

Cambridge IGCSE[™]

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

245405962

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.

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

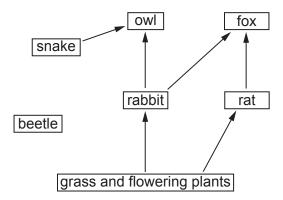


Fig. 1.1

(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	

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

$$6H_2O + 6.....O_2$$
 chlorophyll
$$C_6H_{12}O_6 +O_2$$

[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	(2)	The formula of methanol is CH ₂ OH.
_	(a)	

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.	
			[1]
		I	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.

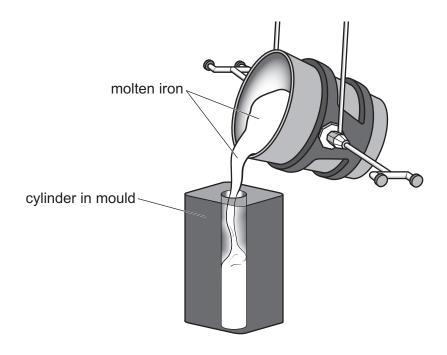


Fig. 3.1

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 cm³.

$$\pi = 3.14$$

[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	e density of molten iron is 6.98 g/cm ³ .
	Exp	plain why the density of molten iron is lower than the density of solid iron.
		[2
(c)		e workers near the furnace wear special clothing to protect them against the infrared lation from the molten iron.
	Exp	plain why the clothing is coated with metal foil to give the best protection.
		[2
		[Total: 9

4	(a)	Foo	d taken in by the	body must be digested so that the body can absorb the nutrients	3 .						
		(i)	Define the term mechanical digestion.								
				cample of mechanical digestion in the human alimentary canal.	[2]						
	(b)	Tab	le 4.1 shows som	ne information about chemical digestion in the human alimentary							
	` ,			Table 4.1							
		diç	gestive enzyme	function							
			lipase	breaks down							
				into							
			protease	breaks down							
				into							
		(i)	State one part o	f the alimentary canal where both lipase and protease are secre	eted.						
					[1]						
		(ii)	Complete Table	4.1.	[2]						
		(ii) (iii)	·	4.1. the alimentary canal where food is ingested.	[2]						

(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.

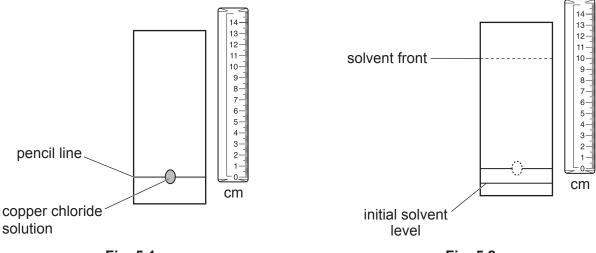


Fig. 5.1

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.

 •	

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

[1]

(C)	Cop	oper 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	: 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.

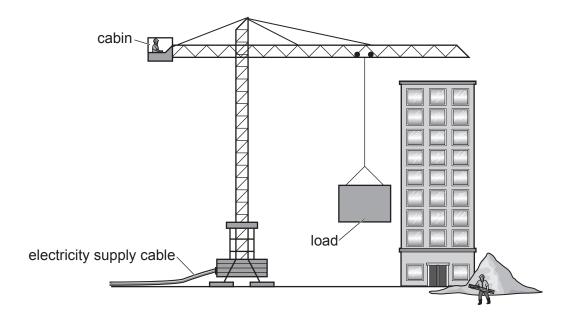


Fig. 6.1

(a)	At the start,	the	load	is a	at rest	on	the	ground.	The	load i	s lifted	at	а	constant	acce	leration
	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

(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]

		16
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.
		(Br) (Br)
		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.

colour change

explanation

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Explain your answer.

(d)	Wh	hen 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]								

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



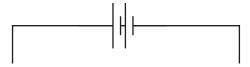
		Fig. 9.1	
(a)		ar driver sees the ambulance appear in the far distance. e driver hears the siren 3s after seeing the blue light.	
	Ехр	plain why the driver sees the blue light before he hears the siren.	
(b)	The	e siren emits sounds at two frequencies, 600 Hz and 1500 Hz. e siren has a plastic casing. The sound travels through the plastic casing at a speed 0 m/s.	
	Cal	culate 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	e motor has a power rating of 20 W and the lamp has a power rating of 60 W.	
		e lamp and the motor both operate at a potential difference (p.d.) of 12V from the 1 bulance battery.	I2V
	(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



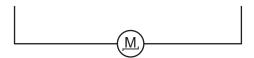


Fig. 9.2

[4]

[Total: 10]

The Periodic Table of Elements

	IIIA	2	He	helium 4	10	Ne	neon 20	18	Ā	argon 40	36	궃	krypton 84	54	Xe	xenon 131	98	R	radon			
	IIΛ				6	ш	fluorine 19	17	Cl	chlorine 35.5	35	Ŗ	bromine 80	53	Н	iodine 127	82	Ą	astatine -			
	IN				80	0	oxygen 16	16	ഗ	sulfur 32	34	Se	selenium 79	52	Б	tellurium 128	84	Ро	molonium –	116	^	livermorium -
	Λ				7	Z	nitrogen 14	15	۵	phosphorus 31	33	As	arsenic 75	51	Sb	antimony 122	83	Ξ	bismuth 209			
	N				9	ပ	carbon 12	14	S	silicon 28	32	Ge	germanium 73	50	Sn	tin 119	82	Ъ	lead 207	114	Ŀ	flerovium -
	Ш				2	В	boron 11	13	Αl	aluminium 27	31	Ga	gallium 70	49	In	indium 115	81	11	thallium 204			
											30	Zu	zinc 65	48	g	cadmium 112	80	Ρ̈́	mercury 201	112	ပ်	copernicium
											29	Cn	copper 64	47	Ag	silver 108	62	Au	gold 197	111	Rg	roentgenium -
dno											28	Z	nickel 59	46	Pd	palladium 106	78	귙	platinum 195	110	Ds	darmstadtium -
Group											27	ဝိ	cobalt 59	45	格	rhodium 103	77	'n	iridium 192	109	¥	meitherium -
		-	I	hydrogen 1							26	Fe	iron 56	44	Ru	ruthenium 101	9/	Os	osmium 190	108	Hs	hassium
											25	Mn	manganese 55	43	ည	technetium -	75	Re	rhenium 186	107	Bh	bohrium –
						pol	ass				24	ပ်	chromium 52	42	Mo	molybdenum 96	74	≯	tungsten 184	106	Sg	seaborgium -
				Key	atomic number	atomic symbo	name relative atomic mass				23	>	vanadium 51	41	qN	niobium 93	73	Та	tantalum 181	105	Dp	dubnium –
						ato	rels				22	j	titanium 48	40	Zr	zirconium 91	72	Ξ	hafnium 178	104	Ÿ	rutherfordium -
								-			21	လွ	scandium 45	39	>	yttrium 89	57-71	lanthanoids		89–103	actinoids	
	=				4	Be	beryllium 9	12	Mg	magnesium 24	20	Ca	calcium 40	38	ഗ്	strontium 88	56	Ba	barium 137	88	Ra	radium
	-				3	:=	lithium 7	1	Na	sodium 23	19	¥	potassium 39	37	Rb	rubidium 85	55	Cs	caesium 133	87	ъ́	francium

Lu Lu	175	103	۲	lawrencium	ı
Vb	_			-	
mL Tm	169	101	Md	mendelevium	ı
89 L	167	100	Fm	fermium	ı
67 Ho	165	66	Es	einsteinium	1
	163	86	ర్	californium	ı
65 Tb	159	97	益	berkelium	ı
Gd	157	96	Cm	curium	ı
Eu Eu	152	92	Am	americium	ı
Sm	150	94	Pn	plutonium	ı
Pm		93	ď	neptunium	ı
9 P N	144	92	\supset	uranium	238
Pr	141	91	Ра	protactinium	231
Ce Ce	140	06	드	thorium	232
57 La	139	68	Ac	actinium	1

lanthanoids

actinoids

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

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