UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

3983879930

PHYSICAL SCIENCE **0652/03**

Paper 3 (Extended) **October/November 2010**

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 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 20.

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	
Total	

This document consists of **17** printed pages and **3** blank pages.

For Examiner's Use

1 Fig. 1.1 shows apparatus used to react dilute solutions of sodium hydroxide and sulfuric acid.

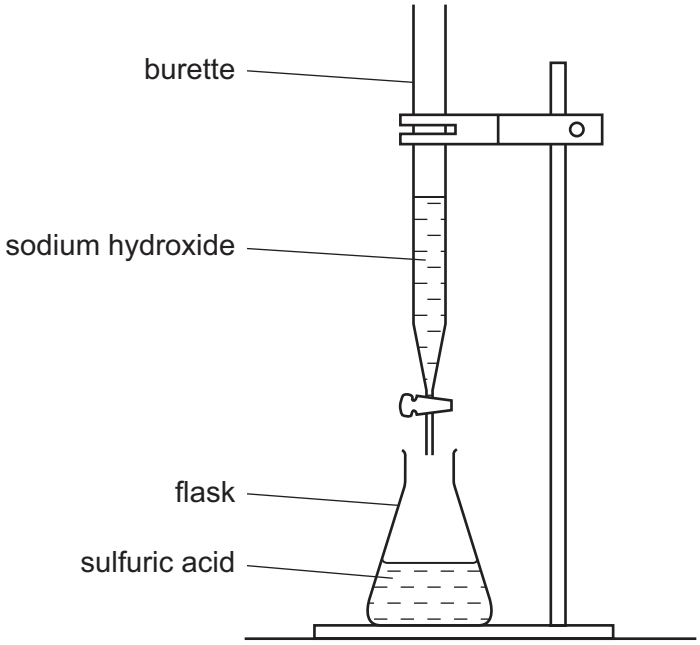

Fig. 1.1

(a) Sodium hydroxide is added slowly from the burette to the flask until in it is in excess.

(i) Suggest a value for the pH of the acid before any sodium hydroxide solution is added.

pH = ... [1]

(ii) Describe the changes in the pH of the liquid in the flask as the sodium hydroxide is added until in excess.

.....

.....

.....

..... [2]

(iii) Suggest how you could observe the change in pH.

..... [1]

(iv) Write a balanced equation for the reaction that takes place.

..... [2]

(b) During the reaction protons are transferred from one reagent to the other.

Identify the source of the protons and explain what is happening.

.....

.....

.....

.....

..... [3]

For Examiner's Use

2 Fig. 2.1 shows a side view of a shallow pool.

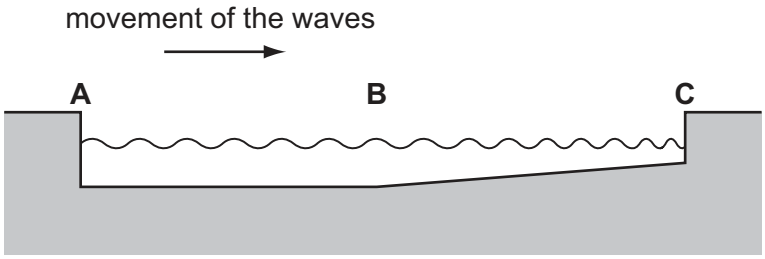

Fig 2.1

Some waves move across the surface of the water.

(a) (i) Mark on the diagram, between **A** and **B**, **one** wavelength of the waves. [1]

(ii) Explain why the wavelength of the waves changes as the waves go across the pool from **B** to **C**.

.....

.....

..... [2]

(b) The wavelength of the waves between **A** and **B** is 12 cm. They move across the pool at a speed of 90 cm/s.

Calculate the frequency of these waves.

Show your working.

frequency ..... [2]

(c) When the pool is perfectly calm, a boy observes that an image of a lamp is formed as shown in Fig. 2.2.

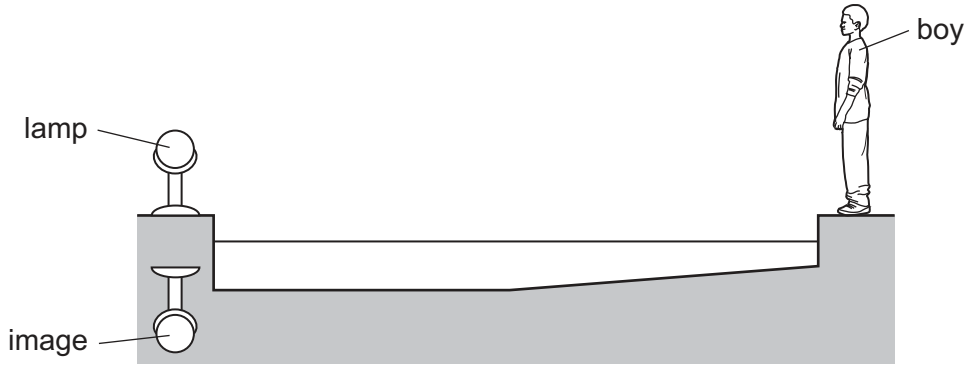

Fig. 2.2

(i) On Fig. 2.2, draw a ray from the lamp to the boy's eye to show how the image is formed. [2]

A breeze blows and ripples form. The appearance of the side view of the surface of the pool is shown in Fig. 2.3.

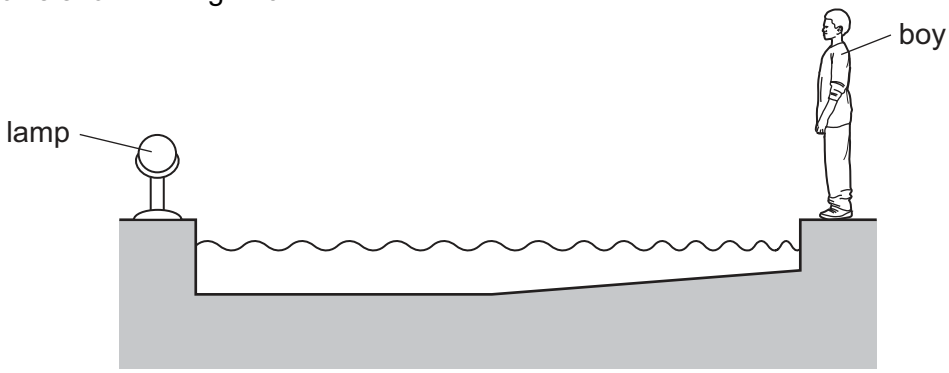

Fig. 2.3

(ii) Explain why a single image of the lamp is no longer seen. Draw suitable rays on Fig. 2.3 to help with your explanation.

.....

.....

..... [3]

For Examiner's Use

3 Ethanol can be made by two different processes:

- fermentation,
- addition of steam to ethene.

(a) (i) Describe how ethanol is made by fermentation.

.....

.....

.....

.....

..... [3]

(ii) Complete and balance this equation to show the formation of ethanol by fermentation.

$C_6H_{12}O_6 \rightarrow$ ..... [2]

(b) Steam is reacted with ethene according to this equation.

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

Calculate the volume of ethene, measured at room temperature and pressure, which reacts to produce 1.0 dm^3 of ethanol.

Ethanol has a density of 0.8 kg/dm^3.

[A_r: C, 12; H,1; O,16.]

[At room temperature and pressure 1 mole of any gas has a volume of 24 dm^3.]

Show your working.

volume of ethene = ... dm^3 [4]

(c) Ethene is made by the cracking of hydrocarbons obtained from crude oil.

Describe this process.

For Examiner's Use

.....

.....

.....

.....

..... [3]

4 Fig. 4.1 shows two conducting spheres. Sphere **B** is connected to earth through a sensitive ammeter. Sphere **A** has a very large positive charge on it. When sphere **B** is brought near to **A**, a spark jumps between the two spheres and the ammeter needle moves rapidly up the scale and then back to zero.

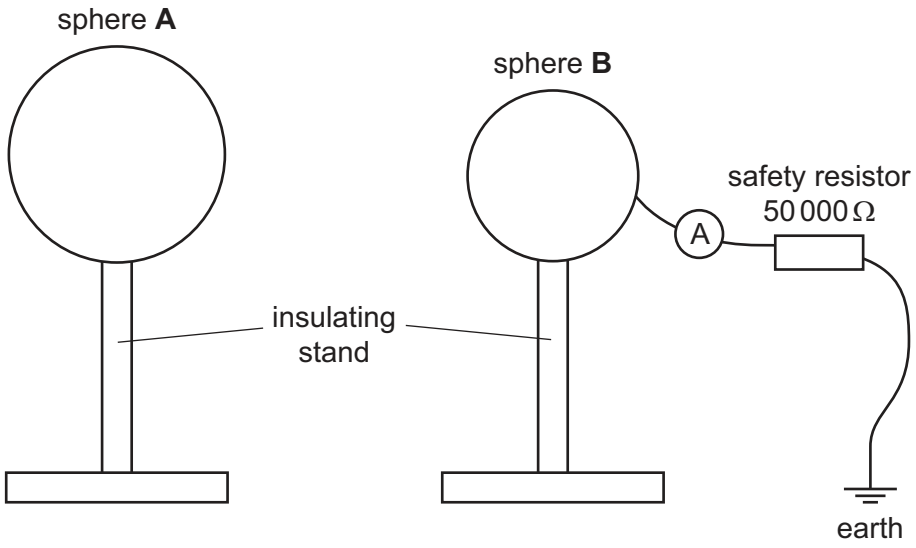

Fig. 4.1

(a) (i) Explain why the ammeter needle moves.

.....

.....

..... [2]

(ii) Describe the energy changes that occur when the spark jumps between the two spheres.

.....

.....

..... [3]

(b) (i) The average current through the ammeter is 0.0012 mA.

Calculate the average potential difference across the safety resistor.

potential difference = ... [2]

(ii) The current lasts for 1.5 ms.

Calculate the charge which flows through the ammeter.

charge = ... [2]

(iii) Calculate the energy transferred in the resistor.

energy = ... [2]

5 Table 5.1 shows the elements in a period of the Periodic Table.

For Examiner's Use

Table 5.1

group	I	II	III	IV	V	VI	VII
element	Li	Be	B	C	N	O	F

(a) Describe the relationship between group number and the number of outer shell electrons in the atoms of these seven elements.

.... [1]

(b) Describe how the character of the elements changes from left to right across these seven elements.

....

.... [1]

(c) Lithium forms an ion Li^{+}. Oxygen forms an ion O^{2-}.

(i) What is the formula for the ionic compound lithium oxide?

.... [1]

(ii) Describe, in terms of electrons, how lithium and oxygen atoms form the compound lithium oxide.

....

....

....

....

.... [3]

(d) In the box below, draw a diagram to show the arrangement of all electrons in a molecule of nitrogen.

For Examiner's Use

[3]

For Examiner's Use

6 Jane is given a radioactive source. She finds out what type or types of radiation it emits.

(a) Describe **one** safety precaution she must take when using the source.

.....

..... [1]

(b) She sets up a GM-tube and finds there is a count of 12 in one minute with no source present. State why there is a count with no source present.

.....

..... [1]

(c) She places the source a few centimetres from the GM-tube. Table 6.1 shows the results she obtains using different absorbers between the GM-tube and the source.

Table 6.1

absorber	reading 1 / counts per minute	reading 2 / counts per minute	reading 3 / counts per minute
none	4352	4429	4388
thin card	1265	1321	1272
2 mm aluminium	1269	1247	1285
4 cm lead	33	45	37

(i) Explain why, when there is no absorber present, the readings vary.

.....

..... [1]

(ii) Complete Table 6.2 and indicate whether each of the three types of radiation are present or absent. Use the evidence from Table 6.1 to explain the presence or absence of each of the three types of radiation.

Table 6.2

type of radiation	present (✓) absent (×)	reason
alpha		
beta		
gamma		

[4]

(d) In a research project a small amount of an alpha emitting isotope is injected into a cancerous tumour in a mouse.

(i) Suggest why alpha radiation might be especially effective at destroying tumours.

.....

.....

..... [2]

(ii) Explain why a beam of alpha particles is not aimed at the tumour from outside the body of the mouse.

.....

..... [2]

For Examiner's Use

7 Fig. 7.1 shows a blast furnace producing iron from iron ore.

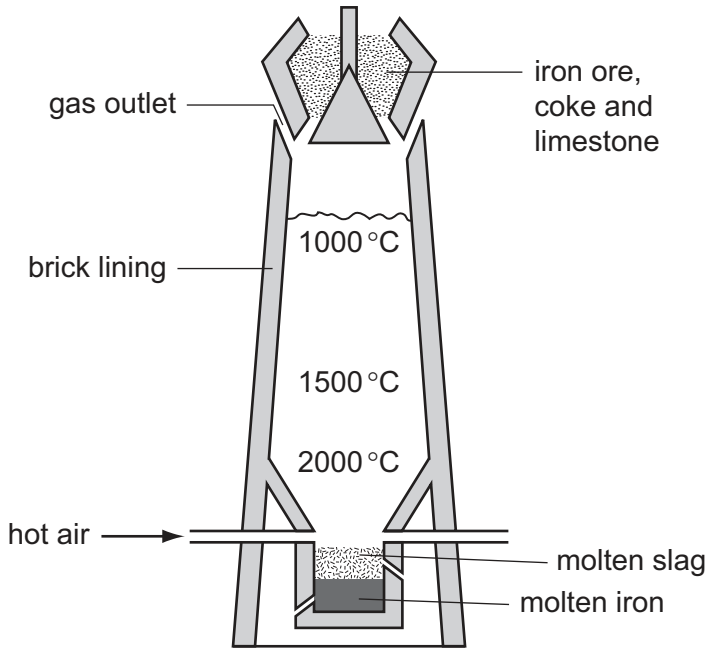

Fig. 7.1

In the blast furnace iron(III) oxide is reduced by carbon monoxide to produce iron metal.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

(a) Carbon monoxide is formed from coke in two stages in the blast furnace.

(i) Describe the **two** stages to show how carbon monoxide is formed in the blast furnace.

stage 1 .....

.....

stage 2 .....

..... [2]

(ii) Write balanced equations for the **two** stages that are involved in this formation of carbon monoxide.

stage 1 .....

stage 2 ..... [2]

(b) A blast furnace produces 60 000 tonnes of iron per week.

Calculate the mass of iron(III) oxide used to produce this iron.

[A_r: Fe, 56; O,16.]

mass = ... tonnes [3]

(c) Mild steel and stainless steel are two alloys of iron.

(i) How are alloys of iron produced?

.....

..... [1]

(ii) Give a reason for producing alloys of iron.

.....

..... [1]

(d) Aluminium ore contains aluminium oxide, Al_2O_3.

Why is aluminium **not** extracted from this ore using a blast furnace?

.....

..... [1]

For Examiner's Use

8 A student measures the density of an irregularly shaped stone.

(a) (i) Name **two** pieces of apparatus he might use.

1. .....

2. ..... [2]

(ii) State the measurements he makes.

.....

.....

..... [2]

(iii) Explain how he uses his results to find the density of the stone.

.....

.....

..... [2]

(b) A beaker contains 280 g of sea water, which has a density of 1.12 g/cm^3.

Calculate the volume of sea water in the beaker.

volume = ... cm^3 [2]

BLANK PAGE

BLANK PAGE

BLANK PAGE

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II									III	IV	V	VI	VII	0
															4 **He** Helium 2
					1 **H** Hydrogen 1										
7 **Li** Lithium 3	9 **Be** Beryllium 4									11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12									27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulfur 16	35.5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	64 **Cu** Copper 29	65 **Zn** Zinc 30	70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La** Lanthanum 57 *	178 **Hf** Hafnium 72	181 **Ta** Tantalum 73	184 **W** Tungsten 74	186 **Re** Rhenium 75	190 **Os** Osmium 76	192 **Ir** Iridium 77	195 **Pt** Platinum 78	197 **Au** Gold 79	201 **Hg** Mercury 80	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

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

Key

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).