

Candidate Name Mark Schame

Centre Number	Candidate Number

International General Certificate of Secondary Education
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE
CO-ORDINATED SCIENCES
PAPER 3
MAY/JUNE SESSION 2000

0654/3

2 hours

Candidates answer on the question paper.
No additional materials are required.

Biol ✓
Chem ✓
Phys ✓

TIME 2 hours

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.
A copy of the Periodic Table is printed on page 24.

FOR EXAMINER'S USE	
1	
2	
3	
4	
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6	
7	
8	
9	
TOTAL	

This question paper consists of 21 printed pages and 3 blank pages.

1 Fig. 1.1 shows a motor neurone.

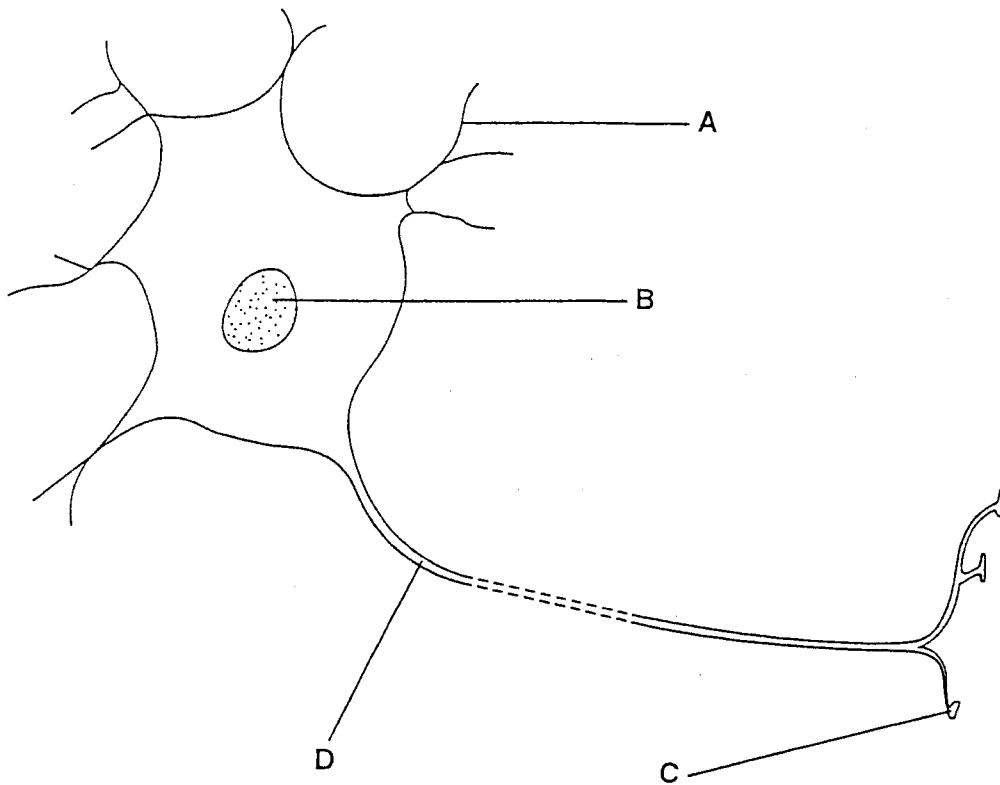


Fig. 1.1

(a) (i) Name the parts labelled A, B, C and D.

- A Dendrite
 B Nucleus
 C Axon
 D Nerve muscle junction [4]

(ii) Where in the human body is the cell body of the motor neurone found?

- Spinal Cord [1]

(b) A motor neurone may be part of a spinal reflex arc.

(i) Give one example of a reflex action.

Any Eg.

(Needs some
explanation for
2 Marks)

Pupil Reflex
In Bright light pupil diameter is reduced

[2]

(ii) With reference to some of the parts labelled on Fig. 1.1, describe the role of the motor neurone in this reflex action.

Impulse arrives at a dendrite;
Passes away from cell body;
Along the axon
To the Nerve Muscle Junction
causes muscle contraction.

[3]

(iii) Describe the value of reflex actions to an organism.

Avoidance of danger;
Increase chances of survival.

[2]

(c) Discuss the similarities and differences between the ways in which an animal and the shoot of a plant respond to light.

Similarities { Light is the stimulus;
Stimulus is detected by a receptor;
Both produce a response;

Differences { Impulse in ~~the~~ Animals is by nervous transmission
Plants it is a chemical;
Animals respond by movement/muscle contraction, Plant by growth;

[3]

- 2 (a) Fig. 2.1 shows an incomplete nucleus of a fluorine atom. The nucleon number of this fluorine atom is 19.
(mass number)

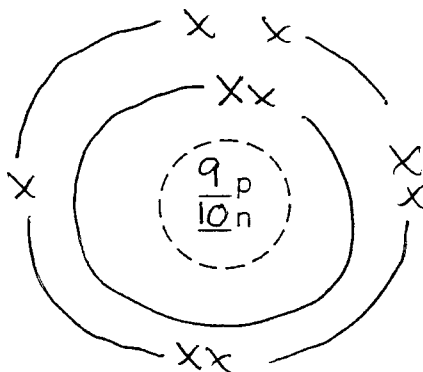
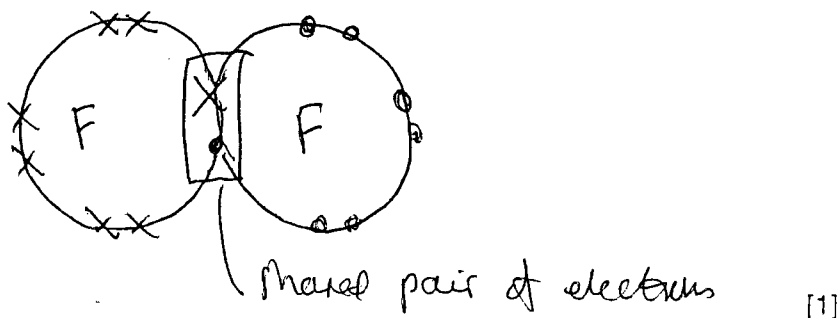


Fig. 2.1

- (i) Write the number of protons and the number of neutrons in the nucleus of this fluorine atom. Use the Periodic Table on page 24 to help you with this question. [1]
- (ii) Show on Fig. 2.1, the number, and arrangement, of electrons in a fluorine atom. [2]
- (iii) Fluorine molecules have the formula F_2 .

Draw a diagram which shows how the outer electrons are arranged in a fluorine molecule.



- (iv) Fluorine is produced industrially by the electrolysis of an electrolyte which contains fluoride ions.

At which electrode, the anode or the cathode, is fluorine formed? Explain your answer.

anode (positive electrode)
because fluoride ions are negative F^-
(opposite charges attract) [2]

- (b) Bacteria in dental plaque produce acids that attack teeth, causing decay.

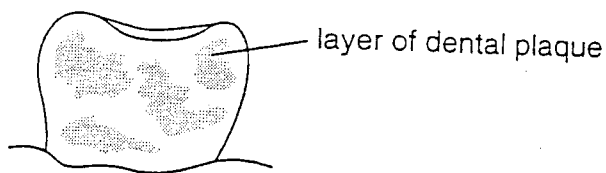


Fig. 2.2

Brushing teeth with toothpaste which contains fluoride ions is known to decrease tooth decay.

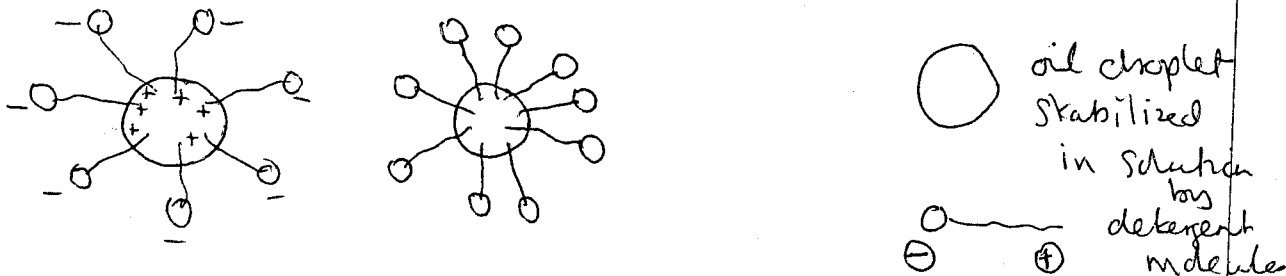
- (i) Fluorine is a highly reactive and corrosive element.

Explain, in terms of electron configuration, why it is safe to use toothpaste containing fluoride ions.

Fluoride ions have gained an ~~extra~~ electron to complete their outer shell which makes the ions more stable & therefore less reactive than F atom. [2]

- (ii) Toothpaste may also contain a detergent such as sodium lauryl sulphate, $C_{11}H_{23}SO_4^-Na^+$. This helps to remove particles of fatty food.

Explain how a detergent such as sodium lauryl sulphate helps to remove fatty food from teeth. You may draw some simple diagrams if it helps your answer.



negative (hydrophilic end) A detergent molecule likes the water and the positive (hydrophobic end) makes the oil/fat, hence small droplets of fat can be removed from the teeth by the detergent. [3]

- (iii) Some toothpastes are colloids called sols.

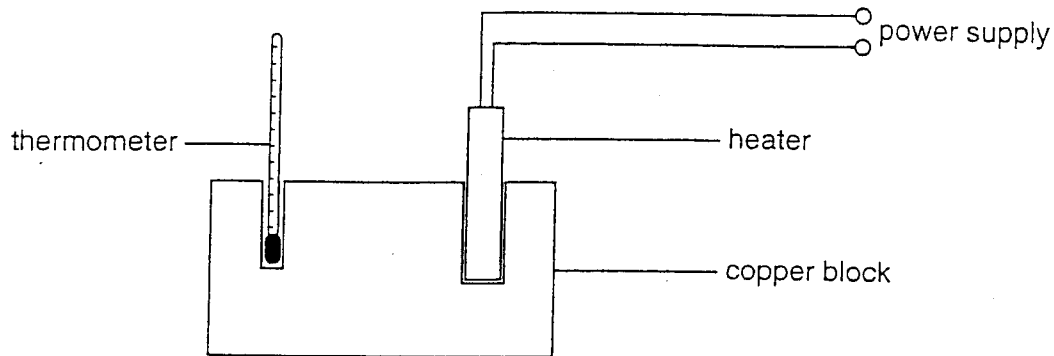
Explain briefly the underlined words.

colloid - a mixture containing small particles dispersed in a continuous phase

sol - solid particles dispersed in liquid phase [2]

(specific example of a colloid)

- 3 An electric heater is used to heat a copper block. Energy is supplied to the block at the rate of 40 J/s.



(a) State, in watts, the power input to the block. 40W [1]

- (b) The block has a mass of 2 kg.
The heater is switched on for 500 s.
The temperature of the block increases from 20 °C to 40 °C.

(i) Calculate the energy supplied to the block.

$$E = mc\Delta\theta = 2 \times$$

$$E = P \times t = 40 \times 500 = 20\,000 \text{ J}$$

.....[2]

(ii) Calculate the energy apparently required to raise the temperature of 1 kg of copper by 1 °C.

$$C = \frac{E}{m\Delta\theta} = \frac{20\,000}{2 \times 20}$$

500 J [2]

(c) In theory, only 400 J of energy is required to raise the temperature of 1 kg of copper by 1 °C.

(i) Suggest why the answer calculated in (b)(ii) is greater than 400 J.

Energy escapes to the surroundings
.....[1]

(ii) Suggest how the apparatus could be changed to make the measured amount of energy more nearly equal to the theoretical amount.

Insulation
.....[1]

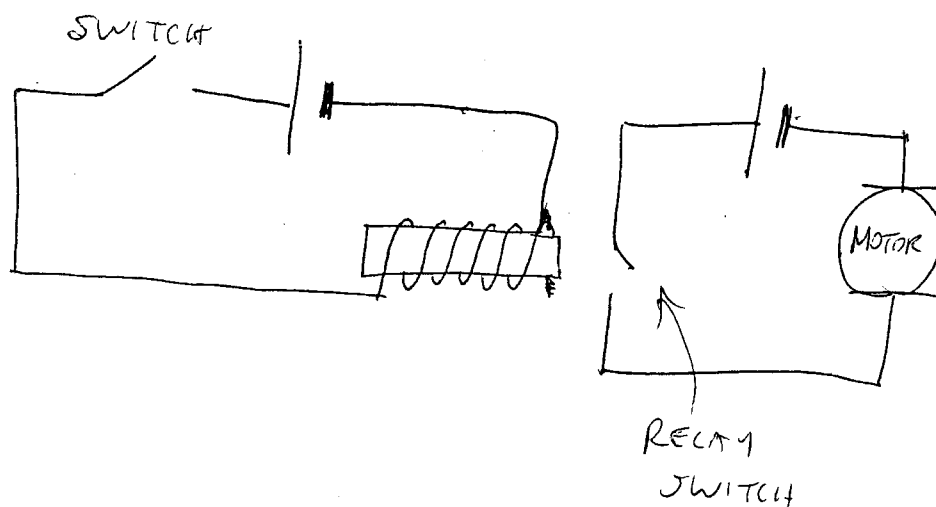
- (d) When electricity flows through a wire, it creates a magnetic field around the wire.

Describe how an electromagnet can be used as part of a relay in a circuit.

You will need to

- describe the apparatus you would use,
 - draw a suitable circuit diagram,
 - explain how the relay works.
- Soft iron Core with
- Copper wire wrapped around it makes an electromagnet.
- When the switch is closed, electromagnet is magnetised
- The relay switch contacts close due to the magnetic effect
- This switches on the motor

(eg)



[6]

- 4 Read the passage below and then use the information and your own knowledge to answer the questions which follow.

In 1998, forest fires burning over much of the island of Borneo in south east Asia released large amounts of smoke into the atmosphere. Many of the fires were begun by people trying to clear forested land for growing crops. However, the weather was unusually dry that year, so the fires raged out of control. Huge areas of forest were destroyed. The smoke spread across Borneo and also to neighbouring countries, such as Singapore.

The smoke caused the atmosphere to appear hazy, reducing the amounts of light reaching plants. The haze contained tiny particles of carbon, which irritated the lungs of people who breathed it. Many schools were closed, so that students could stay indoors rather than having to go outside and breathe the polluted air.

The fires also harmed local wildlife. The forests of Borneo are the main habitat for the orang-utan, a large ape. Orang-utans trying to escape from the burning forests moved closer to the towns, where many were killed by poachers.

- (a) The haze from the fires was a pollutant.

- (i) Suggest a definition of the term *pollutant*.

Harmful substances in the environment.

[1]

- (ii) The haze affected people in a similar way to cigarette smoke.

Describe and explain two effects the haze could have on people's health.

1. Stop Cilia working;
Produce more mucus;

Result in coughing;

2. Coughing could damage cells;
Cells could get infected;
Leading to bronchitis;

[4]

- (iii) Explain how the haze might affect the growth of plants.

Reduced light energy reaching plants;
Less p/synthesis;

[2]

- (b) Suggest how the forest fires might affect the levels of carbon dioxide in the atmosphere. Explain your answer.

Increase;
 Combustion Produces CO_2 ;
 eg. $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$;
[3]

- (c) Explain why biologists believe that it is important that habitats such as the rainforests of Borneo should be conserved.

Maintain Species diversity (WTFE)
 To keep in balance CO_2/O_2 levels (WTFE)
[2]

Anything sensible

- 5 (a) Brass is an alloy of copper and zinc. A piece of brass has a mass of 12.9 g and contains 6.5 g of zinc.

Calculate how many moles of copper are present in the piece of brass. Show your working.

$$\begin{aligned} \text{mass of Cu} &= 12.9\text{g} - 6.5\text{g} \\ &= 6.4\text{g} \\ \text{mols} &= \frac{\text{mass}}{M_r} = \frac{6.4}{64} = \underline{0.1 \text{ mols}} \end{aligned}$$

.....[3]

- (b) The apparatus in Fig. 5.1 is used to react zinc with dilute sulphuric acid. Dilute sulphuric acid is an aqueous solution containing sulphate ions, SO_4^{2-} .

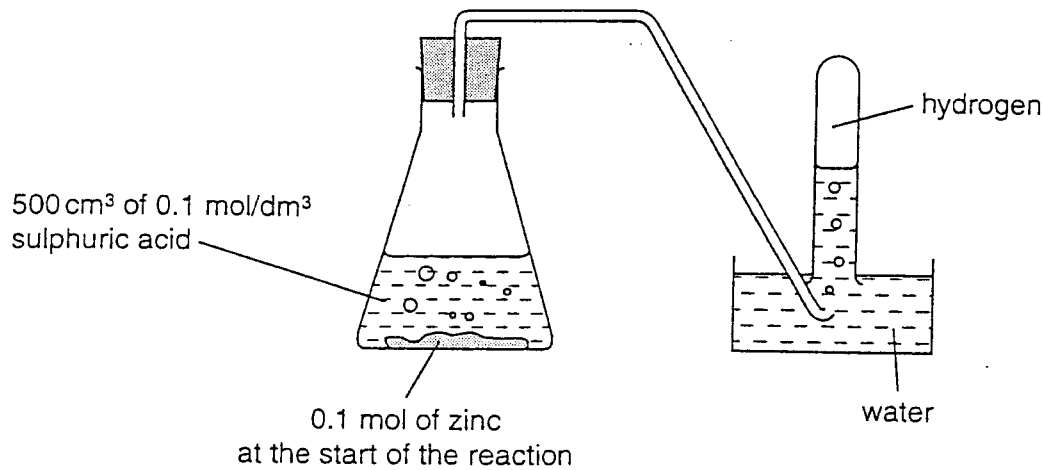
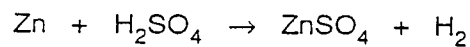


Fig. 5.1

The balanced equation for the reaction is shown.



- (i) Write the symbol and charge of another ion present in dilute sulphuric acid.

H⁺.....[1]

- (ii) Use the information above to deduce the charge on a zinc ion. Explain your answer.

from formula $\text{Zn} : \text{SO}_4 = 1 : 1 \Rightarrow \text{Zn}$ must be +2
to balance charges of SO_4^{2-}[2]

- (iii) Use the information in Fig. 5.1 to predict whether any zinc metal remains in the mixture at the end of the reaction. Show your working.

$$\begin{aligned} \text{mols of sulphuric acid} &= \frac{500}{1000} \times 0.1 \\ &= \underline{0.05} \end{aligned}$$

from equation, mols of zinc that can react with the H_2SO_4
 $= 0.05$ also.
 (1:1 ratio)

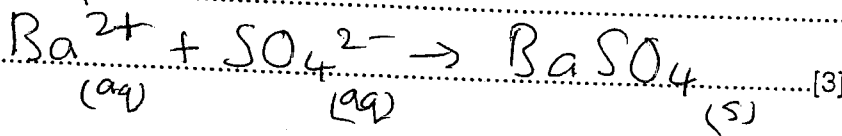
\Rightarrow since 0.1 mols of zinc
 are present, there will be
 an excess of $0.1 - 0.05 = \underline{0.05}$ mols.

[3]

- (c) Barium nitrate solution is used to test for the presence of sulphate ions.

Describe and explain, in terms of the particles involved, what is seen when barium nitrate solution is added to zinc sulphate solution.

Barium ions combine with the sulphate
 ions to form a white precipitate of
 barium sulphate



[3]

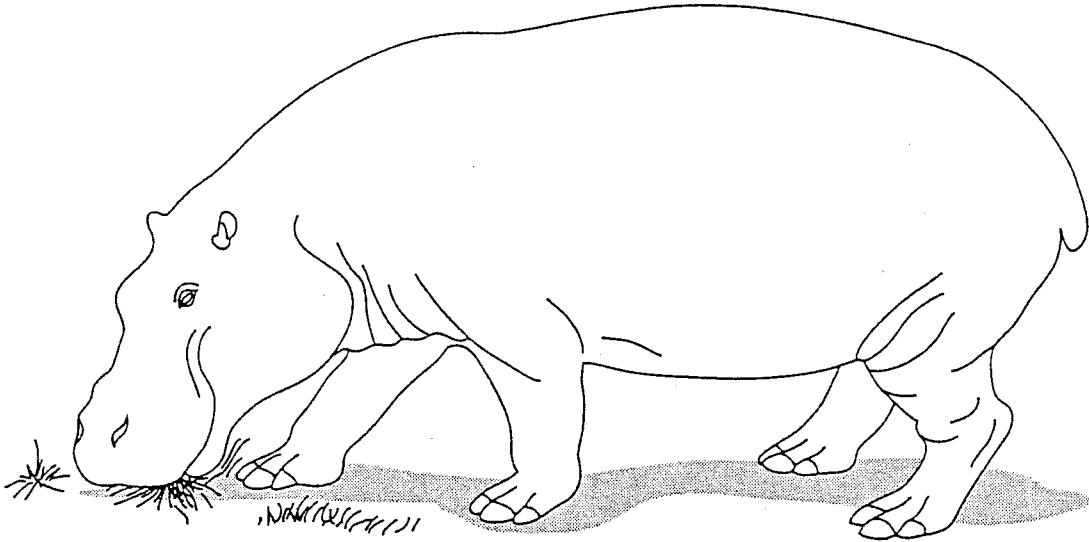


Fig. 6.1

A hippopotamus has a mass of 2000 kg. It has four feet, each of area 100 cm^2 .

- (a) (i) Use the formula

$$\text{pressure} = \text{force}/\text{area}$$

to calculate the average pressure that the hippopotamus exerts on the ground.

$$p = \frac{F}{A} = \frac{2000 \times 10}{100 \times 4} = 50 \text{ N/cm}^2$$

.....[3]

- (ii) The hippopotamus stands with one foot off the ground.

Does the average pressure exerted by the hippopotamus on the ground change?
Explain your answer.

: Increases

: Force is the same, but area
is smaller

.....[2]

- (b) To determine the density of the hippopotamus, its volume must be measured.

Suggest a method for measuring the volume of an irregularly shaped object, such as a hippopotamus.

- Displacement method
 - Immerse in water. Measure volume of displaced water
-[2]

- (c) The volume of the hippopotamus is 2.5 m^3 .

Calculate the density of the hippopotamus. Show your working and state any formula that you use.

$$d = \frac{m}{V} = \frac{2000}{2.5}$$

$$= 800 \text{ kg/m}^3$$

.....[3]

- 7 An investigation was carried out into the activity of amylase in two different parts of the alimentary canal. Fig. 7.1 shows the two parts, A and B, that were tested.

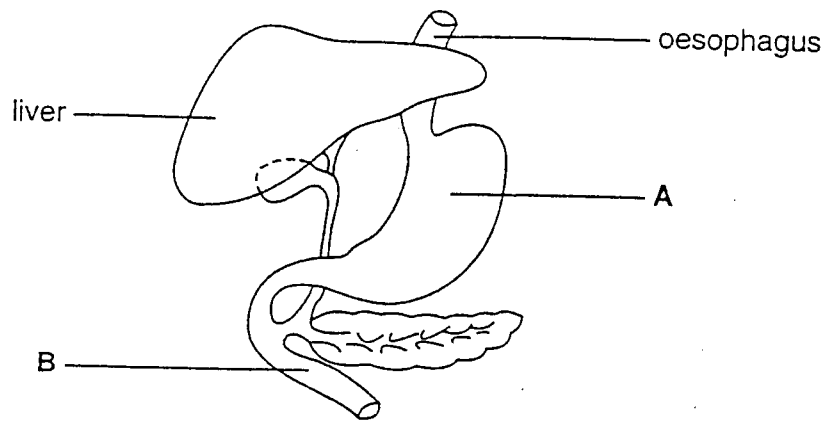


Fig. 7.1

Samples of the contents of these two parts of the alimentary canal were placed on to agar jelly in two separate petri dishes. The agar jelly contained starch.

Fig. 7.2 shows the petri dish containing the sample from part A at the beginning of the experiment.

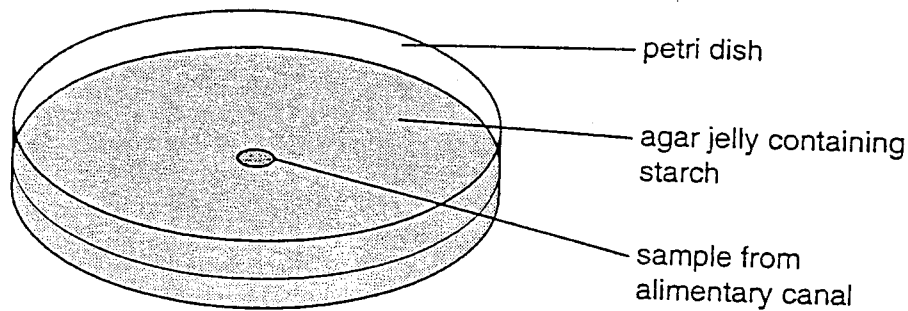


Fig. 7.2

- (a) Describe the effect that amylase has on starch.

Amylase breaks down large starch molecules;
 into smaller molecules, sugars;
 Maltose;

[3]

(b) If any amylase was present in the samples, it would spread into the agar jelly. To see if this had happened, each of the dishes was left for 1 hour, and then iodine solution was poured over the jelly.

(i) Explain how the amylase would spread into the agar jelly.

Spread by diffuse;
 Particles have kinetic energy;
[2]

(ii) Suggest suitable conditions in which the dishes should be left for 1 hour, before testing with iodine solution. Give a reason for your answer.

Room temp / Warm temp
 Diffusion too slow at low temps;
 Amylase destroyed / denatured by high temps;
[2]

(c) Fig. 7.3 shows the two petri dishes after iodine solution was poured over them.

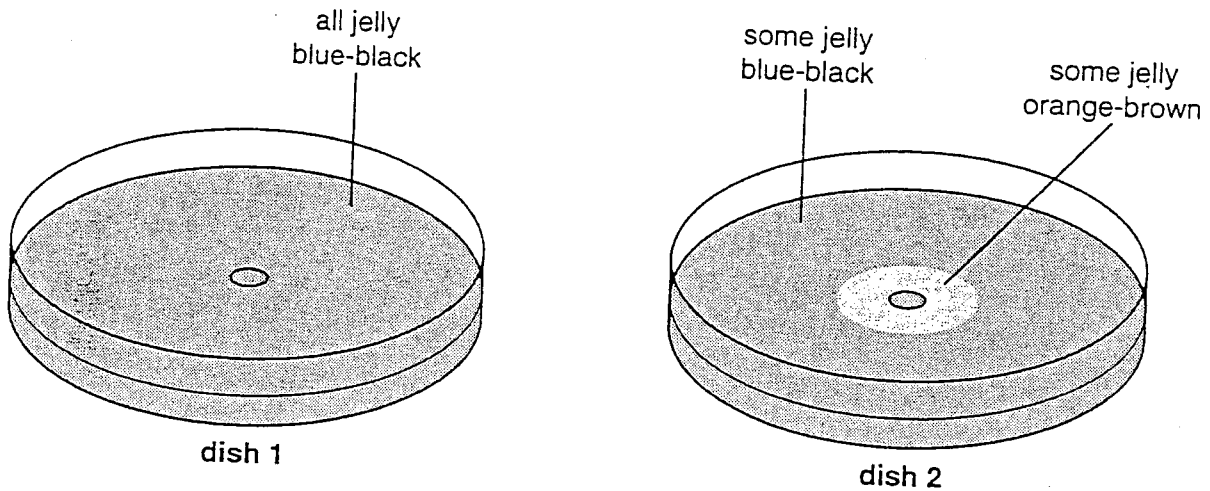


Fig. 7.3

(i) Explain why some areas were blue-black, while other areas were orange-brown.

Blue / Black : Starch still present
 Orange / Brown : Starch digested into maltose / sugars
[2]

(ii) Suggest which petri dish contained the sample from part A and which contained the sample from part B. Explain your answer.

Dish 1 = Sample A
 Dish 2 = " B
 Amylase secreted into small intestine from pancreas
[1]

- 8 Fig. 8.1 shows a large crane used on a building site.

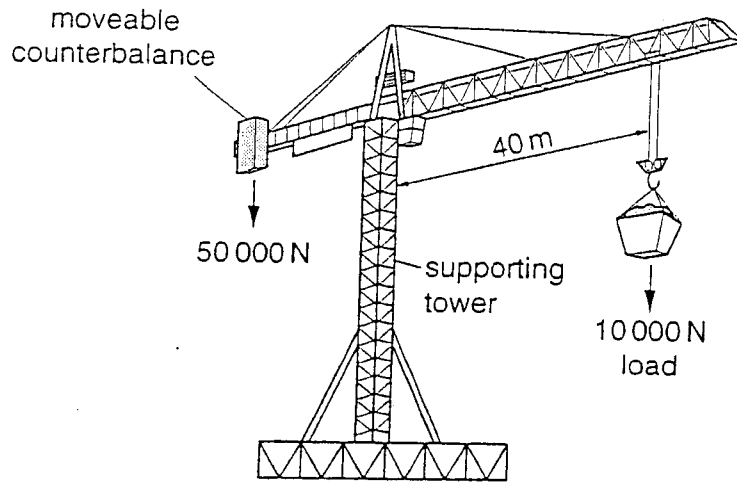


Fig. 8.1

- (a) The crane in Fig. 8.1 is balanced.

- (i) Calculate the moment of the load about the crane's supporting tower. Show your working.

$$\text{Moment} = F \times d = 10\,000 \times 40$$

$$= 400\,000 \text{ N}\cdot\text{m}$$

.....[2]

- (ii) Calculate the distance of the crane's counterbalance from the crane's supporting tower. Show your working.

$$d = \frac{\text{Moment}}{\text{force}} = \frac{400\,000}{50\,000} = 8\text{m}$$

.....[1]

(b) Explain, in terms of forces and moments, why the crane needs a counterbalance.

- Load causes a clockwise moment
- Equal anticlockwise moment is needed to prevent the crane from toppling over. [2]

(c) The graph in Fig. 8.2 shows the speed of the load as it is raised by the crane.

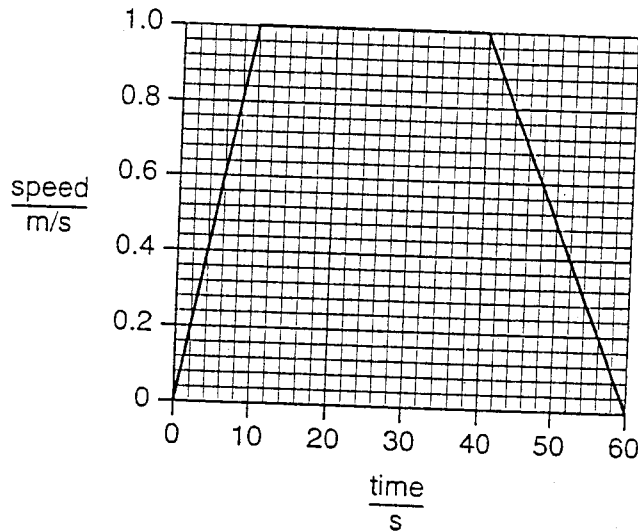


Fig. 8.2

Use Fig. 8.2 to calculate the distance the load has been raised by the crane. Show your working.

Area under graph

$$= \frac{1}{2} \times 1 \times 10 + 1 \times 30 + \frac{1}{2} \times 1 \times 20$$

$$= 45 \text{ m}$$

.....[3]

(d) Calculate the work done in raising the load by the distance you have calculated in (c). Show your working and state any formula that you use.

$$W = F \times d = 10000 \times 45$$

$$= 450000 \text{ J}$$

.....[2]

- 9 Fig. 9.1 shows a catalytic converter fitted to a car. The exhaust gases from the car pass through the converter before they are emitted into the air.

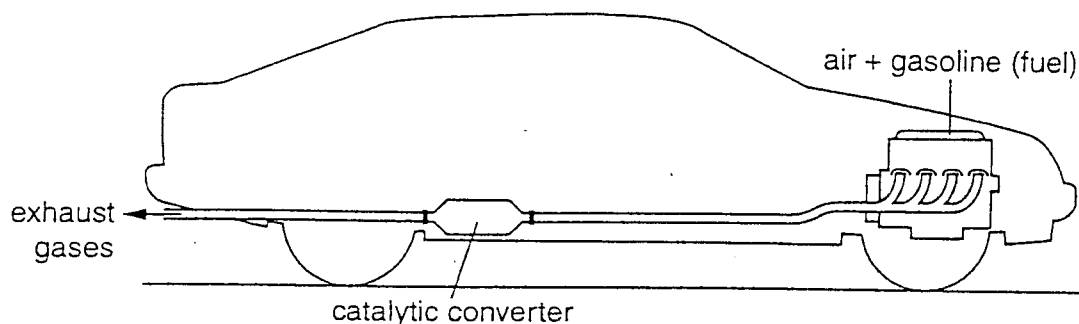


Fig. 9.1

The table in Fig. 9.2 shows some data about the composition of the mixtures of exhaust gases from two identical cars, one with and one without a catalytic converter.

substance in exhaust gases	% by volume	
	car without catalytic converter	car with catalytic converter
nitrogen	67.60	67.65
carbon dioxide	12.00	12.25
water vapour	11.00	11.10
oxygen	9.00	9.00
carbon monoxide	0.20	0
nitrogen dioxide	0.15	0
hydrocarbons	0.05	0

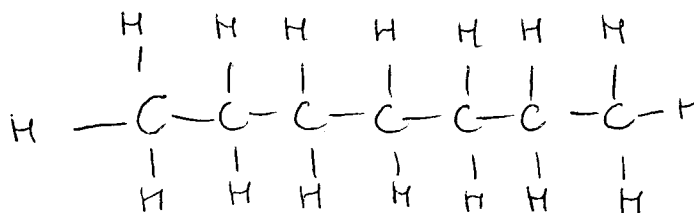
Fig. 9.2

- (a) (i) Name the raw material from which gasoline is extracted.

..... *Crude oil* [1]

- (ii) Gasoline contains heptane, an alkane which contains seven carbon atoms in each of its molecules.

Draw the graphical formula of a heptane molecule.



[2]

- (iii) Explain why the exhaust gases contain large amounts of carbon dioxide, water vapour, oxygen and nitrogen.

carbon dioxide

Carbon present in fuel (hydrocarbons)
which oxidizes to form CO_2 during combustion

water vapour

hydrogen present in fuel (hydrocarbons)
which oxidizes to form water during combustion

oxygen

Some unreacted oxygen from air in fuel mixture
passes out of exhaust.

nitrogen

(78%)
nitrogen present in air[^] remain largely unreacted
in combustion process and escapes in large quantities [4]

(b) Fig. 9.3 shows more detail of the catalytic converter.

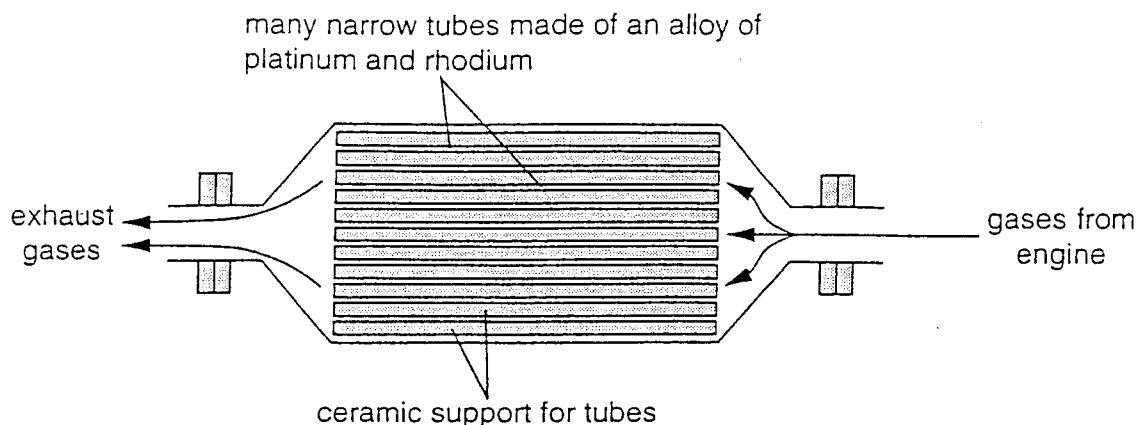


Fig. 9.3

(i) Name the raw material from which ceramic materials are made.

..... Sand / clay [1]

(ii) State **one** property of ceramic materials, other than their strength, that makes them suitable for use in the catalytic converter.

..... high melting point [1]

(iii) Use the information in Fig. 9.2 on page 18 to suggest how the catalytic converter helps to reduce air pollution from cars. You should use the idea of oxidation and reduction in your answer.

Carbon monoxide (a pollutant) is oxidized to
 carbon dioxide which is not. Nitrogen dioxide
 which causes acid rain is reduced to nitrogen
 which is harmless. Unburnt hydrocarbon molecules
 are removed (converted in $\text{CO}_2 + \text{H}_2\text{O}$) so no
 pollutants from this source either.

..... [6]