NAT 5 Electricity and Energy

QUESTION 1

A car headlamp is rated at 55W.The light produced is 20% of the total energy transferred by the lamp.

Calculate the energy transferred by the lamp as light in 30s.

QUESTION 2

A crate of mass 200kg is pushed 20m across a floor with a force of 150N. Calculate the work done in pushing the crate along the floor if the force of friction acting on the crate is 50N.

QUESTION 3

An engine applies a force of 2000N to move a lorry at a constant speed.
The lorry travels 100m in 16s.
Calculate the power developed by the engine.

QUESTION 4

An arrow of mass 150g is fired from a bow as shown below. The archer pulls the string back a distance of 0.50m and exerts a force of 300N on the arrow as it is fired.

Calculate the maximum kinetic energy gained by the arrow.

QUESTION 5

A power station has an efficiency of 40%.
The input power to the station is 1600MW.

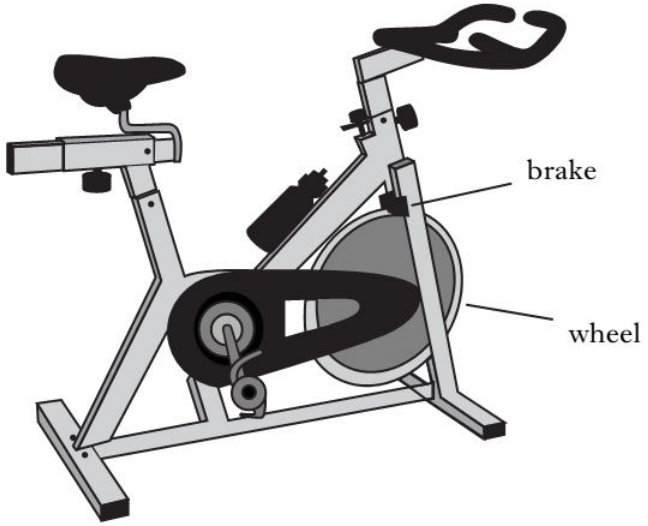
Calculate the useful power output.

QUESTION 6

A person using the exercise bike below, pedals against 300N of frictional forces applied to the wheel of circumference 1.5m by the brake.

a)How much work is done against friction with one turn of the wheel?

b) Calculate the average power produced if the wheel turns 500 times in 5 minutes.



QUESTION 7

An electric motor raises a crate of mass 500kg through a height of 12m in 8s.

Calculate or find:

a) Ep gained by the crate.

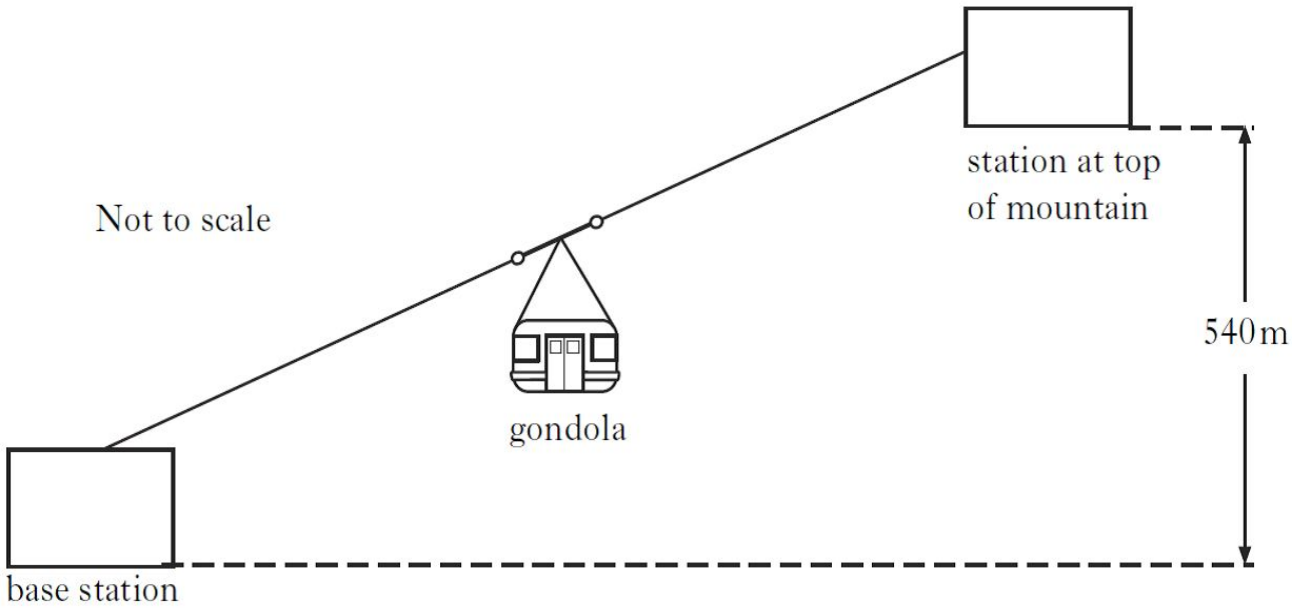
b) Minimum power rating of the electric motor.

QUESTION 8

A ski lift with a gondola of mass 2000kg travels to a height of 540m from the base station.

a) Calculate the gain in gravitational potential energy of the gondola.

b) Calculate the speed of the gondola if it has 36,000J of kinetic energy at one stage in the journey.

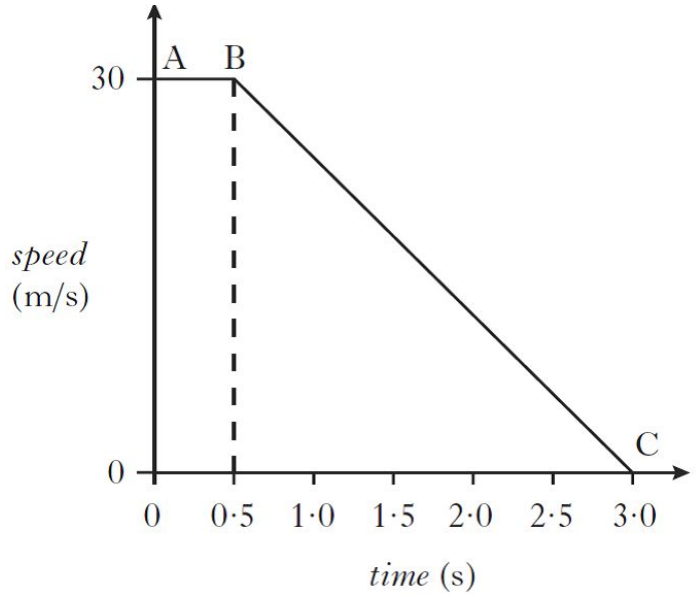


QUESTION 9

The speed-time graph below shows the motion of a 700kg car.

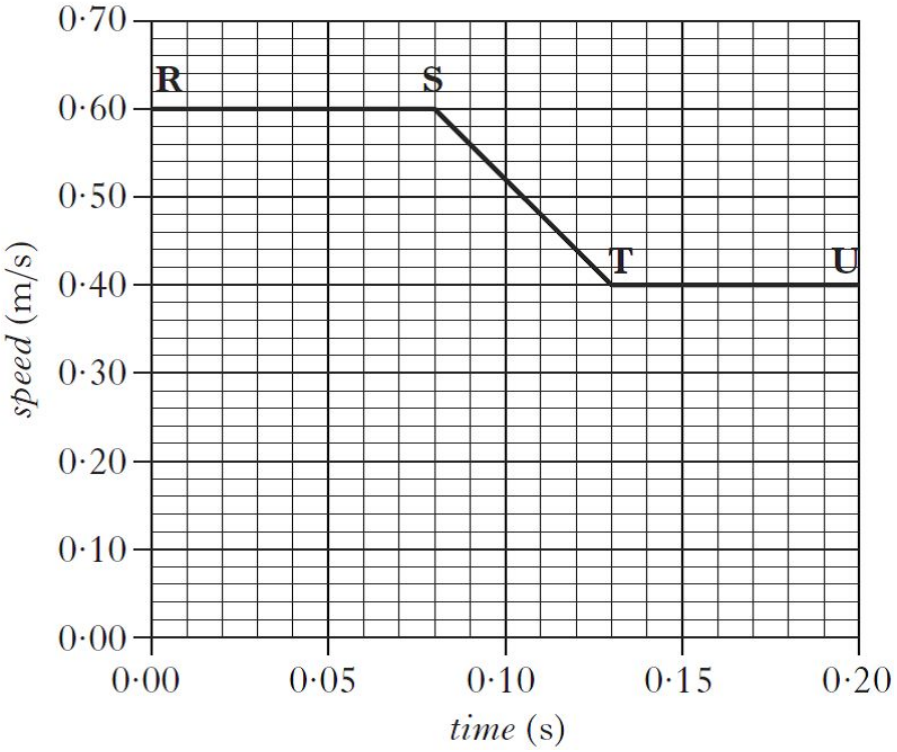
a) Calculate the kinetic energy at A.

b) State the work done in bringing the car to a halt between B and C.



QUESTION 10

The graph below shows the speed-time graph of a 0.50kg object when it is involved in a collision.
Calculate the kinetic energy lost by the object when it is in a collision between S and T.



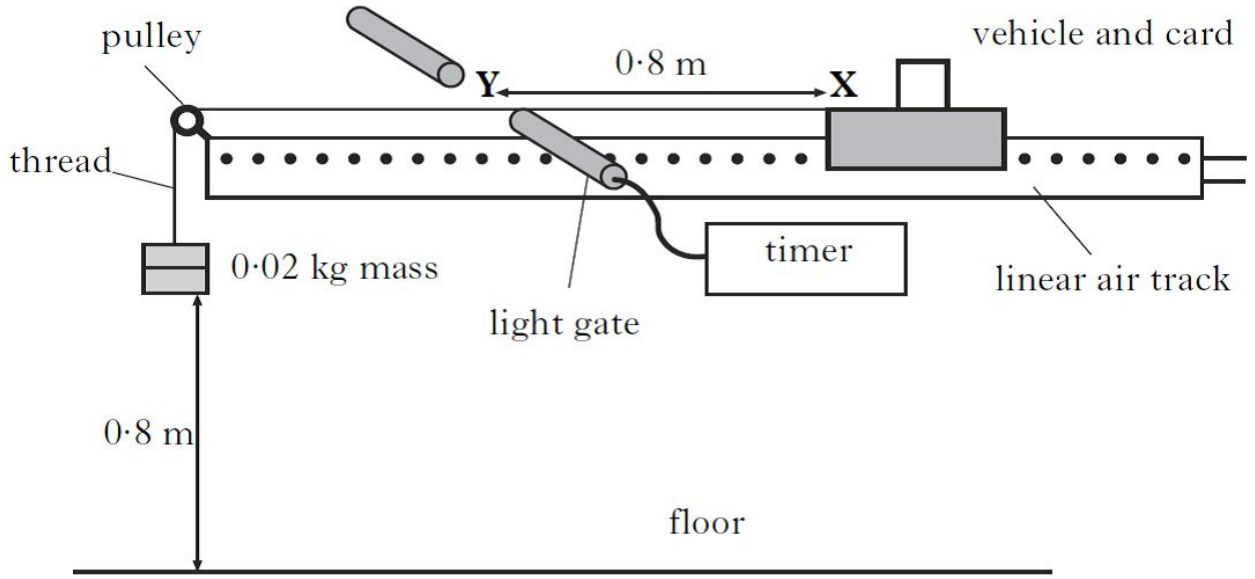
QUESTION 11

A 0.02kg mass detaches from a thread before the vehicle is released from rest and falls 0.80m to the floor.

Calculate or find:

a) Gravitational potential energy stored in the mass before it fell.

b) Speed of the mass before it hits the floor.



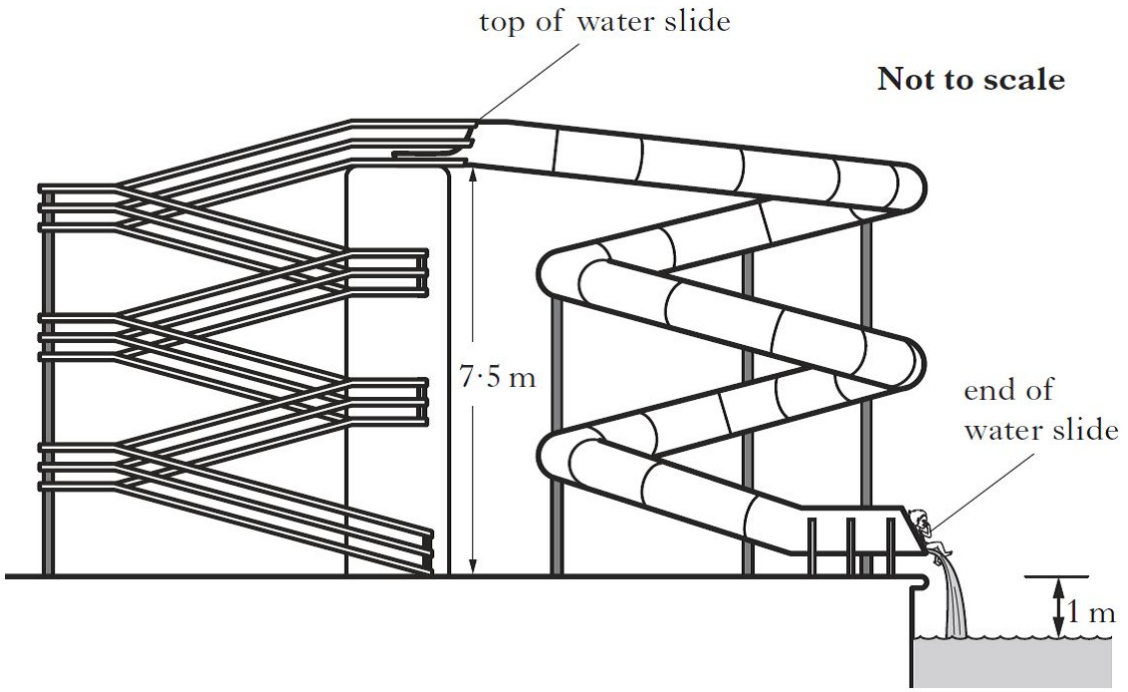
QUESTION 12

A child of mass 50kg is playing on a water slide as shown below.

Calculate or find:

a) Gravitational potential energy of the child at the top.

b) Length of the slide, if 20N of frictional force acts on the child producing 1400J of heat energy.



QUESTION 13

The voltage of an electrical supply is a measure of the

A resistance of the circuit

B speed of the charges in the circuit

C energy given to the charges in the circuit

D power developed in the circuit

E current in the circuit.

QUESTION 14

Which of the following statements are true about electrical conductors

I Only protons are free to move.

II Only electrons are free to move.

III Only negative charges are free to move.

QUESTION 15

A charge of 15C passes through a resistor in 12s. The potential difference across the resistor is 6V.

Calculate the power developed in the resistor.

QUESTION 16

A rechargeable battery is labelled 2600mAh.

Calculate the charge stored in the battery.

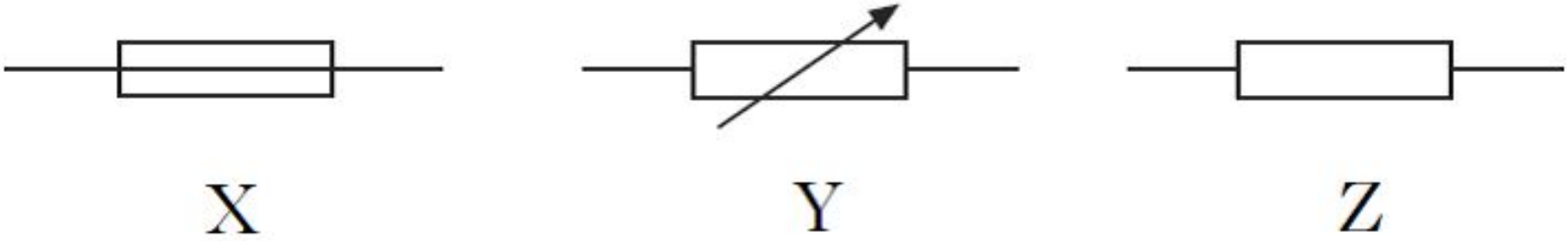
QUESTION 17

The current in an 8Ω resistor is 2A.

Calculate the charge passing through the resistor in 40s.

QUESTION 18

Identify the circuit symbols X,Y and Z.



QUESTION 19

The mains voltage in the UK is 230V ac.

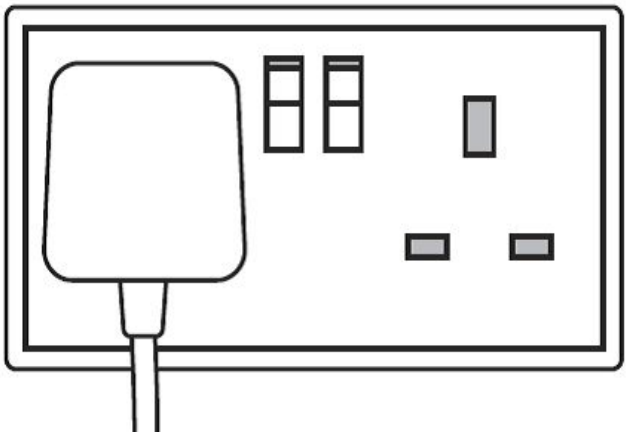
Which row in the table below shows the peak voltage and the mains supply?

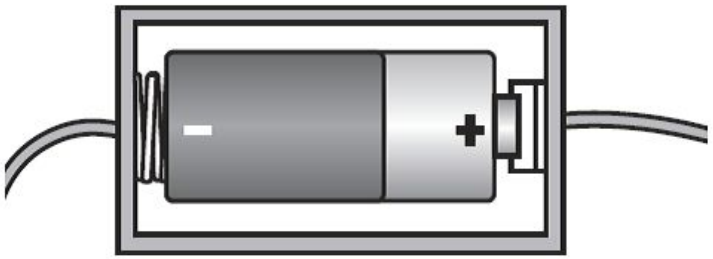
	peak voltage (V)	*frequency* (Hz)
A	175	50
B	175	60
C	230	50
D	325	50
E	325	60

QUESTION 20

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

Label which supply in the diagrams below are ac and dc and describe them both in terms of electron flow.

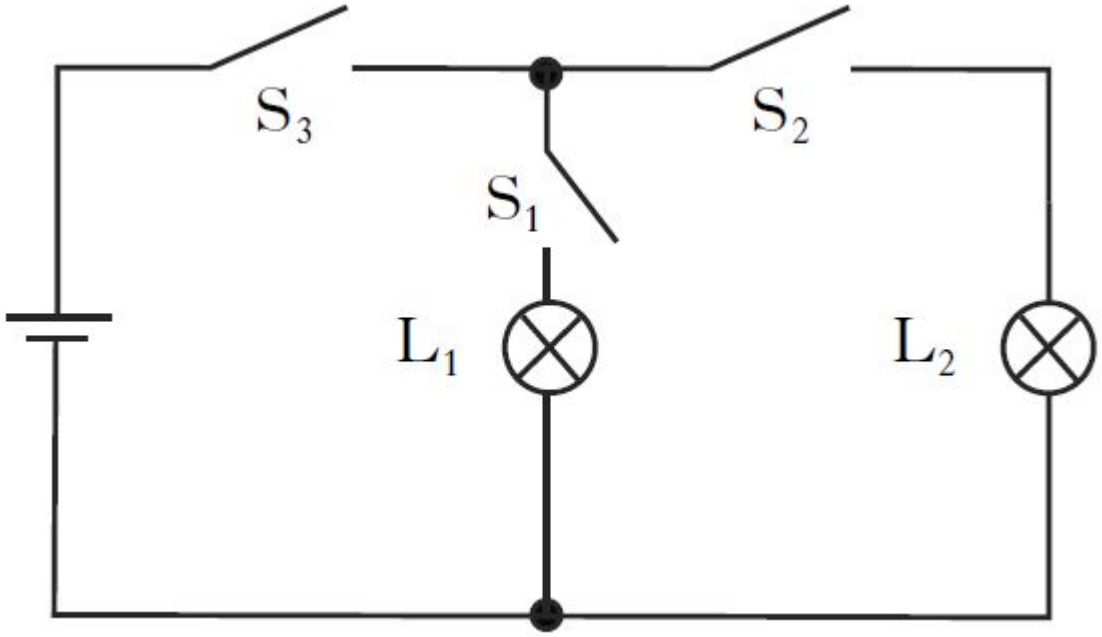




QUESTION 21

A circuit is set up as shown below.

Which switch or switches must be closed to light lamp L_1 only?



QUESTION 22

Which of the following statements that an LHS Physics student made are true?

I The sum of the potential differences across components connected in series is equal to the supply voltage.

II The sum of the currents in parallel branches is equal to the current drawn from the supply.

III The potential difference across components connected in parallel is the same for each component.

QUESTION 23

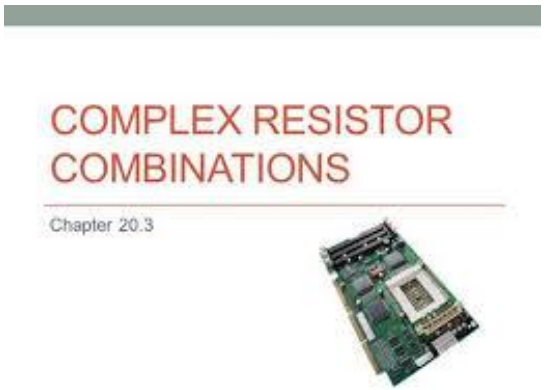
A student is given a task of combining three resistors from a pack containing:

30Ω, 50 Ω, 80 Ω, 120 Ω and 270 Ω.

Show by calculation which three resistors(In series or parallel?) should be used to give

a) the largest combined resistance

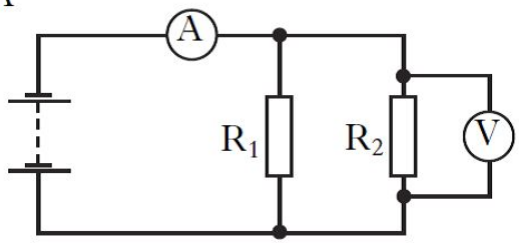
b) the lowest combined resistance.



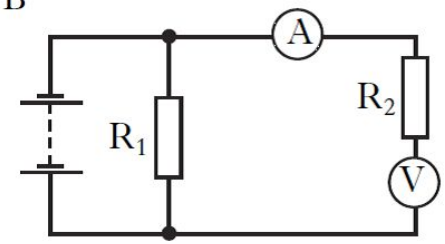
QUESTION 24

Which circuit below is used to find the resistance of Resistor R_2?

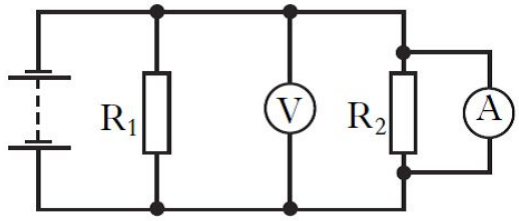
A



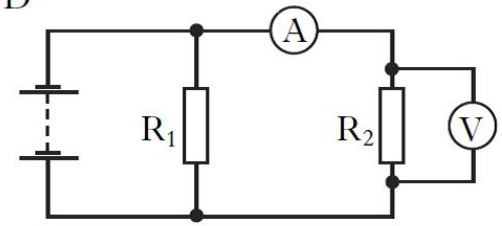
B



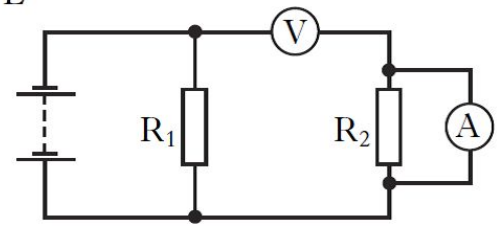
C



D



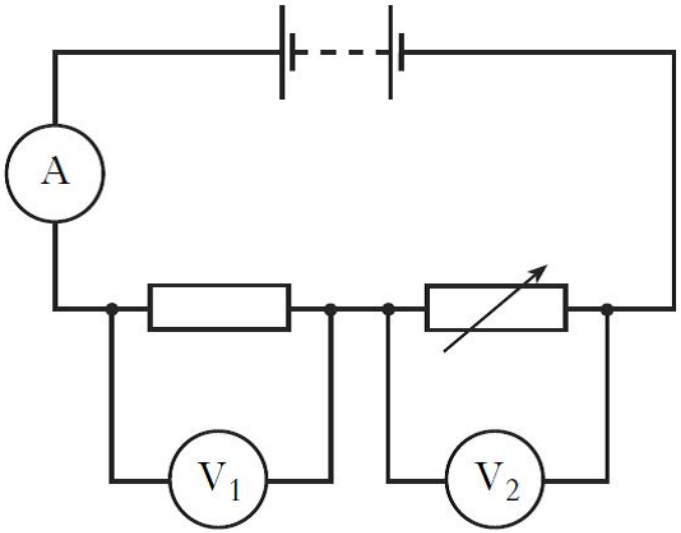
E



QUESTION 25

In the circuit below the resistance of the variable resistor is increased.

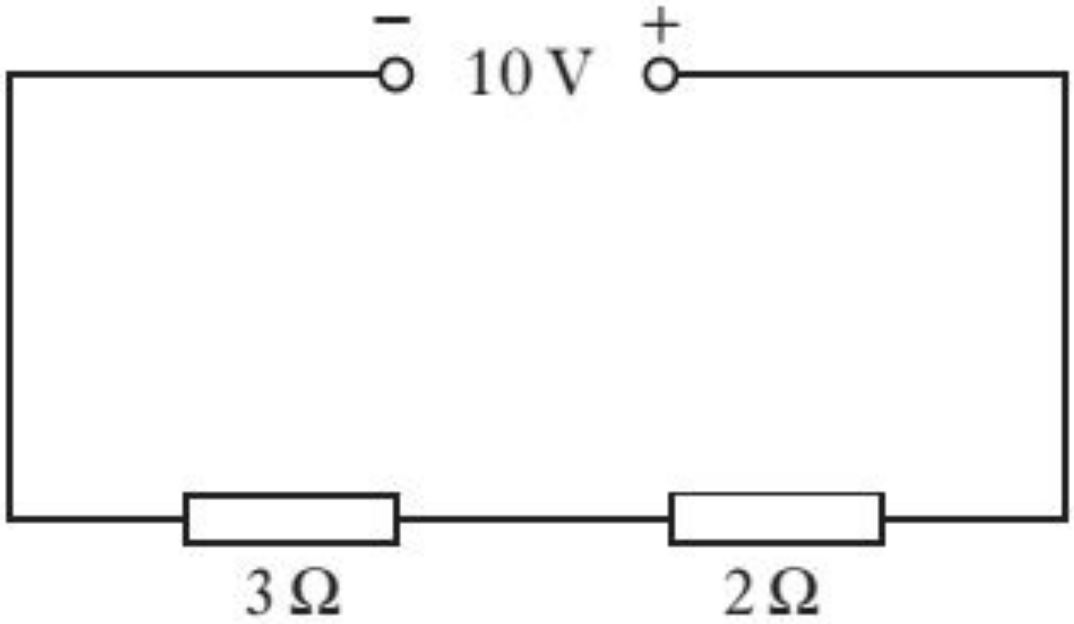
Which row in the table shows the effect on the ammeters and voltmeters?



	Reading on ammeter	*Reading on voltmeter* V_1	*Reading on voltmeter* V_2
A	decreases	decreases	decreases
B	increases	unchanged	increases
C	decreases	increases	decreases
D	increases	unchanged	decreases
E	decreases	decreases	increases

QUESTION 26

Calculate the potential difference across the 2Ω resistor in the circuit below.

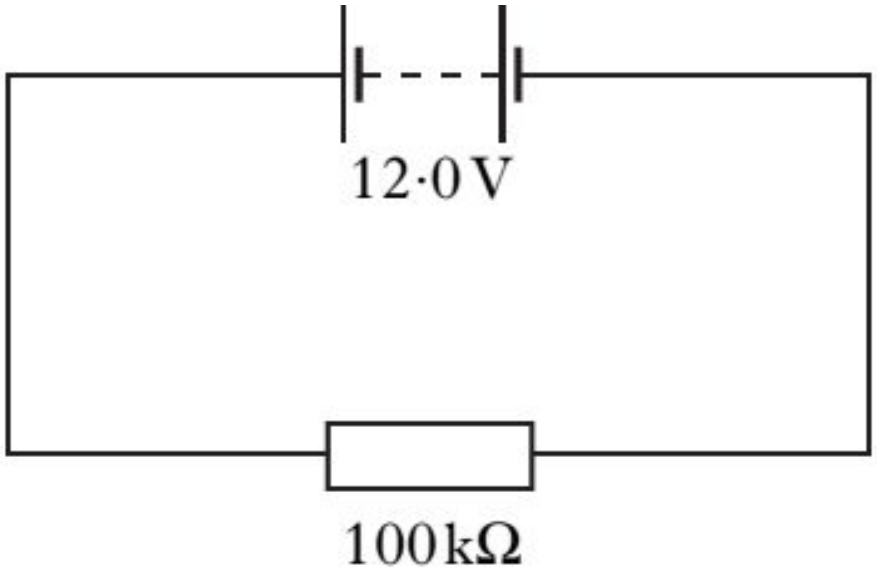


QUESTION 27

Calculate the following from the circuit below:

a) Current through the resistor.

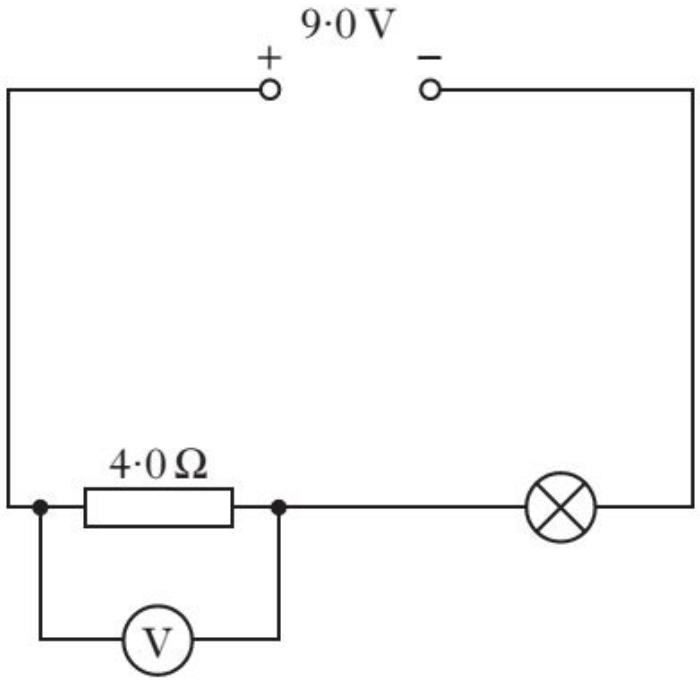
b) Power supplied to the resistor.



QUESTION 28

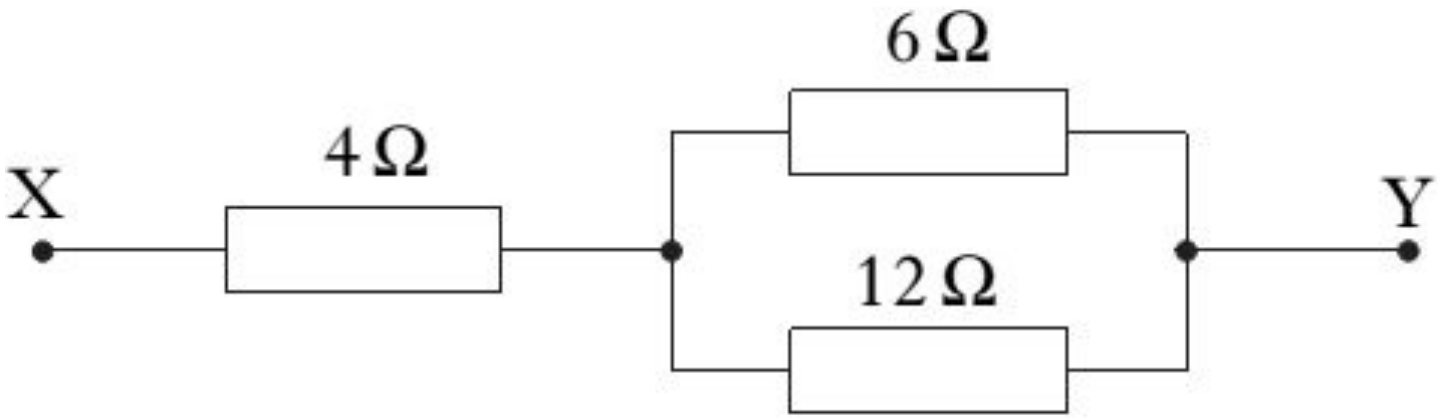
In the circuit below the current in the lamp is 1.5A and the reading on the voltmeter is 6V.

Calculate the power in the lamp.



QUESTION 29

Calculate the total resistance between X and Y in the network below.



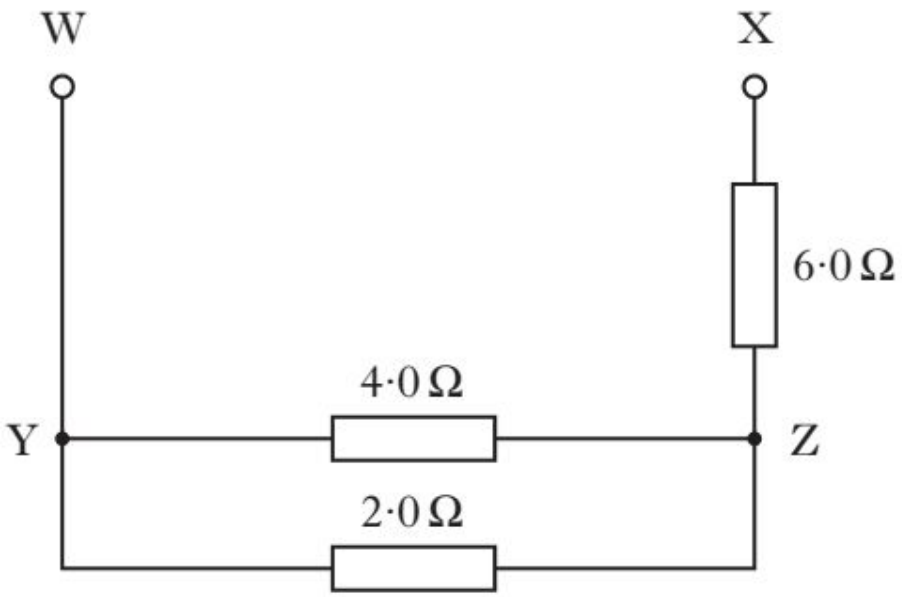
QUESTION 30

Calculate the following in the circuit below:

a) Total resistance between Y and Z.

b) Total resistance between W and X.

c) Voltage across the 2Ω resistor when the current in the 4Ω resistor is 0.10A.



QUESTION 31

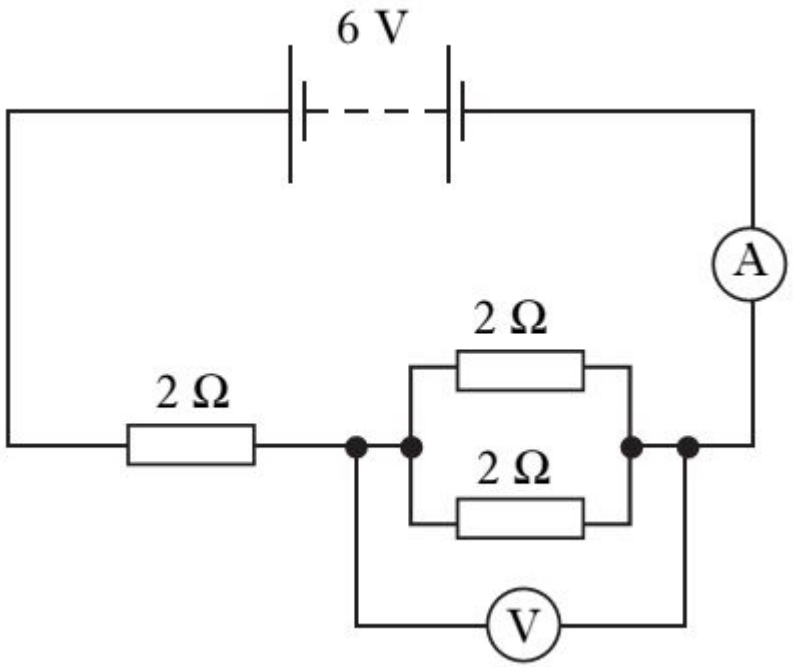
Calculate the following from the circuit below:

a) Total resistance in the circuit.

b) Reading on the ammeter

c) Reading on the voltmeter

d) Power developed in the 2Ω series resistor.



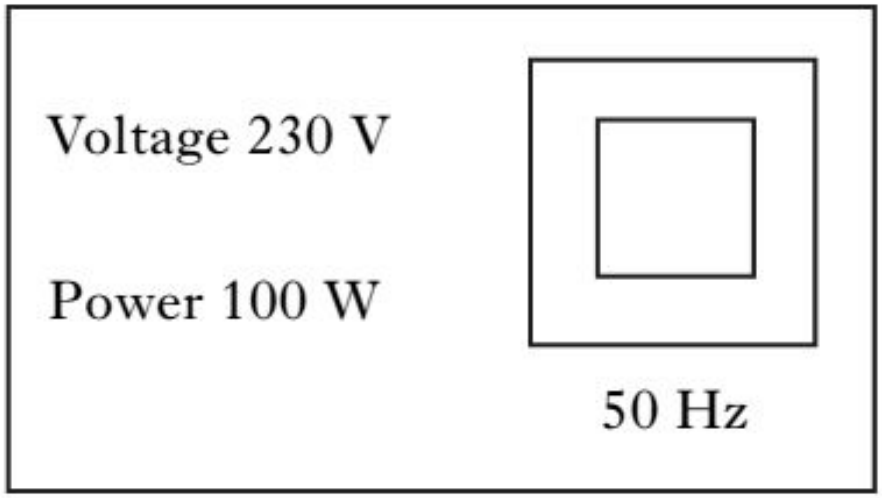
QUESTION 32

Calculate or find the following from the rating plate of an electric food mixer.

a) Resistance of the food mixer

b) Current passing through the food mixer.

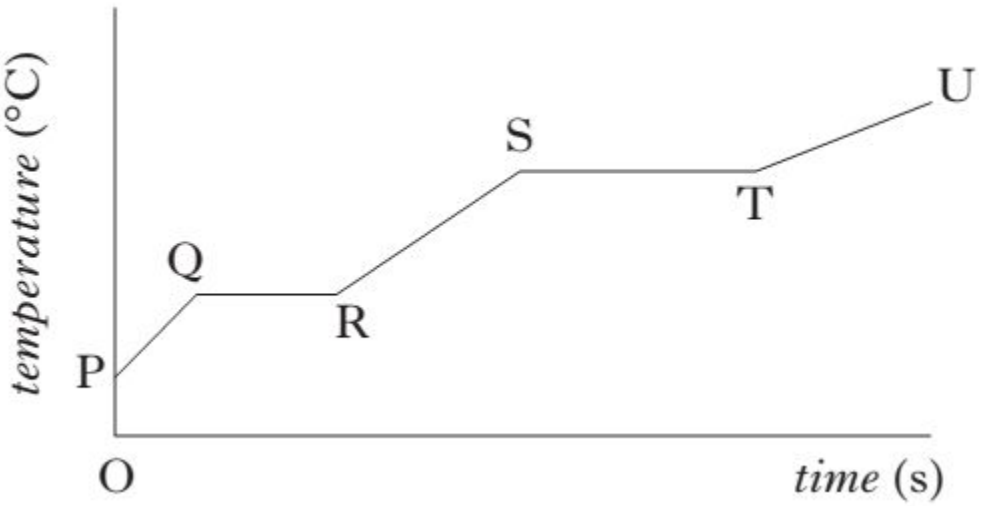
c)The fuse required for the food mixer plug.



QUESTION 33

The graph below shows the temperature of a substance over a period of time.

Which row in the table shows the sections of the graph when the substance is changing state?



	Solid to liquid	*Liquid to gas*
A	QR	TU
B	QR	ST
C	PQ	RS
D	PQ	TU
E	ST	QR

QUESTION 34

The specific latent heat of fusion of a substance is the heat energy required to

A melt 1 kg of the substance at its melting point

B evaporate 1 kg of the substance at its boiling point

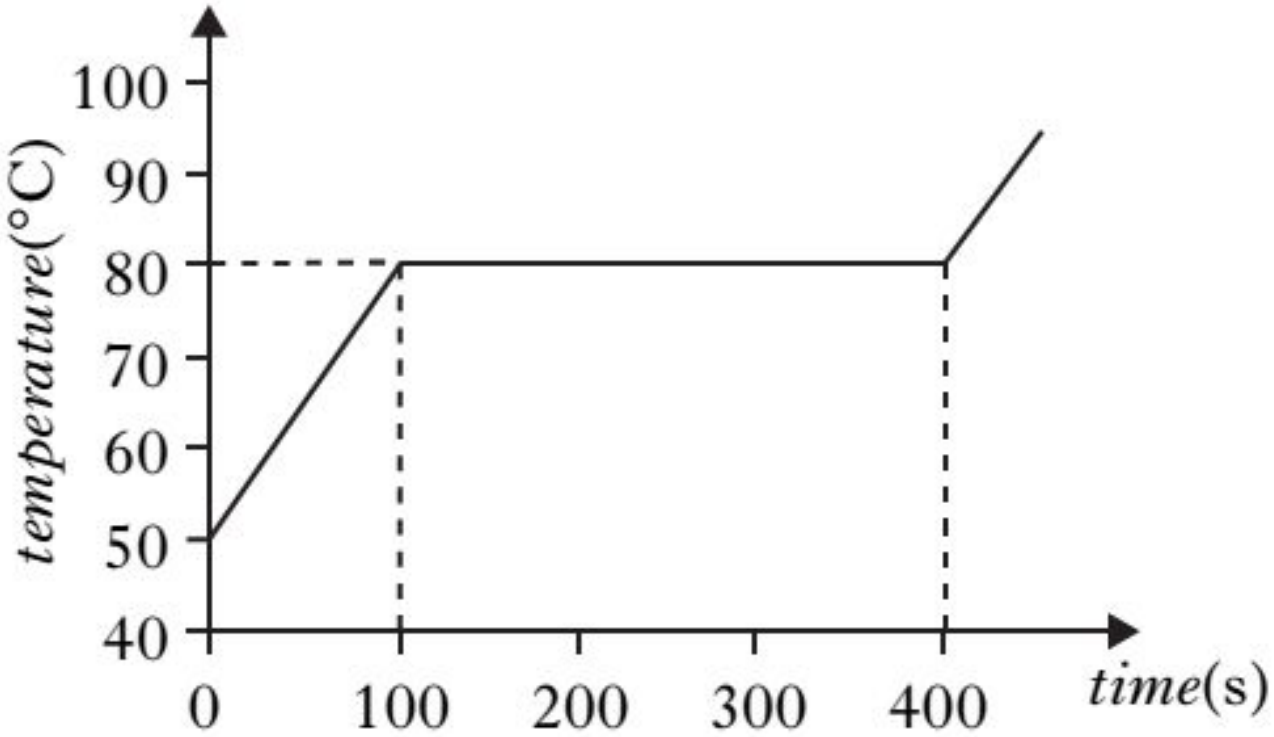
C change the state of the substance without changing its temperature

D change the temperature of the substance without changing its state

E change the temperature of 1 kg of the substance by 1 °C.

QUESTION 35

100g of solid is heated by a 50W heater. Calculate the specific latent heat of fusion of the substance using the graph below.



QUESTION 36

A block of ice of mass 1.5kg is placed in a room at 20°C. If the block of ice is at 0°C, then calculate the minimum energy required to turn the ice at 0°C into water at 20°C.

QUESTION 37

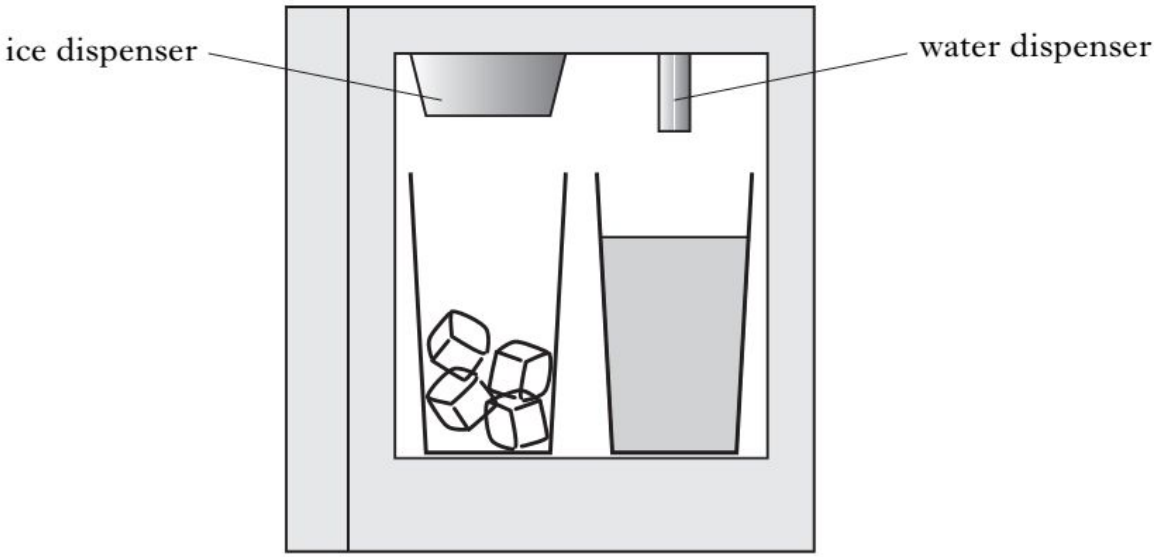
A sample of water at a temperature of 100°C absorbs 23,000J of heat energy.

Calculate the mass of water turned into steam at 100°C using the necessary information from the data book.

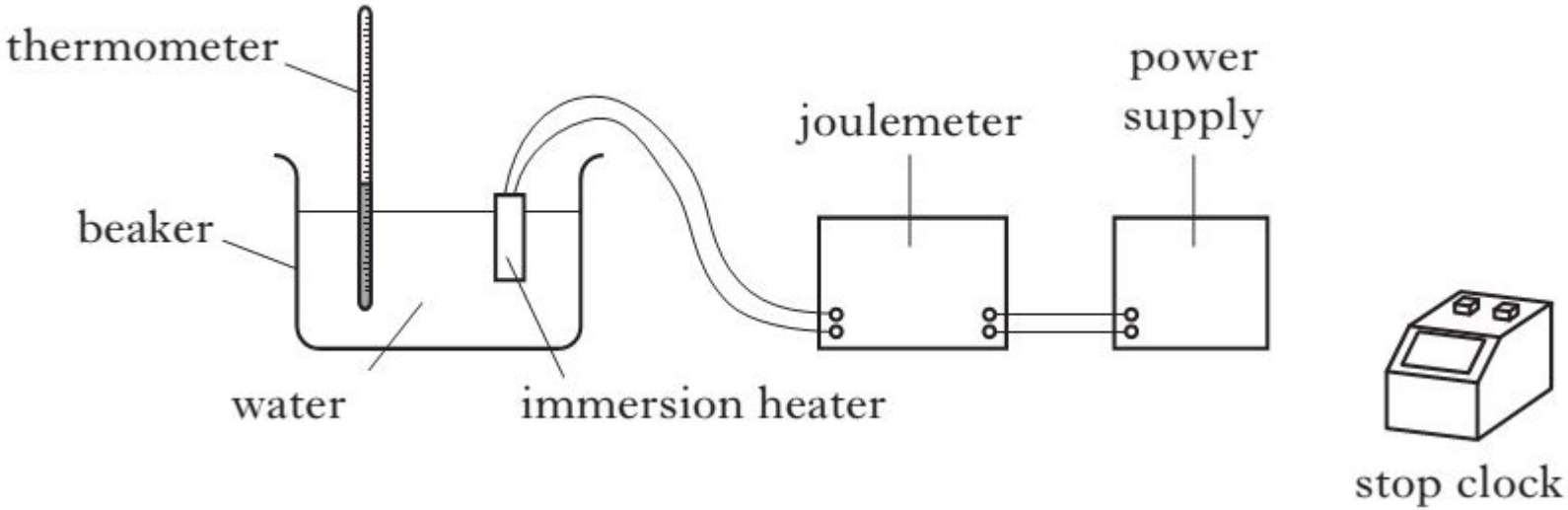
QUESTION 38

A fridge/freezer has water and ice dispensers. 0.15kg of water flows into the freezer at 14°C and is cooled to 0°C.

a) Calculate the heat energy removed when the water cools.
b) Calculate how much heat energy is released when 0.15kg of water at 0°C changes to 0.15kg of ice at 0°C.



QUESTION 39



Initial temperature of the water = 21 °C.
Final temperature of the water = 33 °C.
Initial reading on the joulemeter = 12 kJ.
Final reading on the joulemeter = 120 kJ.
Mass of water = 2·0 kg.
Time = 5 minutes.

QUESTION 39 (Cont'd)

From the experiment and the data obtained above, calculate or find:

a)Specific heat capacity of the water.

b) Power rating of the immersion heater.

c) How does the calculated reading in a) compare with the accepted value in the data book?

d) How could the experiment be improved to provide a specific heat capacity nearer the accepted value in the data book?

QUESTION 40

On the planet Mercury the surface temperature at night is -173°C and during the day it is 307°C.
A rock of mass 80kg lying on the surface of the planet absorbs 3.46×10^7J of heat energy during the day.

a) Calculate the specific heat capacity of the rock.
b) Calculate how long it would take to release 3.46×10^7J of heat energy during the night if it is released at 1500W.

QUESTION 41

A rectangular block of wood of mass 2000g has dimensions of 2m x 1m x 0.1m.

Calculate the greatest pressure that the block can exert when lying on a level surface.

QUESTION 42

The air pressure inside a passenger cabin of an aircraft is 92,000Pa during a flight with the pressure outside being 42,000Pa.

Calculate the resultant force on the cabin door of area $3m^2$, caused by the difference in air pressure.

QUESTION 43

Which of the following statements that an LHS Physics student wrote in her notebook are true?

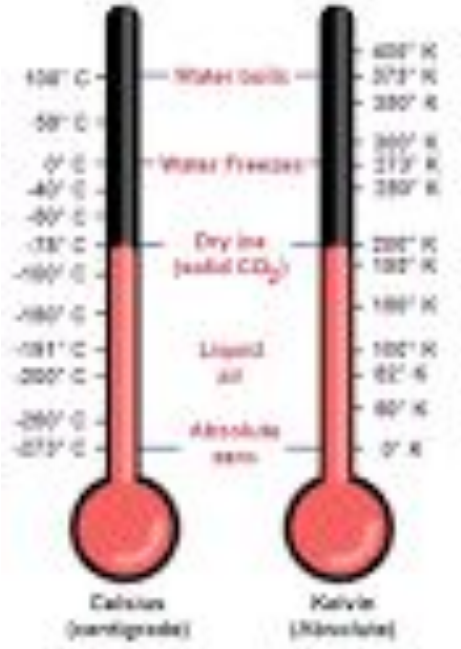
I The pressure of a fixed mass of gas varies inversely as its volume, provided the temperature of the gas remains constant.

II The pressure of a fixed mass of gas varies directly as its kelvin temperature, provided the volume of the gas remains constant.

III A temperature **change** of 20 °C in a gas is the same as a temperature **change** of 293 K.

QUESTION 44

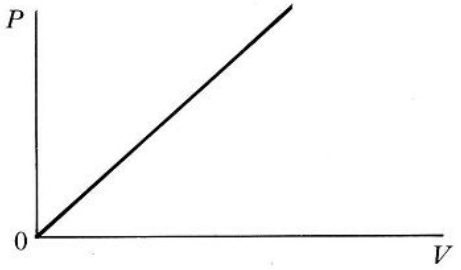
A liquid is heated from 16°C to 40°C. What is the temperature rise in the Kelvin Scale?



QUESTION 45

Which of the following graphs illustrates the correct relationship between the pressure P and the volume V of a fixed mass of gas at constant temperature?

A



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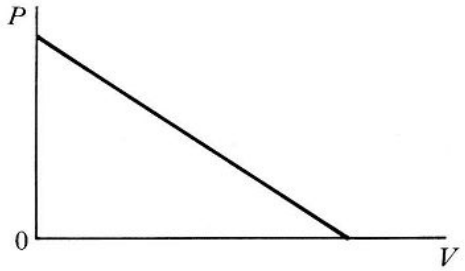
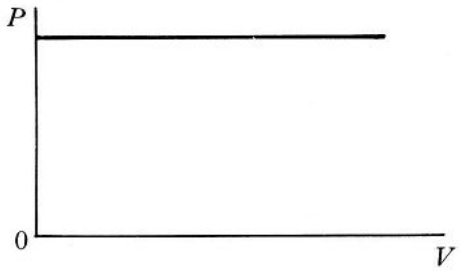


C



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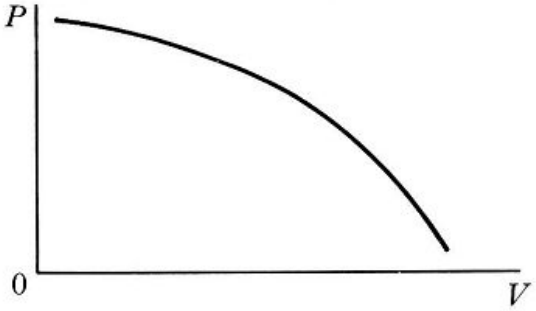
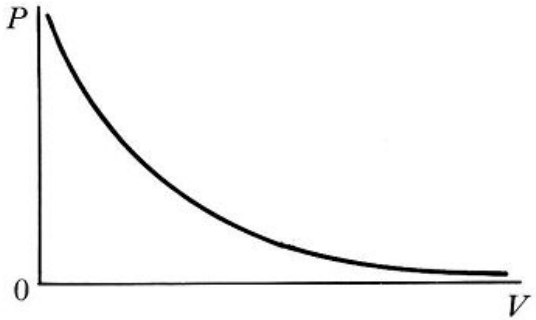


E

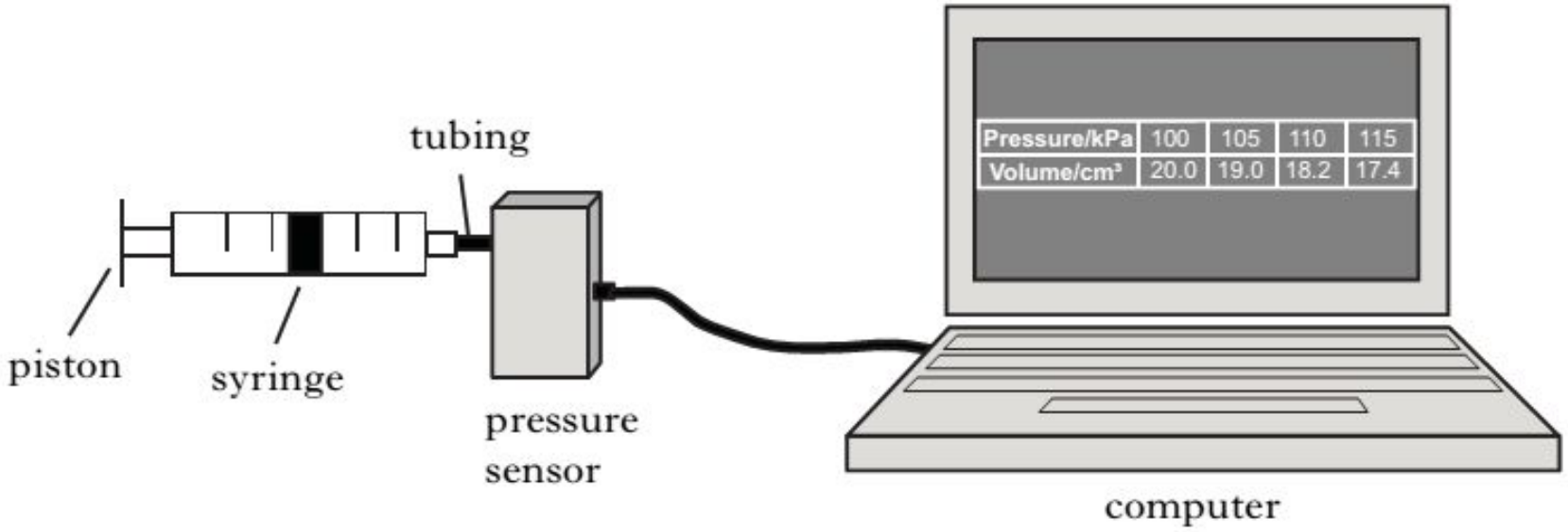


QUESTION 46

A student uses the apparatus shown below to investigate the relationship between the pressure and the volume of a fixed mass of gas at constant temperature.

a) Using all of the data, establish the relationship between the pressure and the volume of the gas.

b) Use the kinetic model to explain the change in pressure as the volume of the gas decreases.



QUESTION 47

On a cold morning at 2°C the pressure of a car tyre was 3×10^5Pa.

After a motorway run the temperature of air in the tyre rose to 57°C, with the volume of the air in the tyre staying constant.

Calculate the pressure of the tyre when its temperature reached 57°C.

QUESTION 48

A balloon with a volume of $6.0m^3$ contains a fixed mass of gas at a temperature of 300K and a pressure of 2.0kPa.

The gas is heated to 600K and the pressure drops to 1.0kPa.

Calculate the new volume of the balloon.

QUESTION 49

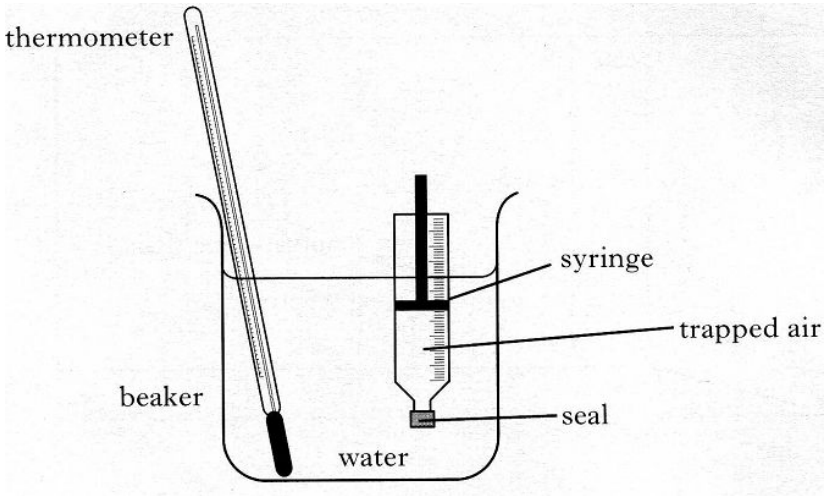
Oxygen is held inside a cylinder at a pressure of 2.82×10^6Pa and temperature of 19°C.

Calculate the pressure of the gas in the cylinder if it is moved to a storage room at 5°C.

QUESTION 50

The apparatus below was used to investigate the relationship between the volume and temperature of a fixed mass of gas at constant pressure.

A table of results was then taken and recorded.



Temperature/°C	25	50	75	100
Volume/ml	20·6	22·6	24·0	25·4

QUESTION 50 (Cont'd)

A student investigates the relationship between the volume and the temperature of a fixed mass of gas at constant pressure.

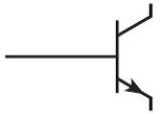
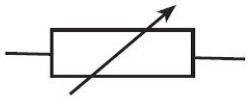
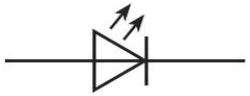
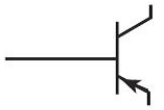
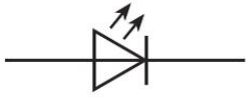
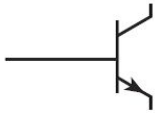
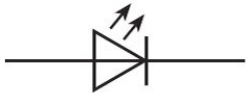
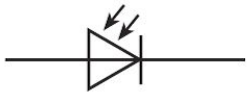
a) Using all of the data, establish the relationship between the temperature and volume for the trapped air.

b) Calculate the volume of the trapped air when the temperature of the water is 65°C.

c) Use the Kinetic Model to explain the change in volume as the temperature increases in the experiment.

QUESTION 51

Which row in the table shows the symbols for an LED and a NPN transistor.

	LED	*NPN transistor*
A		
B		
C		
D		
E		

QUESTION 52

Which of the following devices converts heat energy into electrical energy?

A Solar cell

B Resistor

C Thermocouple

D Thermistor

E Transistor

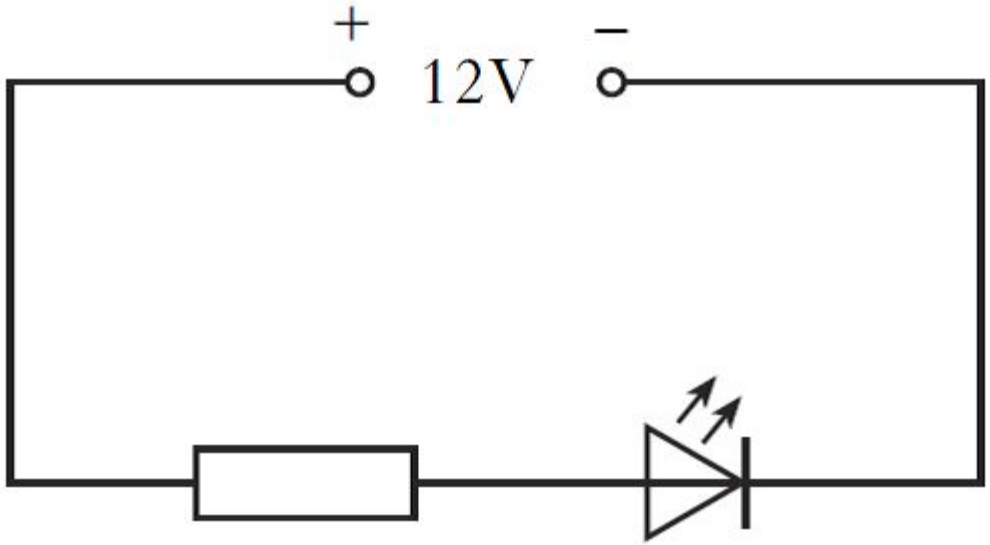
QUESTION 53

In the voltage divider circuit below an LED is connected in series with a resistor.

a) State the purpose of the resistor.

b) When lit, the LED has a voltage of 3.5V across it and a current of 200mA passing through it.

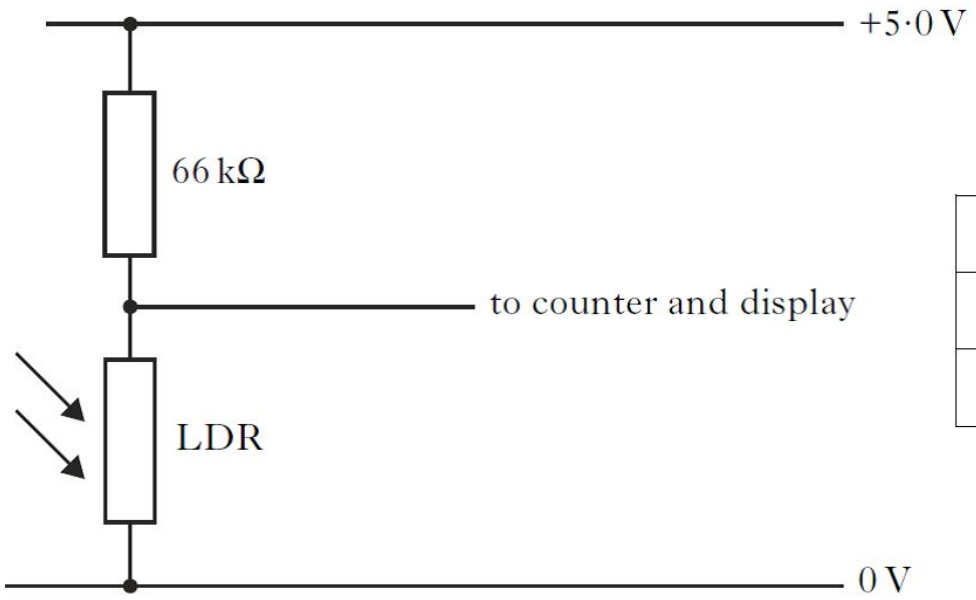
Calculate the unknown resistance.



QUESTION 54

A light sensor circuit contains a LDR and a resistor as shown below.

Using the table, calculate the voltage across the LDR when the light sensor is covered.



Light Sensor	*Resistance of LDR* (kΩ)
covered	22
uncovered	2

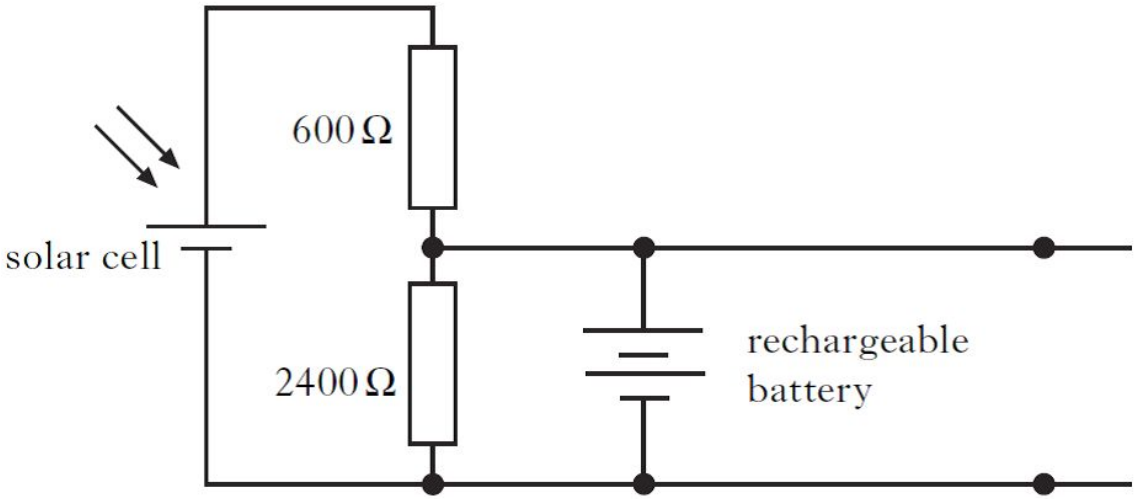
QUESTION 55

The circuit below charges a rechargeable battery during daylight hours.

a) State the energy transformation in the solar cell.

At a particular light level, the voltage generated by the solar cell is 1.5V.

b) Calculate the voltage across the rechargeable battery at this light level.



QUESTION 56

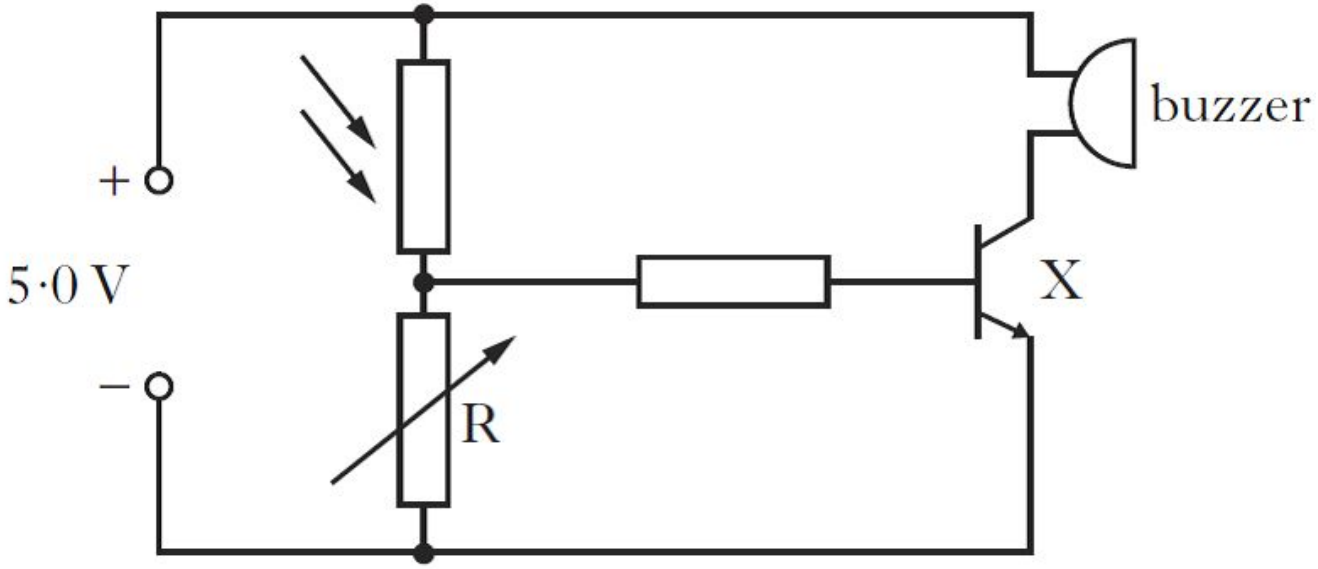
Answer the following questions using the circuit below and the table provided.

a) Name component X.

b) State the purpose of component X in the circuit.

c) Explain how the circuit operates to sound the buzzer.

d) Describe a practical application for this circuit.



QUESTION 57

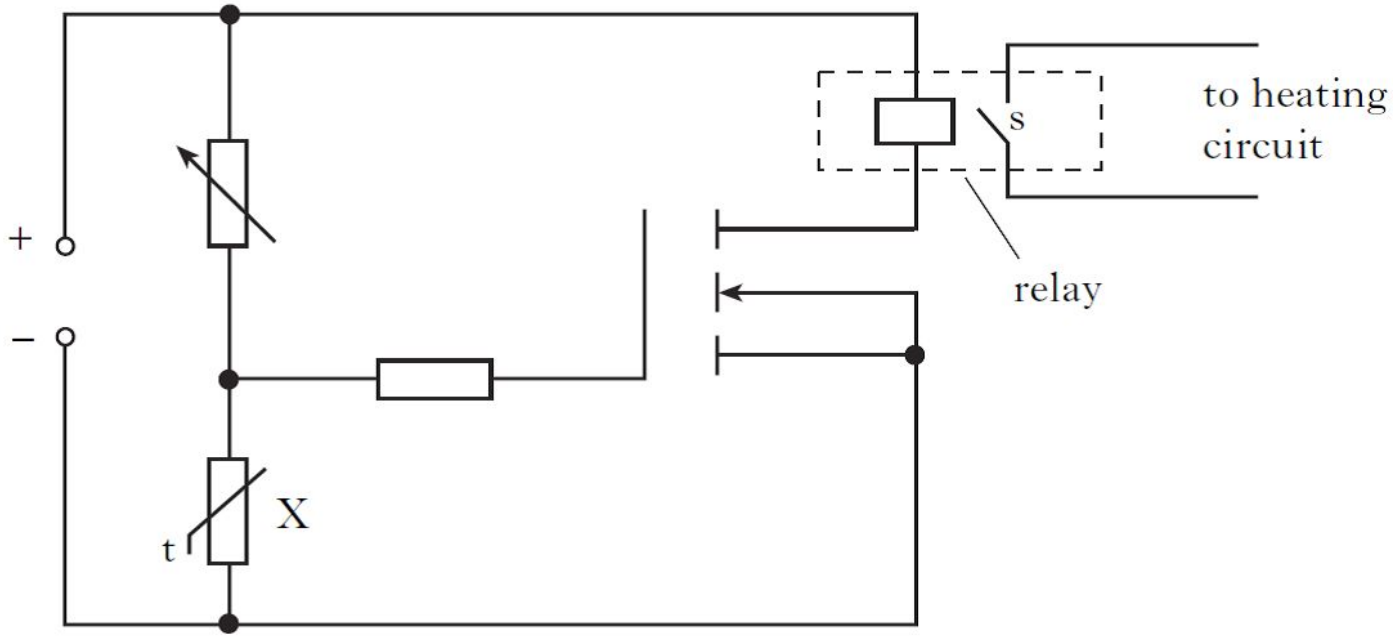
Answer the following questions from the circuit below.

a) Name component X.

b)Explain how the circuit works to switch the heater on.

c) What is the purpose of the variable resistor.

d) Give a possible practical application for this circuit.



QUESTION 58

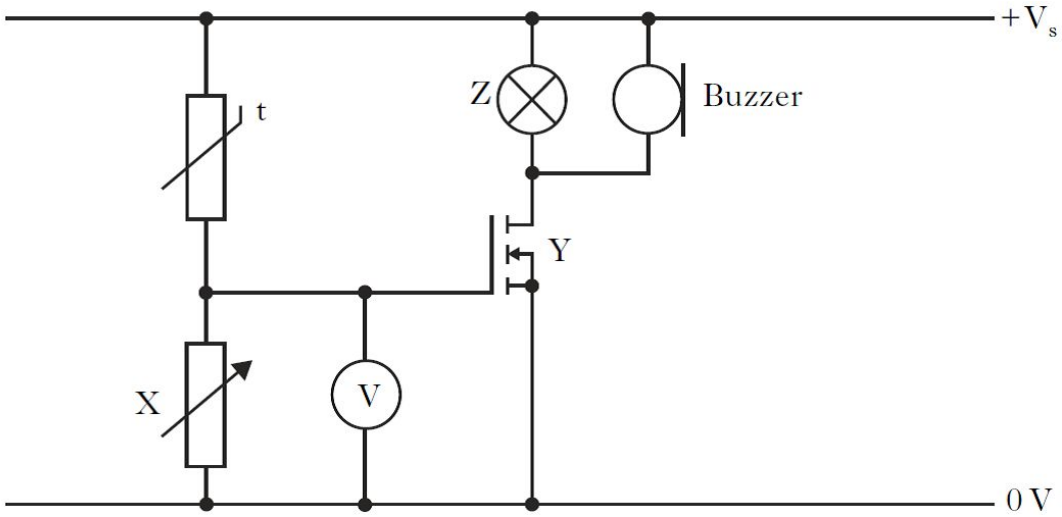
Answer the following questions using the circuit below.

a) Name the components X and Z.

b) What happens to the resistance of the thermistor as the temperature increases?

c)When the voltmeter reading reaches 1.8V the MOSFET switches on. Explain how the circuit operates when the temperature rises.

d) Why is component X used instead of a fixed resistance R?



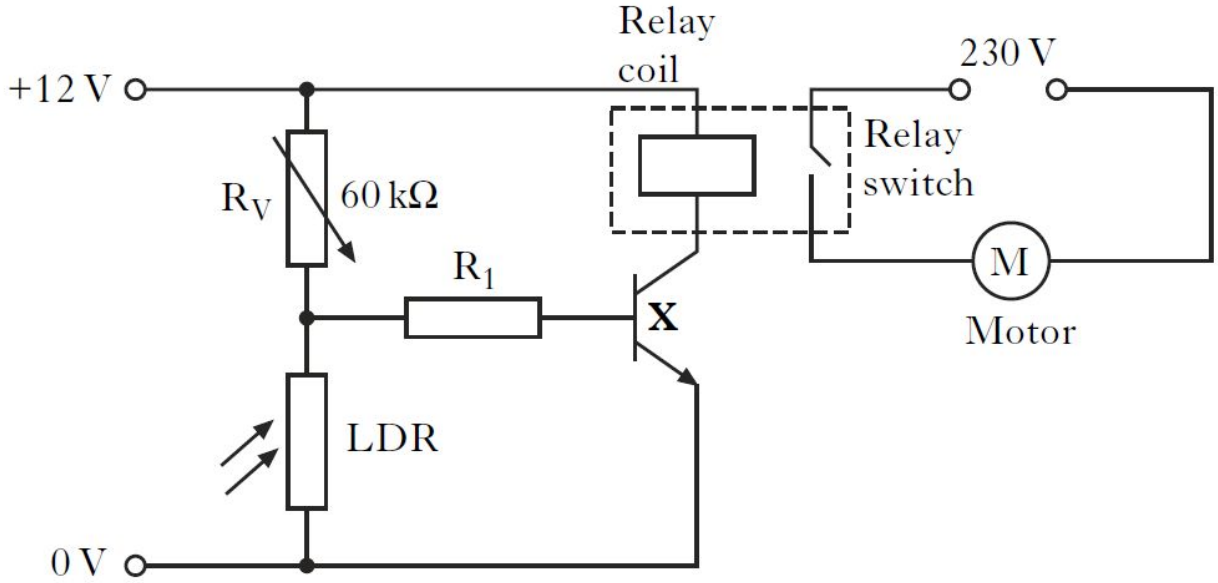
QUESTION 59

Answer the following question using the circuit below.

a) Calculate the voltage across the LDR when its resistance is 4kΩ.

b) Explain how this circuit operates when the light level falls below a certain value.

c) Give a possible practical application for this circuit.

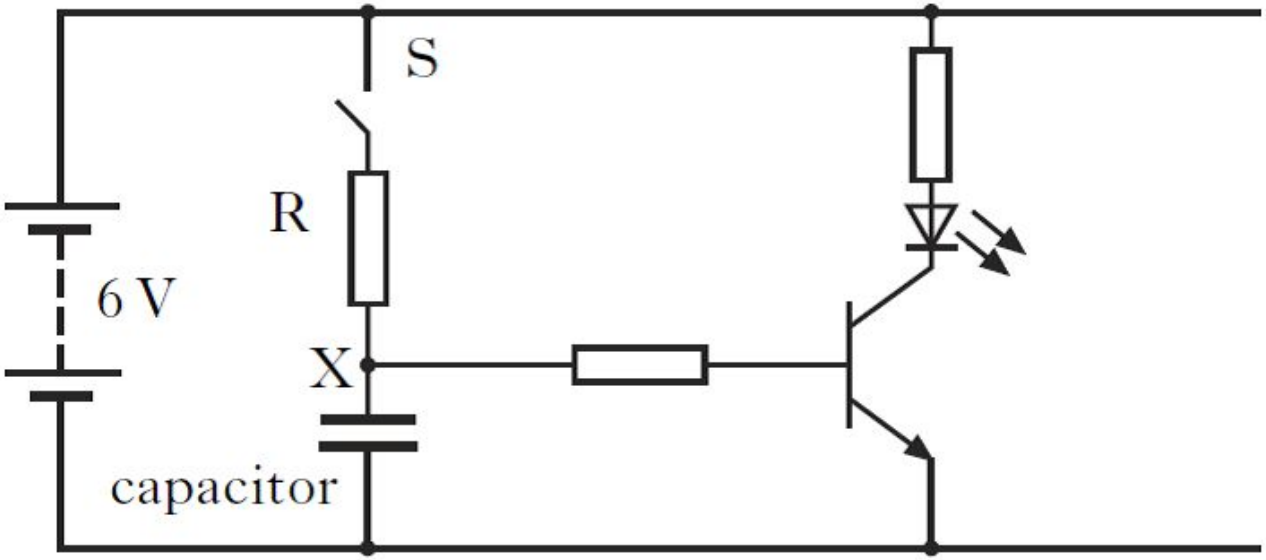


QUESTION 60

Answer the following questions from the circuit below.

a) What happens to the voltage at point X when switch S is closed.

b) State two changes which could be made to the circuit so that the time taken for the LED to come on is reduced.



The End