



CANDIDATE  
NAME

**Answer Key**

CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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\*9332191914\*



**PHYSICS**

**0625/41**

Paper 4 Theory (Extended)

**May/June 2016**

**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 1.0 kg to be 10 N (acceleration of free fall =  $10 \text{ m/s}^2$ ).

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.



- 1 (a) A bus travels at a constant speed. It stops for a short time and then travels at a higher constant speed.

Using the axes in Fig. 1.1, draw a distance-time graph for this bus journey.

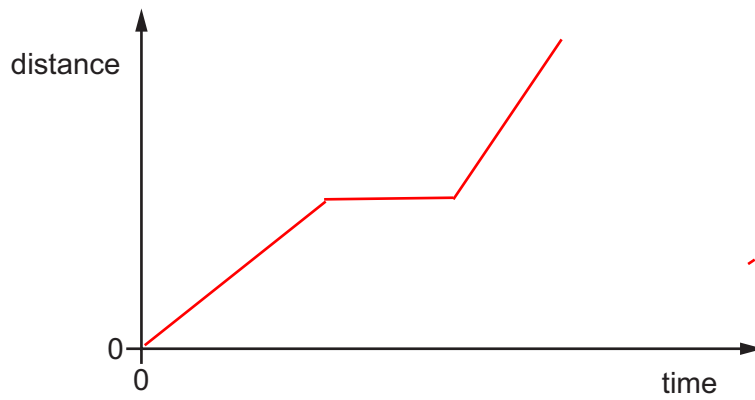


Fig. 1.1

[3]

- (b) A lift (elevator) starts from rest at the ground floor of a building.

Fig. 1.2 is the speed-time graph for the motion of the lift to the top floor of the building.

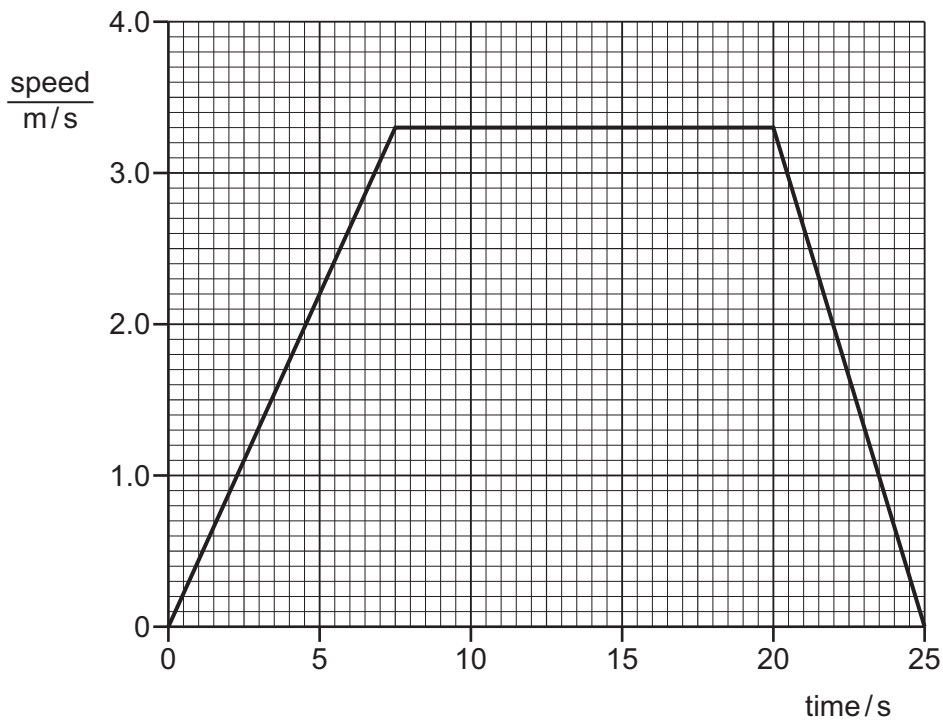


Fig. 1.2

Use the graph to determine the distance from the ground floor to the top floor of the building.

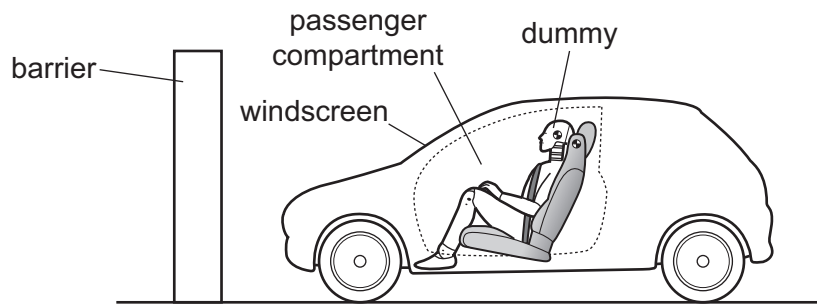
$$\begin{aligned}\text{Distance} &= \text{area under graph stated} \\ &= 0.5 \times 7.5 \times 3.3 + 12.5 \times 3.3 + 12.5 \times 3.3 \\ &= 12.375 + 41.25 + 8.25 = 62 \text{ m}\end{aligned}$$

distance = ..... [4]

[Total: 7]

$$\begin{aligned}\text{OR } \frac{1}{2} (a + b)h \\ &= 0.5 \times (25 + 12.5) \times 3.3\end{aligned}$$

- 2 Fig. 2.1 shows a dummy of mass 70 kg used in a crash test to investigate the safety of a new car.



**Fig. 2.1**

The car approaches a solid barrier at 20 m/s. It crashes into the barrier and stops suddenly.

- (a) (i) Calculate the momentum of the dummy immediately before the crash.

$$\text{momentum} = mv$$

$$P = 70 \times 20 = 1400 \text{ kg m / s}$$

momentum = ..... [2]

- (ii) Determine the impulse that must be applied to the dummy to bring it to rest.

Same numerical answer as above

$$\text{Impulse} = 1400 \text{ kg m / s} - 0$$

$$= 1400 \text{ kg m / s}$$

impulse = ..... [1]

- (b) In the crash test, the passenger compartment comes to rest in 0.20 s.

Calculate the deceleration of the passenger compartment.

$$\begin{aligned} a &= (v - u) / t \\ &= 0 - 20 / 0.2 \\ &= -100 \text{ m/s}^2 \end{aligned}$$

100 m/s<sup>2</sup>

deceleration = ..... [2]

- (c) The seat belt and air bag bring the dummy to rest so that it does not hit the windscreen. The dummy has an average deceleration of 80 m/s<sup>2</sup>.

Calculate the average resultant force applied to the dummy, of mass 70 kg.

$$\begin{aligned} F &= ma \\ &= 70 \times 80 \\ &= 5600 \text{ N} \end{aligned}$$

5600 N

force = ..... [2]

- (d) The deceleration of the dummy is less than the deceleration of the passenger compartment.

Explain why this is of benefit for the safety of a passenger.

Force on passenger or dummy less (than without seat belt / airbag)  
Passenger less likely to be injured / hurt / damaged

..... [2]

[Total: 9]

- 3 Fig. 3.1 shows an oil tank that has a rectangular base of dimensions 2.4 m by 1.5 m.

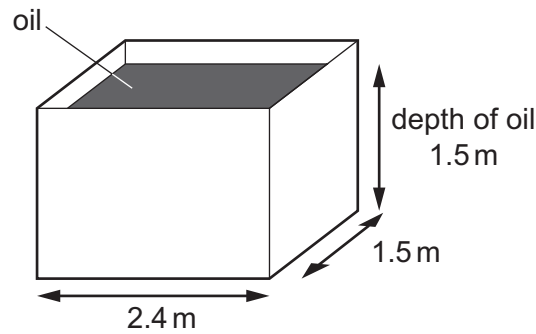


Fig. 3.1

The tank is filled with oil of density  $850 \text{ kg/m}^3$  to a depth of 1.5 m.

(a) Calculate

- (i) the pressure exerted by the oil on the base of the tank,

$$(P =) \text{hdg} = 1.5 \times 850 \times 10 = 12750 \text{ Pa}$$

OR

$$\text{mg} / \text{area of base OR } 850 \times 2.4 \times 1.5 \times 1.5 \times 10 / (2.4 \times 1.5)$$

$$13\ 000 \text{ Pa or N/m}^2$$

pressure = ..... [2]

- (ii) the force exerted by the oil on the base of the tank.

$$P = F/A$$

$$F = PA = 12\ 750 \times (1.5 \times 2.4)$$

$$= 12\ 750 \times 3.6 = 459\ 00 \text{ N}$$

OR

$$(\text{Force} =) \text{weight of oil} = \text{mg} = 2.4 \times 1.5 \times 1.5 \times 850 \times 10$$

$$46\ 000 \text{ N} \quad \text{force} = \dots\dots\dots [2]$$

- (b) The force calculated in (a)(ii) is the weight of the oil.

Calculate the mass of oil in the tank.

$$W = mg$$

$$m = 45900 / 10 = 4590 \text{ kg}$$

$$\text{OR } m = Vd = (2.4 \times 1.5 \times 1.5) \times 850 = 4600 \text{ kg}$$

mass = ..... [1]

- (c) When he is checking the level of oil in the tank, a man drops a brass key into the oil and it sinks to the bottom of the oil.

- (i) State what this shows about the density of brass.

Density of brass is greater than that of oil

[1]

- (ii) Explain how attaching the key to a piece of wood could prevent the key from sinking.

It will not sink because the average density of wood and key is less than density of oil.

..... [1]

[Total: 7]

- 4 (a) Explain, in terms of molecules, why it is possible to compress a gas, but not a liquid.

Gas molecules are very far apart from each other and can be compressed. Molecules of liquid are very close to each other, touching together and cannot be compressed.

..... [2]

- (b) Two containers made of insulating material contain the same volume of water at room temperature. The containers do not have lids. The volume of liquid in each container gradually decreases.

- (i) After a certain time, the temperature of the water has decreased to below room temperature.

Explain, in terms of molecules, why the temperature has decreased.

More energetic water molecules escape due to evaporation and take some heat energy away.

Less energetic molecules left behind which have low kinetic energy, so temperature of the remaining water is lower.

..... [2]

- (ii) One of the containers is wide and shallow. The other container is narrow and deep.

Predict which container has the greater rate of cooling. Explain your answer.

Water in the wide container has the greater rate of cooling. Bigger the surface area, faster the rate of evaporation.

..... [2]

[Total: 6]



- 5 (a) State what happens to the molecules of a gas in a sealed container when the temperature of the gas is increased.

They gain more k.e. and move faster

[1]

- (b) A quantity of gas is contained in a sealed container of fixed volume. The temperature of the gas is increased.

State, in terms of molecules, **two** reasons why the pressure of the gas increases.

1. Molecules hit walls with greater force and exert more pressure

2. Molecules hit the walls of the container more frequently

[2]

- (c) A helium-filled weather balloon is held at ground level. The volume of the balloon is  $4800 \text{ m}^3$ . The pressure of the helium is  $98 \text{ kPa}$ .

The balloon is released and rises to a height where the volume of the balloon is  $7200 \text{ m}^3$ .

- (i) Calculate the new pressure of the helium. Assume that the temperature stays constant.

$$P_1 V_1 = P_2 V_2$$

$$98 \times 4800 = P \times 7200$$

$$P = 65 \text{ kPa}$$

pressure = 65 kPa [2]

- (ii) Suggest why it may be necessary to release helium from the balloon as it rises even higher.

To reduce the pressure inside the balloon to prevent the balloon from bursting.

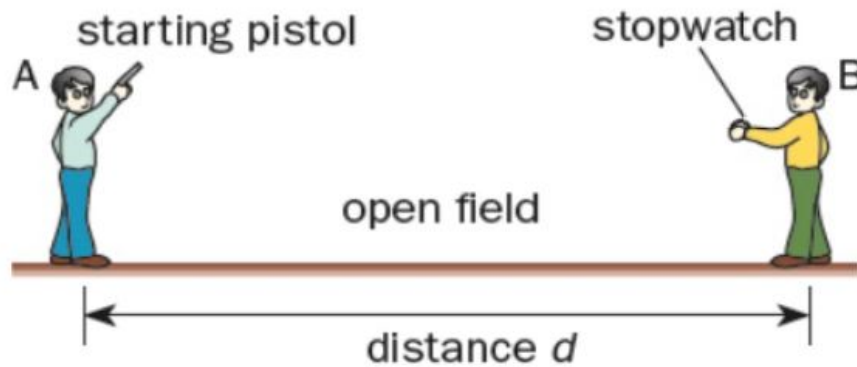
[1]

[Total: 6]

- 6 (a) Two students are measuring the speed of sound.

The students are provided with a starting pistol, a stopwatch and a long measuring tape. The starting pistol, when fired, produces a loud sound and a puff of smoke at the same instant.

Describe how the students use the apparatus and how they calculate the speed. You may draw a diagram.



Long distance is measured between two students with the help of measuring tape. Student A fires pistol at one end of the open field.

Student B at other end starts stopwatch on seeing smoke / light from pistol.

He stops the stopwatch on hearing the sound of the pistol to record the time.

speed = distance / time taken

..... [4]

(b) A device at the bottom of the sea emits a sound wave of frequency 200 Hz.

(i) The speed of sound in sea-water is 1500 m/s.

Calculate the wavelength of the sound in sea-water.

$$v = f \times \lambda$$

$$\lambda = v / f = 1500 / 200$$

$$= 7.5 \text{ m}$$

wavelength = ..... **7.5 m** ..... [2]

(ii) The sound wave passes from the sea-water into the air.

State what happens, if anything, to

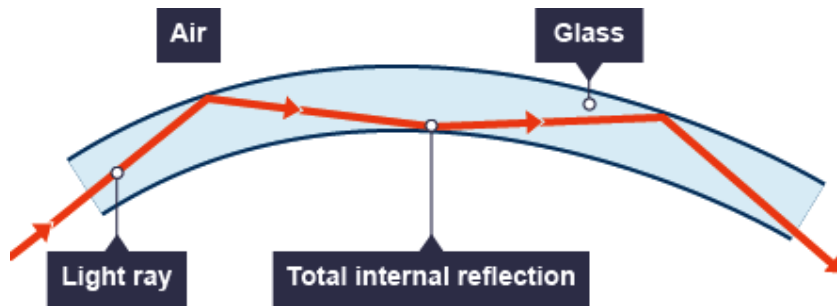
- the frequency of the sound, ..... **stays the same** .....
- the speed of the sound, ..... **decreases** .....

[2]

[Total: 8]

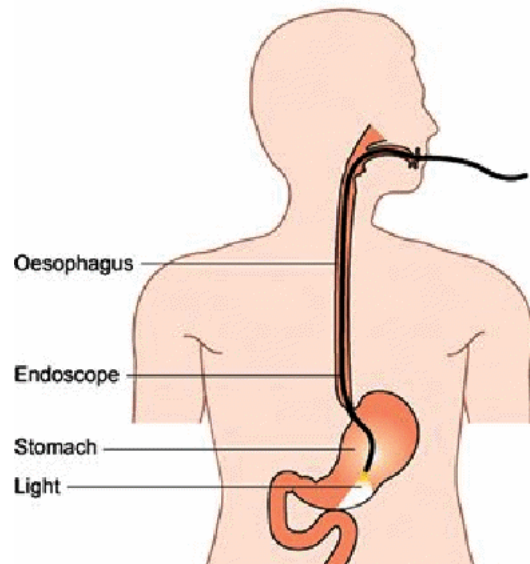
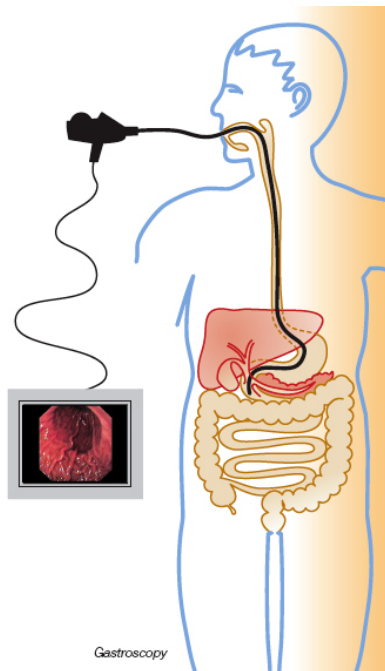
- 7 (a) (i) A ray of light passes through a length of curved optical fibre.

Draw a diagram showing the fibre and the path of the ray of light.



[1]

- (ii) Describe one use of optical fibres in medicine. You may draw a diagram.



Light travels down (optic) fibres into or out of body

To examine internal organ / part

Light travels both ways into and out of body

OR

To destroy (cancerous) cells

by heating

OR

Endoscope / fibre bundle inserted into body

To view internal organ body part OR for keyhole surgery

[3]

(b) Draw a straight line from each wave on the left to the most appropriate speed.

	90 m/s ( $9 \times 10^1$ )
light in air	6000 m/s ( $6 \times 10^3$ )
microwaves in a vacuum	100 000 m/s ( $1 \times 10^5$ )
sound in steel	1 000 000 m/s ( $1 \times 10^6$ )
	300 000 000 m/s ( $3 \times 10^8$ )
	60 000 000 000 m/s ( $6 \times 10^{10}$ )

*Note: Red lines in the original image connect 'light in air' to  $3 \times 10^8$  m/s, 'microwaves in a vacuum' to  $3 \times 10^8$  m/s, and 'sound in steel' to  $3 \times 10^8$  m/s.*

[3]

(c) The refractive index of a block of glass is 1.5.

Use your value for the speed of light from (b) to calculate the speed of light in this block.

$$n = \text{speed in air} / \text{speed in glass}$$

$$1.5 = 3 \times 10^8 / \text{speed in glass}$$

$$\text{speed in glass} = 3 \times 10^8 / 1.5$$

$$= 2.0 \times 10^8 \text{ m / s}$$

speed = ..... [2]

[Total: 9]

- 8 (a) Two straight, vertical wires X and Y pass through holes in a horizontal card.

Fig. 8.1 shows the card viewed from above.

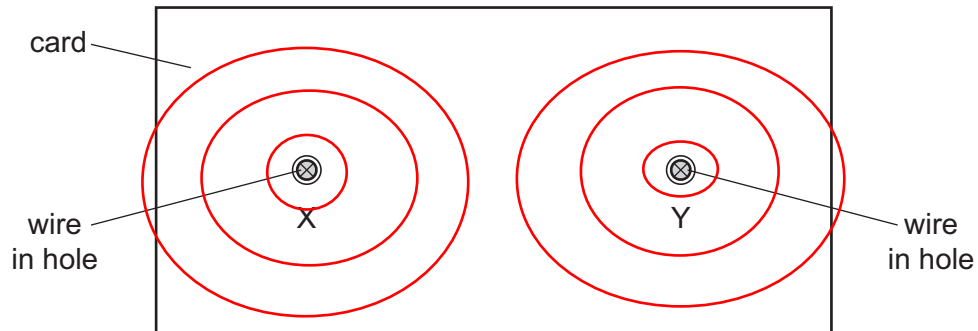


Fig. 8.1

There is a current in each wire in a downward direction (into the page).

- (i) The magnetic field at Y due to the current in X produces a force on Y.

Place a tick in each blank column of the table to indicate the direction of this magnetic field and the direction of the force.

	magnetic field at Y	force on Y
towards the top of the page		
towards the bottom of the page	<input checked="" type="checkbox"/>	
to the left		<input checked="" type="checkbox"/>
to the right		
into the page		
out of the page		

[2]

(ii) State and explain whether there is also a force on wire X.

Yes, there is a force on X due to the magnetic field caused by Y

The two magnetic fields due to X and Y are interacting.

[1]

(b) Fig. 8.2 shows a d.c. supply connected to the input of a transformer.

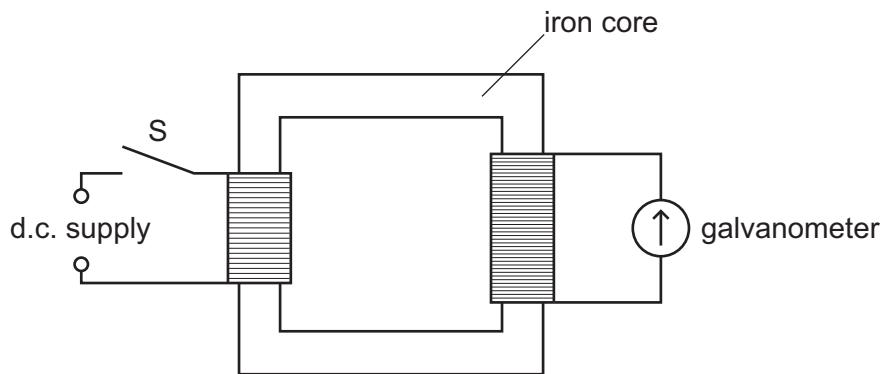


Fig. 8.2

When switch S is first closed, the needle of the galvanometer deflects briefly, then returns to zero.

Explain why the brief deflection occurs.

As switch S is closed, the the flow of current was for short time due to d.c supply. Changing magnetic field cut the secondary coil and causes induced voltage for a very short time ( or induced current)

..... [3]

[Total: 6]

- 9 Fig. 9.1 shows a 12 V battery connected in a circuit containing resistors A, B, C and D. Each resistor has a resistance of  $6.0\ \Omega$ .

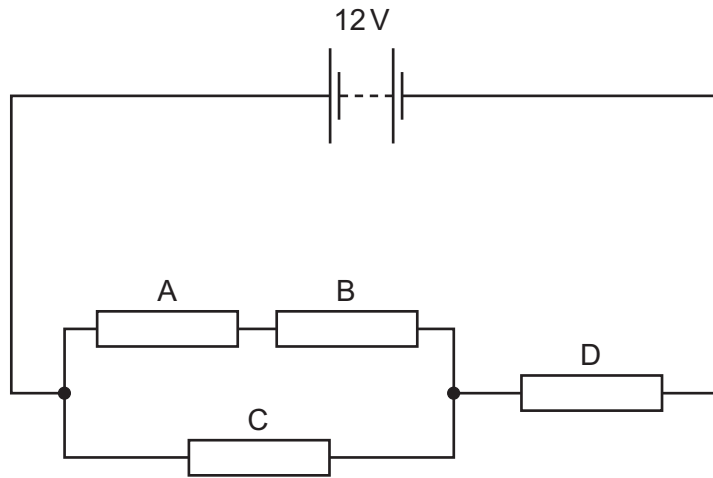


Fig. 9.1

- (a) Calculate the combined resistance of

- (i) resistors A and B,

resistance =  $12\ \Omega$  ..... [1]

- (ii) resistors A, B and C,

$$R = (R_1 \times R_2) / (R_1 + R_2)$$

$$R = (12 \times 6) / (12 + 6) = 4\ \Omega$$

resistance = ..... [2]

- (iii) resistors A, B, C and D.

$$4 + 6 = 10\ \Omega$$

resistance = ..... [1]



(b) Calculate

(i) the current in the battery,

$$I = V/R = 12 / 10$$

$$I = 1.2 \text{ A}$$

current = .....  $1.2 \text{ A}$  ..... [1]

(ii) the energy transferred from the battery to the circuit in 50 s.

$$E = VIt$$

$$E = 1.2 \times 12 \times 50$$

$$E = 720 \text{ J}$$

energy transferred = ..... [2]

[Total: 7]

10 (a) (i) Fig. 10.1 shows the symbol for a circuit component.

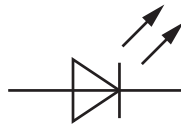


Fig. 10.1

Name this component.

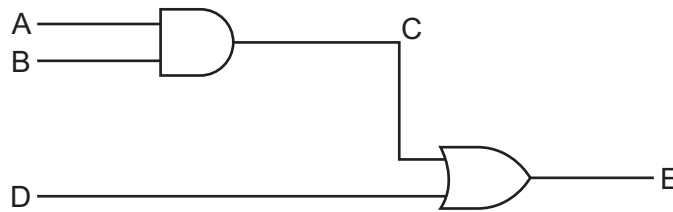
Light emitting diode (LED)

..... [1]

(ii) In the space below, draw the symbol for a NOT gate.

[1]

(b) Fig. 10.2 shows a digital circuit.



AND gate, we multiply  
OR gate, we add

Fig. 10.2

D is  
Given

Complete the truth table for this circuit.

input A	input B	output C	input D	output E
0	0	0	0	0
0	0	0	1	1
0	1	0	0	0
0	1	0	1	1
1	0	0	0	0
1	0	0	1	1
1	1	1	0	1
1	1	1	1	1

[3]

- (c) Suggest a modification to the circuit in Fig. 10.2 to produce the output Z in the truth table below. It may help you to compare this truth table with the truth table in (b).

input A	input B	input D	output Z
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

Replace the OR gate with an AND gate

[1]

[Total: 6]

11 Bismuth-214 is radioactive. It has a half-life of 20 minutes.

(a) The nuclide notation for bismuth-214 is  ${}_{83}^{214}\text{Bi}$ .

State the composition of the nucleus of bismuth-214.

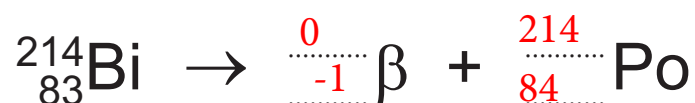
83 protons

131 neutrons

[2]

(b) Bismuth-214 decays by  $\beta$ -decay to an isotope of polonium, Po.

Complete the equation for the decay of bismuth-214.



[3]

(c) The count rate from a sample of bismuth-214 is 360 counts/s.

Predict the count rate from the sample after 60 minutes.

(After 20 min count rate is)  $360 / 2$  or 180 (count / s)

(After 40 min count rate is)  $180 / 2$  or 90 (counts / s)

(After 60 min count rate is)  $90 / 2$

OR new count-rate =  $360 / (2 \times 2 \times 2)$  or  $360 / 8$  or 3 half-lives

45 (counts / s)

count rate = ..... [2]

(d) State **two** of the social, economic or environmental issues involved in the storage of radioactive materials with very long half-lives.

**(Economic):**

high cost of storage / shielding / guarding / need to store for a long time

OR reduction in tourism

OR loss of farming produce / land

OR reduction of land / property values

**(Social):**

fear of cancer / causes cancer / genetic mutations / radiation sickness in people / animals OR local objections OR cause people to move away

**(Environmental):**

crop mutations OR leakage into water supplies

OR pollution of atmosphere / water supply