UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6563002991

PHYSICAL SCIENCE **0652/03**

Paper 3 (Extended) **October/November 2008**

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 16.

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 **16** printed pages.

IB08 11_0652_03/4RP

UNIVERSITY of CAMBRIDGE International Examinations

1 Fig. 1.1 shows a 0.20 kg mass hanging on a spring.

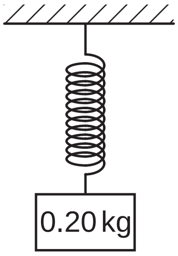

Fig. 1.1

(a) (i) Calculate the weight of the mass.
(g = 10 N / kg)

Show your working.

weight = ...

(ii) Write down the force acting on the mass due to the spring.

force = ... [3]

(b) The mass is pulled down 1.5 cm and released.

Draw an arrow on the diagram and label it F, to show the direction of the resultant force on the mass immediately after it is released. [1]

The graph in Fig. 1.2 shows the results of an experiment in which different loads were attached to the spring.

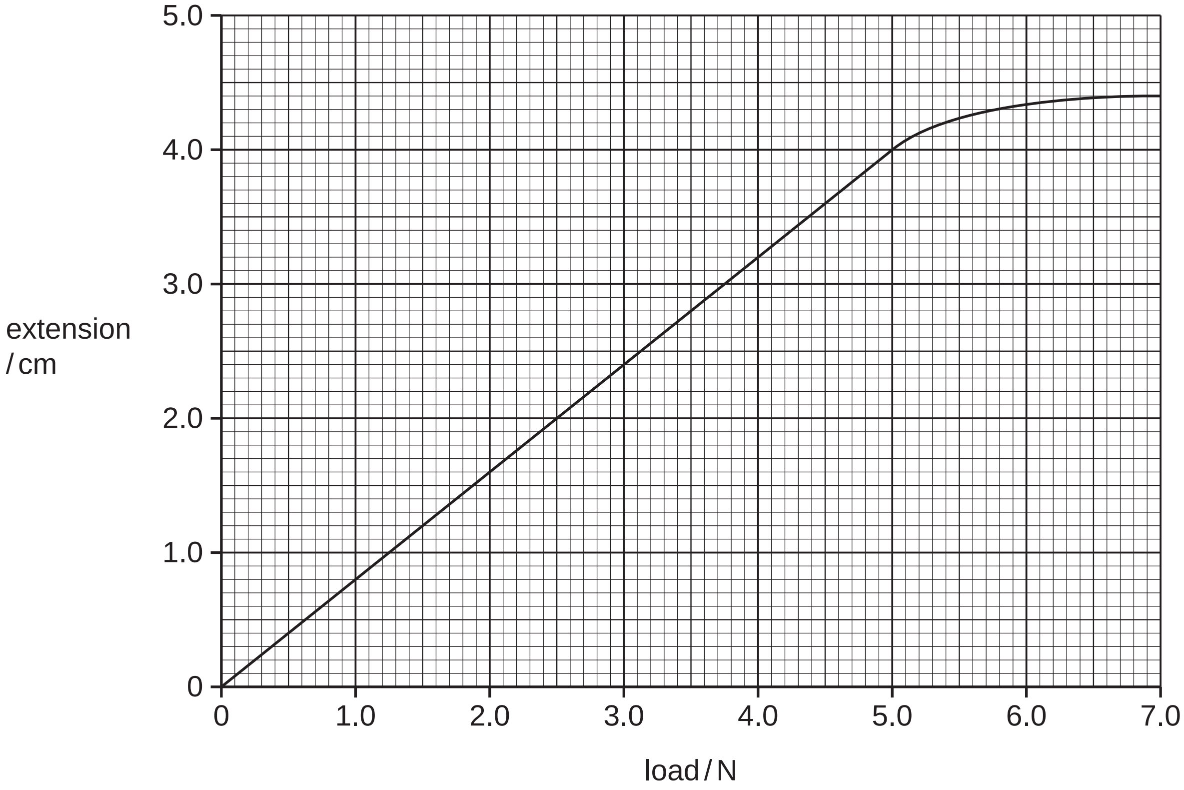

Fig. 1.2

(c) On the graph, mark the limit of proportionality and label it **P**. [1]

(d) **(i)** Use the graph to find the resultant force when the mass is pulled down by 1.5 cm.

resultant force = ...

(ii) Calculate the initial acceleration of the mass when it is released.

acceleration = ... [3]

For Examiner's Use

2 Metal greenhouse frames, as shown in Fig. 2.1, are usually made of steel or aluminium.

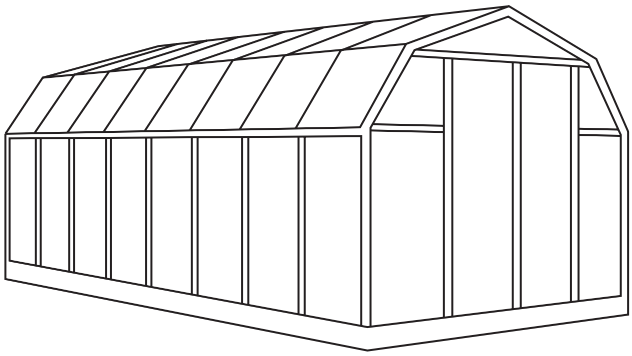

Fig. 2.1

(a) A disadvantage of using steel for a greenhouse frame is that it rusts when in contact with water and air.

This problem can be overcome by galvanising the steel.

(i) Explain what is meant by the term *galvanising*.

....

.... [1]

(ii) Galvanising stops steel from rusting, even if the protective coating is scratched to expose the steel underneath.

Explain why.

....

....

....

.... [3]

(iii) Describe another method that could be used to prevent the steel frame rusting.

....

.... [1]

(iv) Does this method protect the steel frame as well as galvanising?

Explain your answer.

....

.... [1]

(b) An aluminium greenhouse frame does not corrode as quickly as steel.

Explain why.

....

....

.... [2]

(c) Aluminium is also used to make aircraft bodies.

For this use aluminium is alloyed with other metals.

(i) What effect does alloying have on the properties of aluminium that make it more useful for aircraft construction?

....

.... [1]

(ii) Explain why alloying has this effect.

....

....

.... [2]

For Examiner's Use

3 Fig. 3.1 shows a liquid-in-glass thermometer.

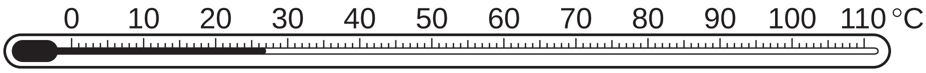

Fig. 3.1

(a) Explain what happens to the liquid when the thermometer is placed in a beaker of hot water.

....

....

.... [2]

(b) Fig. 3.2 shows another type of thermometer, known as a thermocouple.

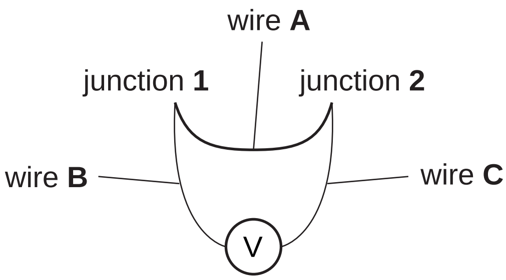

Fig. 3.2

(i) Name suitable materials for

wire **A** ....

wires **B** and **C** .... [2]

(ii) Junction **1** is placed in melting ice. Junction **2** is placed in boiling water. The voltmeter reads 7.2 mV.

Junction **2** is then placed in a beaker of water. The voltmeter reading falls to 4.8 mV. Calculate the temperature of the beaker of water.

Show your working.

temperature .... [2]

For Examiner's Use

(iii) State and explain **one** advantage that the thermocouple has over the liquid-in-glass thermometer.

....

....

.... [2]

For Examiner's Use

For Examiner's Use

4 **(a)** Complete Table 4.1 to show the arrangement of electrons in atoms of these elements.

The first one has been done for you.

Table 4.1

element	electron arrangement			
Mg	2	8	2	
K				
Ar				
N				

[3]

(b) Describe the relationship between the electron arrangement of the atoms of an element and the position of that element in the Periodic Table.

....

....

.... [2]

(c) Elements in Group 7 are called halogens. Table 4.2 gives some information about the physical properties of three halogens.

Table 4.2

halogen	proton number	melting point / °C	boiling point / °C	colour
chlorine	17	−101	−35	pale green
bromine	35	−7	59	deep red
iodine	53	114	184	dark grey

(i) Calcium forms ions with the formula Ca^{2+}. Iodine forms ions with the formula I^{-}.

What is the formula of calcium iodide?

.... [1]

(ii) The element below iodine in this Group is astatine.

Suggest the colour of astatine.

.... [1]

(d) Table 4.3 gives information about four elements in Group 0 of the Periodic Table, called the noble gases.

Table 4.3

element	proton number	melting point / °C	boiling point / °C	density of gas in kg / m^3
helium	2	−272	−269	0.17
neon	10	−248	−246	0.84
argon	18	−189	−186	1.67
krypton	36	−157	−152	3.50

(i) Describe the trend in boiling point for elements in Group 0.

....

.... [2]

(ii) The density of air is 1.20 kg/m^3.

Helium is used in airships and weather balloons. The other noble gases are not.

Use data from the table to suggest why.

....

....

....

.... [3]

5 **(a)** Fig. 5.1 shows a ripple tank with three wavefronts approaching an area of shallow water.

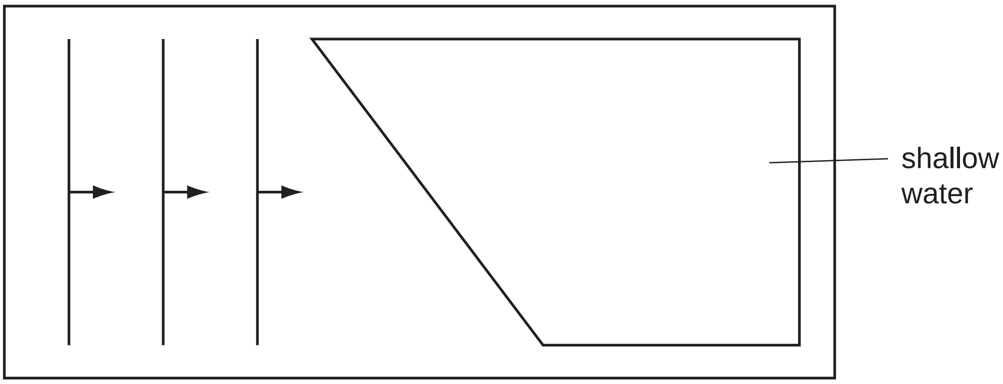

Fig. 5.1

On Fig. 5.1, draw four more wavefronts to complete the diagram. [3]

(b) Fig. 5.2 shows a similar ripple tank, with three wavefronts approaching a gap in a barrier.

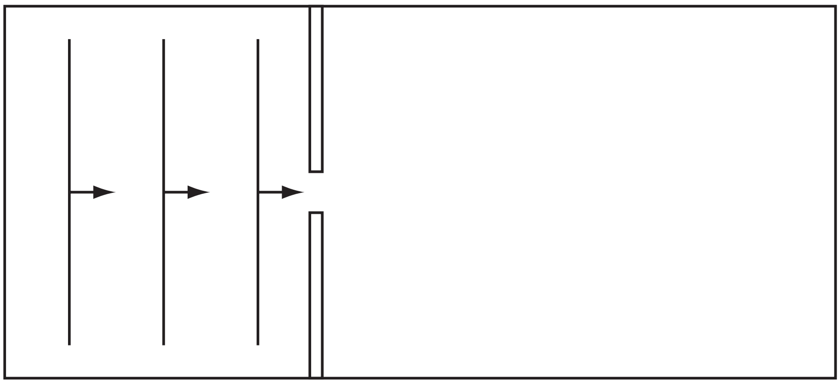

Fig. 5.2

(i) On Fig. 5.2, draw four wavefronts after they pass through the gap. [3]

(ii) Name the process being demonstrated.

.... [1]

6 When petrol is burned in a car engine, pollutant gases are produced.

For Examiner's Use

(a) In the car engine nitrogen and oxygen combine to form oxides of nitrogen, including nitrogen monoxide, NO.

(i) Describe the problems caused by release of oxides of nitrogen into the air.

....

....

.... [2]

(ii) To reduce the quantity of oxides of nitrogen released into the air, modern cars are fitted with catalytic converters.

Explain how a catalytic converter removes nitrogen oxide from car exhaust gases.

....

....

.... [2]

(b) Propane can be used as an alternative fuel to petrol.

Propane burns according to the following equation.

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

Calculate the mass and volume, at room temperature and pressure, of carbon dioxide produced by the complete combustion of 1.0 kg of propane.

Show your working.

[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.]

mass of carbon dioxide = ... kg

volume of carbon dioxide = ... dm^3 [5]

(c) Carbon dioxide is a covalent compound.

Draw a diagram to show the arrangement of outer electrons in a molecule of carbon dioxide.

[3]

7 Ethene is reacted with steam to make ethanol.

For Examiner's Use

(a) Describe how ethene is obtained.

....

.... [2]

(b) Write a balanced equation for the reaction between ethene and steam.

.... [2]

(c) Complete this sentence to describe the conditions used for this reaction.

Ethene and steam are mixed at high pressure in the presence of

.... [1]

8 A nuclear power station supplies 200 000 kW to the National Grid at 55 000 V.

For Examiner's Use

(a) Calculate the current from the power station.
Show your working.

current = ... [3]

(b) The energy is transmitted across the country at this voltage. It is stepped down to 250 V for domestic use.

(i) Explain why the energy is transmitted at a very high voltage.

....

....

....

....

(ii) Name the device used to step down the voltage. ....

(iii) Calculate the turns ratio required to step the voltage down from 55 000 V to 250 V.
Show your working.

primary turns : secondary turns

.......................:...................................... [5]

(c) A transformer is described as 100% efficient.
Explain what is meant by this statement.

....

.... [1]

For Examiner's Use

9 The iodine isotope, $^{131}_{53}I$, decays by emitting a β–particle.

(a) Explain what is meant by a β–particle.

....

.... [2]

(b) **(i)** Complete the equation which describes the decay.

$$^{131}_{53}I = {}^{\cdots\cdots}_{\cdots\cdots}X + {}^{\cdots\cdots}_{\cdots\cdots}\beta$$

(ii) Use the Periodic Table, on page 16, to identify the element X and comment on its reactivity.

....

.... [4]

(c) This isotope has a half-life of 8.1 days and is used in medical diagnosis and treatment.

Suggest why the isotope is suited for this purpose.

....

.... [2]

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 **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** Sulphur 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 †															

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

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

Key: a **X** b

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

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