



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

* 0 5 7 3 5 3 0 6 1 6 *

CO-ORDINATED SCIENCES

0654/31

Paper 3 (Extended)

October/November 2010

2 hours

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 a soft pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 28.

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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **26** printed pages and **2** blank pages.



- 1 Fig. 1.1 shows the apparatus a student used to study the rate of reaction between 1.0 g of powdered metal and dilute hydrochloric acid.

For
Examiner's
Use

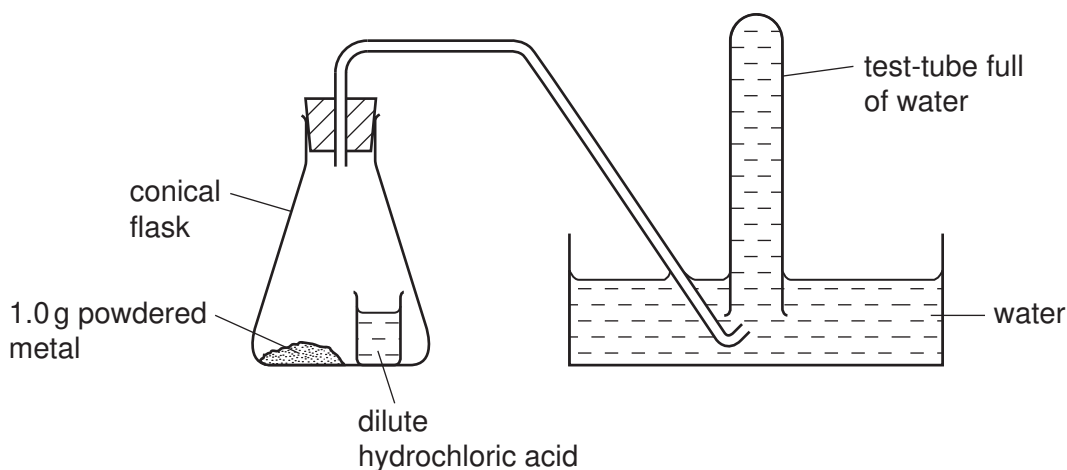


Fig. 1.1

When the student tilted the conical flask, the acid mixed with the powdered metal. If a reaction occurred, any gas which was produced collected in the test-tube, pushing the water out. The student measured the time taken for the test-tube to fill with gas.

- (a) (i) Name the gas produced when metals react with dilute hydrochloric acid.

..... [1]

- (ii) State the formula of the *ion* which is present in relatively high concentrations in all acids.

..... [1]

- (b) The student used the apparatus and method described above to compare the rates of reaction between dilute hydrochloric acid and three powdered metals, X, Y and Z.

The results the student obtained are shown in Table 1.1.

Table 1.1

metal	mass of metal /g	time for gas to fill the test-tube / seconds
X	1.0	154
Y	1.0	28
Z	1.0	76

- (i) The student was careful to ensure that the only variable (factor) which differed between the experiments was the type of metal.

State **two** variables, other than the mass and surface area of the metals, which the student must keep the same in each experiment.

1

2 [2]

- (ii) Explain how the results show that the rate of reaction was the lowest when metal X was used.

.....

..... [1]

- (iii) The student repeated the experiment with metal Y but this time he used a single piece of metal which had a mass of 1.0 g.

State how the rate of reaction would differ from the experiment in which 1.0 g of powdered metal was used.

Explain your answer in terms of the collisions between atoms in the surface of the metal and ions in the solution.

.....

.....

.....

.....

..... [3]

(c) When magnesium reacts with dilute hydrochloric acid, HCl , one of the products is magnesium chloride, MgCl_2 .

For
Examiner's
Use

(i) Construct a balanced symbolic equation for this reaction.

..... [2]

(ii) Magnesium chloride is a compound which causes hardness in water.

Describe briefly how the process of *ion exchange* is used to soften hard water. You may draw a simple diagram if it helps you to answer this question.

.....
.....
.....
..... [2]

BLANK PAGE

Please turn over for Question 2.

2 Fig. 2.1 shows a mobile phone (cell phone).



mobile phone
containing a battery

Fig. 2.1

(a) Energy is stored inside the mobile phone in a battery.

Describe the energy changes taking place when the battery is being charged.

.....
..... [2]

(b) The quality of digital signals is maintained far better than that of analogue signals.

Explain why.

.....
.....
..... [2]

- (c) The strength of phone cases can be tested by dropping the phones onto different surfaces from a height of 2 m.

A phone of mass 80 g is dropped onto a concrete path. The case breaks when it hits the concrete. When an identical mobile phone is dropped onto a soft carpet from the same height, the case does not break.

- (i) State the momentum of each phone after it has landed on the surface.

..... [1]

- (ii) As a phone was about to hit the concrete path, its momentum was 1.2 kg m/s. It took 0.03 s to stop.

The force it experienced as it hit is given by the formula

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken to stop}}$$

Calculate this force.

Show your working.

..... [2]

- (iii) The phones that hit the concrete and the soft carpet had the same change in momentum. Suggest why the phone dropped onto the soft carpet did not break.

.....

 [2]

3 Fig. 3.1 shows a generalised reflex arc.

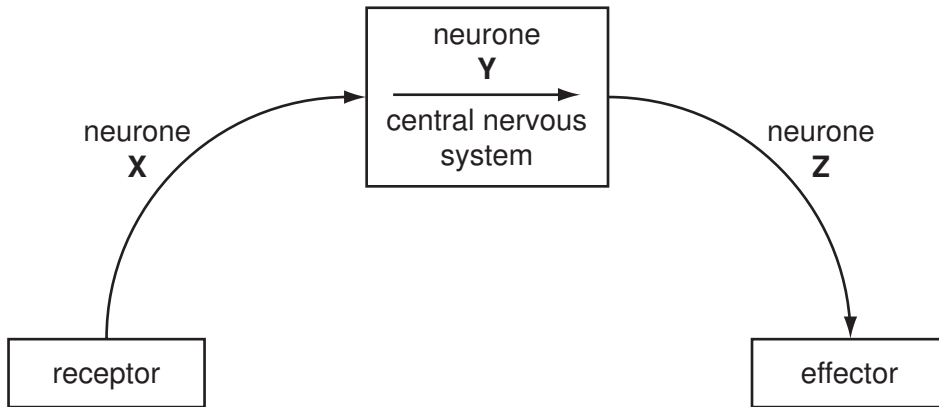


Fig. 3.1

(a) (i) Name the neurones labelled X, Y and Z.

X

Y

Z

[3]

(ii) Name **one** part of the central nervous system in which neurone Y might be found.

.....

[1]

(b) A student hears a sudden, loud bang. Receptors in his ear respond to the sound by generating electrical impulses in neurone X. These impulses travel along the reflex arc, eventually reaching an effector.

Suggest what the effector could be in this reflex, and how it would respond.

effector

response

[2]

(c) Another reflex action involves the secretion of saliva into the mouth in response to the smell of food.

(i) Describe the role of saliva in the digestion of food.

.....

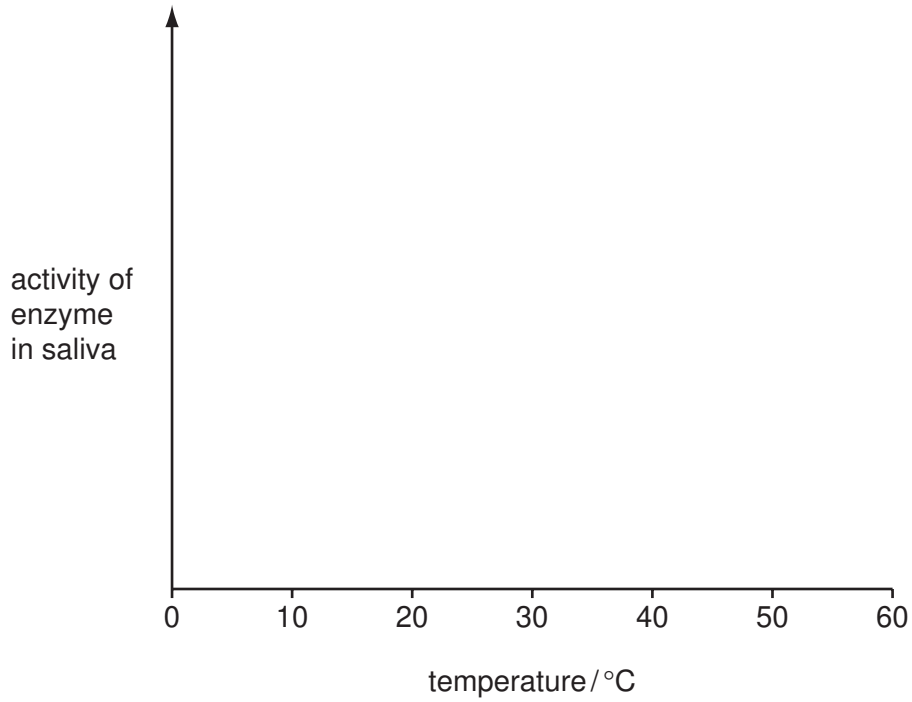
[2]

(ii) Explain why it is necessary for most types of food that we eat to be digested.

.....
.....
..... [2]

For
Examiner's
Use

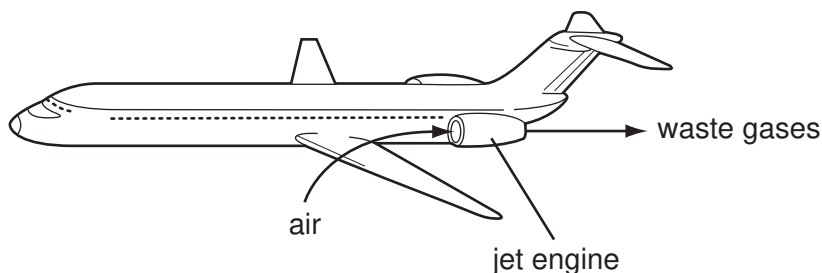
(iii) On the axes below, sketch a curve to show how the activity of enzyme from human saliva would vary with temperature.



[2]

- 4 In jet engines, hydrocarbon molecules from the jet fuel mix with air and burn. This releases a large amount of energy and produces a mixture of waste gases. These waste gases pass out through the back of the jet engine into the atmosphere.

For
Examiner's
Use



- (a) Fig. 4.1 shows a molecule of octane, which is a typical hydrocarbon molecule in jet fuel.

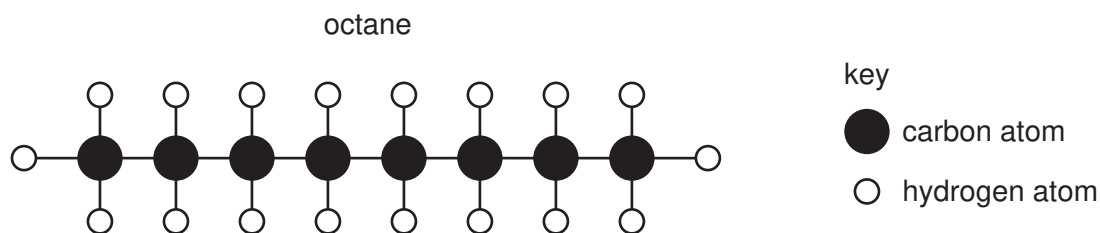
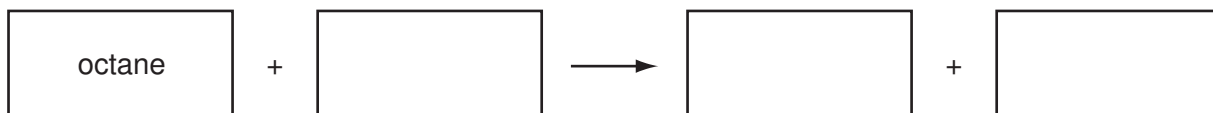


Fig. 4.1

- (i) State the chemical formula of octane.

..... [1]

- (ii) Complete the word equation below for the complete combustion of octane.



[2]

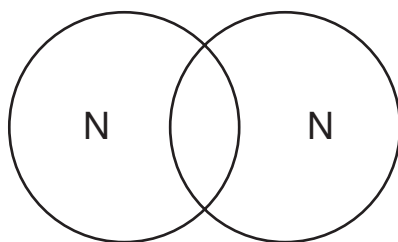
- (b) The mixture of waste gases coming from the jet engine contains a large amount of the free element nitrogen, N_2 , which exists naturally in the air. The atoms in a nitrogen molecule are held together by a triple covalent bond as shown in the displayed formula below.



- (i) State the number of outer electrons in a single nitrogen atom.

..... [1]

- (ii) Complete the bonding diagram below to show how the outer electrons are arranged around the atoms in a nitrogen molecule.



[2]

- (iii) The temperature inside the jet engine is very high.

Suggest why most of the nitrogen molecules which pass through the engine do **not** break up into individual atoms.

.....

.....

..... [2]

For
Examiner's
Use

(c) Table 4.1 shows information about some metallic materials.

For
Examiner's
Use

Table 4.1

material	strength	density
mild steel	very high	very high
aluminium	low	low
duralumin (an aluminium alloy)	very high	low

(i) Duralumin is used in the manufacture of aircraft.

Explain why the properties of this material make it suitable for this purpose.

.....

.....

.....

.....

..... [2]

(ii) A sample of duralumin has a mass of 50.00g and contains 1.73 moles of aluminium.

Calculate the percentage by mass of aluminium in this sample of duralumin.

Show your working.

..... [3]

BLANK PAGE

Please turn over for Question 5.

- 5 A student investigated the relationship between the potential difference across a lamp and the current passing through it.

For
Examiner's
Use

(a) Fig. 5.1 shows her results.

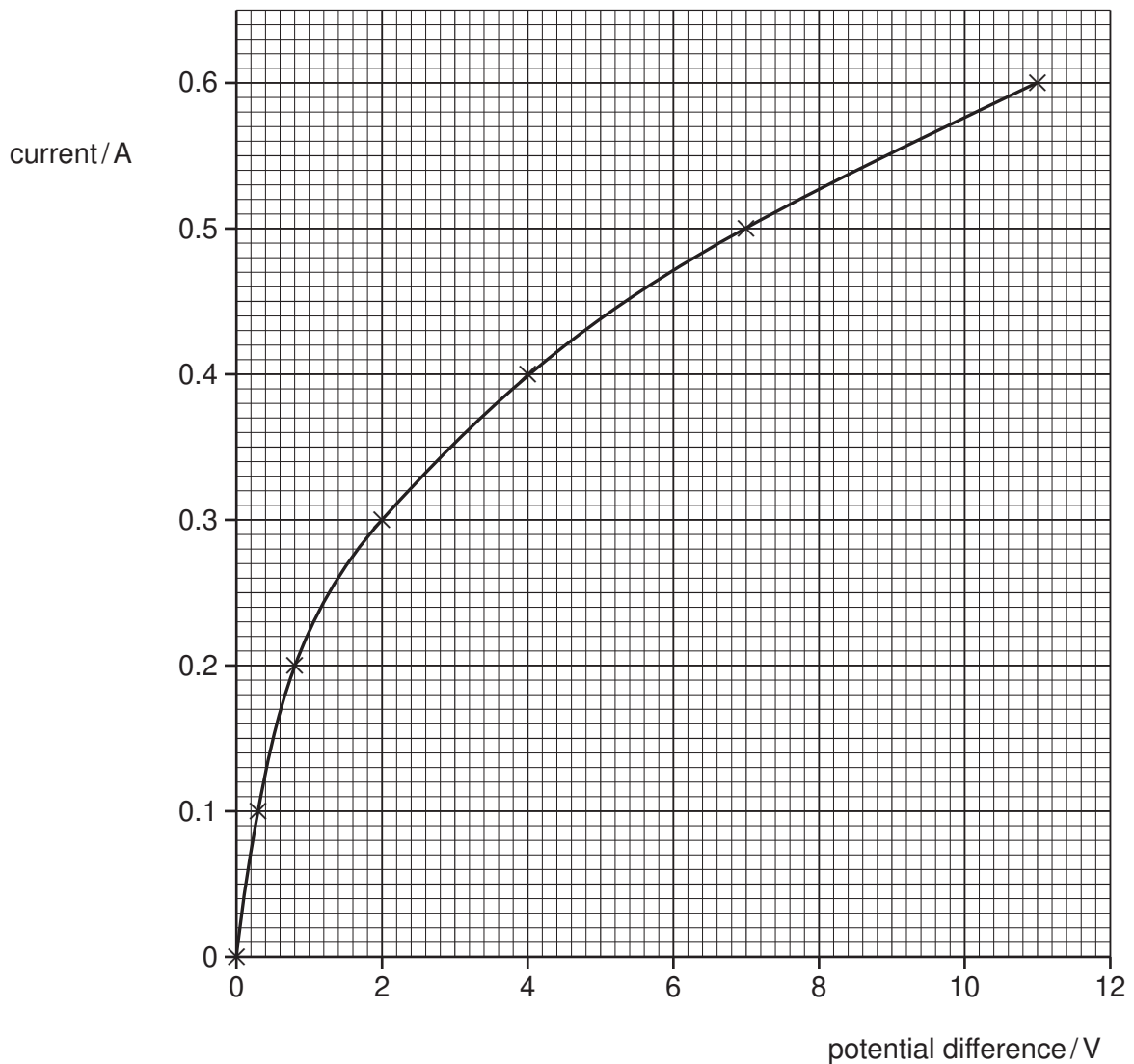


Fig. 5.1

- (i) What is the current when the potential difference is 6 V?

..... [1]

(ii) Calculate the resistance of the lamp when the potential difference is 6 V.

State the formula that you use and show your working.

formula used

working

..... [2]

(b) A student was given two bar magnets and a bar of soft iron. She carried out the following experiments.

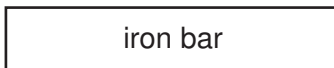
(i) She brought the magnets close together with like poles facing.



State what she observed.

.....
..... [1]

(ii) She brought the soft iron bar towards one of the magnets.



State what she observed.

.....
..... [1]

For
Examiner's
Use

- (c) Fig. 5.2 shows a strip of aluminium foil hung between the poles of a magnet. When the current is switched on, the foil experiences a force as shown.

For
Examiner's
Use

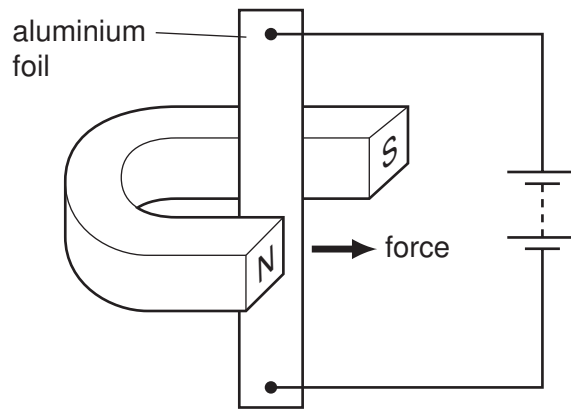


Fig. 5.2

- (i) Explain why a force is produced.

.....

 [2]

- (ii) State **two** changes which would increase the size of the force acting on the aluminium foil.

1
 2 [2]

(d) A transformer used in a television set has 100 turns on the primary coil.

The potential difference across the primary coil is 240 V and the potential difference across the secondary coil is 35 000 V.

Calculate the number of turns on the secondary coil.

Use the formula $V_p/V_s = N_p/N_s$.

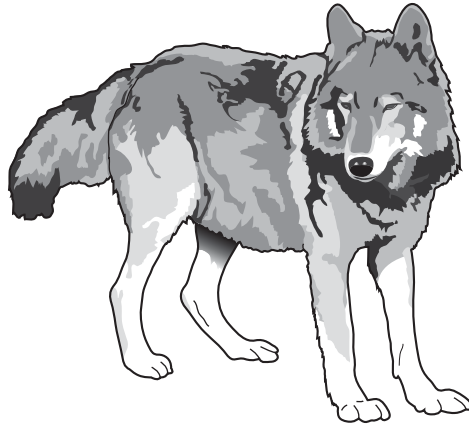
Show your working.

For
Examiner's
Use

..... [2]

- 6 The gray wolf, *Canis lupus*, is a predator. In Wisconsin, Canada, the wolves' diet consists mainly of white-tailed deer, beavers, snowshoe hares and mice.

For
Examiner's
Use



(a) White-tailed deer eat grasses and other plants.

(i) Construct a food chain including white-tailed deer and wolves.

[1]

(ii) Sketch a pyramid of biomass for the food chain you have constructed in (i). Label the trophic levels in your pyramid.

[3]

(iii) With reference to your answers in (i) and (ii), suggest why wolves are rarer than white-tailed deer.

.....

.....

..... [2]

- (b) People used to shoot gray wolves. In 1978, a conservation programme for gray wolves began in Wisconsin and people were no longer allowed to shoot them. The main causes of death of wolves are disease, starvation and accidents such as collisions with vehicles.

For
Examiner's
Use

Fig. 6.1 shows the size of the gray wolf population in Wisconsin between 1986 and 2010. It also shows the predicted wolf population if the conservation programme is successful.

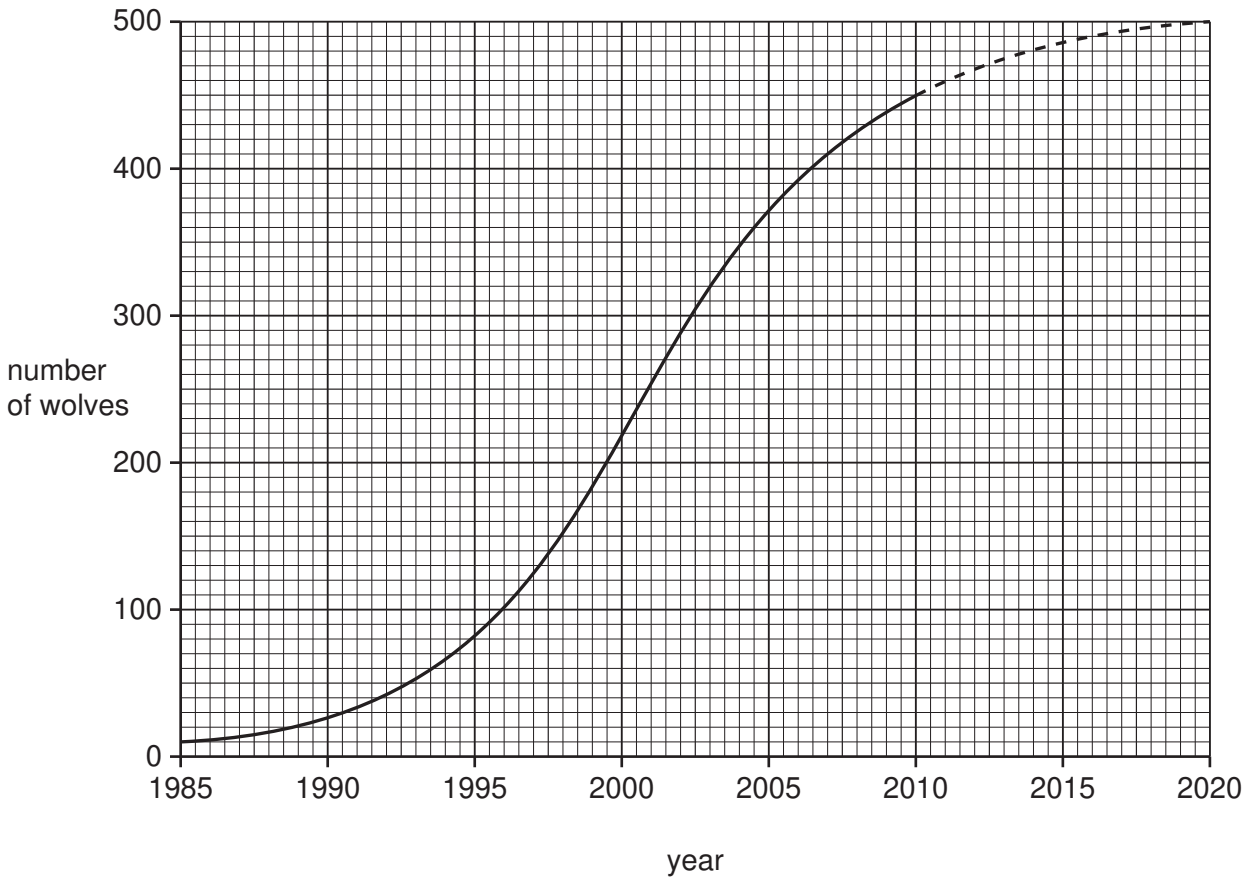


Fig. 6.1

- (i) Suggest why the population of gray wolves in Wisconsin is not expected to increase beyond about 500 individuals, even if they are no longer killed by humans.

.....

 [2]

- (ii) Some people in Wisconsin are opposed to the wolf conservation programme. Explain why it is important to conserve species such as the gray wolf.

.....

 [2]

7 Copper metal reacts with oxygen gas to form copper oxide.

(a) Table 7.1 shows information about two different types of copper oxide.

For
Examiner's
Use

Table 7.1

name	colour	chemical formula
copper(II) oxide	black	CuO
copper(I) oxide	red	Cu ₂ O

(i) Copper is a transition metal.

State **one** property, shown in Table 7.1, which is typical of transition metals.

..... [1]

(ii) The formula of the oxide ion is O²⁻.

Use the formula of copper(I) oxide to deduce the charge of the copper ion in this compound.

Show your working.

.....
..... [2]

- (b) Fig. 7.1 shows apparatus and materials needed for the electrolysis of aqueous solutions of ionic compounds, using graphite electrodes.

For
Examiner's
Use

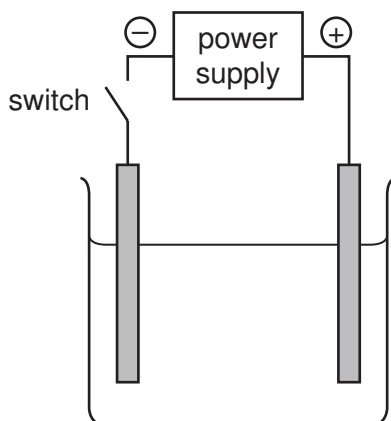


Fig. 7.1

Table 7.2 shows the observations made when solutions of three compounds, **W**, **X** and **Y**, were each electrolysed.

Table 7.2

compound in solution	observation at the cathode	observation at the anode
W	bubbles of gas	bubbles of gas which bleach damp litmus paper
X	orange / pink solid layer forms	bubbles of gas which bleach damp litmus paper
Y	bubbles of gas	orange solution produced

- (i) On Fig 7.1, clearly label the **anode** and the **electrolyte**. [2]
- (ii) Suggest the name of compound **X**. [1]
- (iii) Name the gas produced at the cathode when compound **W** is electrolysed. [1]
.....
- (iv) Explain which compound, **W**, **X** or **Y**, could be potassium bromide.
compound [2]
.....
.....
.....

8 (a) Explain why plants need light for photosynthesis.

.....
.....
..... [2]

(b) A student fixed a piece of black paper over a leaf, which was still attached to the plant. He left the plant in the sun for two days.

He then removed the leaf from the plant and tested it for starch, after removing the black paper.

(i) Describe how the student should test the leaf for starch.

.....
.....
.....
.....
.....
..... [4]

(ii) Fig. 8.1 shows the leaf before and after he did the starch test.

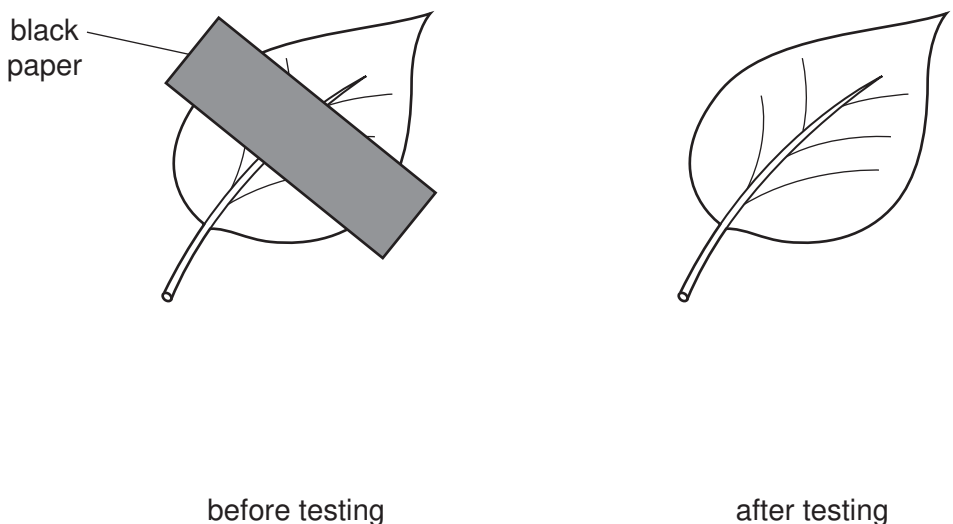


Fig. 8.1

Complete the diagram of the leaf after testing in Fig. 8.1, using labels to show the colours of each part. Do **not** colour the diagram. [2]

- (c) In daylight, plant leaves take in carbon dioxide and give out oxygen. In darkness, they take in oxygen and give out carbon dioxide.

For
Examiner's
Use

Explain why this happens.

.....

.....

.....

.....

.....

.....

..... [3]

- 9 Fig. 9.1 shows a rock that is falling from the top of a cliff into the river below.

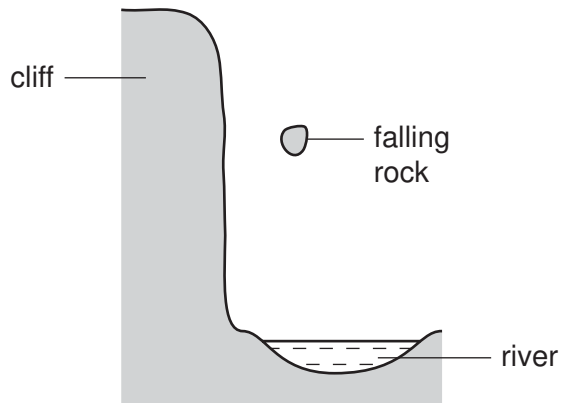


Fig. 9.1

- (a) The rock accelerates downwards at 9.8 m/s^2 . The mass of the rock is 2000 g.

Calculate the weight of the rock.

State the formula that you use and show your working.

formula used

working

..... [2]

For
Examiner's
Use

- (b) Fig. 9.2 is a speed-time graph for the motion of the rock. This graph ignores the effect of air resistance on the rock.

For
Examiner's
Use

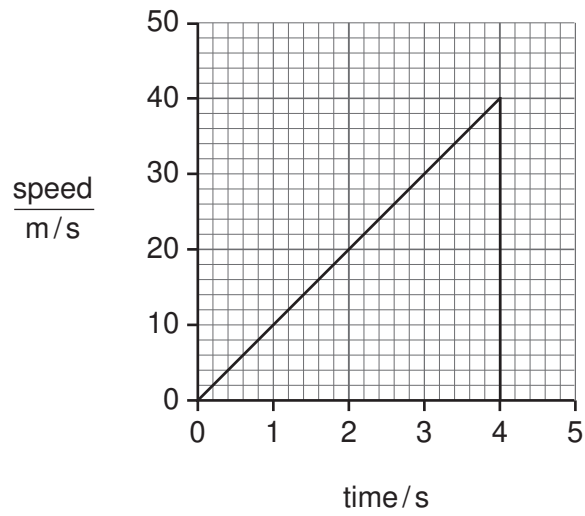


Fig. 9.2

- (i) Calculate the kinetic energy of the rock as it hits the water.

State the formula that you use and show your working.

formula used

working

..... [3]

- (ii) Calculate the height of the cliff.

Show your working.

..... [2]

(c) The rock has an irregular shape. It has a mass of 2000 g and a volume of 700 cm³.

(i) Calculate the density of the rock.

State the formula that you use and show your working.

formula used

working

..... [2]

(ii) Describe how you could find the volume of an irregularly shaped object such as a rock. You should state the apparatus you would use and the measurements you would need to make.

.....
.....
.....
.....
..... [2]

(d) The rock contains radioactive substances emitting high levels of ionising radiation.

(i) State how the radioactivity could be detected.

..... [1]

(ii) Explain why it would be dangerous for a person to handle this rock without proper protection.

.....
..... [1]

DATA SHEET
The Periodic Table of the Elements

		Group									
		I	II	III	IV	V	VI	VII	0		
		1 H Hydrogen 1									
		4 He Helium 2									
7	9	3	4	5	6	7	8	9	10		
Li Lithium	Be Beryllium	B Boron	C Carbon	N Nitrogen	O Oxygen	F Fluorine	Ne Neon				
23	24	11	12	13	14	15	16	17	18		
Na Sodium	Mg Magnesium	Al Aluminium	Si Silicon	P Phosphorus	S Sulfur	Cl Chlorine	Ar Argon				
39	40	19	20	21	22	23	24	25	26	27	
K Potassium	Ca Calcium	Sc Scandium	Ti Titanium	V Vanadium	Cr Chromium	Mn Manganese	Fe Iron	Co Cobalt	Ni Nickel	Cu Copper	
85	88	37	40	39	40	41	42	43	44	45	
Rb Rubidium	Sr Strontium	Y Yttrium	Zr Zirconium	Nb Niobium	Mo Molybdenum	Tc Technetium	Ru Ruthenium	Rh Rhodium	Pd Palladium	Ag Silver	
133	137	55	56	57	58	59	60	61	62	63	
Cs Caesium	Ba Barium	La Lanthanum	Hf Hafnium	Ta Tantalum	W Tungsten	Re Rhenium	Os Osmium	Ir Iridium	Pt Platinum	Au Gold	
	226	88	89	87	88	89	90	91	92	93	
Fr Francium	Ra Radium	Ac Actinium									
207	208	82	83	84	85	86	87	88	89	90	
Pb Lead	Bi Bismuth	Po Polonium	At Astatine	Rn Radon							
162	163	66	67	68	69	70	71	72	73	74	
Dy Dysprosium	Ho Holmium	Er Erbium	Tm Thulium	Yb Ytterbium	Lu Lutetium						
140	141	58	59	60	61	62	63	64	65	66	
Ce Cerium	Pr Praseodymium	Nd Neodymium	Pm Promethium	Sm Samarium	Eu Europium	Gd Gadolinium	Tb Terbium	Dy Dysprosium	Ho Holmium	Er Erbium	
232	238	90	91	92	93	94	95	96	97	98	
Th Thorium	Pa Protactinium	U Uranium	Np Neptunium	Pu Plutonium	Am Americium	Cm Curium	Bk Berkelium	Cf Californium	Es Einsteinium	Fm Fermium	
175	173	71	70	102	101	100	99	98	97	96	
Lu Lutetium	Yb Ytterbium	No Nobelium	Md Mendelevium	Lr Lawrencium							

*58-71 Lanthanoid series
†90-103 Actinoid series

	a	X	a = relative atomic mass
Key	b	X	X = atomic symbol
			b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.