

Cambridge IGCSE[™]

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

COMBINED SCIENCE

0653/32

Paper 3 Theory (Core)

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 is a diagram of a human heart.

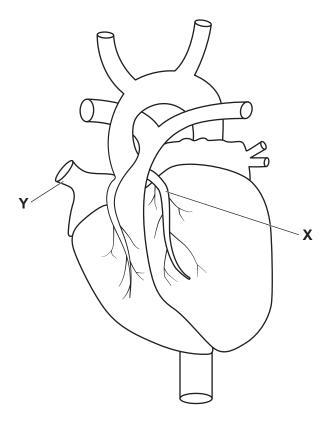


Fig. 1.1

(i)	Name artery X shown in Fig. 1.1.	
		[1]
(ii)	Vein Y brings blood to the heart from the body.	
	Name vein Y shown in Fig. 1.1.	
		[1]
(iii)	Name the structures that make sure there is one-way flow of blood through the heart	·.
		[1]

(iv) Fig. 1.2 is a diagram of the cross-section of three different blood vessels, P, Q and R.

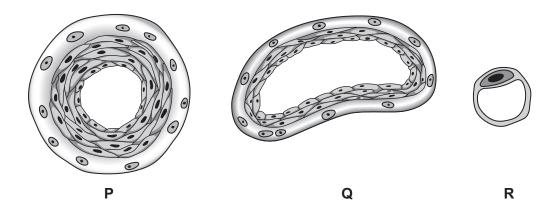


Fig. 1.2

Identify which blood vessel, ${\bf P},\,{\bf Q}$ or ${\bf R},$ represents a vein. Explain your answer.

blood vessel P, Q or R	
explanation	
	2

(b) Fig. 1.3 shows the pulse rate of two students before, during and after exercise.

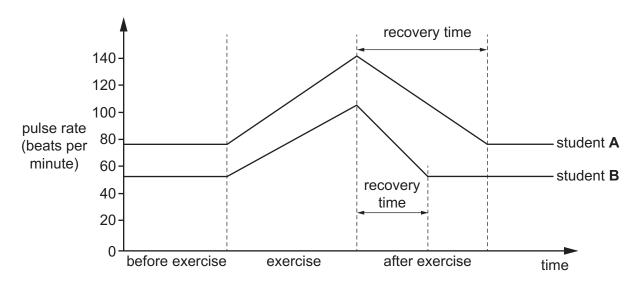


Fig. 1.3

Describe **one** similarity and **two** differences in the pulse rates of students **A** and **B** shown in Fig. 1.3.

similarity	
difference 1	
difference 2	
	[3]

[Total: 8]

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2 (a) A student investigates three solid elements, X, Y and Z.

Element **X** is a dark grey solid. When it is warmed it turns to a purple vapour.

Element **Y** is a soft grey solid. It reacts vigorously with water.

Element **Z** is a dense grey solid. It has a high melting point.

(i) Use the letters **X**, **Y** and **Z** to identify:

a Group I element	
a Group VII element	
a transition element	

[2]

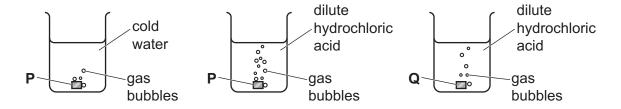
(ii) Describe the trend in the melting points of the elements going down Group I.

-
 _

(b) The student then investigates four other solid metals P, Q, R and S.

He adds equal sized pieces of each metal to cold water and to dilute hydrochloric acid.

Some of his observations are shown in Fig. 2.1.



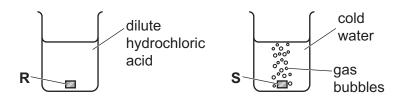


Fig. 2.1

(i)	Use the letters	s P, Q, R and S to identify these four metals.	
	calcium		
	magnesium		
	iron		
	copper		[2]
(ii)	Suggest two v	ways of increasing the rate of reaction of metal Q with hydrochloric a	
	1		
	2		[2]
(iii)	Identify the ga	s that is formed when metal S reacts with dilute hydrochloric acid.	
			[1]
(iv)	When metal sincreases.	S reacts with dilute hydrochloric acid, the temperature of the r	nixture
	State the name	e given to a chemical reaction that causes the temperature to increa	ase.
			[1]
		Т]	otal: 9]

3 Fig. 3.1 shows liquid (molten) iron being poured from a furnace into a mould to form a rectangular block of iron (iron bar).

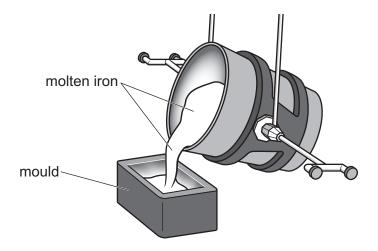


Fig. 3.1

Fig. 3.2 shows the solid iron bar after it has cooled down.

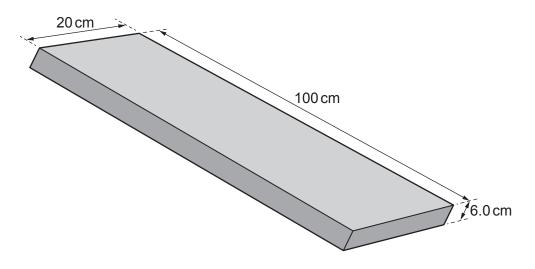


Fig. 3.2

(a) (i) The bar is 100 cm long, 20 cm wide and 6.0 cm thick.

Calculate the volume of the bar.

volume = cm³ [1]

(ii) The mass of the iron bar is 94 kg.

Calculate the mass of the iron bar in grams.

mass = g [1]

(iii) Use your answers to (a)(i) and (a)(ii) to calculate the density of iron.

	density = g/m³ [2]
(b)	As the molten iron cools and turns to solid iron, changes occur in the arrangement of iron atoms.
	Describe one way in which the arrangement of atoms in solid iron is different from the arrangement of atoms in liquid (molten) iron.
	[1]
(c)	Describe how the motion of the iron atoms changes as the molten iron cools, turns to a solid, and the solid iron cools.
	[2]
(d)	The melting point of iron is 1538 °C.
	Suggest why a liquid-in-glass thermometer cannot be used to measure the temperature of molten iron.
	[1]
	[Total: 8]

4 (a) Fig. 4.1 shows a cross-section of a leaf as viewed under a microscope.

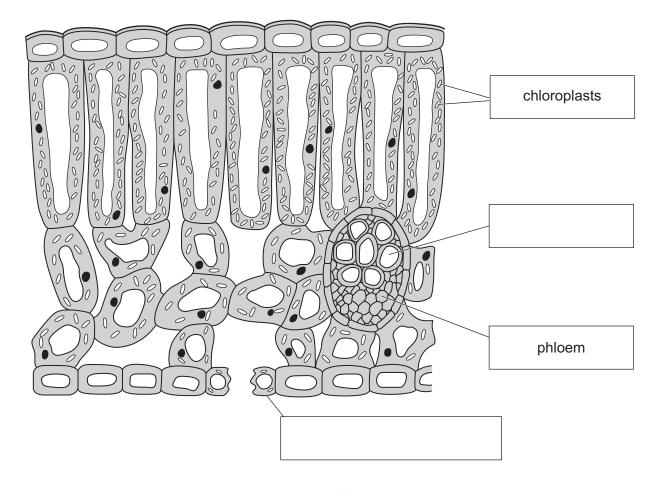


Fig. 4.1

guard cell

(i) Complete the labels on Fig. 4.1, using words from the list.

	stomata	upper epidermis	xylem	[2]
(ii)	State the function of a ch	hloroplast.		
				[1]
(iii)	State the function of phlo	oem.		
				[1]

palisade cell

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cuticle

(b)	The	leaf of a plant produces glucose.			
	(i)	Plants and animals use glucose to make t	wo dif	ferent larger molecules for storage.	
		Name one of these larger molecules.			[4]
	(ii)	Glucose is needed by plants and animals		owth.	ניו
		Complete the sentence to define the term	growt	h.	
		Growth is defined as a		increase in size.	[1]
	(iii)	Glucose is a carbohydrate.			
		List the three chemical elements that make	e up	carbohydrates.	
		1			
		2			
		3			
					[1]
(c)	The	leaf of a plant needs water for photosynthe	esis.		
	The	statements show the pathway taken by wa	ater fro	om the soil to the leaf.	
	The	statements are not in the correct order.			
	Use	numbers 1 to 5 to show the correct order.			
	The	third statement has been identified.			
	los	t through the stomata as water vapour			
	en	ters mesophyll cells of leaf			
	pa	sses through root cortex cells			
	pa	sses into xylem	3		
	tak	en in by root hair cells			
					[2]

[Total: 9]

5 Refinery gas, gasoline and gas oil are fuels obtained from petroleum in the process shown in Fig. 5.1.

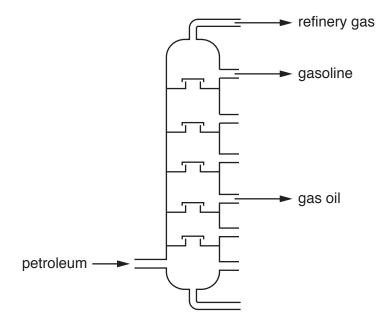


Fig. 5.1

(a)	Sug	gest one	use for bottled refinery gas fuel.	
			[1]
(b)	Pet	roleum is	a mixture that contains alkanes.	
	Alka	anes are	saturated compounds that contain carbon and hydrogen atoms only.	
	The	complete	e combustion of alkanes forms water and one other compound.	
	(i)	Name th	ne type of compound that contains carbon and hydrogen atoms only.	
			[1]
	(ii)	Identify	one other compound that is formed during the complete combustion of alkane	s.
			[[1]
	(iii)	Describe	e one chemical test for water and give the positive result.	
		test		
		result		
				[2]

(c) Methane, CH_4 , is an alkane.

The structure of a molecule of methane is shown in Fig. 5.2.



Fig. 5.2

	(i)	Name the type of bonding in methane.	
			. [1]
	(ii)	Explain how bonds form between carbon atoms and hydrogen atoms in methane.	
		Use ideas about electrons.	
			. [1]
(d)	Ethe	ene is an alkene.	
	Alke	enes are unsaturated compounds.	
	(i)	Describe the difference in the structure of molecules of alkenes and alkanes.	
		Use ideas about bonds.	
			. [1]
	(ii)	Name the addition polymer that forms from ethene monomer units.	
			. [1]
		[Tota	al: 9]

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

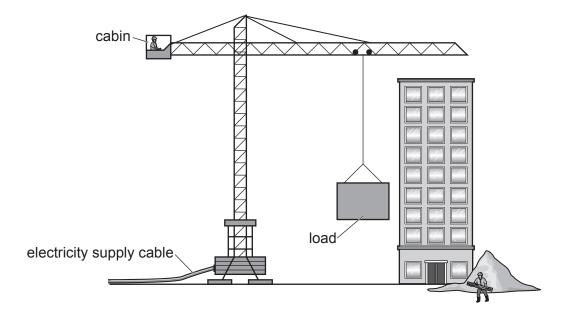
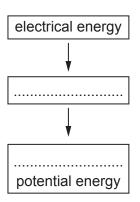


Fig. 6.1

(a) (i) Complete the sequence of useful energy transfers that occur as the crane lifts the load from the ground to the top of the building.



[2]

(ii) The electrical energy supplied is 250 000 J. When the load stops at the top of the building, the gain in potential energy by the load is 150 000 J.

State what has happened to most of the rest of the energy supplied.

.....[1]

		15
(b)	The	e crane lifts the load from rest on the ground with an upward force of 6000 N.
	The	e load weighs 5000 N.
	(i)	Fig. 6.2 shows the load attached to a rope for lifting the load.
		On Fig. 6.2 draw force arrows to show the weight and the lifting force acting on the load.
		Label the force arrows with their values.
		load
		Fig. 6.2 [2]
	(ii)	Calculate the resultant force on the load.
		resultant force = N [1]
	(iii)	The resultant force causes the load to move upwards.
		Describe the upward motion of the load.
		[1]
(c)		e crane is operated by a woman in the cabin at the top of the crane. Before starting to lift load, she shouts a warning to a worker on the ground.
	The	e distance from the woman to the worker is 30 m.
	Spe	eed of sound in air = 330 m/s.
	Cal	culate the time taken for the shouted warning to reach the worker.

time = s [2]

[Total: 9]

7 (a) Fig. 7.1 shows part of the alimentary canal and associated organs.

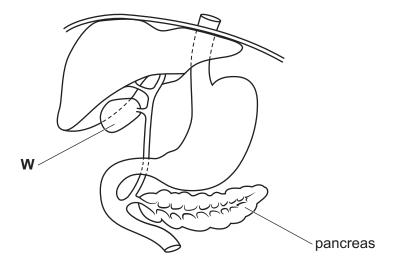


Fig. 7.1

(i)	Name the part W shown in Fig. 7.1.	
		[1]
(ii)	Some people need to have their pancreas removed due to illness.	
	Describe how removing the pancreas may affect the person's digestion.	
		[2]
(iii)	The pancreas also produces hormones.	
	Place ticks (✓) in two boxes to show the correct ideas about hormones.	

alter the activity of organs	
HIV is one example of a hormone	
they are chemical substances	
produced by target organs	
transported in red blood cells	

[2]

(b) Fig. 7.2 shows a food web.

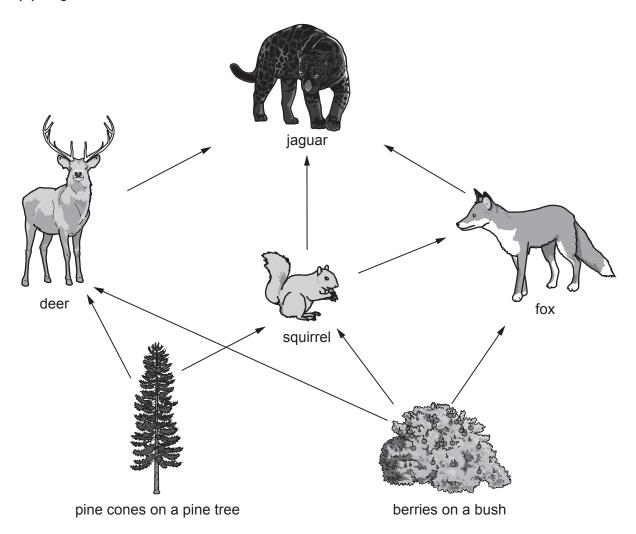


Fig. 7.2

(i)	Identify one animal shown in Fig. 7.2 that feeds on the pine tree.
	[1]
(ii)	The fox is both a primary consumer and a secondary consumer.
	Use the names of organisms shown in Fig. 7.2 to complete these sentences to explain why.
	The fox is a primary consumer when
	The fox is a secondary consumer when
	[2]

(iii)	Berries contain seeds.
	Seeds germinate and grow into new plants.
	State two environmental conditions needed for germination of seeds.
	1
	2
	[2]

[Total: 10]

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- **8** Sodium chloride, NaC*l*, is an ionic compound.
 - (a) Name **one** method of obtaining solid sodium chloride from aqueous sodium chloride.

(b) The electronic structures of an atom of sodium, Na, and of an atom of chlorine, C*l*, are shown in Fig. 8.1.

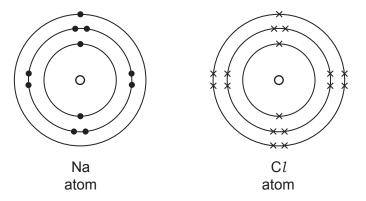


Fig. 8.1

Complete Fig. 8.2 to show the electronic structure of a sodium ion, Na^+ , and of a chloride ion, Cl^- .

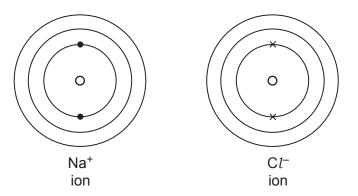


Fig. 8.2

[2]

(c) Concentrated aqueous sodium chloride is electrolysed using inert electrodes, as shown in Fig. 8.3.

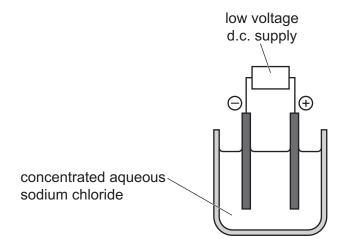
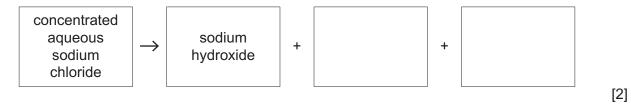


Fig. 8.3

Complete the word equation for the electrolysis of concentrated aqueous sodium chloride.



(d) Suggest the pH of aqueous sodium hydroxide and its effect on the colour of Universal Indicator.

рН	
colour	 [2]

(e) State the effect of chlorine gas on damp litmus paper.

[·]	[1	1]	
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[Total: 8]

- **9** Fig. 9.1 shows a police car. On the roof it has
 - · a flashing blue lamp that emits visible light
 - a radio aerial to transmit radio waves.



Fig. 9.1

(a) (i) On Fig. 9.2 place radio waves and visible light in their correct positions in the incomplete electromagnetic spectrum.

◀	increa	asing freque	ency		
gamma radiation				micro- waves	

Fig. 9.2

(ii)	State the meaning of the term frequency.	
		[1]

(b) The resistance of the lamp when lit is 1.5Ω .

The battery supplies a voltage of 12 V.

Calculate the current through the lamp when lit.

State the unit of your answer.

current =unit[3]

[2]

(c) Complete Fig. 9.3 to show how a beam of light from the lamp is reflected from a plane mirror to an observer.

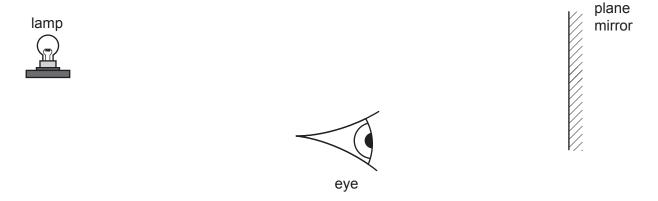


Fig. 9.3

[2]

(d) The blue lamp is connected in series to the car battery and a switch.

On Fig. 9.4 complete the circuit diagram for the blue lamp.

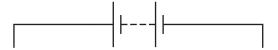


Fig. 9.4

[2]

[Total: 10]

The Periodic Table of Elements

	III/	2	Не	helium 4	10	Ne	neon 20	18	Ā	argon 40	36	궃	krypton 84	54	Xe	xenon 131	98	R	radon			
	IIA				6	ட	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 -
	^				7	Z	nitrogen 14	15	₾	phosphorus 31	33	As	arsenic 75	51	Sb	antimony 122	83	Ξ	bismuth 209			
	Ν				9	ပ	carbon 12	14	Si	silicon 28	32	Ge	germanium 73	50	Sn	tin 119	82	Ъ	lead 207	114	Ŀ	flerovium -
	≡				2	М	boron 11	13	Al	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	R	ruthe nium 101	92	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	Оþ	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	Ļ.	francium

71	ŋ	lutetium 175	103	ئ	lawrencium	ı
		ytterbium 173				
69	Tm	thulium 169	101	Md	mendelevium	ı
89	ш	erbium 167	100	Fm	fermium	ı
29	유	holmium 165	66	Es	einsteinium	1
99	۵	dysprosium 163	86	Ç	californium	1
65	Д	terbium 159	26	益	berkelium	1
64	gg	gadolinium 157	96	Cm	curium	1
63	En	europium 152	92	Am	americium	1
62	Sm	samarium 150	94	Pu	plutonium	1
61	Pm	promethium -	93	δ	neptunium	1
		neodymium 144				
59	Ā	praseodymium 141	91	Ра	protactinium	231
		cerium 140				
22	Га	lanthanum 139	88	Ac	actinium	ı

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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