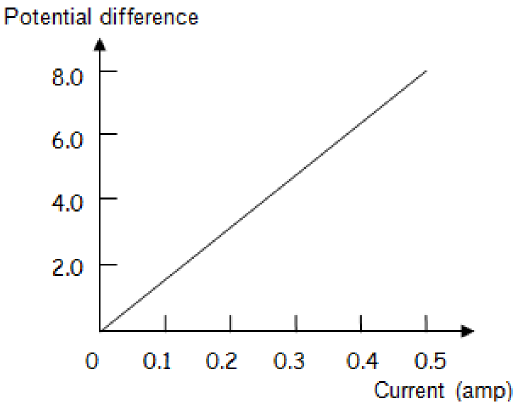
**B** $L_1$ and $L_3$ only would light

**C** $L_2$, and $L_3$ only would light

**D** $L_1$, $L_2$, $L_3$ and $L_4$ would light.

The diagram represents a circuit containing two resistors, a voltmeter, an ammeter and a battery.




The graph shows the relation between the current through $R_2$ and the potential difference across it.

**Question 46**

Which one of the following is most nearly the current flowing through resistor $R_2$ when the potential difference across it is 5.0 volt?

**A** 0.33 A **B** 2.4 A **C** 0.40 A **D** 3.3 A

**Question 47**

The resistance of resistor $R_2$ is closest to

**A** 1.5 Ω **B** 15 Ω **C** 1.7 Ω **D** 17 Ω

**Question 48**

If the EMF of the battery needed to supply a current of 0.40 A is 8.0 V, what is the resistance of the resistor $R_1$?

**A** 3 Ω **B** 18.5 Ω **C** 5 Ω **D** 20 Ω

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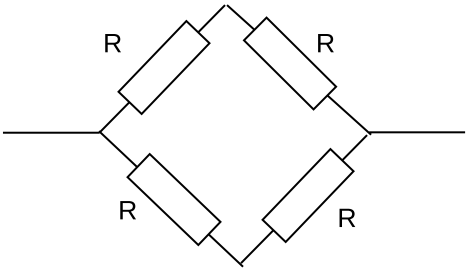
The diagram represents a section of a circuit showing the connections between four equal resistors. Each resistor has a resistance of R Ω



**Question 49**

What is the equivalent resistance of this network?

**A** R Ω **B** 2R Ω **C** 0.5R Ω **D** 4R Ω

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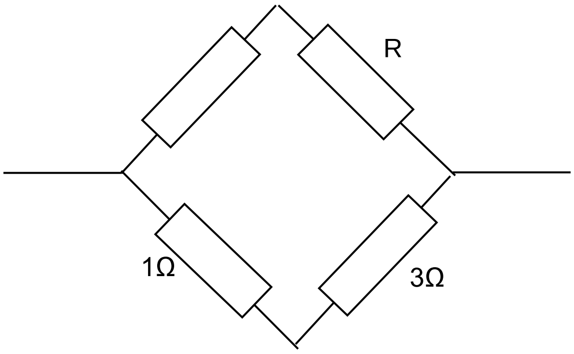
**Question 50**

In the circuit below what is the value of the resistor R, if the total resistance of the combination is 3.2 ohm?

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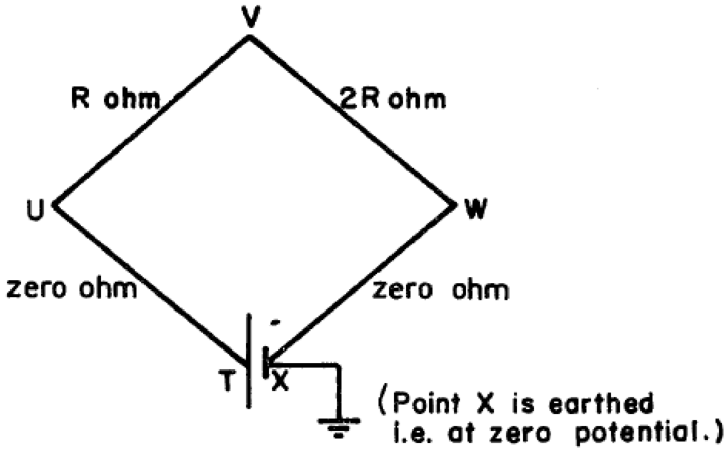
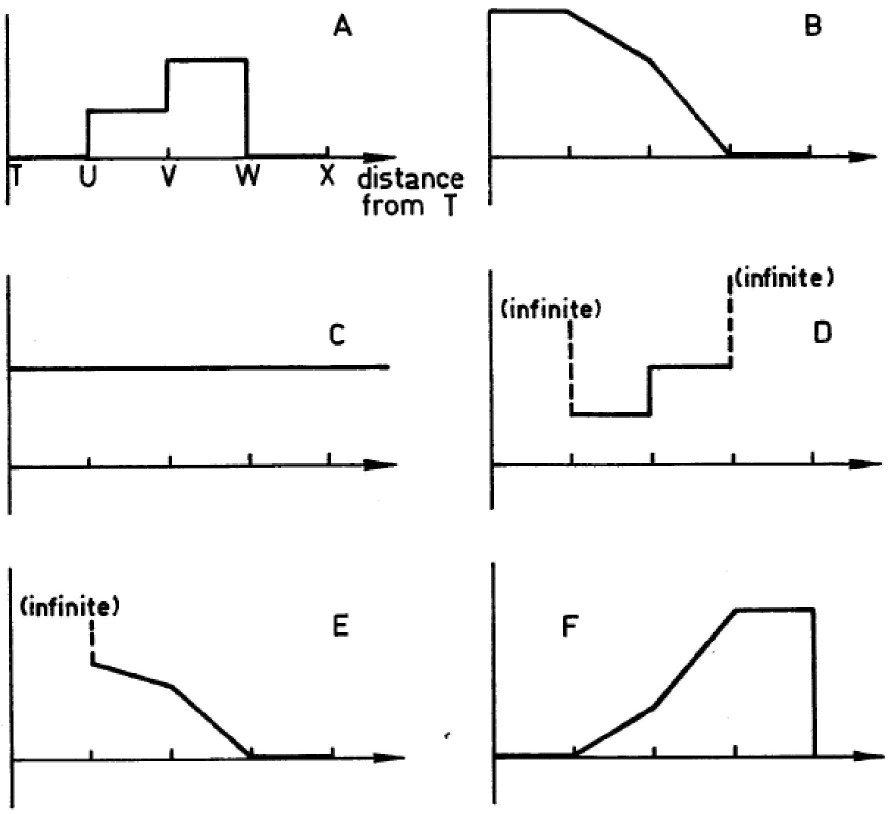



A network of four different wires of equal length is connected to a battery as shown.




**Question 51 (1971 Question 70)**

Which graph best represents the electric potential versus distance relation around the circuit?

**Question 52 (1971 Question 71)**

Which graph best represents the current versus distance relation around the circuit?

**Question 53 (1971 Question 72)**

What would happen in the circuit if T and V were connected by a wire of zero resistance?

**A.** Theoretically, there would be an infinite current in the circuit; in practice, the battery would be short-circuited, and quickly lose its store of energy.

**B.** The current in TUV would fall to zero, and the current in VWX would increase.

**C.** The current in UV would be doubled, and the current in VW halved.

**D.** The current in both UV and VW would decrease.

**E.** There would (theoretically) be an infinite current in TV.

**F.** There would be no change in the currents in the circuit.

- ***investigate and analyse theoretically and practically electric circuits using the relationships P = I V = E / t***

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## ELECTRICAL ENERGY AND POWER

## ELECTRICAL ENERGY

When a current passes through a resistor, the resistor gets hot. Electrical energy is being converted to thermal energy. Electrical energy can also be converted into mechanical energy.

If 'Q' of charge passes through a potential difference of 'V', the work done by the electrical force is

$$W = Q\,V.$$

So if it takes 'V' joules of energy to get '1' coulomb of charge form one place to another, then it takes 'VQ' joules to get 'Q' coulomb from one place to another

As the current is the rate at which charge is moving, the total charge Q = I t.

$$\Rightarrow \quad W = V\,i\,t.$$

## ELECTRIC POWER

The rate of energy transferred or the rate of work done is called **power**. In a circuit component the power can be calculated in terms of potential difference and current

$$P = \frac{W}{t} = \frac{QV}{t} = I\,V$$

The unit for power is the watt (W).

One watt is equal to one joule per second. $1\text{ W} = 1\text{ J s}^{-1}$

In terms of the volt and ampere 1 W = 1 V A

A larger unit for power is the kilowatt (kW). 1 kW = 1000 W.

Since P = I V and V = I R

$$P = I\,V = I^2 R = \frac{V^2}{R}$$

The energy supplied in time 't' is

$$W = I^2 R\,t = \frac{V^2}{R}\,t = V\,I\,t = P\,t$$

## UNITS FOR ELECTRICAL ENERGY

The unit for electrical energy is the joule. In industry and in household consumption of electricity the unit kilowatt hour (kWh) is used. One kWh is the energy delivered in one hour at a rate of 1000 W.

$$\Rightarrow \quad 1\text{ kWh} = 1000 \times 3600\text{ s}$$

$$\Rightarrow \quad = 3.6 \times 10^6\text{ J}$$

**Question 56**

Calculate the amount of energy transformed in a toaster if it has a voltage drop of 240 V and 50 C of charge pass through it.

**Question 64 (1990 Question 41)**

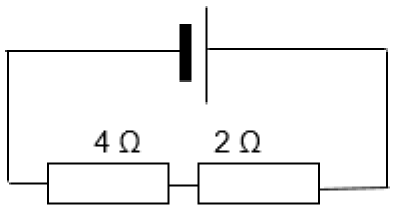
A lightning bolt transfers 30 C of charge to the Earth through a potential difference of 2.0 x $10^8$ V. How much energy is dissipated in this lightning strike?

**Question 65 (1990 Question 42)**

The lightning strike lasts for only 1.5 x $10^{-3}$ s.
What is the average current flowing during the strike?

**Questions 66 to 68** refer to the following information.

The diagram represents the connection between a battery and two resistors.




**Question 66**

The ratio $\frac{\text{potential difference across 4 ohm resistor}}{\text{potential difference across 2 ohm resistor}}$

**A** $\frac{2}{1}$ **B** $\frac{1}{2}$ **C** $\frac{1}{1}$

**Question 67**

The ratio $\frac{\text{current in the 4 ohm resistor}}{\text{current in the 2 ohm resistor}}$

**A** $\frac{2}{1}$ **B** $\frac{1}{2}$ **C** $\frac{1}{1}$

**Question 68**

The ratio $\frac{\text{power dissipated (4 ohm resistor)}}{\text{power dissipated (2 ohm resistor)}}$

**A** $\frac{4}{1}$ **B** $\frac{2}{1}$ **C** $\frac{1}{2}$ **C** $\frac{1}{4}$

**Questions 69 to 71** refer to the following information.

A steady current of 0.3 amp passed through a lamp for 2 minutes. The EMF of the supply was 6.0 volt.

**Question 69**

What is the resistance of the lamp filament?

**Question 70**

What quantity of electricity passed through the lamp?

**Question 71**

What power was dissipated in the lamp?

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**Question 72**

What is the power dissipated by an electric light filament of resistance 2.0 ohms if a potential of 12 volts is maintained across the terminals?

**A** 6.0 watts **B** 48 watts **C** 24 watts **D** 72 watts

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**Question 73**

How much current is used in a 60 W, 240 V light globe?

**A** 0.25 A **B** 4 A **C** 15 A **D** 960 A

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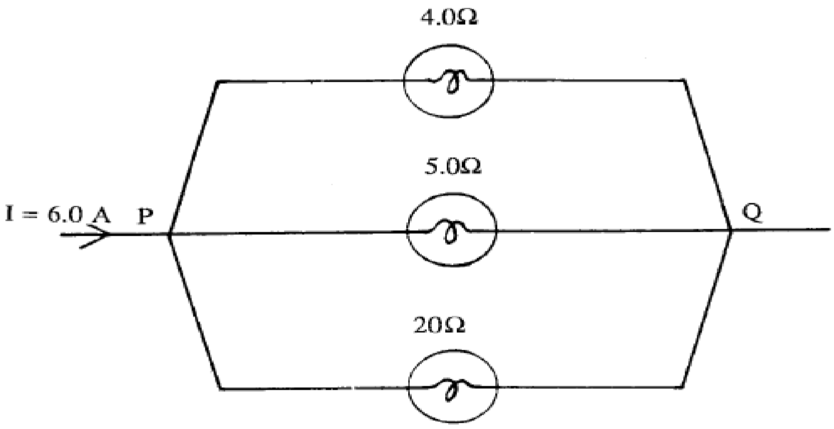
**Question 74**

How much current is used by a 100 W car windscreen wiper motor?

**A** 12.0 A **B** 2.40 A **C** 0.12 A **D** 8.33 A

Three light globes are connected as shown below. A total current of 6.0 A flows as shown. Under these conditions the light globes have resistances of 4.0 ohm, 5.0 ohm and 20 ohm.




**Question 81 (1989 Question 42)**

Find the electric potential difference between the points P and Q.

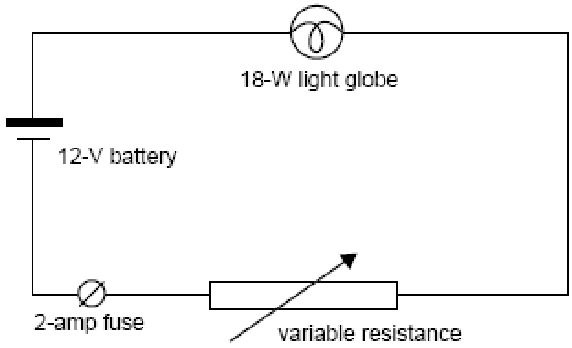
**Question 82 (1989 Question 43)**

Find the current flowing through the 4.0 ohm globe.

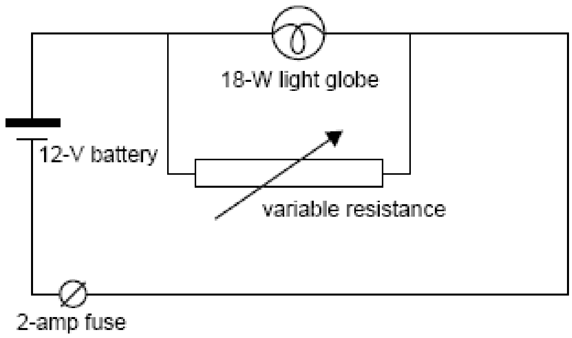
**Question 83 (1989 Question 44)**

What power is the 4.0 ohm globe dissipating?

Kim decides to design a circuit to control the light intensity of a portable lamp. The circuit consists of a 12-V light globe rated at 18 W, a variable resistor, a 12 V battery, and a 2 amp fuse with negligible resistance. Kim is considering two different circuits, shown as circuit A and circuit B.




circuit A




circuit B

When the variable resistance in circuit A is zero, or when the variable resistance in circuit B is infinite, the light globe operates at its rated value. The resistance of the filament is 8.0 Ω, and can be assumed to be independent of its temperature.

**Question 84 (2003 Question 5, 3 marks)**

Using circuit A, what is the value of the variable resistance when the power dissipated in the light globe is 9.0 W?

**Question 85 (2003 Question 6, 3 marks)**

When using circuit B, what is the value of the variable resistance when the fuse burns out?

**Question 86 (2003 Question 7, 3 marks)**

Which circuit, A or B, should Kim choose? Justify your answer.

It requires 6.0 x $10^5$ joules of energy to boil a quantity of water in a particular electric kettle. The supply voltage to the element of the kettle is 240 V and the current flowing in the element is 10 A.

**Question 87 (1986 Question 59)**

What is the time taken to boil the water?

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An electric motor rated at 15 watt, brought from the United States, is designed to operate from a 120 volt supply. In order to use it with a 240 volt supply, a 240 volt light globe is used as a series resistance. Standard globes are available at the following rating:

**A.** 20 W

**B.** 40 W

**C.** 60W

**D.** 100 W

**E.** 150 W

**Question 88 (1982 Question 60)**

Which of these (A - E) would be most suitable?

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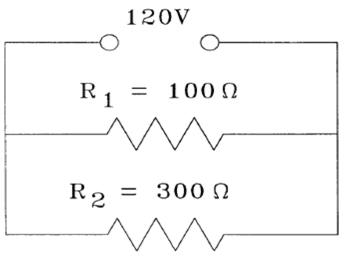
An electric heater consists of two elements connected in parallel and is operated from a 120 V DC supply.




**Question 89 (1990 Question 43)**

What is the total resistance of the heater?

**Question 90 (1990 Question 44)**

What current passes through the 100 Ω element when both elements are operating?

**Question 91 (1990 Question 45)**

At what power will the heater be operating when both elements are on?

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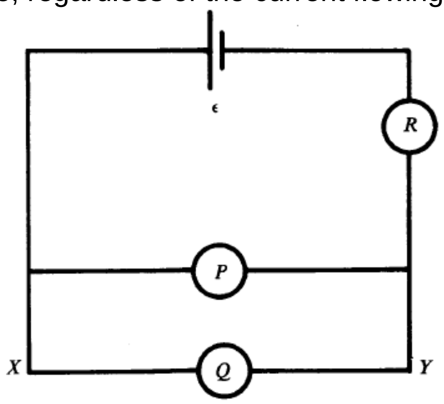
P, Q and R, are three identical light globes connected to a voltage source, ε. The light globes always have the same resistance, regardless of the current flowing through them.




**Example 92 (1986 Question 56)**

What is the ratio: $\frac{\text{rate of heat dissipated in R}}{\text{rate of heat dissipated in Q}}$?

**Example 93 (1986 Question 57)**

If globe Q is removed from its socket, what is the ratio:

$$\frac{\text{current flowing through lamp R before lamp Q was removed}}{\text{current flowing through lamp R after lamp Q was removed}}?$$

**Example 94 (1986 Question 58)**

Which of the following statements (**A - D**) best describes any change in the potential difference between points X and Y as a result of removing lamp Q?

**A.** The potential difference between points X and Y will increase.

**B.** The potential difference between points X and Y will become zero.

**C.** The potential difference between points X and Y will not change.

**D.** The potential difference between points X and Y will decrease.

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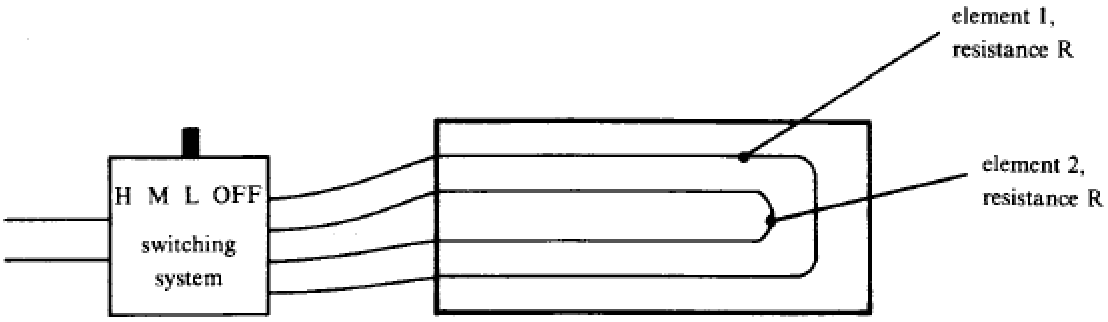
The following diagram represents an electric blanket.




A single bed electric blanket, with a three heat selector switch, consists of two electric heating elements of the same resistance. To obtain the three heat settings (high, medium and low) the switching system is used to connect the two elements to the 240 V supply in the following combinations –

**parallel** : elements 1 and 2 are connected in parallel.

**series** : elements 1 and 2 are connected in series.

**one element** : only element 1 is connected, element 2 is not used.

**Question 95 1983 Question 59**

Which line in the table below correctly indicates the way the two elements must be connected to provide the three heat settings?

| | HIGH | MEDIUM | LOW |
|---|---|---|---|
| **A.** | parallel | series | one element |
| **B.** | parallel | one element | series |
| **C.** | series | parallel | one element |
| **D. .** | series | one element | parallel |
| **E. .** | one element | series | parallel |
| **F.** | one element | parallel | series |

**Question 96 1983 Question 60**

What is the value of the following quantity?

$$\frac{\text{power dissipated in series connection}}{\text{power dissipated in parallel connection}}$$

## Solutions

### Question 1

Positive charge proton
Negative charge electron

### Question 2

1 coulomb is $1/(1.6 \times 10^{-19}) = 6.25 \times 10^{18}$ electrons

### Question 3

Has to be a multiple of $1.6 \times 10^{-19}$.
∴ A and C

### Question 4

Q = It
∴ Q = 5 x 4 = 20 Coulomb

### Question 5

0.57 A = 570 mA

### Question 6

Conductor: Substances that have a weak hold on some of their electrons, eg copper, steel
Insulator: Substances that have a strong hold on some of their electrons, eg rubber

### Question 7

In DC the polarity of the voltage is stays in the same direction, eg battery
In AC the polarity usually reverses 50 times every second. Eg power point

### Question 8

35 mA

### Question 9

We need to use 3V as the full scale deflection (fsd).
Reading from that scale we get 1.4 V.

### Question 10

D
You need the voltmeter to read across the resistance, hence it needs to be in parallel with the resistor, and you need the ammeter to be in series with the resistance.

### Question 11

3 x 0.8 = 2.4 Ω
∴ C

### Question 12

C

### Question 13 1984 Question 59

If the length is increased by a factor of 4, the resistance is increased by a factor of 4. This will decrease the resistance by a factor of 4.

∴ 5 ÷ 4 = 0.125

∴ **0.125 Ω (ANS)**

### Question 14 1984 Question 60

Using $R = \frac{\rho L}{A}$, if the diameter is decreased by a factor of $\frac{1}{0.4}$ = 2.5, the area will decrease by a factor of $2.5^2$. This means that the resistance will increase by a factor of 6.25, so the current will decrease by this factor.

I = 0.5 ÷ 6.25

∴ **I = 0.08 A (ANS)**

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### Question 15 1985 Question 52

Use $R = \frac{\rho L}{A}$ and ratios

∴ $\frac{\times 1 \times 2}{\times 4}$

∴ $\times \frac{1}{2} \times 100$

∴ **$R_{New}$ = 50 Ω (ANS)**

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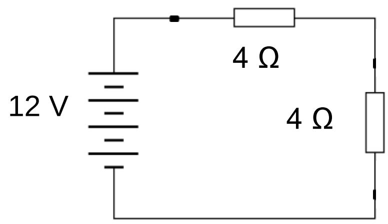
### Question 16

1.3 A, out of the junction

### Question 17




Using V = iR, gives I = 1.5 amp.
(since $R_T$ = 8 Ω)
∴ 1.5 Coulomb of charge passes through each resistor each second.

**Question 18**

Each coulomb of charge is given 12 Joule of energy, as the EMF is 12V.

**Question 19**

Each coulomb of charge would have 9 Joule of energy, as the EMF is 9V.

**Question 20**

The sum of the potential drops around the circuit must be 9.0 V.

$\therefore V_{ab} = 9.0 - 7.8$

$= 1.2$ V

**Question 21**

The potential at the points a and b is 9.0. If the voltage drop across cd is 3.5 V, and the potential at d = 0.

$\therefore$ The potential at c must be 3.5 V.(Because this is how much it has to lose to get to zero at d).

**Question 22**

The 'voltage drop' or potential drop is the energy transferred to a circuit component per unit charge (in coulomb). It is measured in volts.

**Question 23**

In the question each measurement has 2 significant figures, so your answer can only be quoted to 2 sig figs.

$\therefore$ C (ANS)

**Question 24**

Using V = iR, this can be rearranged as

$$R = \frac{V}{i}$$

$$\therefore R = \frac{240}{0.25}$$

$$\therefore R = 960\ \Omega$$

**Question 25**

Using V = iR

$\therefore V = 4.0 \times 330$

$= 1320$ V

**Question 26**

In series

$R_{total} = R_1 + R_2 + R_3$

$= 220 + 450 + 1\ 100$ (convert all to ohms)

$= 1770\ \Omega$

**Question 17**

All elements are in series. Therefore the current is the same at all points in the circuit.

$\therefore$ 0.5 A

**Question 28**

Using V = iR

$V = 0.5 \times 16$

$\therefore V = 8$ V

**Question 29**

The EMF of the supply is 12 V, therefore the sum of the voltage drops around the circuit will add to 12 V

$\therefore 12 = V_{R1} + V_{R2}$

$\therefore 12 = 8 + V_{R2}$

$\therefore V_{R2} = 4$ V

**Question 30**

Use V = iR

$\therefore 4 = 0.5 \times R_2$

$\therefore R_2 = 8\ \Omega$.

A logic argument would also have provided that since the voltage drop is half of $R_1$, with the current the same then the resistance of $R_2$ will be half $R_1$.

**Question 31**

As the elements are in series.

$\Sigma R = R_{ab} + R_{bc}$

$\therefore \Sigma R = 70 + 230$

$\therefore \Sigma R = 300\ \Omega$.

**Question 32**

The current at point b is the same as the current everywhere else in the circuit.

Use V = iR for the circuit,

$\therefore 12 = i \times 300$

$\therefore i = 0.04$ A

**Question 33**

$V_{ab} = i \times R_{ab}$

$\therefore V_{ab} = 0.04 \times 70$

$= 2.8$ V

**Question 34**

Use $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

$\therefore \frac{1}{R_T} = \frac{1}{20} + \frac{1}{5}$

$\therefore \frac{1}{R_T} = \frac{1}{20} + \frac{4}{20}$

$\therefore \frac{1}{R_T} = \frac{5}{20}$

$R_T = \frac{20}{5}$

$\therefore R_T = 4\ \Omega$

**Question 35**

Use $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

$\therefore \frac{1}{R_T} = \frac{1}{60} + \frac{1}{30}$

$\therefore \frac{1}{R_T} = \frac{1}{60} + \frac{2}{60}$

$\therefore \frac{1}{R_T} = \frac{3}{60}$

$R_T = \frac{60}{3}$

$\therefore R_T = 20\ \Omega$

**Question 36**

As both elements are in parallel the voltage drop across them will be the same. In this case there aren't any more elements in the circuit, so the total voltage drop occurs across the combination in parallel.
∴ the voltage drop across the 60 Ω resistor is 9 volts, and the voltage drop across the 30 Ω resistor is also 9 volts.

**Question 37**

Use V = iR

$\therefore 9 = i \times 60$

$\therefore i = 0.15$ A

**Question 38**

The current flowing through the 30 Ω resistor is found from
V = iR

∴ $\therefore 9 = i \times 30$

$\therefore i = 0.3$ A

Therefore the current being supplied by the source is 0.15 A + 0.3 A

∴ 0.45 A

**Question 39**

The effective resistance is the sum of the 10 Ω resistance and the effective resistance of the parallel elements.
To find the effective resistance of the parallel elements

Use $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

$\therefore \frac{1}{R_T} = \frac{1}{15} + \frac{1}{30}$

$\therefore \frac{1}{R_T} = \frac{2}{30} + \frac{1}{30}$

$\therefore \frac{1}{R_T} = \frac{3}{30}$

$R_T = \frac{30}{3}$

$\therefore R_T = 10\ \Omega$

∴ The effective resistance of the complete circuit is 10 Ω + 10 Ω (parallel elements)

$\therefore R_{total} = 20\ \Omega$

**Question 40**

This is a circuit that is effectively a 10 Ω resistor followed by a 10 Ω resistor in series.

∴ the potential drop across the parallel elements will be half the EMF.
∴ 22.5 volts is lost across the parallel elements and 22.5 volts is lost across the 10 Ω resistor.

∴ the voltage drop across the 15 Ω resistor will be 22.5 V.

**Question 41**

Use V = iR to find the current in the 30 Ω resistor.

$\therefore 22.5 = i \times 30$

$\therefore i = 0.75$ A

**Question 42**

In parallel circuits (and from Kirchhoff's Law) the current into any point on the circuit is equal to the current out of that point.

$\therefore I = I_1 + I_2$

∴ D

**Question 43**

The globes will only glow if their circuit is complete.
With $S_2$ closed, $L_1$, $L_2$, and $L_3$ will operate.
∴ C

**Question 44**

With $S_5$ closed, $L_1$ and $L_4$ will operate.
∴ C

**Question 45**

With $S_3$ and $S_4$ closed, $L_1$ will operate.
∴ A

$L_3$ will not operate, because $S_4$ is creating a short circuit and the current will not flow through $L_3$.

**Question 46**

From the graph, 0.33
∴ A

**Question 47**

The resistance is the gradient of the graph, or found from V = iR
Use 5 = 0.33 x R
∴ R = 15 Ω
∴ B

**Question 48**

If the current in the circuit is 0.4 A, the voltage drop across $R_2$ is given by

$V = iR_2$
∴ V = 0.4 x 15
∴ V = 6 V

This means that the voltage across $R_1$ is given by 8.0 – 6.0 = 2.0 V
If the current in $R_1$ is 0.40 A (as they are in series)

∴ V = iR
∴ 2.0 = 0.40 x R
∴ R = 5 Ω

**Question 49**

Each arm of the parallel system has two resistors in series.
The resistance of each arm is 2R
∴ the effective resistance is given by

Use $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

$\therefore \frac{1}{R_T} = \frac{1}{2R} + \frac{1}{2R}$

$\therefore \frac{1}{R_T} = \frac{2}{2R}$

$\therefore \frac{1}{R_T} = \frac{1}{R}$

∴ $R_T = R$
∴ A

**Question 50**

Use $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

$\therefore \frac{1}{3.2} = \frac{1}{R+8} + \frac{1}{1+3}$

$\therefore \frac{1}{3.2} = \frac{1}{R+8} + \frac{1}{4}$

$\therefore \frac{1}{3.2} - \frac{1}{4} = \frac{1}{R+8}$

$\therefore \frac{4}{12.8} - \frac{3.2}{12.8} = \frac{1}{R+8}$

$\therefore \frac{0.8}{12.8} = \frac{1}{R+8}$

$\therefore \frac{12.8}{0.8} = \frac{R+8}{1}$

∴ R + 8 = 16
∴ R = 8 Ω

You may choose to do this on your calculator.

**Question 51**

B

**Question 52**

C

**Question 53**

B

**Question 54**

F

**Question 55**

C

**Question 56**

W = VQ
$\therefore$ W = 240 x 50
$\therefore$ W = 12 000 J

**Question 57**

W = Vit
$\therefore$ W = 12 x 80 x 15
$\therefore$ W = 14 400 J

**Question 58**
You must get all the units into MKSA.
W = Vit
$\therefore$ W = 9.0 x (350 x $10^{-3}$) x (30 x 60) (secs)
$\therefore$ W = 9.0 x 0.350 x 1800
$\therefore$ W = 5670 J

**Question 59**

Power = VI
$\therefore$ P = 240 x 2
$\therefore$ P = 480 W

**Question 60**

P = VI
$\therefore$ 60 = 240 x i
$\therefore$ i = 0.25 A

**Question 61**

By definition of voltage, as being the energy given to each coulomb.
**$\therefore$ 12 Joule (ANS)**

**Question 62**

Use P = VI
$\therefore$ 30 = 12 × I
**$\therefore$ I = 2.5 A (ANS)**

**Question 63**

Use $P = \frac{V^2}{R}$

$\therefore R = \frac{V^2}{P}$

$= \frac{12^2}{30}$

**= 4.8 Ω (ANS)**

---

**Question 64**

Use E = VQ
$\therefore$ E = 2.0 x $10^8$ x 30
**= 6.0 x $10^9$ J (ANS)**

**Question 65**

Use Q = It

$\therefore I = \frac{30}{1.5 \times 10^{-3}}$

**$\therefore$ I = 2.0 x $10^4$ A (ANS)**

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**Question 66**

Use V = iR, where i is the same, since the elements are in series
$\therefore$ A

**Question 67**

Elements are in series
$\therefore$ C

**Question 68**

P = $i^2$R
Since i is the same, the power is proportional to the resistance.
$\therefore$ B

**Question 69**

Use V = iR
$\therefore$ 6 = 0.3 R
$\therefore$ R = 20 Ω

**Question 70**

Use Q = it
$\therefore$ Q = 0.3 x 2 x 60 (secs)
$\therefore$ Q = 3.6 C

**Question 71**

Use P = $i^2$R
$\therefore$ P = $0.3^2$ x 20
$\therefore$ P = 1.8 W

**Question 72**

Use $P = \frac{V^2}{R}$

$\therefore P = \frac{12^2}{2}$

$\therefore$ P = 72 W
$\therefore$ D

**Question 73**

Use P = VI
∴ 60 = 240 x i
∴ i = 0.25 A
∴ A

**Question 74**

Use P = VI
You need to understand that the battery in a car is 12 volts.
∴ 100 = 12 x i
∴ i = 8.3 A
∴ D

**Question 75**

Use P = VI
∴ P = 3 x 0.2
∴ P = 0.6 W
∴ B

**Question 76**

Use P = VI
∴75 = V x 5
∴ V = 15 V
∴ B

**Question 77 1984 Question 55**

Energy = P × t
∴ E = 480 × 100
**∴ 4.8 × $10^4$ J (ANS)**

**Question 78 1984 Question 56**

Use $P = \frac{V^2}{R}$

$\therefore R = \frac{V^2}{P}$

$\therefore R = \frac{240^2}{480}$

**∴ R = 120 Ω (ANS)**

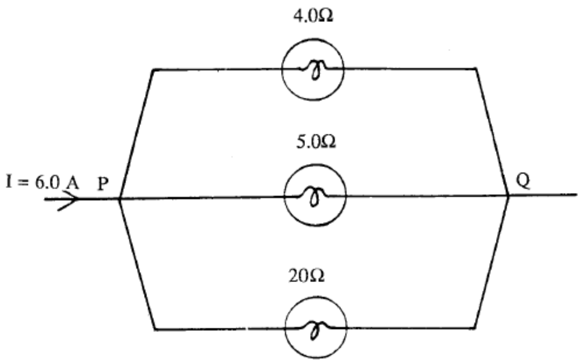
**Question 79**

9.0 W

**Question 80**

3.0 A

**Question 81**




Use $V_{PQ} = iR_{total}$

$\frac{1}{R_{total}} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R}$ becomes

$\frac{1}{R_{total}} = \frac{1}{4} + \frac{1}{5} + \frac{1}{20}$

$\frac{1}{R_{total}} = \frac{5}{20} + \frac{4}{20} + \frac{1}{20}$

$\frac{1}{R_{total}} = \frac{10}{20}$

∴ $R_{total} = 2$

∴ $V_{PQ} = 6 \times 2$
**= 12 V (ANS)**

**Question 82**

Use V = iR
∴ 12 = i x 4
**∴ i = 3 A (ANS)**

**Question 83**

Use P = Vi to give
P = 12 x 3
**= 36 W (ANS)**

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**Question 84**

Since the elements in the circuit are in series, the current through both will be the same.
Power in globe = $I^2R$,
∴ $9 = I^2 \times 8$
∴ I = 1.06.
The voltage drop across the globe will be
V = IR
∴ V = 1.06 × 8
= 8.49V.
This means that the voltage drop across the variable resistor is
12 – 8.49 = 3.51.
∴ $V_{resistor} = IR$

$\therefore$ 3.52 = 1.06 × $R_{resistor}$
$\therefore$ R = 3.31Ω
**$\therefore$ R = 3.3Ω (to 2 sig figs.) (ANS)**

**Question 85**

The fuse burns out when the current is 2A. Using V = iR for the entire circuit, the effective resistance of the two elements in parallel must be 6Ω.

$$\frac{1}{6} = \frac{1}{8} + \frac{1}{R}$$
$$\therefore \frac{1}{R} = \frac{1}{6} - \frac{1}{8}$$
$$\therefore \frac{1}{R} = \frac{2}{48}$$

**$\therefore$ R = 24Ω (ANS)**

**Question 86**

When justifying your answer it is preferable if you can prove your case and disprove the others.
In circuit A, when altering the variable resistor, the voltage drop (and current) of the globe will change, this will cause the brightness to change.
In Circuit B, altering the variable resistor will not change the voltage across the globe, it will always be 12V. The resistance of the globe does not change.

$\therefore$ The power (intensity) of the globe ($\frac{V^2}{R}$) will be constant.

**$\therefore$ A (ANS)**

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**Question 87**

It requires 6.0 x l0$^5$ joules of energy to boil a quantity of water in a particular electric kettle. The supply voltage to the element of the kettle is 240V and the current flowing in the element is l0 A.
Use E = VQ = Vit
$\therefore$ 6.0 x 10$^5$ = 240 x 10 x t
**$\therefore$ t = 250 secs (ANS)**

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**Question 88**

I think that this is a very interesting question. The role of the light globe in series is to share the voltage. This is a basic voltage divider question.
You need the voltage drop across both the light globe and the motor to be 120 V.
This means that the light globe must have the same resistance as the motor.
To find the resistance of the motor use

$$P = \frac{V^2}{R}$$
$$\therefore R = \frac{V^2}{P}$$
$$= \frac{120^2}{15}$$
$$= 960\ \Omega$$

To find the power of the light globe use

$$P = \frac{V^2}{R}$$
$$= \frac{240^2}{960}$$
$$= 60\ W$$

**$\therefore$ C (ANS)**

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**Question 89**

$$\frac{1}{R_{total}} = \frac{1}{R} + \frac{1}{R} \text{ becomes}$$
$$\frac{1}{R_{total}} = \frac{1}{100} + \frac{1}{300}$$
$$\frac{1}{R_{total}} = \frac{4}{300}$$

**$\therefore$ $R_{total}$ = 75Ω (ANS)**

**Question 90**

Use V = iR
$\therefore$ 120 = i x 100
**$\therefore$ i = 1.2 A (ANS)**

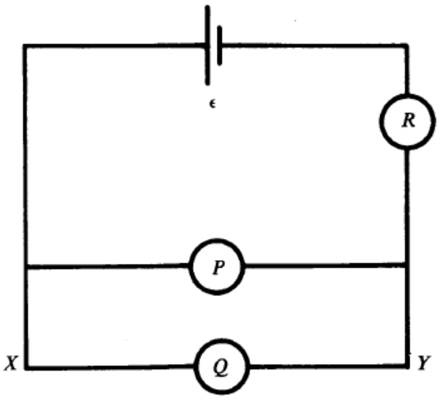
**Question 91**

Use $P = \frac{V^2}{R}$

$$\therefore P_{total} = \frac{120^2}{100} + \frac{120^2}{300}$$

**$\therefore$ $P_{total}$ = 192 W (ANS)**

**Question 92 1986 Question 56**




$$\frac{\text{rate of heat dissipated in R}}{\text{rate of heat dissipated in Q}} = \frac{P_R}{P_Q}$$

Use $P = i^2R$.

The current in R is twice the current in Q, (because there is the same current in P and Q).

$$\therefore \frac{P_R}{P_Q} = \frac{(2i)^2R}{(i)^2R}$$

**= 4** **(ANS)**

**Question 93 1986 Question 57**

When the globe Q is removed the effective resistance of the circuit changes.

Initially the total resistance of the circuit is given by

$R_{total} = R + R_{parallel}$

$R_{parallel}$ is given by $\frac{1}{R_{parallel}} = \frac{1}{R} + \frac{1}{R}$

$\therefore R_{parallel} = \frac{R}{2}$

$\therefore R_{total} = \frac{3R}{2}$

Using $I = \frac{V}{R}$ we get $I = \frac{2V}{3R}$

When globe Q is removed the total resistance becomes R + R = 2R

Using $I = \frac{V}{R}$ we get $I = \frac{V}{2R}$

Therefore

$$\frac{\text{current flowing through lamp R before lamp Q was removed}}{\text{current flowing through lamp R after lamp Q was removed}}$$

becomes $\frac{\frac{2V}{3R}}{\frac{V}{2R}} = \mathbf{\frac{4}{3}}$ **(ANS)**

**Example 94 1986 Question 58**

The potential difference between X and Y (which is the same as across P) changes because the resistance of the circuit changes.

Initially $R_{total} = \frac{3R}{2}$, when globe Q was removed $R_{total}$ became 2R.

Therefore initially $\frac{1}{3}$ of the voltage was lost across the parallel section, but finally $\frac{1}{2}$ of the voltage was lost across P (XY)

So the potential drop across XY increases.

∴ **A** **(ANS)**

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**Question 95 1983 Question 59**

In parallel $R_{TOTAL} = \frac{R}{2}$

In series $R_{TOTAL} = 2R$

One element $R_{TOTAL} = R$

Use power = $\frac{V^2}{R}$, where V = 240 V.

This means that the larger the value of $R_{TOTAL}$ the less heat.

∴ **B** **(ANS)**

**Question 96 1983 Question 60**

Use power = $\frac{V^2}{R}$, where V = 240 V.

∴ **0.25** **(ANS)**

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**Question 97 1983 Question 61**

Since R is constant, you use $P = \frac{V^2}{R}$

This leads to $\frac{1}{4}$ of the original power. This means that it will take four times as long.

∴ **E** **(ANS)**

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**Question 98 1985 Question 51**

Use P = VI

∴ 25 = 250 × I

∴ I = 0.1

∴ **100 globes** **(ANS)**

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