

Cambridge IGCSE[™]

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

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.

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[Turn over

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

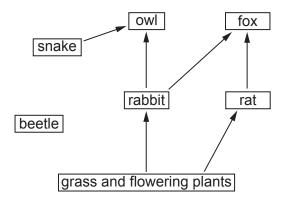


Fig. 1.1

(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	
	12

- (b) The grass and flowering plants make their own organic nutrients during photosynthesis.
 - (i) Complete the balanced symbol equation for photosynthesis.

$$\begin{array}{c} \text{6H}_2\text{O} \ + \ 6..... \\ \hline \\ \text{chlorophyll} \end{array} \xrightarrow{\text{light}} \text{C}_6\text{H}_{12}\text{O}_6 \ + \\text{O}_2 \\ \end{array}$$

[1]

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

(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 ₂ OI	Η.
--	---	-----	-----	---------	-------------	----	--------------------	----

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

C-O

(b)	(i)	Explain why methanol is not an alkane.	[1]
	(ii)	Explain why a molecule of methanol contains only covalent bonds.	[1]
(c)	Met	thanol can be used as a fuel. It burns in oxygen and releases energy.	
	(i)	Complete the equation for the complete combustion of methanol.	
		2CH ₃ OH + + +	[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)	Met	thane is a greenhouse gas.	
	Stat	te one effect of increased levels of greenhouse gases in the atmosphere.	
			[Total: 8]
			[iotal. 0]

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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.

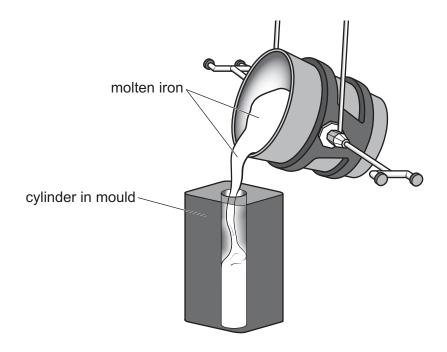


Fig. 3.1

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



Fig. 3.2

0653/42/F/M/20

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

Show that the volume of the rod is 6280 cm³.

$$\pi = 3.14$$

[2]

(ii) The density of solid iron is $7.86\,\mathrm{g/cm^3}$.

	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

(a)	a) Food taken in by the body must be digested so that the body can absorb the nutrients.						
	(i)	(i) Define the term mechanical digestion.					
				[2			
	(ii)	Describe one ex	cample of mechanical digestion in the human alimentary canal.				
				[1			
(b)	Table	e 4.1 shows som	ne information about chemical digestion in the human alimentary	canal.			
			Table 4.1				
	dig	estive enzyme	function				
		lipase	breaks down				
			into				
		protease	breaks down				
			into				
	(i)	State one part o	of the alimentary canal where both lipase and protease are secre	eted.			
				[1			
(ii) Complete Table 4.1.				[2			
(iii) State the part of the alimentary canal where food is ingested.							

(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.

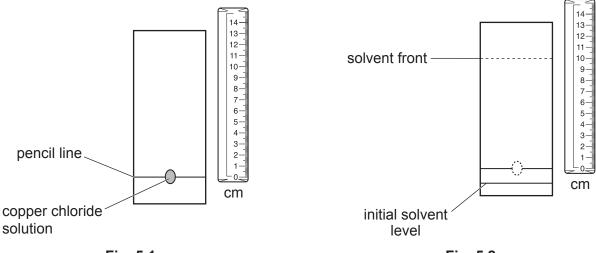


Fig. 5.1

Fig. 5.2

Copper chloride contains copper ions, Cu²⁺. The R_f value for Cu²⁺ ions is 0.6.

On Fig. 5.2, draw a small circle to show the position of the Cu²⁺ 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 \rightarrow copper + carbon dioxide

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

Explain your answer.

	[1]
Explain why sodium oxide does not react with heated carbon.	

(ii)

(C)	Cop	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)	Broi	nze is an alloy of copper and tin. Bronze is used to make coins.					
	Ехр	lain why pure copper is not used to make coins.					
			[1]				
		[Total	l: 7]				

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.

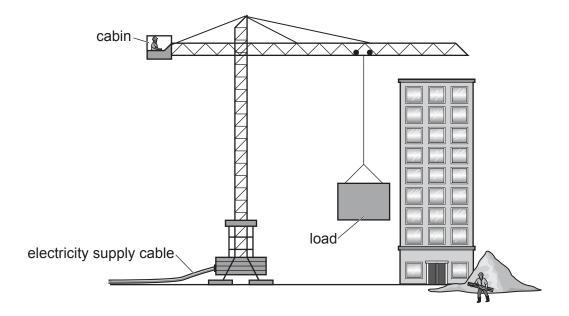


Fig. 6.1

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

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

(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 $10\mathrm{N/kg}$.
		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
Α	0.1	80	85
В	0.4	80	80
С	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)	Sug dry.	gest why it is an advantage for a plant to have longer root hairs in areas where the soil is
		וכז

(c)	Min	eral 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 co	ntains 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.

(Br) (Br)

Fig. 8.1

[2]

		L - .
(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	

(d)	Wh	en 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	e formula of aluminium bromide is $\mathrm{A}l_2\mathrm{Br}_6$.	
	The	e melting point of aluminium bromide is 97 °C and the boiling point is 255 °C.	
	Exp	plain how this information suggests that aluminium bromide contains covalent bonds.	
	Use	e 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.



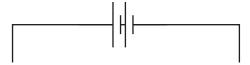
		Fig. 9.1
(a)		r driver sees the ambulance appear in the far distance. driver hears the siren 3s after seeing the blue light.
	Expl	ain why the driver sees the blue light before he hears the siren.
(b)	The	siren emits sounds at two frequencies, 600 Hz and 1500 Hz. siren has a plastic casing. The sound travels through the plastic casing at a speed of 0 m/s.
	Calc	ulate the wavelength of the 600 Hz sound.
		wavelength = m [2]
(c)	An e	lectric 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.
		lamp and the motor both operate at a potential difference (p.d.) of 12V from the 12V ulance 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 12V car battery.

The circuit symbol for a siren is



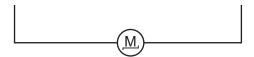


Fig. 9.2

[4]

[Total: 10]

The Periodic Table of Elements

								Group	dnc								
_	=											≡	≥	>	5	=	≣>
							_										2
							I										Не
				Key			hydrogen 1										helium 4
3	4		e	atomic number		-		_				2	9	7	80	6	10
=	Be		ato	atomic symbo	loc							В	ပ	z	0	ш	Ne
lithium	beryllium		2	name	į.							boron 11	carbon	nitrogen	oxygen	fluorine	neon
`	0		מ	live atomic lie	200							=	7	<u>+</u>	2	2	707
7	12											13	4	15	16	17	18
Na	Mg											Αl	:S	<u>_</u>	ഗ	C	Ā
sodium 23	magnesium 24											aluminium 27	silicon 28	phosphorus 31	sulfur 32	chlorine 35.5	argon 40
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
¥	Ca	လွ	F	>	ပ်	Mn	Fe	ပိ	z	D O	Zu	Ga	Ge	As	Se	Ā	궃
potassium 39	calcium 40	scandium 45	titanium 48	vanadium 51	chromium 52	manganese 55	iron 56	cobalt 59	nickel 59	copper 64	zinc 65	gallium 70	germanium 73	arsenic 75	selenium 79	bromine 80	krypton 84
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
8	ഗ്	>	Zr	q	Мо	ည	Ru	돈	Pd	Ag	р	I	Sn	Sp	<u>e</u>	Ι	Xe
rubidium 85	strontium 88	yttrium 89	zirconium 91	niobium 93	molybdenum 96	technetium -	ruthenium 101	rhodium 103	palladium 106	silver 108	cadmium 112	indium 115	tin 119	antimony 122	tellurium 128	iodine 127	xenon 131
55	56	57–71	72	73	74	75	9/	77	78	62	80	81	82	83	84	82	98
Cs	Ba	lanthanoids	Ξ	Д	>	Re	Os	'n	귙	Au	Нg	11	Ъ	<u>.</u>	Ъо	¥	R
caesium 133	barium 137		hafnium 178	tantalum 181	tungsten 184	rhenium 186	osmium 190	iridium 192	platinum 195	gold 197	mercury 201	thallium 204	lead 207	bismuth 209	polonium –	astatine -	radon
87	88	89–103	104	105	106	107	108	109	110	111	112		114		116		
ъ	Ra	actinoids	¥	Op	Sg	Bh	H	Ĭ	Ds	Rg	ပ်		F1				
francium	radium		rutherfordium	dubnium	seaborgium	pohrium	hassium	meitnerium	darmstadtium	roentgenium	copernicium		flerovium		livermorium		
ı	ı		ı	ı	ı	ı	ı	ı	1	ı	ı		1		ı	_	

Lu	lutetium 175	103	۲	lawrencium	ı
v A Vp	ytterbium 173	102	8	nobelium	-
mL	thulium 169	101	Md	mendelevium	ı
88 Ē	erbium 167	100	Fm	fermium	_
67 Ho	holmium 165	66	Es	einsteinium	-
® Dy	dysprosium 163	86	ರ	californium	-
65 Tb	terbium 159	26	益	berkelium	-
Gd Gd	gadolinium 157	96	Cm	curium	_
e3 Eu	europium 152	92	Am	americium	ı
ss Sm	samarium 150	94	Pu	plutonium	_
Pm	promethium -	93	δ	neptunium	ı
° PN	neodymium 144	92	\supset	uranium	238
Pr	praseodymium 141	91	Ра	protactinium	231
C e	cerium 140	06	드	thorium	232
57 La	lanthanum 139	68	Ac	actinium	1

lanthanoids

actinoids

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

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