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GCSE

Physics

Session: 1994 June
Type: Question paper
Code: 1700

MIDLAND EXAMINING GROUP **1700/1**

General Certificate of Secondary Education

Science: PHYSICS

PAPER 1

Thursday **16 JUNE 1994** Afternoon 45 minutes

Additional materials:
Personalised Answer sheet (Form MS4)
Soft pencil

TIME 45 minutes

INSTRUCTIONS TO CANDIDATES

There are 40 questions in this paper. Answer **all** the questions.
For each question, five possible answers, labelled **A**, **B**, **C**, **D** and **E**, are given. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate answer sheet.

Read very carefully the instructions on the answer sheet.

INFORMATION FOR CANDIDATES

One mark will be scored for each correct answer. A mark will not be deducted for a wrong answer.

This question paper consists of 19 printed pages and 1 blank page.

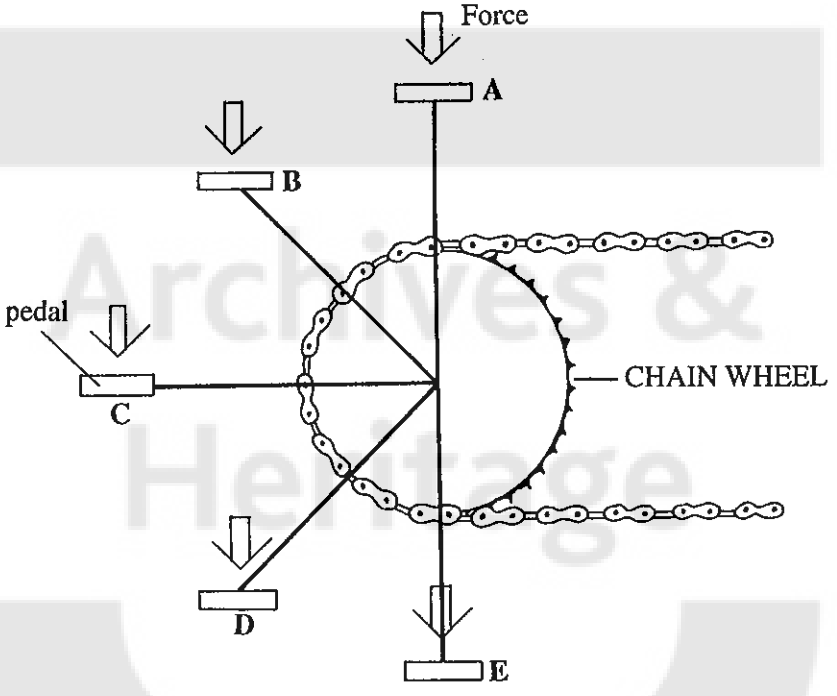
1 A car journey takes three hours. For the first two hours, the average speed is 90 km/h. For the remaining hour, the average speed is 60 km/h.

distance = average speed × time.

What is the total distance travelled, in km?

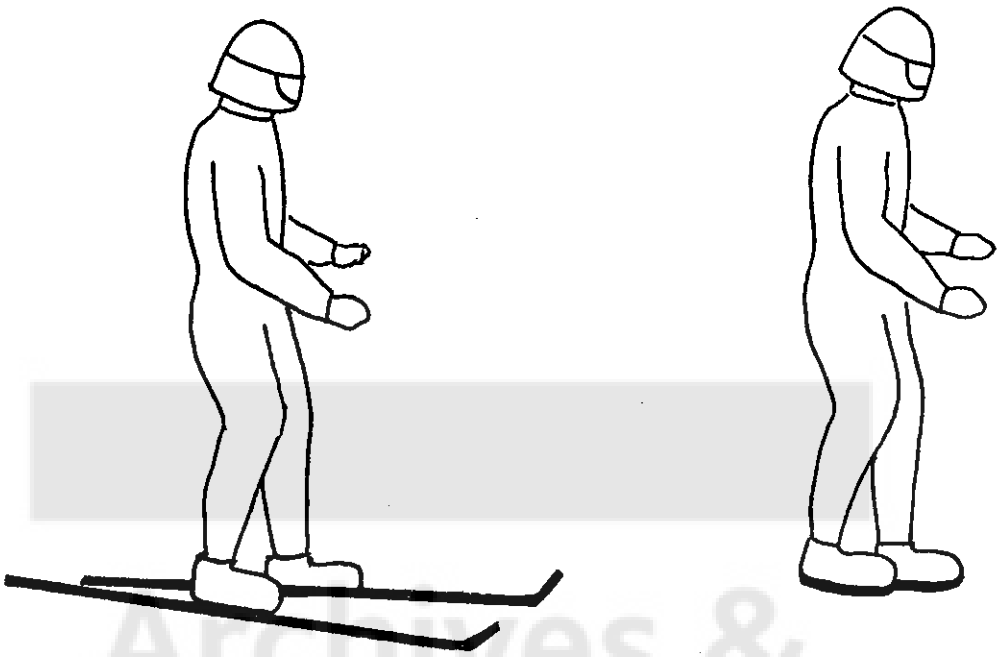
A 150 **B** 210 **C** 225 **D** 240 **E** 315

2 A boy riding a bicycle pushes straight downwards with his whole weight on one pedal.



Where is the pedal when the boy exerts the greatest turning effect on the chain wheel?

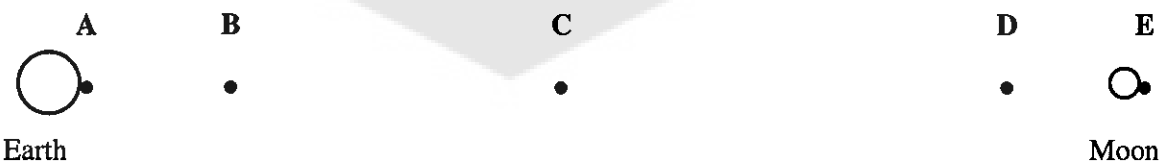
3 John stands on the snow wearing skis. David has the same weight as John and is wearing boots.



Why does David sink further into the snow?

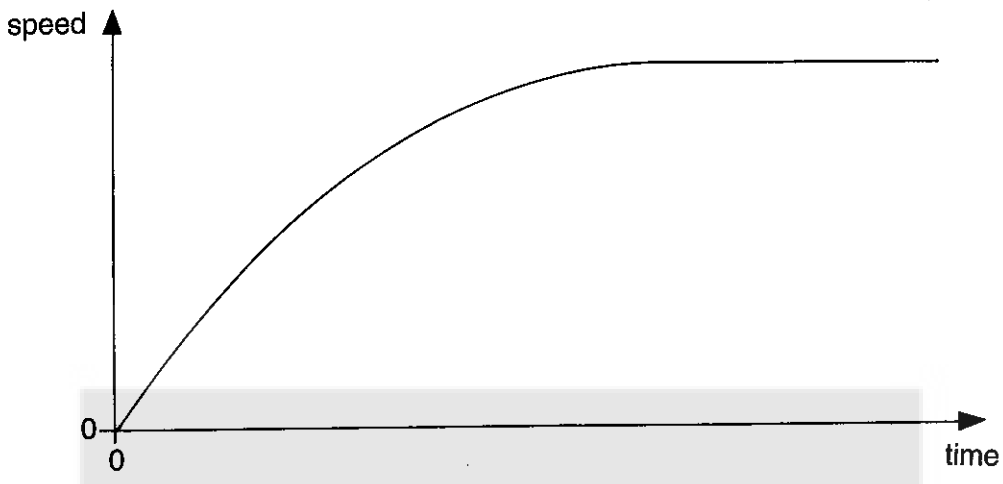
A The boots have a smaller surface area than the skis.
B The boots are warmer than the skis and melt the snow.
C The boots have a much rougher surface than the skis.
D The skis weigh less than the boots.
E The skis help to reduce John's weight.

4 Any object weighs less on the Moon than it does on Earth. A spacecraft leaves Earth for the Moon.



At which point is the pull of the Moon on the spacecraft equal and opposite to the pull of the Earth?

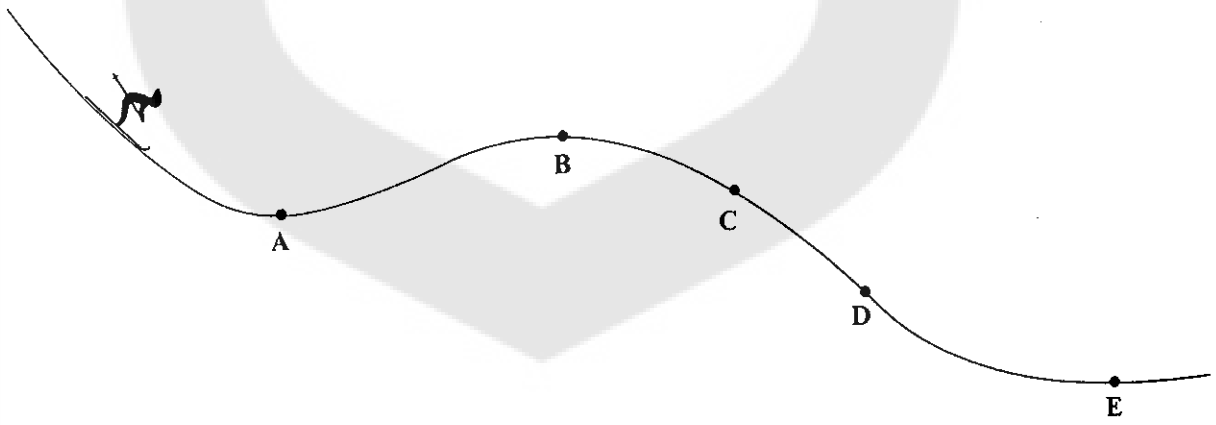
5 This is a graph of speed plotted against time for the motion of a steel ball.



How might the ball be moving?

A falling freely from rest in a vacuum
B falling from rest in a deep tank of water
C rolling at constant speed along a table
D rising up into the air
E rolling up a steep hill

6 A skier skis down a mountain.



At which of the points **A, B, C, D, E** does the skier have the most gravitational potential energy?

7 Five pupils, in turn, climb to the top of a rope in the school gym.

The Table shows the work done and the time taken by each pupil.

pupil	A	B	C	D	E
work done/J	1000	1000	1500	2000	2000
time taken/s	4	8	5	10	5

$$power = \frac{work\ done}{time\ taken}$$

Which pupil develops the greatest power?

8 A substance can float in a liquid if it is less dense than the liquid.

The Table gives the densities of five substances.

	substance	density (g/cm^3)
A	cork	0.25
B	ice	0.92
C	oak	0.65
D	polystyrene foam	0.016
E	softwood	0.50

The density of paraffin oil is 0.80 g/cm^3.

Which substance will **not** float in paraffin oil?

9 A tea-bag is put into a saucer of water and left for several hours. The brown colour of the tea slowly spreads through the water. What is the name of the process that causes the spreading?

A Brownian motion
B conduction
C convection
D diffusion
E evaporation

10 A thermostat controls the temperature in a centrally-heated room.

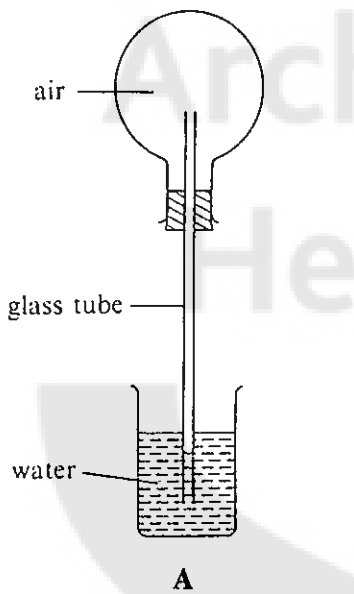
Which temperature setting would give a comfortable room temperature?

A 0°C **B** 22°C **C** 37°C **D** 50°C **E** 70°C

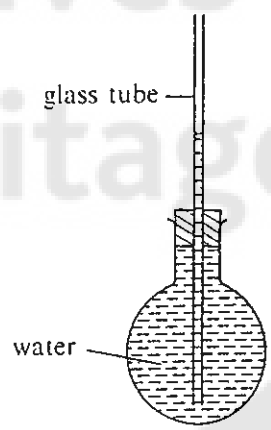
11 In which weather conditions will water in an outdoor swimming pool evaporate most quickly?

A cool and calm weather
B warm and calm weather
C rainy and windy weather
D cool and windy weather
E warm and windy weather

12 Which of these arrangements would be best to show expansion of a gas when it is heated?



A



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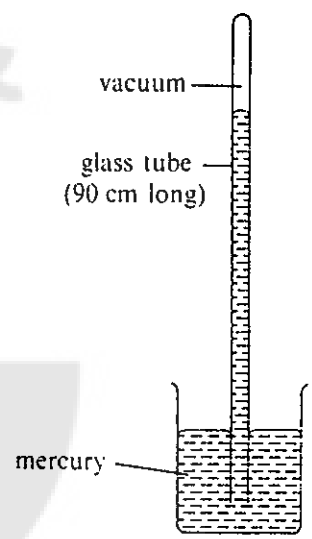
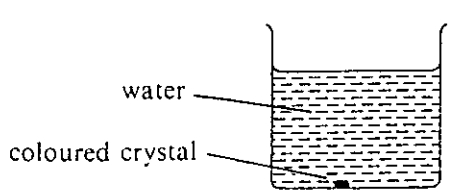
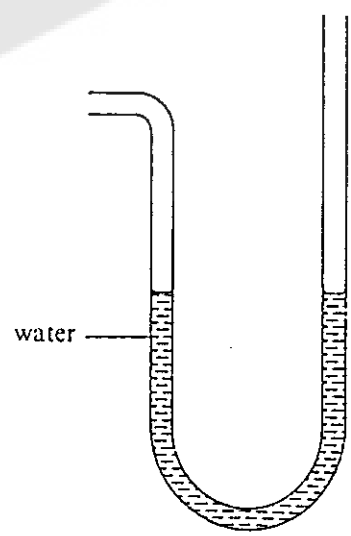


C



D



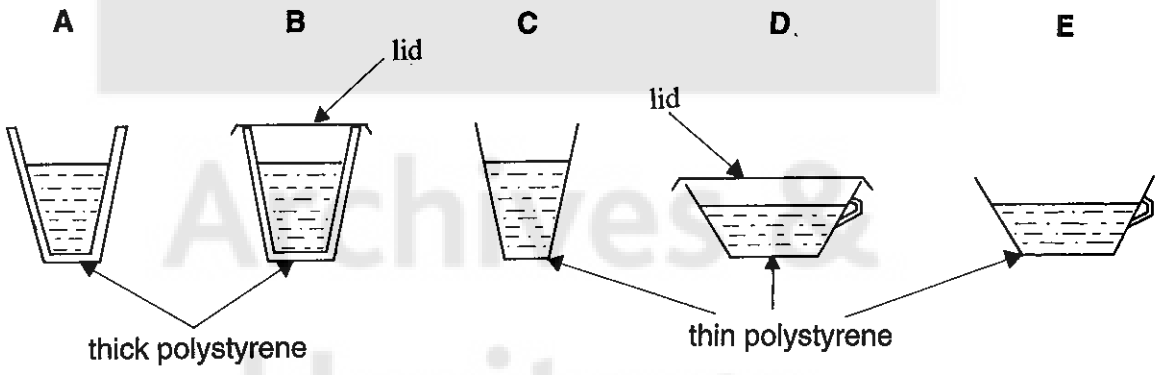
E

13 A pair of denim jeans is taken out of a hot tumble drier after drying for 20 minutes.

Why do the metal buttons feel hotter than the denim material?

A They are at a higher temperature than the denim.
B They have a shinier surface than the denim.
C They conduct heat better than the denim.
D They radiate heat better than the denim.
E They absorb heat better than the denim.

14 Equal volumes of coffee at 90°C are poured into different cups.



In which cup will the coffee cool most quickly?

15 Zoe leaves two toy cars in front of a fire. One car has a shiny surface and the other is dull black. They are the same distance from the fire.

Why does the black car feel hotter than the shiny one when Zoe picks them up?

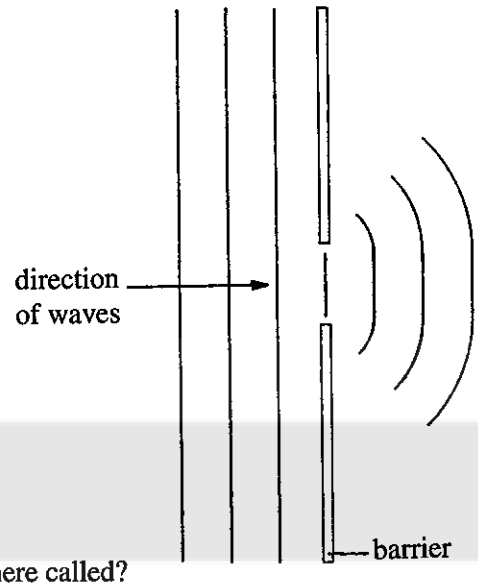
A The black car is a better absorber of heat radiation than the shiny one.
B The black car is a poorer absorber of heat radiation than the shiny one.
C The black car is a better conductor of heat than the shiny one.
D The black car is a poorer conductor of heat than the shiny one.
E The black car is a poorer radiator of heat than the shiny one.

16 A gas is cooled. The molecules move slower and the average distance between them becomes about ten times smaller.

What process does this describe?

A boiling
B condensation
C evaporation
D expansion
E melting

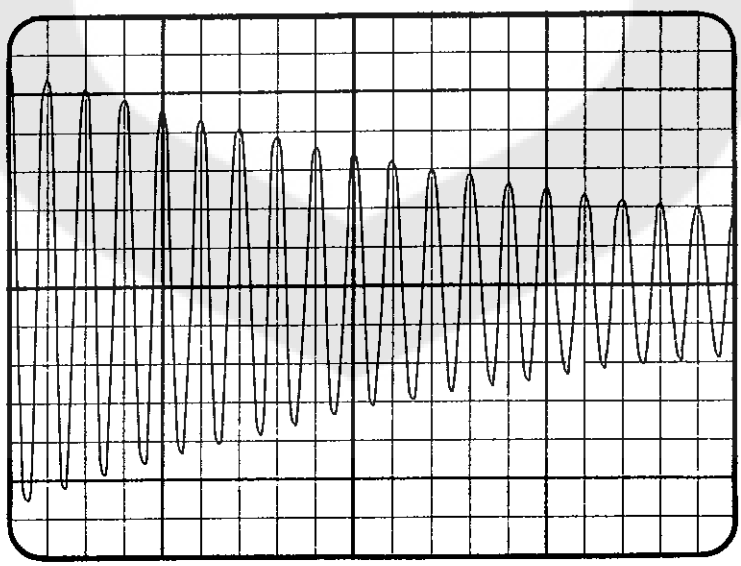
17 The diagram shows water waves passing through a gap in a barrier.



What is the effect shown here called?

A deviation
B diffraction
C interference
D reflection
E refraction

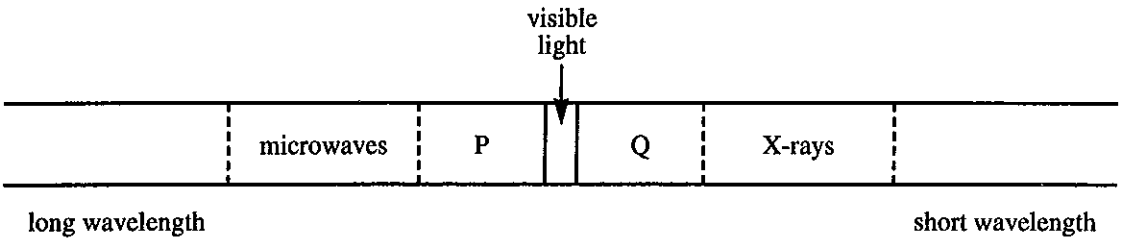
18 A microphone and an oscilloscope are used to show the waveform of a note from an electronic organ.



Which property of the wave is decreasing with time?

A quality **B** frequency **C** amplitude
D speed **E** wavelength

19 The figure shows part of the electromagnetic spectrum of radiations.



What kinds of radiation are P and Q?

	P	Q
A	gamma rays	infra-red
B	infra-red	radio waves
C	infra-red	ultra-violet
D	radio waves	gamma rays
E	ultra-violet	radio waves

20 Which are most suitable to examine a broken bone?

A infra-red waves **B** microwaves **C** ultra-violet waves

D visible light waves **E** X-rays

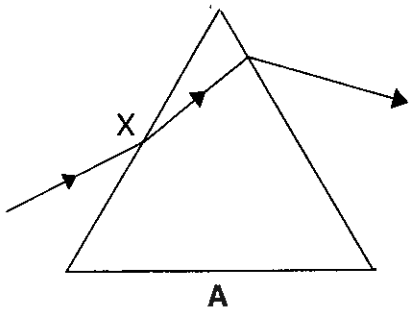
21 A driver looks into his rear-view mirror. He sees a vehicle behind him. He reads the word AMBULANCE on the image of this vehicle.

Which of the following is painted on the front of the vehicle?

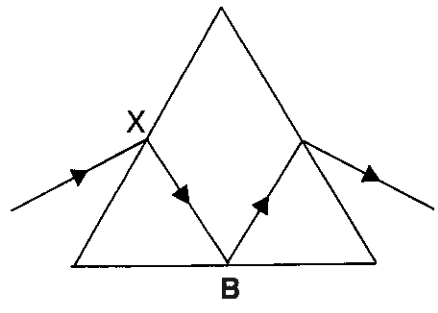
A AMBULANCE
B ƎNCALUBMA
C ∀WBULANCE
D ECNALUBMA
E ƎƆИALUƃMA

22 A ray of red light strikes the face of a triangular glass prism at a point X.

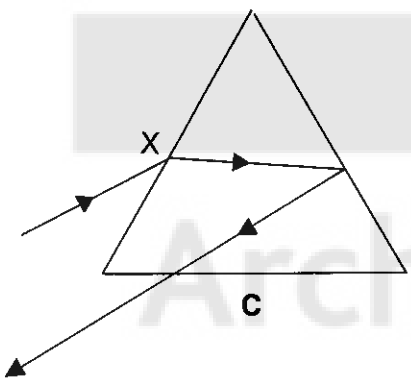
Which diagram shows correctly what happens to the ray when it passes through the prism?



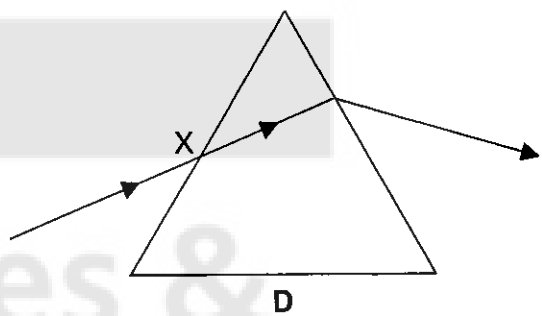
A



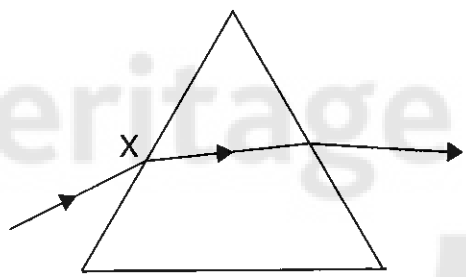
B



C

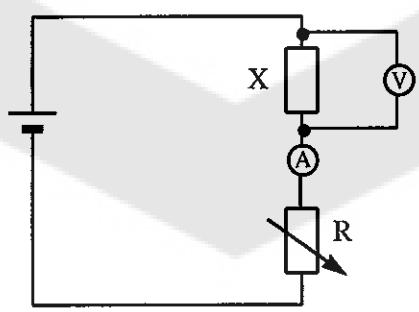


D



E

23 The circuit was set up to measure the resistance of the resistor X.



The resistance of the variable resistor R is increased.

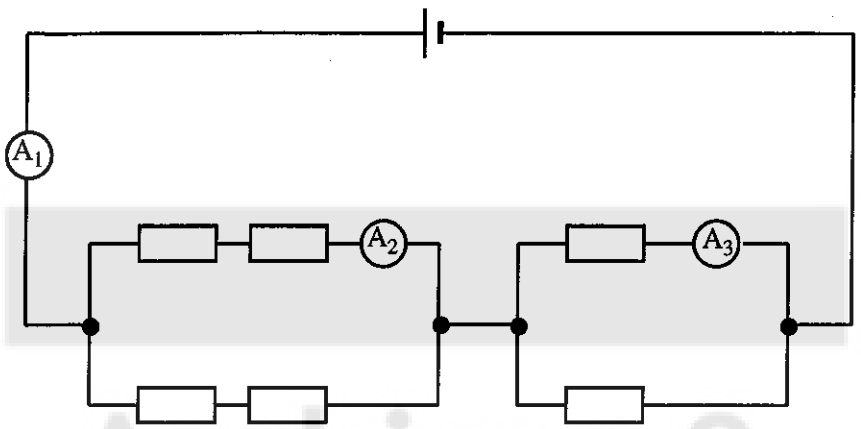
Which line below correctly describes what happens to the ammeter and voltmeter readings?

	ammeter	*voltmeter*
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases
E	unchanged	unchanged

24 Which of these is a unit of electrical resistance?

A ampere **B** joule **C** ohm **D** volt **E** watt

25 The circuit contains six identical resistors.

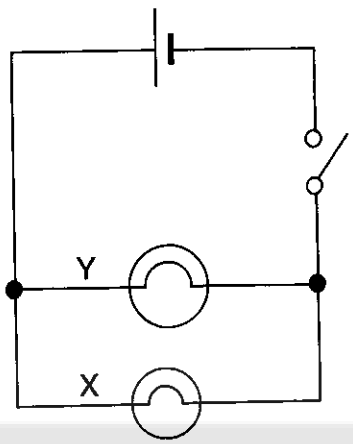


The ammeter A_1 reads 1.0 A.

Which are the correct readings for ammeters A_2 and A_3?

	Reading of A_2	Reading of A_3
A	0.5 A	0.25 A
B	0.25 A	0.5 A
C	0.5 A	0.5 A
D	1.0 A	1.0 A
E	4.0 A	2.0 A

26 The circuit contains two lamps which are **not** identical.



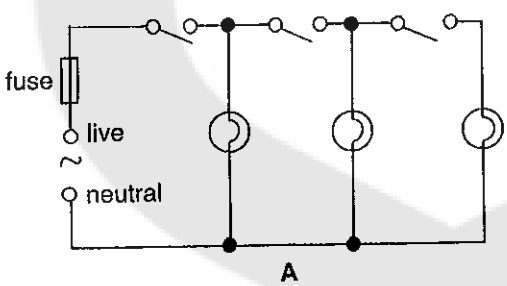
When the switch is closed, lamp Y is brighter than lamp X.

What *must* be the same for each lamp?

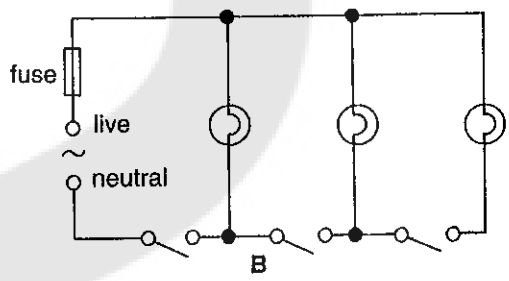
A the current through each lamp
B the lengths of the lamp filaments
C the potential difference across each lamp
D the power of each lamp
E the resistance of each lamp

27 Three lamps are wired to the mains supply. Each lamp is to be switched on and off separately.

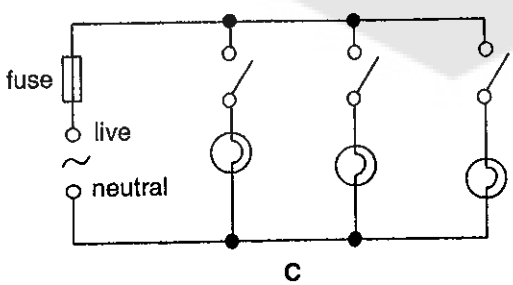
Which diagram shows the correct circuit?



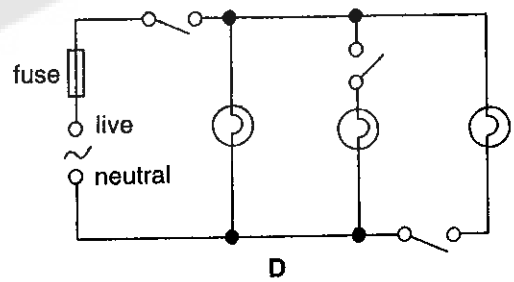
A



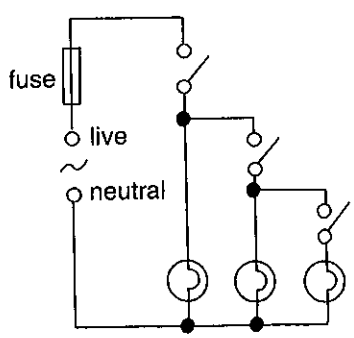
B



C



D



E

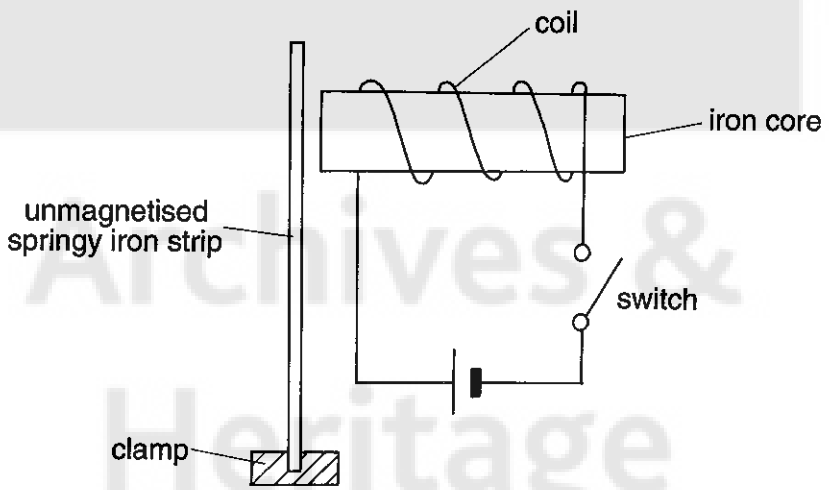
28 A hair dryer is rated as '600 W, 240 V'.

Which value of fuse should be fitted in the plug?

$$current = \frac{power}{potential\ difference}$$

A 1 A **B** 5 A **C** 10 A **D** 13 A **E** 30 A

29 The switch in this circuit is open.

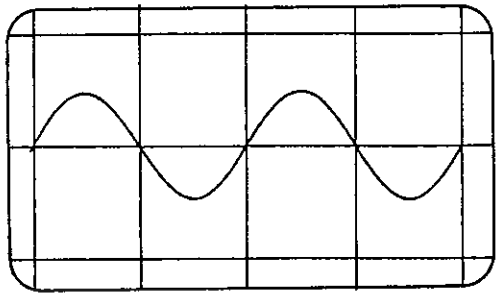


The switch is now closed.

What happens to the iron strip?

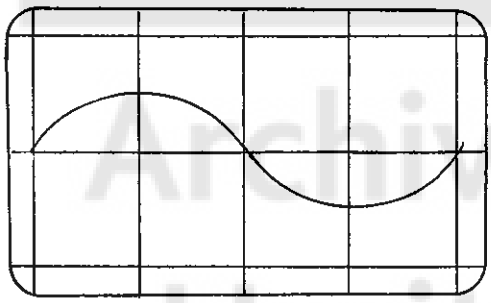
A It bends to the left and stays there.
B It bends to the left and returns to its starting position.
C It remains at rest.
D It bends to the right and stays there.
E It bends to the right and returns to its starting position.

30 An oscilloscope is used to show how the output voltage of an a.c. generator changes with time. This trace is obtained.

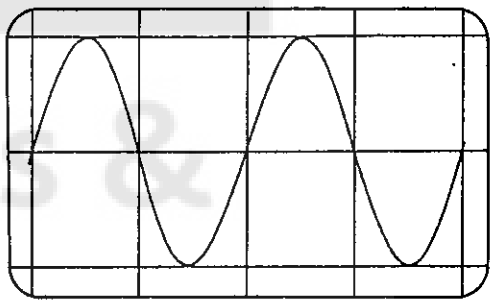


The coil of the a.c. generator is now rotated at twice its original speed. Which oscilloscope trace shows how the output voltage now changes with time?

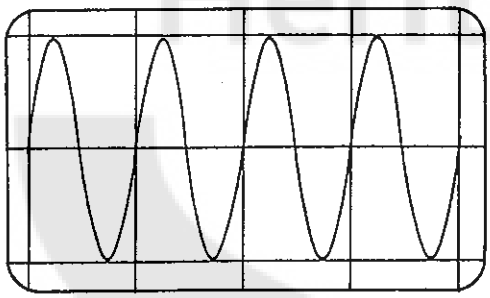
A



B



C



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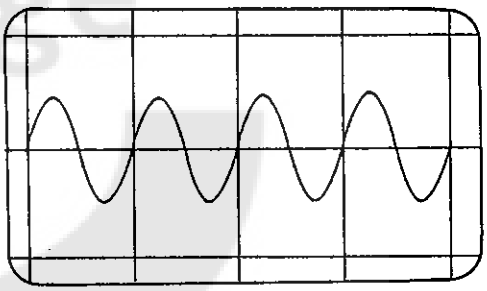
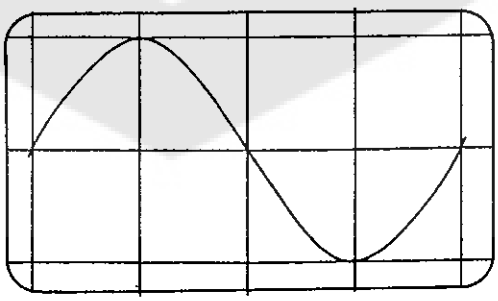
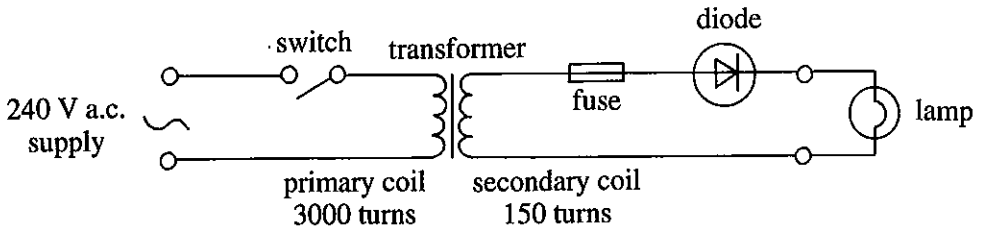


E



31 The diagram shows a simple circuit for a power pack. It is used to light a lamp.



Which of the following is correct?

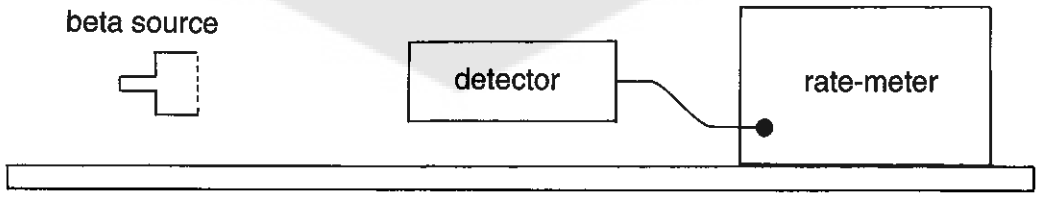
A The transformer converts a.c. to d.c..
B The transformer will step up the voltage supplied to the lamp.
C The diode reverses the direction of the current.
D The fuse breaks the circuit if the current becomes too high.
E The fuse controls the current supplied to the lamp.

32 Metal cables are used to conduct electricity along a power line. The cable is supported from a metal pylon.

What material is used to insulate the cable from the pylon?

A copper
B aluminium
C lead
D iron
E glass

33 The drawing shows a source of beta particles about 20 cm from a radiation detector and rate-meter.



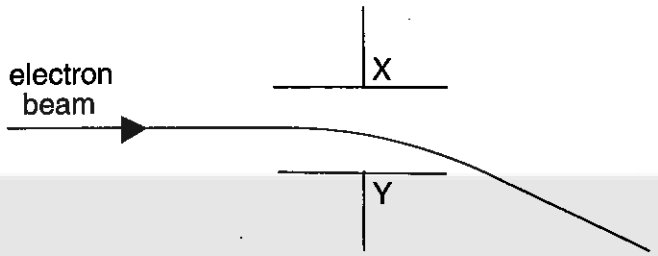
What can be done to increase the count-rate shown on the rate-meter?

A Move the source further from the detector.
B Place a vertical magnetic field between the source and the detector.
C Put a thin sheet of aluminium between the source and the detector.
D Reduce the amount of air between the source and detector.
E Wait for a time equal to the half-life of the source.

34 Iodine-131 is a radioactive substance with a half-life of 8 days. A sealed container holds 16 mg of iodine-131. How much iodine-131 will be left after 24 days?

A 2 mg **B** 4 mg **C** 8 mg **D** 12 mg **E** 16 mg

35 A narrow beam of electrons passes between the horizontal plates X and Y in a cathode ray tube.



What is the reason for this deflection of the electron beam ?

A Gravity pulls the beam downwards.
B A magnetic field acts from X to Y.
C Electrons are slowing down.
D X is charged positively and Y negatively.
E X is charged negatively and Y positively.

36 $^{234}_{90}Th$ is an isotope of thorium.

Which statement about a nucleus of this isotope is correct?

A The number of protons is 90.
B The number of neutrons is 90.
C The number of protons is 234.
D The number of neutrons is 234.
E The number of electrons is 234.

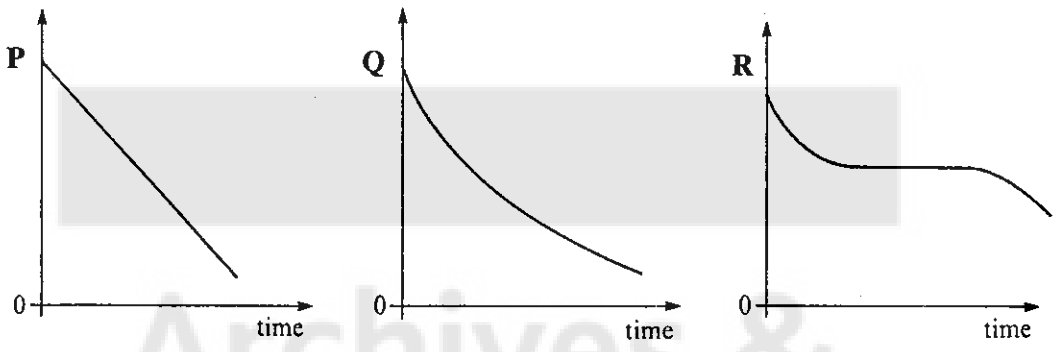
37 The three graphs show

(i) *temperature* of molten wax as it turns solid.

(ii) the *activity* of a radioactive source as it decays.

(iii) the *velocity* of a car moving with a constant deceleration.

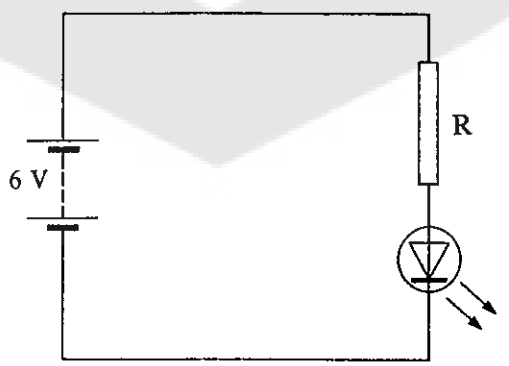
(The graphs are not printed in that order.)



Which line shows the correct labels for the Y-axes of the graphs?

	P	Q	R
A	velocity	temperature	activity
B	velocity	activity	temperature
C	activity	velocity	temperature
D	activity	temperature	velocity
E	temperature	velocity	activity

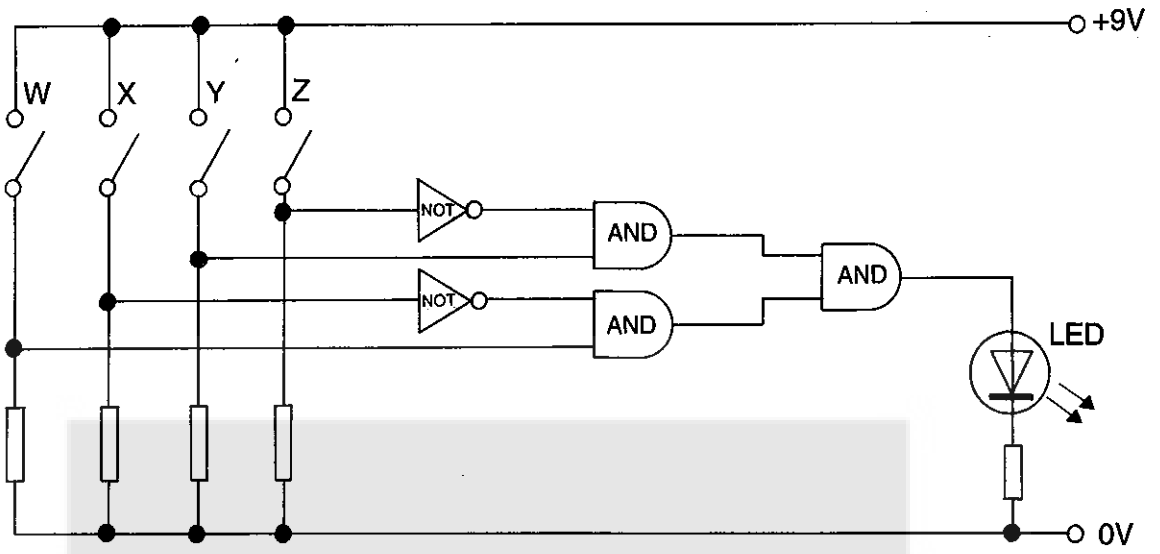
38 When a light-emitting diode is connected in a circuit, a resistor is connected in series with it, as shown.



What is the purpose of the resistor R?

A to make the light emitting diode glow
B to change the colour of the light emitted
C to stop the current flowing the wrong way
D to increase the potential difference across the diode
E to limit the size of the current through the diode

39 Four switches, W, X, Y and Z control a logic circuit.



Which switches must be closed to light the LED?

A W and Y
B W and Z
C W and X
D X and Y
E Y and Z

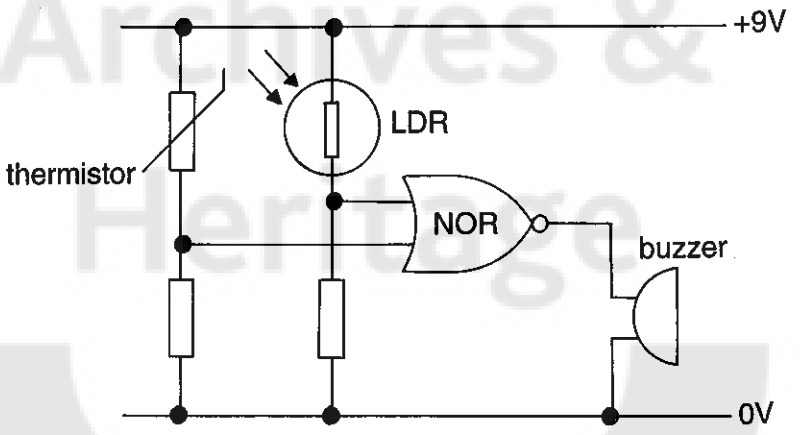
40 This is the truth table for a NOR gate:

Inputs		Output
0	0	1
0	1	0
1	0	0
1	1	0

In this circuit, both inputs to the NOR gate are logic 1 if

(i) the thermistor is *hot,* and

(ii) the LDR is in the *light.*



The buzzer sounds. What must be the states of the thermistor and LDR?

	thermistor	*LDR*
A	cold	dark
B	cold	light
C	warm	light
D	hot	dark
E	hot	light

	Centre Number	Candidate Number
Candidate's Name		
Centre		

MIDLAND EXAMINING GROUP 1700/2

General Certificate of Secondary Education

Science: PHYSICS

PAPER 2

Monday **20 JUNE 1994** Morning 1 hour 15 minutes

Candidates answer on the question paper.
No additional material required.

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre, centre number and candidate number in the spaces provided above.

Answer **all** questions on this paper.

Read each question carefully and make sure you know what you have been asked to do before starting your answer.

Show **all** your working when answering numerical questions.

Lines are provided on the question paper for your answer. You should confine your answers to these lines.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part-question.

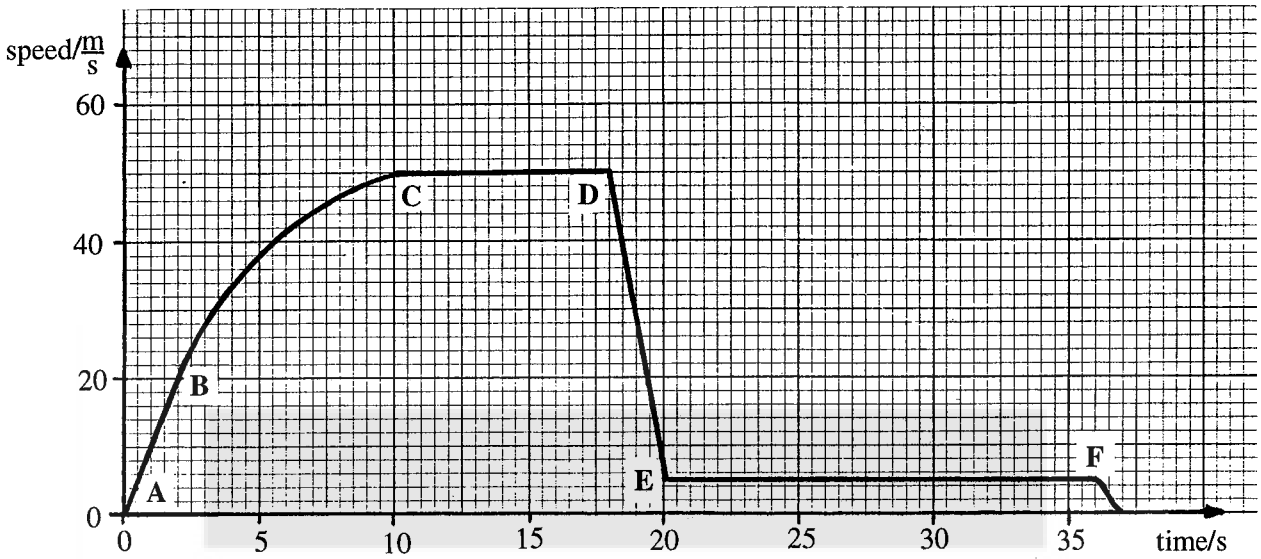
Marks will be awarded for the correct use of spelling, punctuation and grammar.

For Examiner's Use

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
sub-total	
SPG	
Total	

This question paper consists of 13 printed pages and 3 blank pages.

1 A sky diver jumps from an aeroplane. After a while she opens her parachute. The graph below shows how her vertical speed changes during the fall.



(a) What motion is shown by the graph:

from A to B? .....

from B to C? .....

from C to D? .....

from D to E? .....[4]

(b) Name the largest force acting on the diver in part AB of the graph.

.....[1]

(c) Explain her motion between B and D. Write about the forces acting on her.

.....

.....[2]

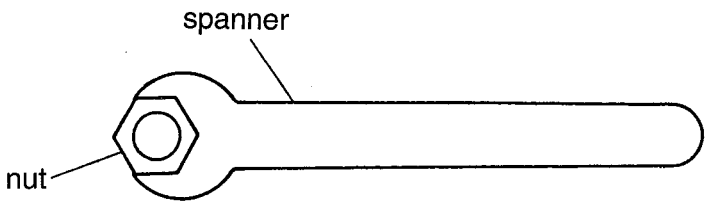
(d) At which point does she open her parachute? Explain.

.....

.....

.....[2]

2 **(a)** The diagram shows a spanner round a nut.



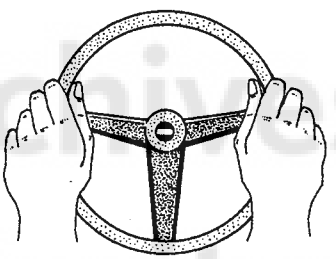
A force is applied to the spanner to turn the nut.

On what does the turning effect of the force depend?

.....

..... [2]

(b) The diagram shows two hands on the steering wheel of a car.



(i) The steering wheel is turned in an **anticlockwise** direction. To do this, two forces are applied to the steering wheel by the driver.

On the diagram, draw two arrows to show these forces. [2]

(ii) A larger turning effect can be produced by the same force.

How can the design of the steering wheel be changed to do this?

..... [1]

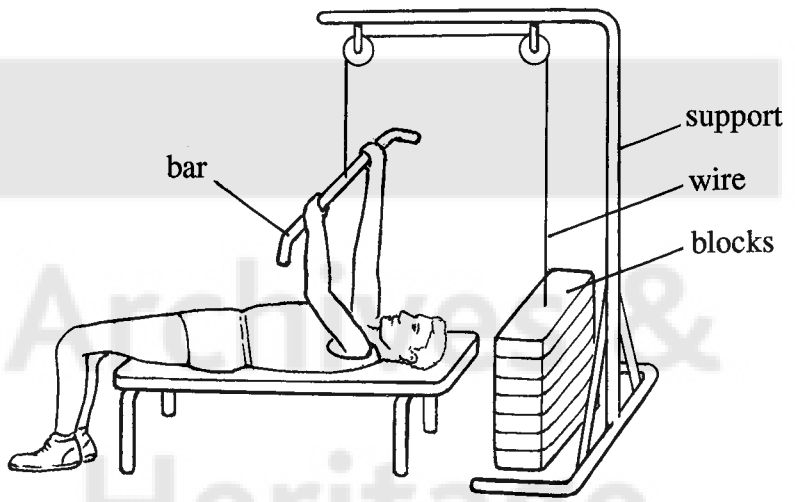
3 This question is about keep-fit equipment used to strengthen muscles.

In the question you may find these equations useful:

Work done = force × distance moved in the direction of the force

$$power = \frac{work\ done}{time\ taken}$$

(a) Mark pulls down the bar and so lifts the blocks.



(i) In one lift, Mark raises blocks weighing 250 N through a height of 0.40 m.

Calculate how much work he does.

.....

..... [2]

(ii) Mark takes 1 minute to do 20 lifts.

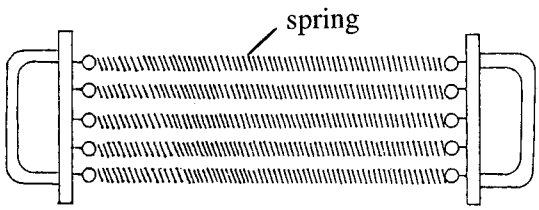
Calculate the power of his muscles.

.....

.....

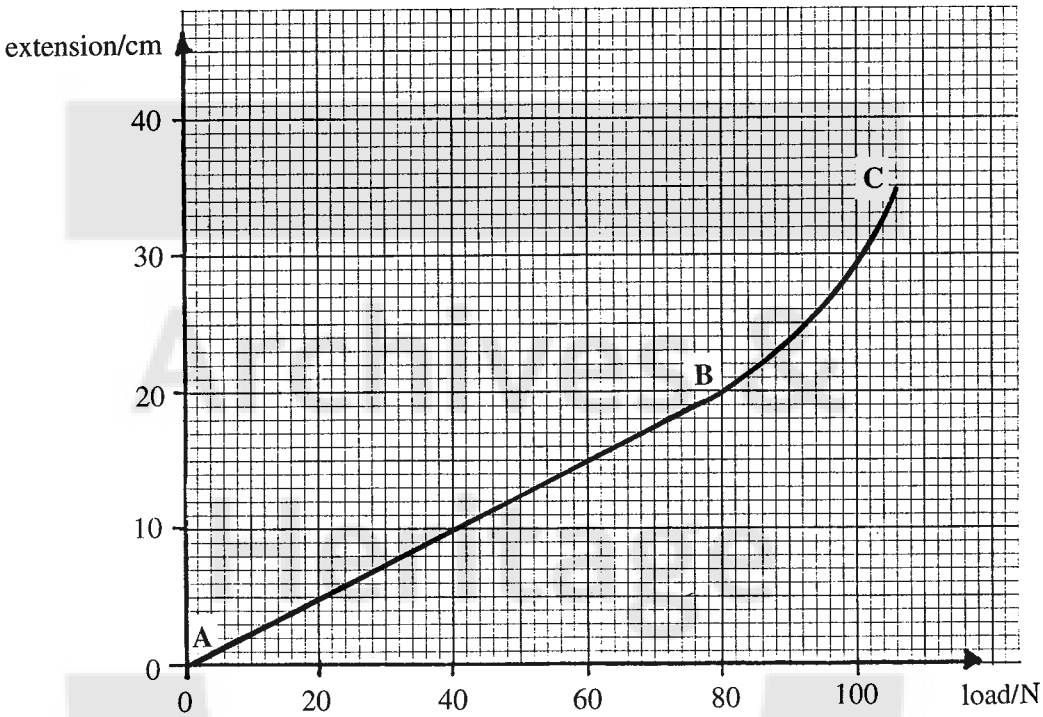
..... [3]

(b) Mark now uses a chest expander. It is made up of five identical springs.



One spring is removed from the frame.

A graph of extension against load for this spring is shown below.



(i) What does the graph show about the behaviour of this spring,

between A and B?

.....

..... [1]

between B and C?

.....

..... [1]

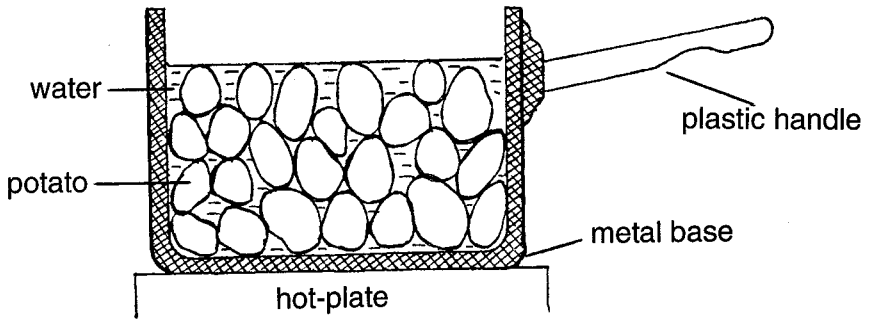
(ii) Use part AB of the graph to find how big a force is needed to extend this spring by 10 cm.

..... [1]

(iii) Mark uses all five springs in the chest expander. How big a force is needed to extend the expander by 10 cm?

..... [1]

4 **(a)** The diagram shows some potatoes being heated in a pan of water.



(i) Name the process by which energy passes through the base of the pan.

.....[1]

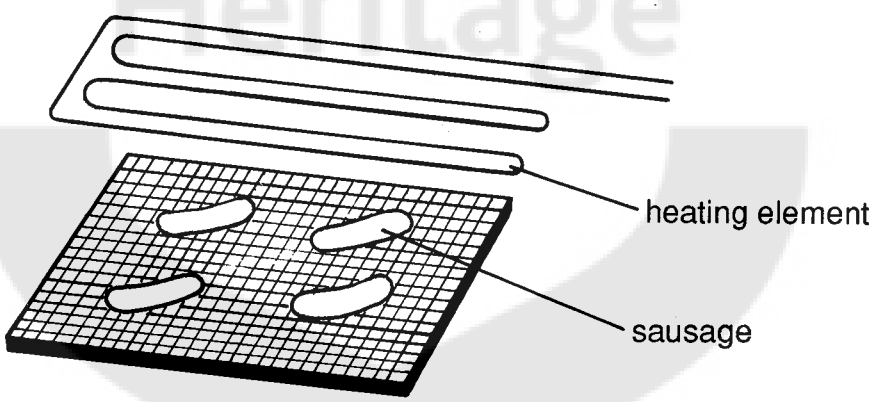
(ii) Explain how energy reaches the potatoes at the top.

.....

.....

.....[3]

(b) The diagram shows some sausages being heated under the heating element of a grill. The temperature of the surface of the sausages is 200°C.



Name the process by which:

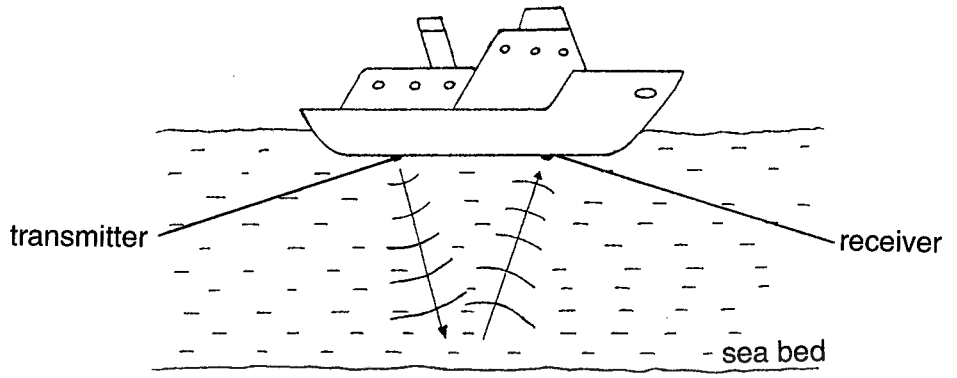
(i) most heat energy reaches the food from the heating element.

.....[1]

(ii) the insides of the sausages become hot.

.....[1]

5 A ship is using ultrasonic waves to check the depth of the sea.



A short pulse of ultrasonic waves is emitted by a transmitter under the ship.

(a) What are ultrasonic waves?

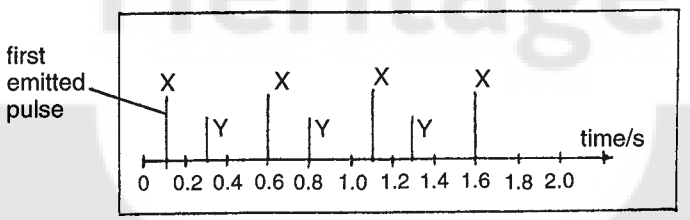
.....[2]

(b) Why does the pulse return to the ship?

.....

.....[2]

The pulses emitted by the ship are shown on a chart as traces X. The return pulses are also displayed on the chart as traces Y which follow each emitted pulse X.



(c) What is the time interval between the emitted pulses?

.....[1]

(d) What is the time between a pulse leaving the ship and returning to it?

.....[1]

(e) Use the equation to calculate the distance a pulse travels between leaving the ship and returning to it.

The speed of ultrasonic waves in sea water is 1500 m/s.

distance = speed × time

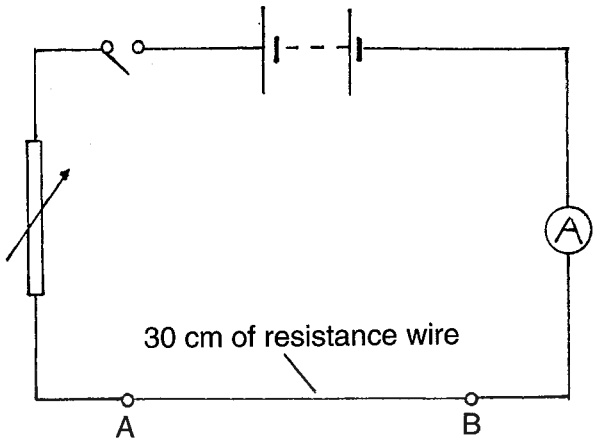
.....

.....[2]

(f) How deep is the water under the ship?

.....[1]

6 **(a)** Christine sets up a circuit to measure the current in a resistance wire AB of length 30 cm.



She now measures the p.d. across the 30 cm length of resistance wire.

(i) Name the instrument she should use for this.

.....[1]

(ii) **On the diagram**, show where she should connect this instrument. [2]

(iii) The p.d. across the wire is 1.5 V and the current is 0.5 A.

Use the equation to calculate the resistance for this length of wire.

$$resistance = \frac{p.d.}{current}$$

.....

.....

.....[3]

(iv) What would be the resistance of:

a 60 cm length of the same wire? .....[1]

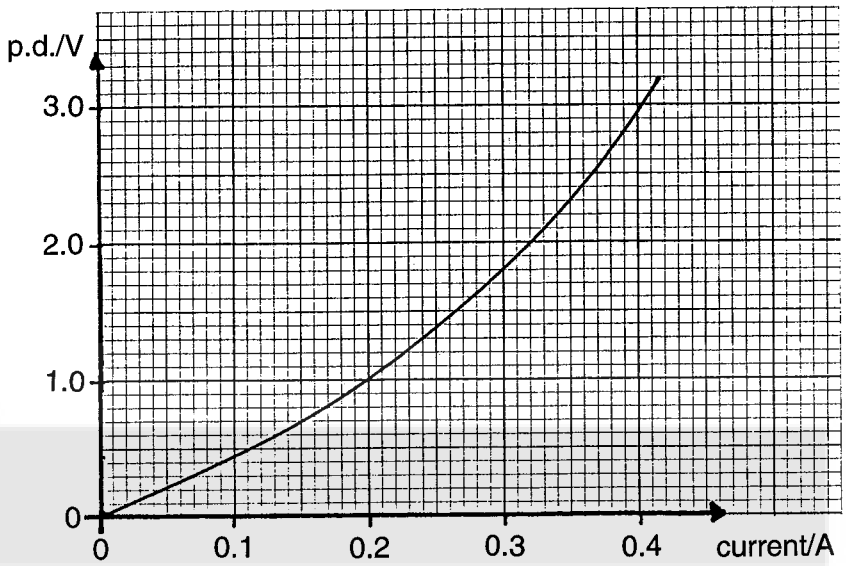
a 15 cm length of the same wire? .....[1]

(v) How does the resistance depend on the length of the wire?

.....

.....[2]

(b) The graph shows how the p.d. across a filament lamp changes with the current.



What happens to the resistance of the filament as the current increases?

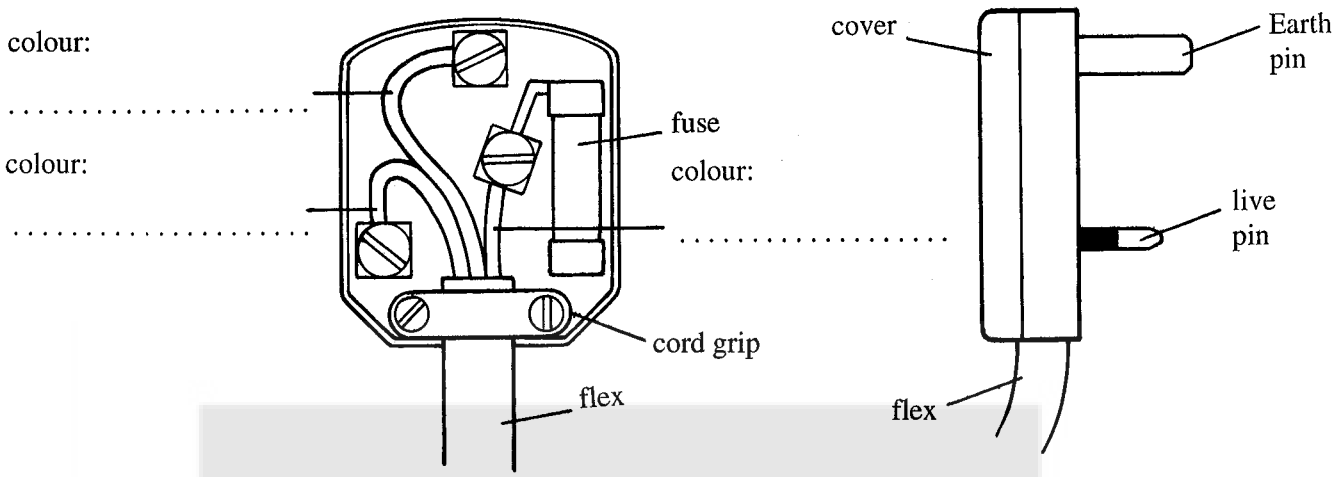
.....

How can you tell this from the graph?

.....

..... [2]

7 This question is about a mains plug.



(a) **In the spaces in the diagram labels**, write the colour of the insulation on each of the wires shown. [3]

(b) The Earth pin on the plug is longer than the others.

Why is this?

..... [1]

(c) You are connecting a new plug to the flex of an electric heater.

State **TWO** safety checks you should make to the plug before putting its cover on.

.....

..... [2]

(d) The heater is switched on. The live wire **inside the heater** becomes loose. It touches the metal case of the heater.

Describe and explain what happens.

.....

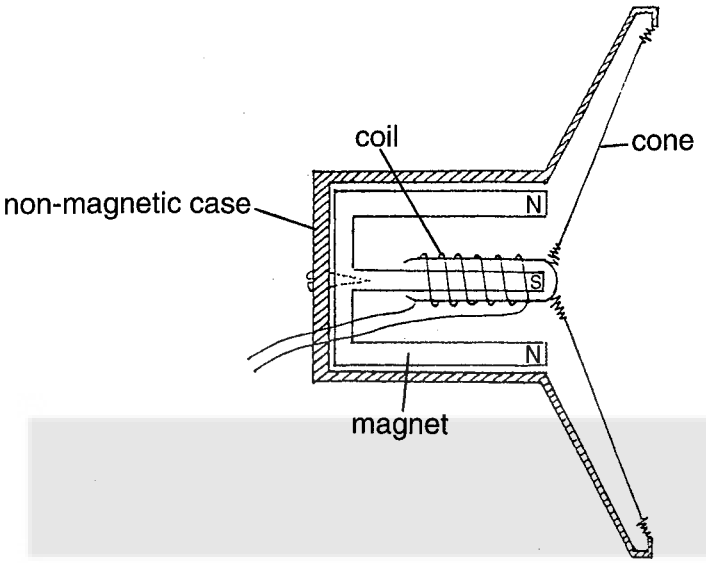
.....

.....

.....

..... [3]

8 The diagram shows a loudspeaker.



(a) The coil is connected to a d.c. supply,

What happens to the cone when the current is switched on?

.....[1]

(b) The coil is now connected to an a.c. supply of frequency 1000 Hz.

(i) In what way does an a.c. supply differ from a d.c. supply?

.....

.....[1]

(ii) What happens to the cone when the a.c. is switched on?

.....[1]

(iii) Describe the sound which is heard.

.....[1]

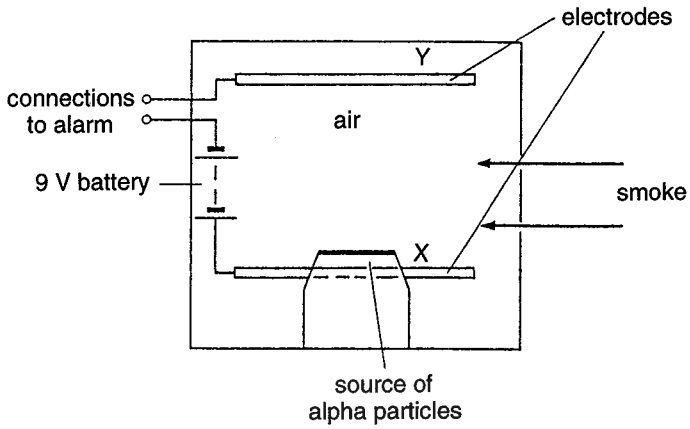
(c) The frequency of the a.c. is reduced to 100 Hz. The amplitude of the a.c. is also reduced.

In what ways does the sound produced by the loudspeaker change?

.....

.....[2]

9 The diagram shows part of a smoke detector.



An alpha-particle source is used to produce *ions* in the air between plates X and Y.

(a) What are *ions*?

.....

..... [2]

(b) Why is an alpha-particle source more suitable than a gamma ray source?

..... [1]

(c) Plates X and Y are connected to a battery.

What happens to the positive ions and to the negative ions?

Positive ions: .....

.....

Negative ions: .....

..... [2]

(d) When smoke enters the detector, the number of ions reaching the plates X and Y falls. The current falls and the alarm sounds. What else might cause the current to fall and make the alarm sound?

..... [1]

(e) Why should the alpha-particle source have a long half-life?

..... [1]

(f) The smoke detector is usually placed on the ceiling.
Why is this?

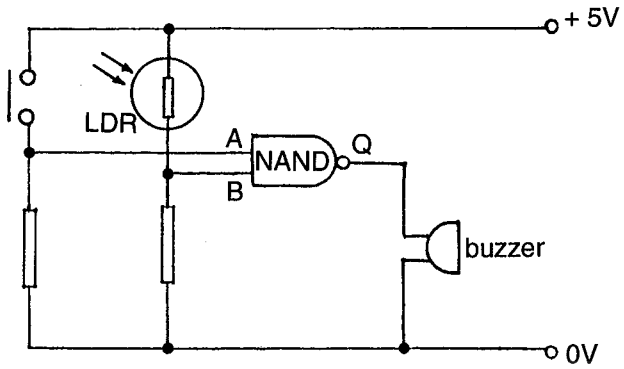
..... [1]

(g) Explain whether or not this source of alpha particles causes a safety problem.

.....

..... [1]

10 The diagram shows the circuit for an alarm.



The switch is fastened to a door frame. The switch is closed when the door is closed. This switch is open when the door is open.

(a) **(i)** What is the logic level of the input A to the NAND gate when the door is closed?

.....[1]

The truth table for a NAND gate is given below.

inputs A	inputs B	output Q
0	0	1
0	1	1
1	0	1
1	1	0

(ii) A light is shining on to the LDR. This makes the input B to the NAND gate logic 1. The door is still closed.

What is the logic level of the output, Q, of the NAND gate?

.....[1]

(b) What will make the buzzer sound? Explain.

.....

.....

.....

.....[4]

Centre Number	Candidate Number

Candidate's Name ....

Centre ....

MIDLAND EXAMINING GROUP 1700/3

General Certificate of Secondary Education

Science: PHYSICS

PAPER 3

Thursday **23 JUNE 1994** Morning 1 hour 30 minutes

Additional materials
Answer paper

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre, centre number and candidate number in the spaces at the top of this page and on all separate answer paper used.

SECTION A

Answer **ALL** questions in the spaces provided.

SECTION B

Answer **TWO** questions. Write your answers to this section on the separate answer paper provided. At the end of the examination, fasten the answer paper securely to this question paper.

Read each question carefully and make sure you know what you have been asked to do before starting your answer.

Show **ALL** your working when answering numerical questions.

Answers to numerical questions should be given to a suitable number of significant figures.

INFORMATION FOR CANDIDATES

The number of marks is shown in brackets [ ] at the end of each question or part-question.

You will find formulae on page 2.

Marks will be awarded for the accurate use of spelling, punctuation and grammar.

For Examiner's use

1	
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Sub-total	
SPG	
TOTAL	

MEG 515 **Turn over**

This question paper consists of 16 printed pages.

The following information may be useful.

1 $Density = \frac{mass}{volume}$

2 $Pressure = \frac{force}{area}$ $\quad P = \frac{F}{A}$

3 $Force = mass \times acceleration$ $\quad F = ma$

4 The strength of the gravitational field at Earth's surface (g) can be taken as 10 newtons per kilogram.

$Weight = mass \times gravitational\ field\ strength$ $\quad W = mg$

5 Relationships between initial velocity (u), constant acceleration (a), final velocity (v), and distance travelled (s) after time (t):

$$a = \left(\frac{v-u}{t}\right)$$

$$Average\ velocity = \left(\frac{u+v}{2}\right)$$

$$s = average\ velocity \times time = \left(\frac{u+v}{2}\right) t$$

6 For a body of mass m moving with velocity v,

$kinetic\ energy = {}^1/_2 mv^2$

7 For a body of mass m raised through a height h,

$gravitational\ potential\ energy = mgh$

8 $Work\ done = force \times distance\ moved\ along\ line\ of\ action\ of\ force$

9 $Power = \frac{energy\ transformed}{time\ taken} = \frac{work\ done}{time\ taken}$

10 $The\ efficiency\ of\ a\ machine\ or\ system = \frac{useful\ output\ energy}{total\ input\ energy} = \frac{useful\ output\ power}{total\ input\ power}$

11 $The\ moment\ of\ a\ force\ about\ a\ pivot = force \times perpendicular\ distance\ from\ force\ to\ pivot$

12 $Wave\ speed = frequency \times wavelength$ $\quad v = f\lambda$

13 $Frequency = \frac{1}{period}$

14 $Resistance = \frac{potential\ difference}{current}$ $\quad R = \frac{V}{I}$

15 $Electric\ power = potential\ difference \times current$ $\quad P = VI = I^2 R = \frac{V^2}{R}$

16 *Electrical energy* (in kW h) = *power* (in kW) × *time* (in h)

17 For a transformer,

$$\frac{secondary\ voltage}{primary\ voltage} = \frac{number\ of\ turns\ on\ secondary\ coil}{number\ of\ turns\ on\ primary\ coil} \quad \frac{V_s}{V_p} = \frac{N_s}{N_p}$$

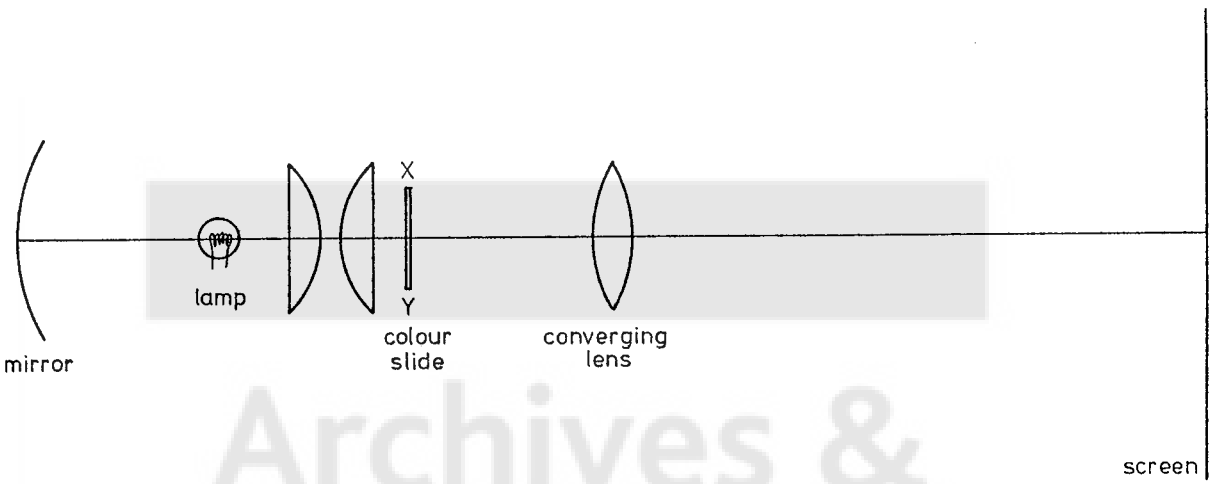
18 For a transformer with an efficiency of 100%,

$secondary\ power = primary\ power$ $\quad V_s I_s = V_p I_p$

Section A

Answer **ALL** *the questions in this section*

1 In a slide projector, light from a bright lamp is concentrated on a colour slide, XY, shown in the diagram below. This makes the slide a brightly lit object. The converging lens then forms an image of the slide on a distant screen.



(a) **On the diagram** draw rays from X and Y to show how the lens forms a focussed image of the slide on the screen. [3]

(b) Why does the slide have to be put in the projector upside down?

.....

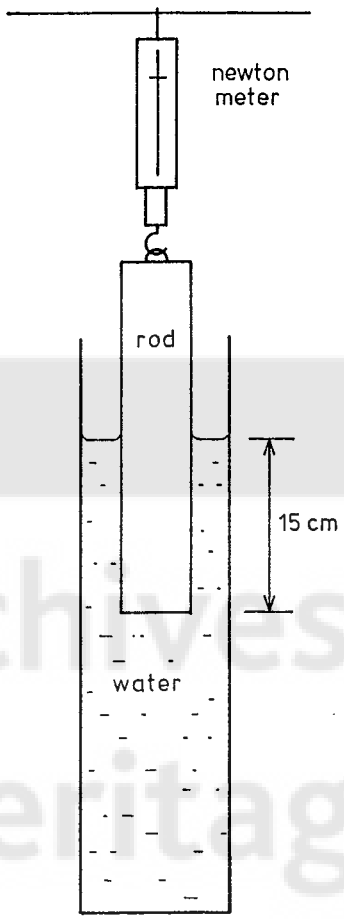
..... [1]

(c) Why is the image on the screen much larger than the slide?

.....

..... [1]

2 A cylindrical wooden rod is hung from a newton meter. The meter reads 5.4 N. When the rod is lowered into the water, as shown in the diagram, the reading of the meter falls to 2.4 N.



(a) Calculate the force exerted by the water on the rod.

..... [1]

(b) Explain, in terms of water pressure, why the reading on the newton meter falls as the rod is lowered further into the water.

.....

.....

.....

..... [2]

(c) When the rod is lowered further, eventually it floats. The newton meter then reads zero and the rod is in equilibrium. (You may assume that the rod remains upright.)

(i) Write down the size of the force exerted by the water on the rod when the rod floats.

.....[1]

(ii) Calculate the length of rod which is under the water when the rod floats.

.....

.....

.....

..... [2]

(iii) What have you assumed about the water pressure in calculating this length?

.....

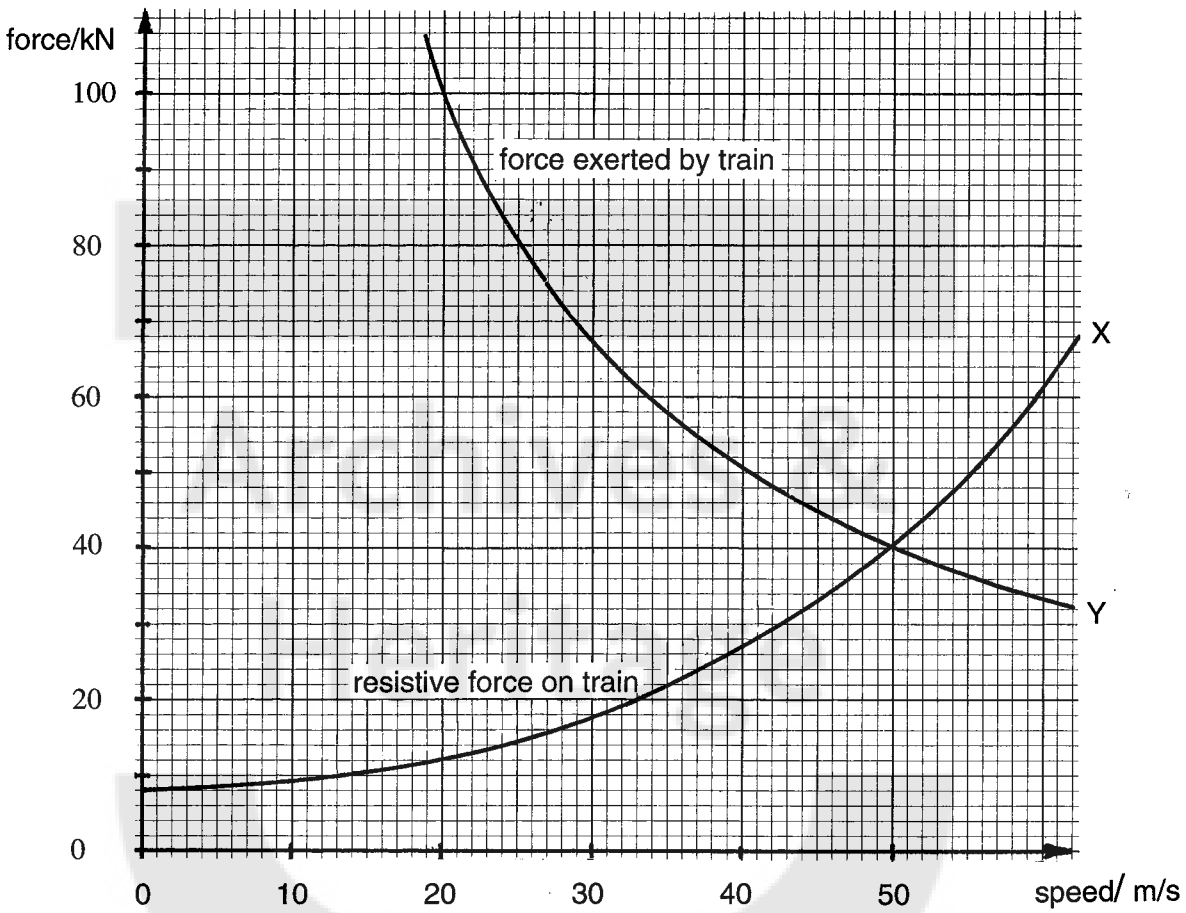
.....

..... [1]

3 When a train of railway carriages is moving, various forces resist the movement.

Curve X shows the total resistive force on a train of carriages at different speeds as they run along a straight and level track.

Curve Y shows the maximum force the engine can exert on the train at these speeds.



(a) Use the curves to explain why the acceleration of the train decreases as its speed increases.

. . . . . .

. . . . . .

. . . . . [2]

(b) The carriages have a total mass of 400×10^3 kg.

Calculate the maximum acceleration of the train when the speed is 20 m/s.

. . . . . .

. . . . . .

. . . . . .

. . . . . [5]

(c) What will be the maximum speed of this train on a level track? Explain your answer.

.....

..... [2]

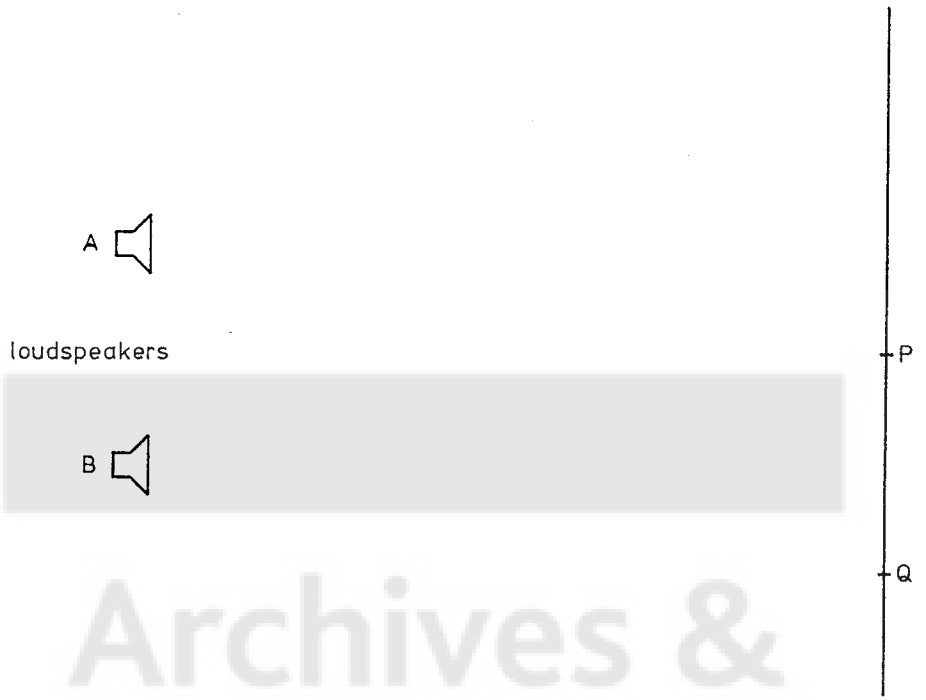
(d) The engine does work as it pulls the train of carriages. Calculate the power output of the engine when the train is running at the maximum speed.

.....

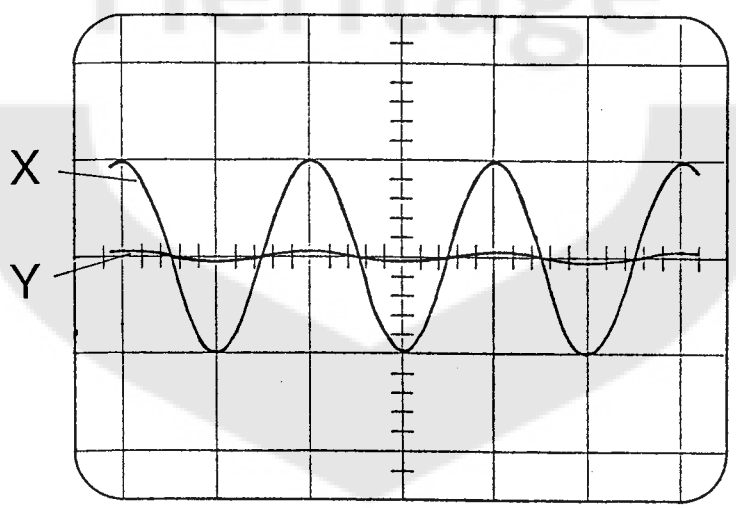
.....

..... [4]

4 Two loudspeakers, A and B, are placed about 3 m apart in the open air as shown. They face the same way and emit the same pure note with a wavelength of 1.6 m. A microphone, connected to an oscilloscope, is moved in front of the loudspeakers along the line PQ.



(a) Point P is the same distance from loudspeaker A as from B. When the microphone is placed at P, line X is seen on the oscilloscope.



Point Q is 0.8 m further from source A than from source B. When the microphone is placed at point Q, line Y is seen on the oscilloscope.

Explain why the two lines are so different.

.....

.....

.....

..... [4]

(b) The frequency of the note the loudspeakers produce is now doubled but the amplitude is unchanged.

(i) What happens to the wavelength?

. . . . . [1]

(ii) **On the diagram** draw what will be seen on the oscilloscope when the microphone is at Q. [2]

5 **(a)** Fig. 5.1 shows a magnet rotating at a constant speed next to a coil which has a large number of turns.

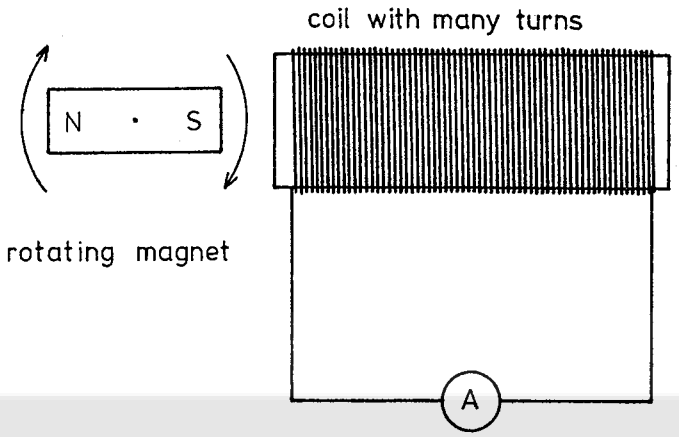


Fig. 5.1

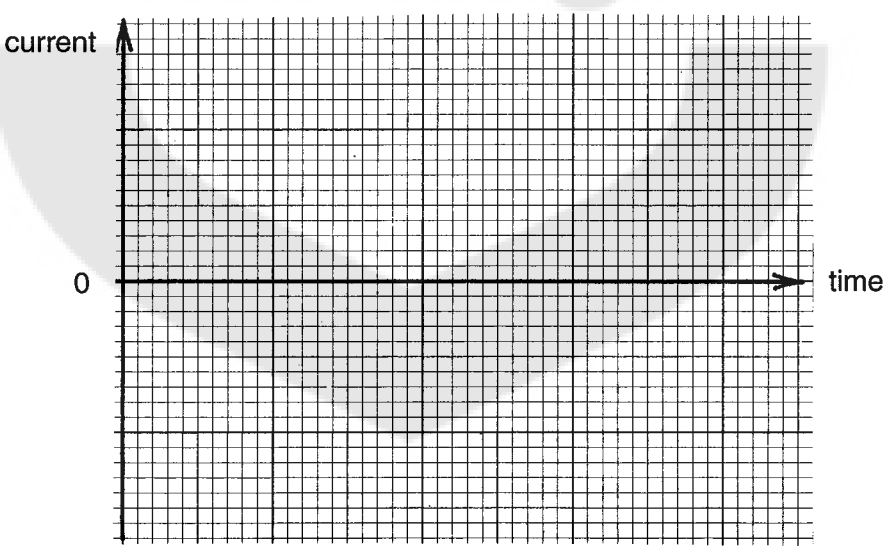
(i) Explain why there is a current in the coil.

.....

.....

..... [2]

(ii) On the axes below, draw a graph to show how the current changes with time as the magnet makes **two** complete revolutions.



[2]

(b) Fig. 5.2 shows a bicycle dynamo where the magnet is rotated by the tyre of the bicycle wheel. The dynamo is used to light a lamp.

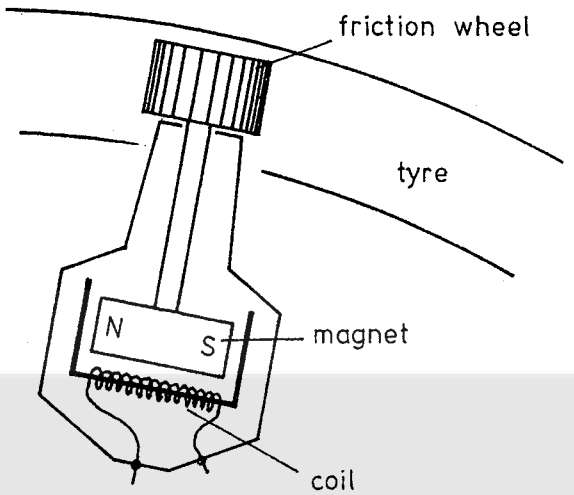


Fig. 5.2

(i) The bicycle is travelling very slowly. Explain what happens in the lighting circuit if the bicycle travels faster.

.....

.....

.....

..... [3]

(ii) It is harder to pedal the bicycle when the lights are switched on. Explain why.

.....

.....

..... [2]

6 Fig. 6.1 shows a circuit containing a bistable latch.

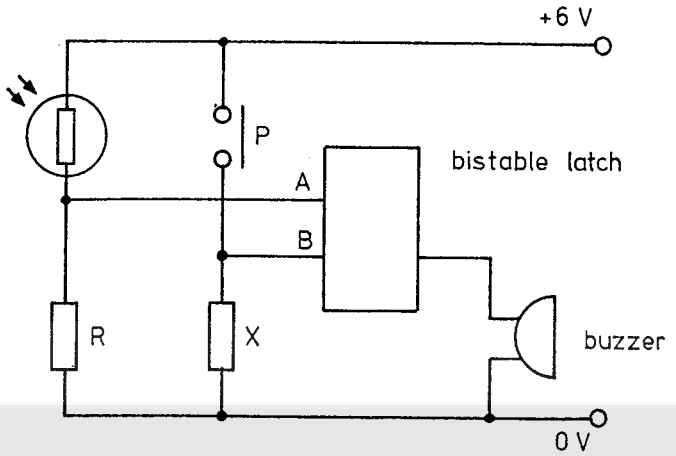


Fig. 6.1

Fig. 6.2 shows how the resistance of the LDR varies with light intensity.

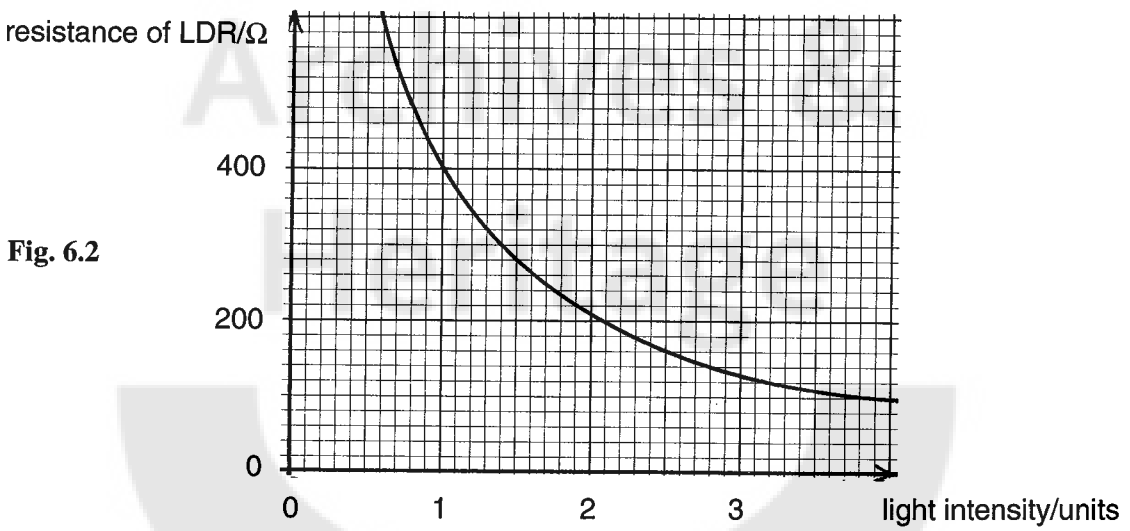


Fig. 6.2

(a) When the light on the LDR gets brighter, at a light intensity of 1 unit the buzzer sounds.

The light intensity is then increased from 1 to 2 units and then reduced back to 0 units. Describe what is heard.

.....

..... [1]

(b) **(i)** What is the purpose of the switch P?

..... [1]

(ii) Explain why the circuit includes a resistor X, and not just a piece of copper wire.

.....

..... [2]

(**c**) When the light intensity is 1 unit, the p.d. across R is 2 V. Calculate the resistance of R.

. . . . . .

. . . . . .

. . . . . [3]

(**d**) What should be done in the circuit if the buzzer is to start to sound at a lower light intensity?

. . . . . .

. . . . . .

. . . . . [2]

Section B

Answer any **TWO** *of questions 7, 8 and 9, using the lined paper provided.*
Each question is worth 15 marks.

7 The heating element of a hair dryer used on 240 V mains has a resistance of 36 Ω at its normal working temperature.

(a) Calculate the power of the heating element. [3]

(b) Another heating element works at the same temperature and uses wire of the same length and the same metal, but half the diameter.

What is its resistance? [3]

(c) The hair dryer also contains a motor which drives a fan. The motor is marked 240 V.

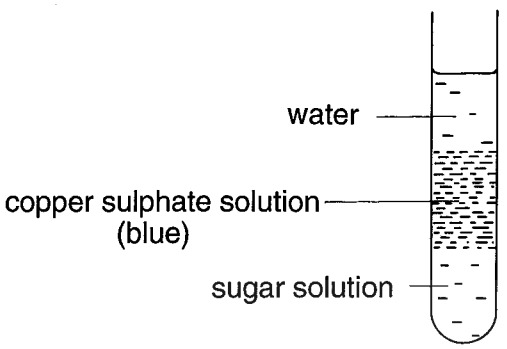
Draw a circuit diagram to show how the heating element and the motor are connected through a fuse to the mains supply. Include two switches which allow the motor to be switched on by itself, or the heater and motor to be switched on together. (The heater must not come on unless the motor is on too.) [5]

(d) Why is the circuit of the hair dryer arranged so that the heater cannot be switched on unless the motor is on too? [2]

(e) The plug on the lead to the hair dryer contains a fuse. Hair dryers are double insulated.

Describe and explain a fault in the hair dryer that would cause the fuse to melt. [2]

8 **(a)** A test-tube is prepared containing three distinct layers of liquid, as shown in the diagram.



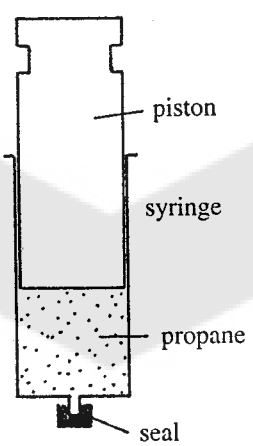
(i) After five hours it is noticed that the blue colour of the copper sulphate solution has spread several millimetres into both the water and the sugar solution. Explain this. [3]

(ii) The sugar solution for this experiment is prepared as follows.

40 g of sugar is added to 160 cm^3 of water and stirred until the sugar dissolves. It is noticed that the volume of liquid increases by 26 cm^3 as the sugar dissolves.

Calculate the density of the sugar solution. (1 cm^3 of water has a mass of 1 g) [4]

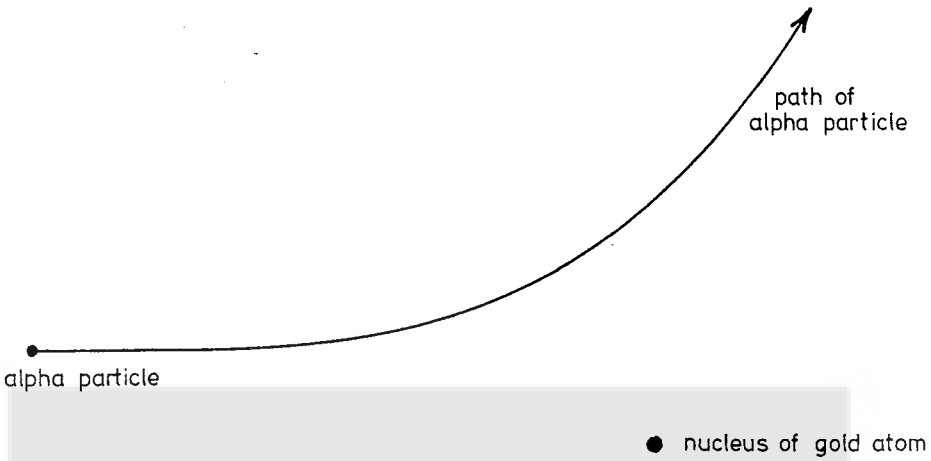
(b) Propane melts at a temperature of −188 °C and boils at a temperature of −42 °C. A sealed syringe contains propane at room temperature. The piston of the syringe can move freely but it does not allow the propane to leak out.



(i) Explain, by writing about molecules, why the volume of the propane increases when the temperature of the syringe is increased. [5]

(ii) The syringe is slowly cooled to the temperature of boiling liquid nitrogen. Describe and explain what is seen to happen to the piston. (Nitrogen boils at −196 °C.) [3]

9 **(a)** Geiger and Marsden performed an experiment in which they fired a beam of alpha particles at a thin gold foil.

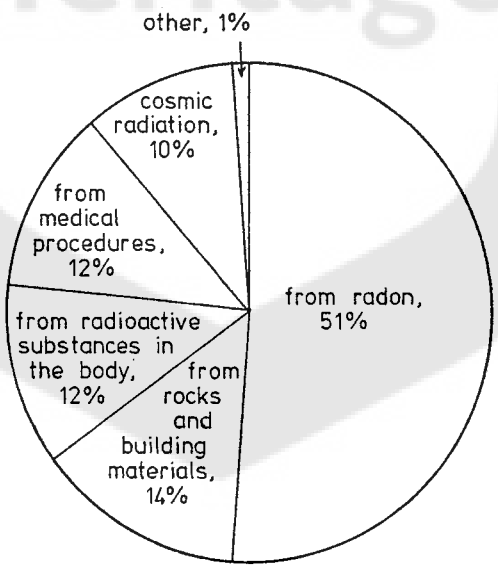


(i) The diagram shows the path of an alpha particle passing the nucleus of a gold atom. Why is the alpha particle deflected? [2]

(ii) Describe what happens to an alpha particle which approaches the nucleus head-on. [1]

(iii) In Geiger and Marsden's experiment most of the alpha particles went through the gold foil without being deflected noticeably. Explain this. [3]

(b) The pie chart below shows the relative proportions of ionising radiation received from various sources by a typical person in the United Kingdom.



(i) State two sources of ionising radiation which contribute to the pie section labelled "other". [2]

(ii) Radon is a naturally occurring radioactive gas which emits alpha particles when it decays. It collects in badly ventilated buildings. Why is this gas dangerous to a person? [3]

(iii) Radon-220 is often used in school experiments. It has a half-life of 56 s. Give a reasoned estimate of how long it will take for 99% of the atoms in a sample of radon-220 to decay. [4]