Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

2454059626

COMBINED SCIENCE **0653/42**

Paper 4 Theory (Extended) **February/March 2020**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **20** pages. Blank pages are indicated.

DC (LEG/FC) 183837/5

[Turn over

1 **(a)** Fig. 1.1 shows an incomplete food web of some organisms in a field.

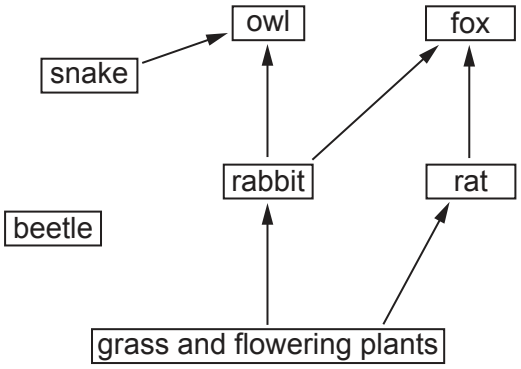

Fig. 1.1

(i) The beetle feeds on grass and flowering plants.
The snake and owl both feed on the beetle.

Use this information to draw arrows to complete the food web in Fig. 1.1. [2]

(ii) Name an organism in the food web in Fig. 1.1 which feeds at the same trophic level as the fox.

Explain your answer.

organism .....

explanation .....

.....
[2]

(b) The grass and flowering plants make their own organic nutrients during photosynthesis.

(i) Complete the balanced symbol equation for photosynthesis.

$$6H_2O + 6..... \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + ...O_2$$

[1]

(ii) Describe the role of chlorophyll in the production of glucose during photosynthesis.

.....

.....

..... [2]

(iii) Many glucose molecules may be joined together to form starch.

State the function of starch in plants.

..... [1]

(iv) Name **one other** large molecule made from many glucose molecules joined together.

..... [1]

[Total: 9]

2 **(a)** The formula of methanol is CH_3OH.

Complete the structure of a molecule of methanol. Include all atoms and all bonds.

C – O

[1]

(b) **(i)** Explain why methanol is **not** an alkane.

.....

..... [1]

(ii) Explain why a molecule of methanol contains **only** covalent bonds.

.....

..... [1]

(c) Methanol can be used as a fuel. It burns in oxygen and releases energy.

(i) Complete the equation for the **complete** combustion of methanol.

$2CH_3OH$ + ... → ..... + ...

[2]

(ii) The combustion of methanol is an exothermic reaction.

Describe what is meant by *exothermic*.

Use ideas about energy, bond breaking and bond forming in your answer.

.....

.....

..... [2]

(d) Methane is a greenhouse gas.

State **one** effect of increased levels of greenhouse gases in the atmosphere.

.....

..... [1]

[Total: 8]

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3 Fig. 3.1 shows liquid (molten) iron being poured from a furnace into a mould to form an iron rod in the shape of a cylinder.

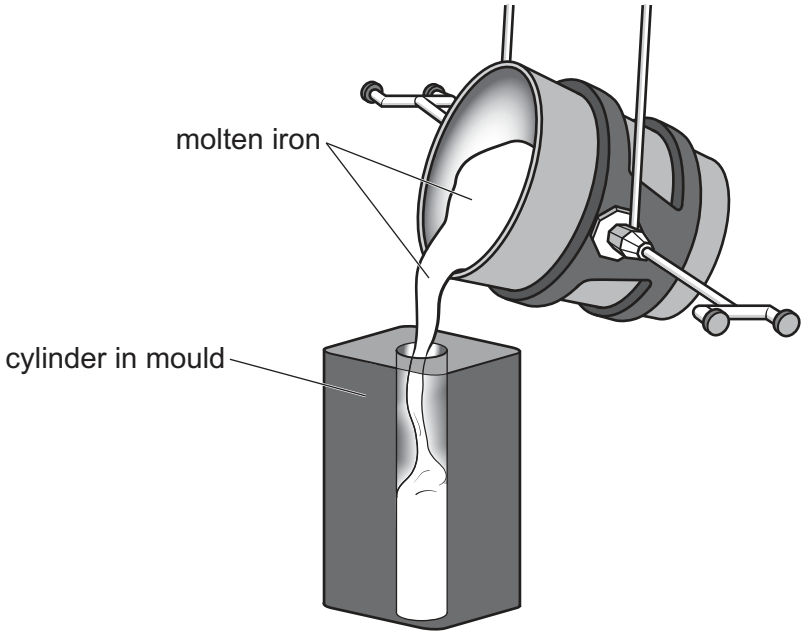

Fig. 3.1

Fig. 3.2 shows the iron rod after it has cooled down.

Fig. 3.2

(a) (i) The bar is 80.0 cm long and 10.0 cm in diameter.

Show that the volume of the rod is 6280 cm^3.

$\pi = 3.14$

[2]

(ii) The density of solid iron is 7.86 g / cm^3.

Calculate the mass of the rod in kilograms (kg).

mass = ... kg [3]

(b) The density of molten iron is 6.98 g / cm^3.

Explain why the density of molten iron is lower than the density of solid iron.

.....

.....

.....

.....

..... [2]

(c) The workers near the furnace wear special clothing to protect them against the infrared radiation from the molten iron.

Explain why the clothing is coated with metal foil to give the best protection.

.....

.....

..... [2]

[Total: 9]

[Turn over

4 **(a)** Food taken in by the body must be digested so that the body can absorb the nutrients.

(i) Define the term *mechanical digestion*.

.....

.....

..... [2]

(ii) Describe **one** example of mechanical digestion in the human alimentary canal.

.....

..... [1]

(b) Table 4.1 shows some information about chemical digestion in the human alimentary canal.

Table 4.1

digestive enzyme	function
lipase	breaks down ..... into .....
protease	breaks down ..... into .....

(i) State **one** part of the alimentary canal where **both** lipase **and** protease are secreted.

..... [1]

(ii) Complete Table 4.1. [2]

(iii) State the part of the alimentary canal where food is ingested.

..... [1]

(c) Table 4.2 shows some statements about aerobic respiration.

In Table 4.2 place a tick (✓) to show the correct statements about aerobic respiration.

Table 4.2

statement about aerobic respiration	tick (✓) if correct
consists of chemical reactions	
energy released is used to relax muscles	
only takes place in animals	
produces oxygen	
produces water	
requires heat	

[2]

[Total: 9]

5 **(a)** A student places a spot of copper chloride solution onto a piece of chromatography paper, as shown in Fig. 5.1.

She places the chromatography paper in a solvent until the solvent front reaches the position shown in Fig. 5.2.

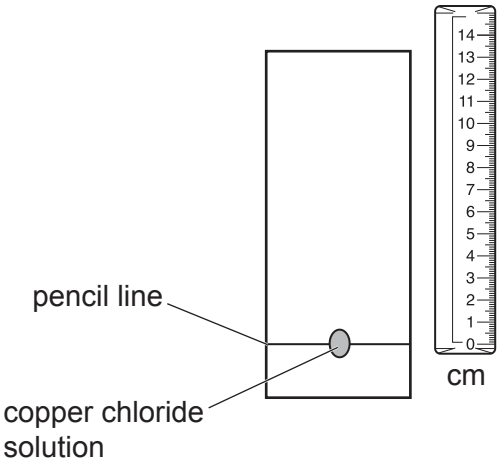

Fig. 5.1

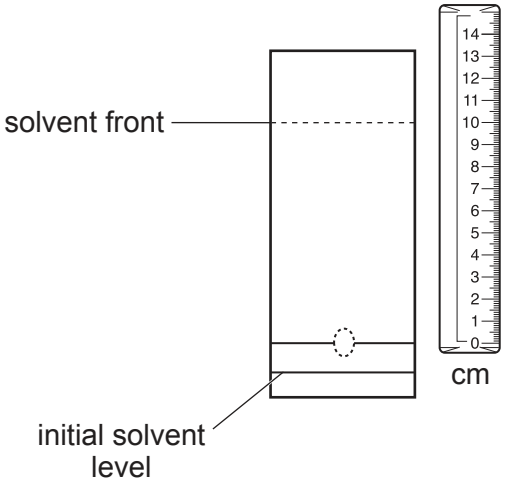

Fig. 5.2

Copper chloride contains copper ions, Cu^{2+}. The R_f value for Cu^{2+} ions is 0.6.

On Fig. 5.2, draw a small circle to show the position of the Cu^{2+} ions. [1]

(b) Copper is extracted from copper oxide by heating with carbon.

(i) The word equation for this reaction is shown.

copper oxide + carbon → copper + carbon dioxide

State whether copper oxide is oxidised or reduced in this reaction.

Explain your answer.

.....

.....

..... [1]

(ii) Explain why sodium oxide does **not** react with heated carbon.

.....

..... [1]

(c) Copper is also extracted by electrolysis of molten copper chloride.

(i) State **one other** product obtained during this electrolysis.

..... [1]

(ii) Describe what happens to a copper ion, Cu^{2+}, at the cathode during this electrolysis.

Use ideas about electrons in your answer.

.....

.....

..... [2]

(d) Bronze is an alloy of copper and tin. Bronze is used to make coins.

Explain why pure copper is **not** used to make coins.

..... [1]

[Total: 7]

[Turn over

6 Fig. 6.1 shows a crane lifting a load to the top of a building. The crane uses an electric motor to lift the load.

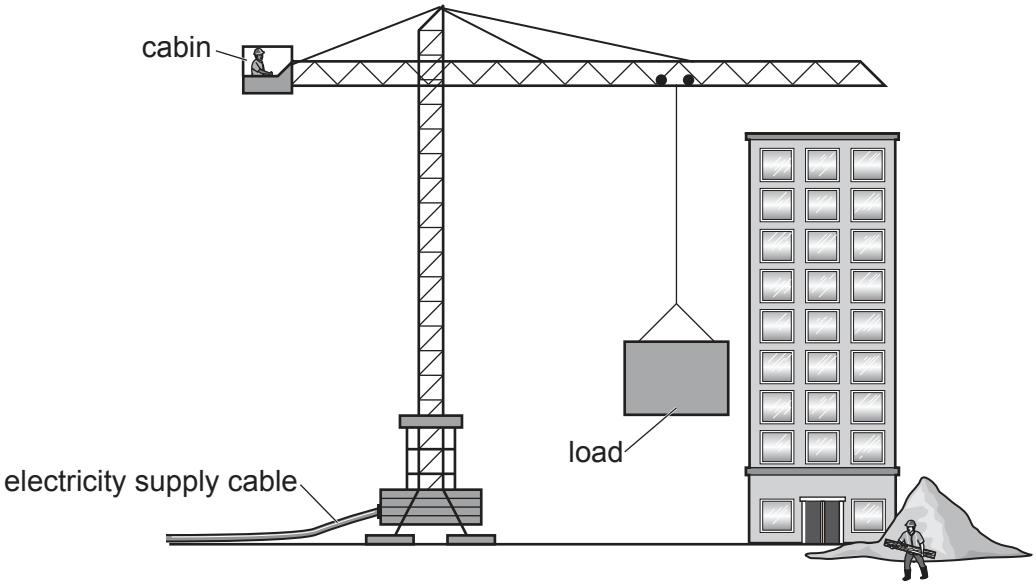

Fig. 6.1

(a) At the start, the load is at rest on the ground. The load is lifted at a constant acceleration for 2.0 s.

At 2.0 s the load is moving upwards at a constant speed of 0.50 m / s.

Calculate the acceleration of the load during the first 2.0 s and give the unit.

acceleration = ... unit ..... [3]

(b) The mass of the load is 500 kg.

(i) The load is lifted from the ground to the top of the building 25 m above the ground. Gravitational field strength is 10 N / kg.

Calculate the work done on the load.

Show your working.

work done = ... J [2]

(ii) The power of the electric motor lifting the load is 5 kW.
The crane takes 56 s to lift the load to the top of the building.

Calculate the electrical energy supplied to the electric motor in this time.

energy = ... J [2]

(iii) The electrical energy supplied is greater than the useful work done on the load. Some electrical energy is transferred in other ways.

Suggest **one** other way in which this electrical energy is used.

.....

.....

..... [1]

[Total: 8]

7 **(a)** Potato pieces **A**, **B** and **C** are immersed in salt solutions of different concentrations for 30 minutes.

The lengths of the potato pieces are measured before and after immersion.

Table 7.1 shows the results.

Table 7.1

potato piece	concentration of salt solution / mol per dm^3	length of potato piece before immersion / mm	length of potato piece after immersion / mm
A	0.1	80	85
B	0.4	80	80
C	0.6	80	76

(i) Calculate the percentage increase in length of potato piece **A**.

increase = ...% [2]

(ii) Explain why the length of potato piece **C** decreases.

Use the term *osmosis* in your answer.

.....

.....

.....

..... [3]

(b) Suggest why it is an advantage for a plant to have longer root hairs in areas where the soil is dry.

.....

.....

..... [2]

(c) Mineral ions are essential for the healthy growth of plants.

(i) State the function of magnesium ions in plants.

.....

..... [1]

(ii) Describe the effect of a deficiency in magnesium ions in plants.

..... [1]

[Total: 9]

8 **(a)** A bromine atom contains seven electrons in its outer shell.

Complete the dot-and-cross diagram of a molecule of bromine in Fig. 8.1. Show only the outer shell electrons.

Fig. 8.1

[2]

(b) The boiling point of liquid bromine is 59 °C.

Explain what happens to bromine molecules when liquid bromine boils.

Use ideas about molecules and energy changes in your answer.

.....

.....

.....

..... [2]

(c) Orange aqueous bromine is mixed with colourless aqueous potassium chloride.

Predict the colour change, if any, in this reaction.

Explain your answer.

colour change .....

explanation .....

..... [2]

(d) When large hydrocarbon molecules are cracked, alkenes are produced.

(i) State **two** conditions needed for this process.

1. .....

2. ..... [2]

(ii) Aqueous bromine is used to test for the presence of alkenes.

State the colour change that indicates a positive result for this test.

from ..... to ..... [1]

(e) The formula of aluminium bromide is Al_2Br_6.

The melting point of aluminium bromide is 97 °C and the boiling point is 255 °C.

Explain how this information suggests that aluminium bromide contains covalent bonds.

Use ideas about attractive forces in your answer.

.....

.....

..... [2]

[Total: 11]

9 Fig. 9.1 shows an ambulance. On the roof it has a flashing blue lamp and a siren.

Fig. 9.1

(a) A car driver sees the ambulance appear in the far distance.
The driver hears the siren 3 s after seeing the blue light.

Explain why the driver sees the blue light before he hears the siren.

.....

..... [1]

(b) The siren emits sounds at two frequencies, 600 Hz and 1500 Hz.
The siren has a plastic casing. The sound travels through the plastic casing at a speed of 2200 m / s.

Calculate the wavelength of the 600 Hz sound.

wavelength = ... m [2]

(c) An electric motor rotates a mirror around the blue lamp to reflect a bright beam of light.

The motor has a power rating of 20 W and the lamp has a power rating of 60 W.

The lamp and the motor both operate at a potential difference (p.d.) of 12 V from the 12 V ambulance battery.

(i) State the type of circuit arrangement required for the motor and the lamp.

..... [1]

(ii) Calculate the current in the motor when turning the mirror.

current = ... A [2]

(iii) The lamp and motor are switched on by one switch even if the siren is not being used.

The siren has its own switch and also operates at 12 V.

On Fig. 9.2 complete the diagram for the circuit that operates the lamp, the motor and the siren from the 12 V car battery.

The circuit symbol for a siren is 

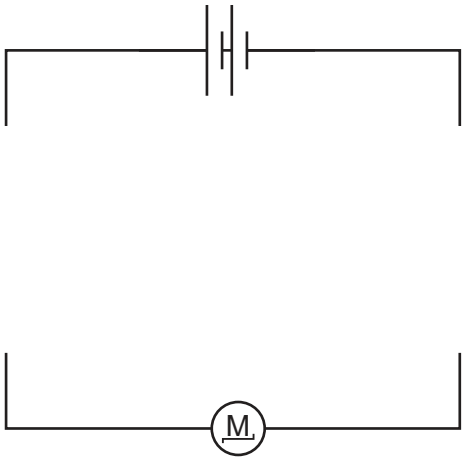

Fig. 9.2

[4]

[Total: 10]

The Periodic Table of Elements

Key: atomic number / atomic symbol / name / relative atomic mass

Group I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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