Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME: **Solved By Smart Exam Resources-Smart Edu Hub**

CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | | |

2094772086

PHYSICS **0625/42**

Paper 4 Theory (Extended) **May/June 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
Take the weight of 1 kg to be 10 N (acceleration of free fall = $10\,m/s^2$).

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **20** printed pages.

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CAMBRIDGE International Examinations

[Turn over

1 (a) (i) Speed is a scalar quantity and velocity is a vector quantity.

State how a *scalar* quantity differs from a *vector* quantity.

(A scalar quantity does not have direction

....[1]

(ii) Underline the **two** scalar quantities in the list below.

energy **force** **impulse** **momentum** **temperature** [1]

(b) A boat is moving at constant speed.

On Fig. 1.1, sketch a distance-time graph for the boat.

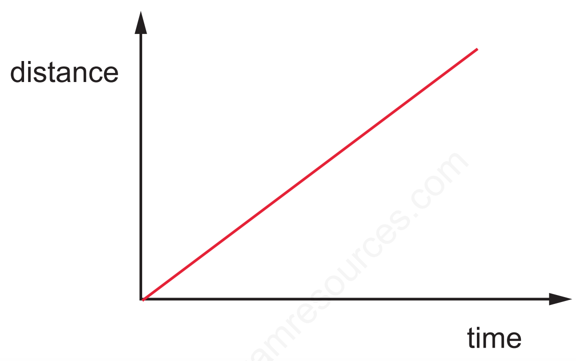


Fig. 1.1

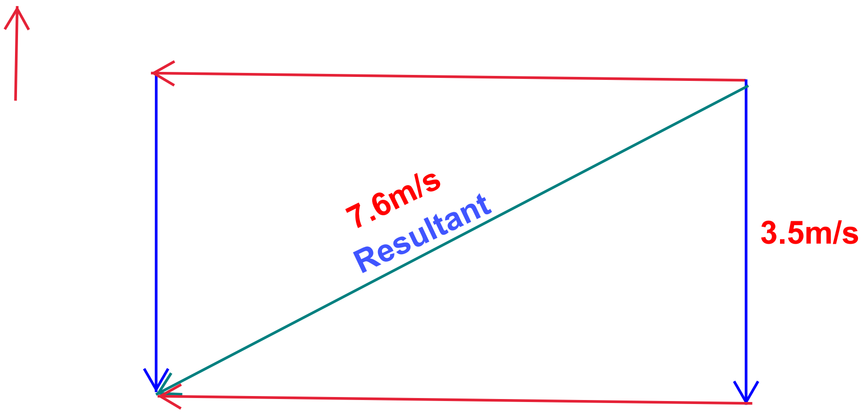
[1]

(c) The boat in **(b)** is moving due west at a speed of 6.5 m/s relative to the water. The water is moving due south at 3.5 m/s.

In the space below, draw a scale diagram to determine the size and direction of the resultant of these two velocities. State the scale used.

Scale: 1cm=1.1m/s

Our diagram here is not to scale



Note:

- **The resultant should be between 7.2 to 7.6m/s**
- **The direction should be as shown by the resultant vector [diagonal) and in the same direction**

scale .... **1.1cm=1m/s**

size of resultant velocity = ... **7.6 m/s**

direction of resultant .... **South-west**

[4]

[Total: 7]

2 Fig. 2.1 shows a vehicle designed to be used on the Moon.

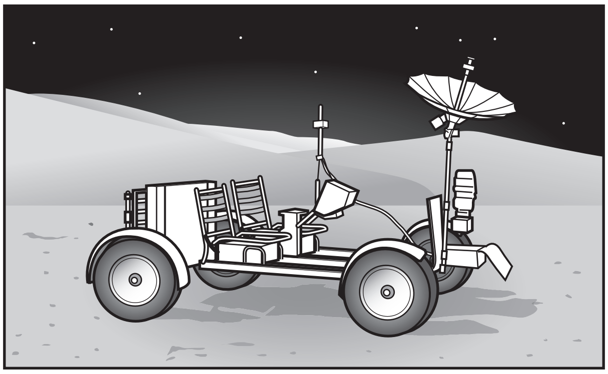


Fig. 2.1

The brakes of the vehicle are tested on Earth.

(a) The acceleration of free fall on the Moon is one sixth ($\frac{1}{6}$) of its value on Earth.

Tick **one** box in each column of the table to predict the value of that quantity when the vehicle is used on the Moon, compared to the test on Earth.

	mass of vehicle on Moon	weight of vehicle on Moon	deceleration of vehicle on Moon with same braking force
10 × value on Earth			
6 × value on Earth			
same as value on Earth	✓		✓
$\frac{1}{6}$ × value on Earth		✓	
$\frac{1}{10}$ × value on Earth			

[3]

(b) Fig. 2.2 shows the brake pedal of the vehicle.

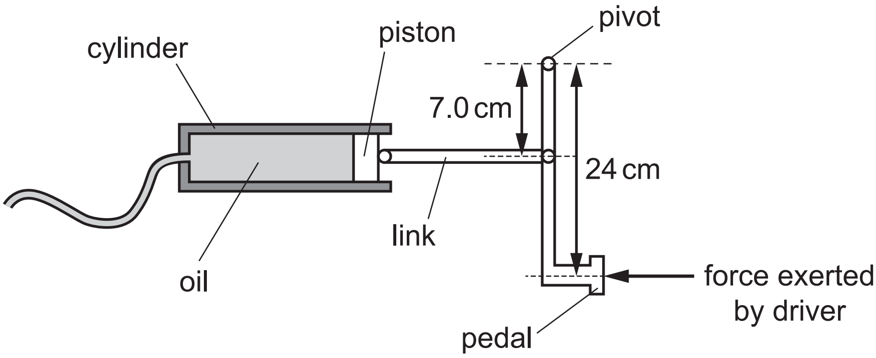


Fig. 2.2 (not to scale)

The driver exerts a force on the pedal, which increases the pressure in the oil to operate the brakes.

The area of the piston in the cylinder is $6.5 \times 10^{-4}\,m^2$ ($0.00065\,m^2$). The pressure increase in the oil is 5.0×10^5 Pa (500 000 Pa).

Calculate the force exerted by the driver on the brake pedal.

$P=F/A$
$F=P \times A$
$F_1 = 500\,000 \times 0.00065$
$=330N$
Since pressure is transmitted, we have:
$F_1 d_1 = F_2 d_2$
$F_2 = F_1 d_1 / d_2$
$=325 \times 7/24$
$=95$ N

force = 95N ....[4]

[Total: 7]

3 (a) Underline the pair of quantities which must be multiplied together to calculate *impulse*.

force and mass	force and velocity	mass and time
time and velocity	weight and velocity	force and time

[1]

(b) Fig. 3.1 shows a collision between two blocks A and B on a smooth, horizontal surface.

before collision

after collision

Fig. 3.1

Before the collision, block A, of mass 2.4 kg, is moving at 3.0 m/s. Block B, of mass 1.2 kg, is at rest.

After the collision, blocks A and B stick together and move with velocity *v*.

(i) Calculate

1. the momentum of block A before the collision,

momentum =mv
=2.4 × 3
=7.2 kg m / s

APPROVED
By Smart Edu Hub at 8:26 pm, Nov 02, 2022

momentum = 7.2kgm/s [2]

2. the velocity *v*,

Since momentum is conserved:
Momentum after impact=momentum before impact
(mA + mB)v = mA x 3
(2.4+1.2)v = 2.4 x 3
3.6v= 7.2
v= 7.2/3.6
=2.0 m / s

velocity = 2.0m/s [2]

3. the impulse experienced by block B during the collision.

(impulse (Ft)=m(v - u)
impulse (Ft)= 1.2 × (2-0)
= 2.4 kg m /s

impulse = 2.4kgm/s [2]

(ii) Suggest why the total kinetic energy of blocks A and B after the collision is less than the kinetic energy of block A before the collision.

Sound energy

[1]

[Total: 8]

4 A balloon contains a fixed mass of gas.

(a) Explain, in terms of the momentum of molecules, how the gas in the balloon exerts a pressure.

There is a change of momentum of molecules during collision. The force due to the change in momentum of molecules causes pressure.

....[2]

(b) Explain, in terms of molecules, why the pressure of the gas increases when the volume of the balloon decreases. The temperature of the gas is constant.

When the volume decreases, there are more frequent collisions with the balloon walls. Thus a greater total-force is caused by molecules

....[2]

(c) The initial volume of the gas is 500 cm^3 and its pressure is 1.1×10^5 Pa. The volume is reduced to 200 cm^3. The temperature of the gas is constant.

Calculate the new pressure.

$p_1V_1 = p_2V_2$

$p_2 = p_1V_1 / V_2$

$p_2 = 500 \times 1.1 \times 10^5 / 200$

$= 2.8 \times 10^5$ Pa

pressure = 2.8×10^5 ....[2]

[Total: 6]

0.6kg

5 (a) (i) An electric kettle contains 600 g of water at 20 °C. The heater in the kettle operates at 240 V. The specific heat capacity of water is 4200 J / (kg °C).

The current in the heater is 12 A.

Calculate the time taken for the temperature of the water to rise to 100 °C.

E = mc(Δ)T
E= 0.6 × 4200 × (100-20)
=200 000 (J)
E = VIt
t=E/VI
t=201 600/(12 × 240)
t=70 s

time = t=70s ....[4]

(ii) State **one** assumption you made in your calculation in **(a)(i)**.

No thermal energy losses ....[1]

(b) Using the apparatus shown in Fig. 5.1, describe an experiment to demonstrate good and bad emitters of thermal radiation. Include the expected results and the conclusion.

You may use a diagram.

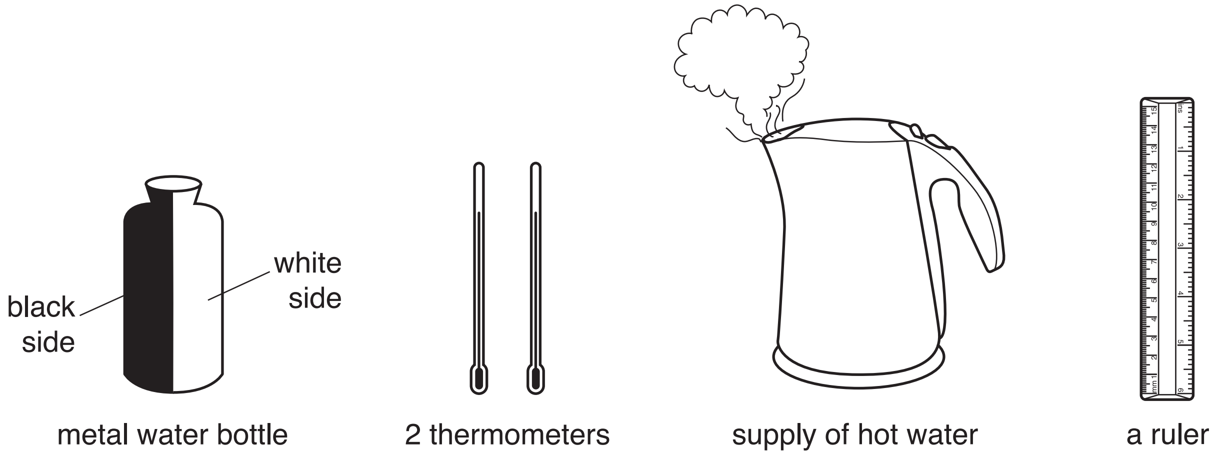
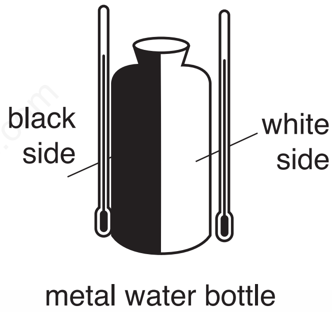


Fig. 5.1



Put hot water in the bottle and place the thermometers on each side of centre of bottle. Ensure that the thermometers are equal distances from bottle. Also , the thermometer bulbs should be at the same height. Record the temperatures at regular time intervals. Expected result will be that the thermometer near black surface has higher reading as compared to the white side. Conclusion will be that black surfaces are good absorbers of radiations.
....[4]

[Total: 9]

6 **(a)** The graph in Fig. 6.1 represents a wave on a rope.

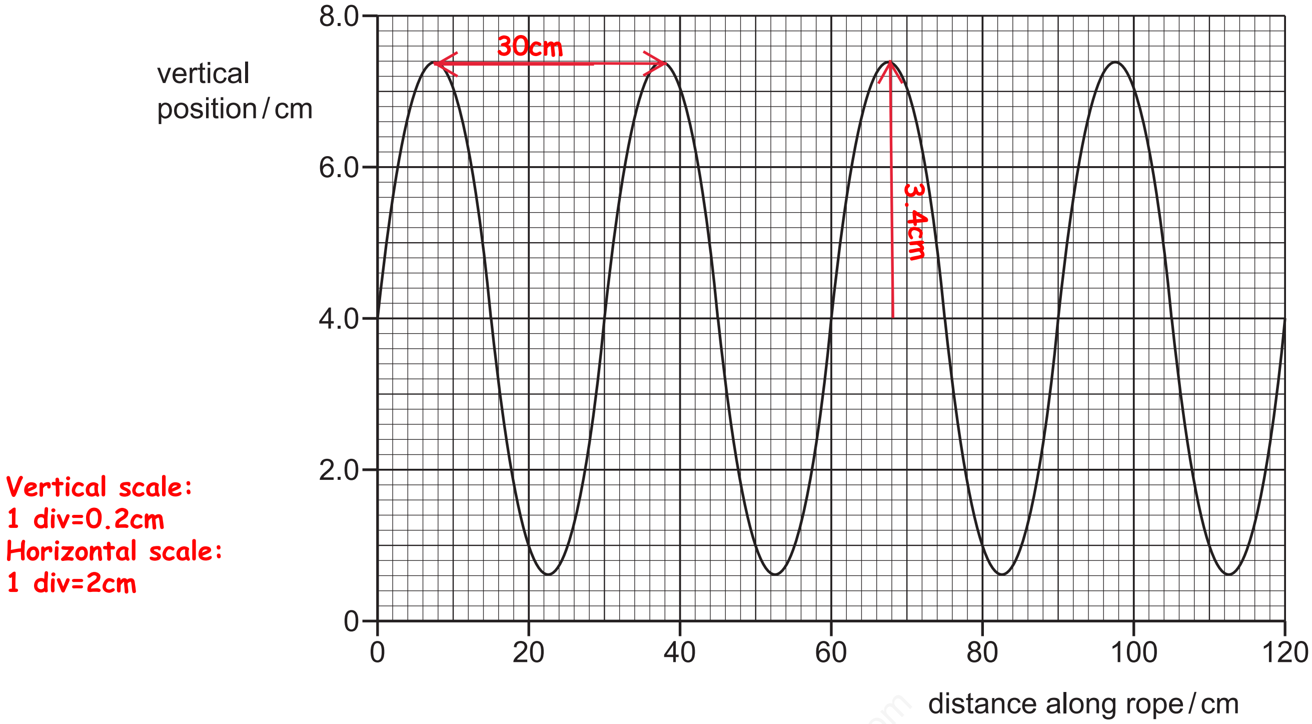


Fig. 6.1

Using Fig. 6.1, determine

(i) the amplitude of the wave,

17 divisions x 0.2=3.4cm

amplitude = 3.4 cm [1]

(ii) the wavelength of the wave.

15 divisions x 2=30cm

wavelength = 30 cm [1]

(b) A wave travelling on the surface of water has a wavelength of 2.5 cm and a speed of 8.0 cm/s.

Calculate the frequency of the wave.

$v = f\lambda$
$f = v / \lambda$
$= 8.0/2.5$
$= 3.2$ Hz

3.2Hz

frequency = ...[2]

(c) The wave in **(b)** approaches a barrier that has a large gap in its centre.

Fig. 6.2 shows the crests of the wave viewed from above.

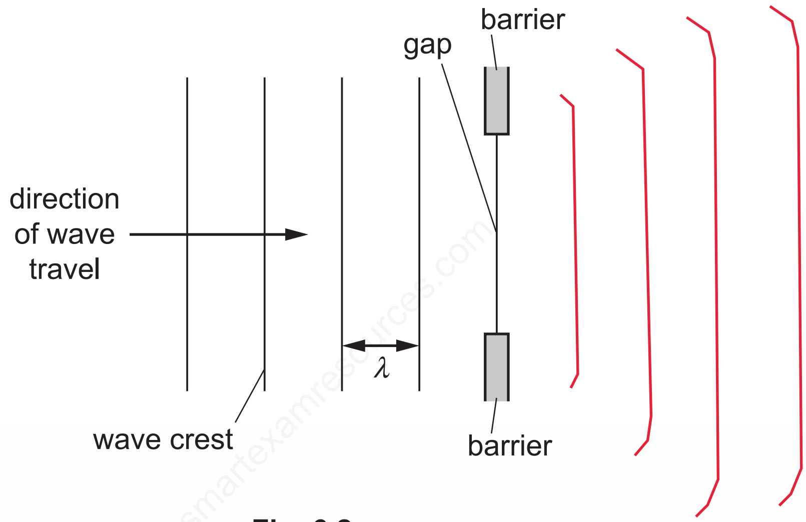


Fig. 6.2

The gap in the barrier is larger than the wavelength λ.

(i) On Fig. 6.2, draw the pattern formed by three crests after the wave passes through the gap in the barrier. [2]

(ii) Water is added to the tank and the speed of a wave in the deeper water is greater than that in the shallower water. The frequency of the wave remains constant but its wavelength is different.

1. State and explain how the wavelength in the deeper water has changed.

The wavelength increases because wave has higher speed.

....

....[1]

2. Apart from the change in wavelength, describe **one** other difference in the pattern formed by the crests after the wave passes through the gap.

There is more diffraction

....

....[1]

[Total: 8]

7 **(a)** The speed of light in air is 3.0×10^8 m/s.
The speed of light in a transparent liquid is 2.0×10^8 m/s.

A ray of light is incident on the surface of the liquid at an angle of incidence of 40°.

Calculate

(i) the refractive index of the liquid,

(n = speed in air / speed in liquid
$= 3 \times 10^8 / 2.0 \times 10^8$)
= 1.5

refractive index = 1.5 [2]

(ii) the angle of refraction in the liquid.

n = sin i / sin r
$r = \sin^{-1}$ (sin 40 / 1.5)
= 25°

angle of refraction = 25^0 [2]

(b) Fig. 7.1 shows a side view of an object at the bottom of a tank of liquid. Light travels slower in this liquid than in air.

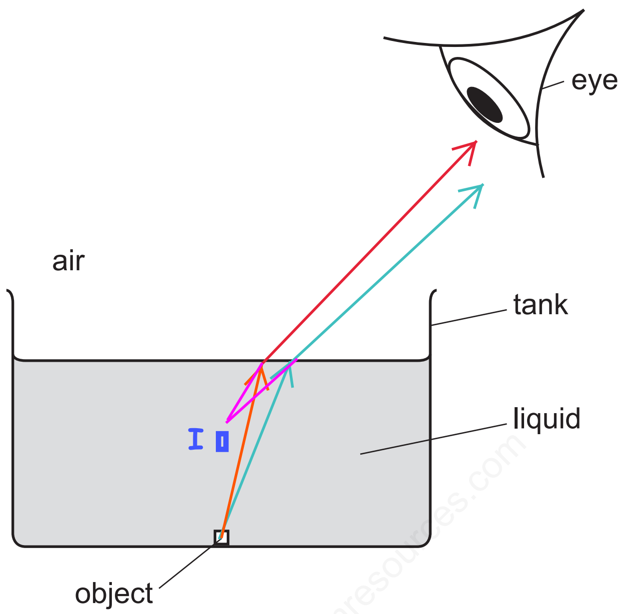


Fig. 7.1

On Fig. 7.1, draw **two** rays from the object into the air. Use these rays to locate the image. Label this image I. [3]

[Total: 7]

8 Fig. 8.1 shows a 12.0 V power supply connected in a circuit.

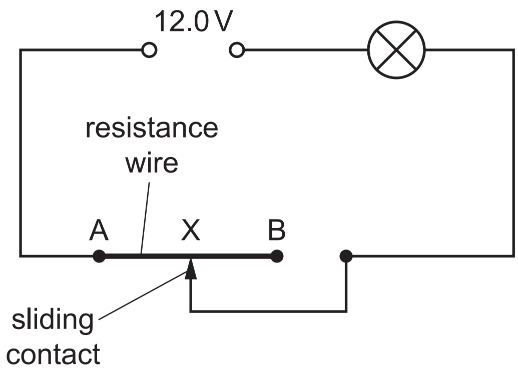


Fig. 8.1 (not to scale)

The circuit includes a lamp and a resistance wire AB of constant cross-sectional area. There is a sliding contact that can be moved between A and B.

(a) The rating of the lamp at normal brightness is 6.0 V, 9.0 W.

Calculate

(i) the current in the lamp at normal brightness,

P=VI
(I=P/V
I = 9.0 / 6.0
=1.5 A

current = ...1.5A....................[2]

(ii) the resistance of the lamp at normal brightness.

V=IR
R = V/I
R = 6.0 / 1.5
=4.0 Ω

resistance = ...4.0 Ω....................[2]

(b) AB is 1.00 m long and has a resistance of 5.0 Ω. The lamp has normal brightness when the sliding contact is at X.

(i) The sliding contact is moved to B.

Explain, without a calculation, why the lamp becomes dimmer.

Resistance of wire is greater than at X

....[1]

(ii) Calculate the distance AX for the lamp to have normal brightness.

(for normal brightness of lamp,)
resistance of circuit = V/I=12 / 1.5 = 8.0 Ω

resistance of wire
=Total resistance-Resistance of the lamp
= (8.0 – 4.0 =) = 4.0 Ω
(distance AX = 1.0 × 4/5
=0.80 m

distance AX = 0.80m ....[3]

[Total: 8]

9 Fig. 9.1 shows a horizontal wire PQ placed in the gap between the N pole and the S pole of a magnet.

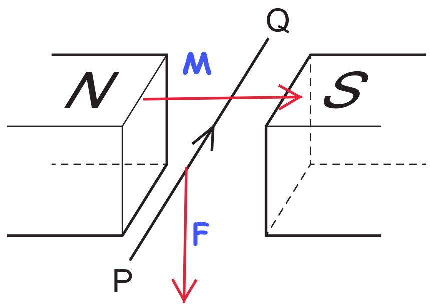


Fig. 9.1

There is a current in the wire in the direction P to Q.
A force acts on the current-carrying wire in the magnetic field.

(a) On Fig. 9.1, draw

(i) an arrow, labelled M to show the direction of the magnetic field in the gap between the poles of the magnet, [1]

(ii) an arrow, labelled F to show the direction of the force on the current-carrying wire due to the magnetic field of the magnet. [1]

(b) State the effect of reversing the direction of the current in wire PQ.

The direction of force is also reversed ....[1]

(c) The magnet is removed and the horizontal, current-carrying wire is left on its own, as shown in Fig. 9.2.

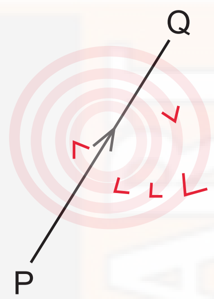


Fig. 9.2

(i) On Fig. 9.2, sketch the pattern of the magnetic field due to the current in the wire. Indicate the field direction. [3]

(ii) The current in PQ is **increased**.

State the effect of this change in current on the magnetic field.

The magnetic field becomes stronger ....[1]

(d) A small magnet is placed at a point where the magnetic field is vertically upwards. State the direction of the force on the S pole of the small magnet.

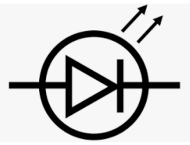
The direction of the force on the S Pole is vertically downwards

....

....[1]

[Total: 8]

10 **(a)** In the space, draw the standard symbol for a light-emitting diode (LED).



[1]

(b) Table 10.1 shows the truth table for a logic gate.

Table 10.1

input 1	input 2	output
0	0	1
0	1	0
1	0	0
1	1	0

State the name of the logic gate which has this truth table.

NOR

....[1]

(c) It is possible to connect together the two inputs of the gate in **(b)**.

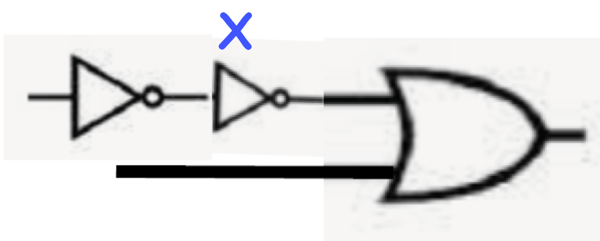
Using two or more of the logic gates in **(b)**, design a circuit with two inputs and one output which has the truth table shown in Table 10.2.

Table 10.2

input 1	input 2	intermediate point, X	output
0	0		0
0	1		1
1	0		1
1	1		1

(i) Draw your circuit in the space below.

There is no need to use the symbol for the logic gate. Boxes with the two inputs and one output are sufficient.



[2]

(ii) Label an intermediate point of your circuit with the letter X. Complete the table with the logic levels for this point in the blank column of the table. [1]

[Total: 5]

11 **(a)** The arrows in Fig. 11.1 represent the paths of three α-particles moving towards gold nuclei in a thin foil. The gold nuclei are shown as shaded circles.

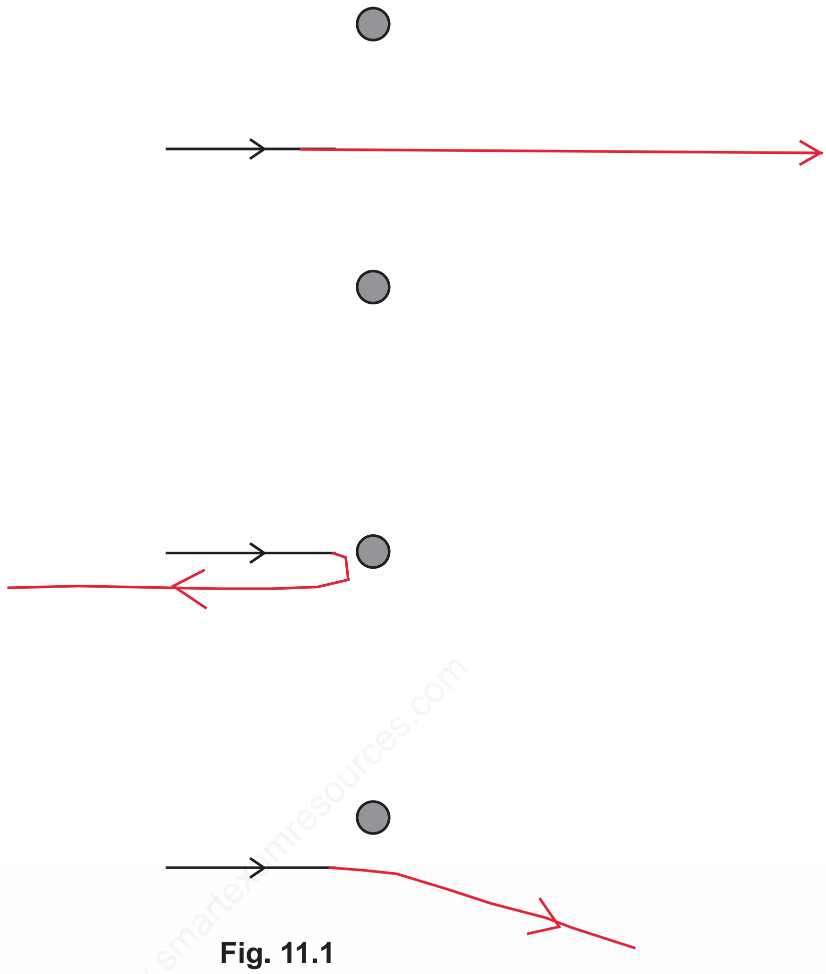


Fig. 11.1

On Fig. 11.1, complete the paths of the three α-particles. [3]

(b) Fig. 11.2 shows a geologist holding a radiation detector near a rock.

Fig. 11.2

She holds the detector in a fixed position and records the readings shown in Table 11.1.

Table 11.1

time / minutes	0	1	2	3	4	5
detector reading / counts / minute	16	14	17	13	17	15

Explain the changes in the detector readings.

1. There is radiation from background
2. There is random variation of radiation

[2]

(c) A technician is handling a solid radioactive sample that emits α-particles and β-particles.

The technician wears thick rubber gloves.

Explain why this may provide some protection from the radiation, but it is not sufficient protection.

1. thick gloves would stop alpha ,so would be helpful
2. Some β radiation would penetrate gloves and each other body parts, so this implies insufficient protection

[2]

[Total: 7]