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COMBINED SCIENCE **0653/41**

Paper 4 Theory (Extended) **May/June 2024**

MARK SCHEME

Maximum Mark: 80

Published

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 [Turn over

Question	Answer	Marks
1(a)	ventricle ; pulmonary ; lungs ; closes / shuts ;	**4**
1(b)(i)	120 – 160 beats per minute (ticked) ;	**1**
1(b)(ii)	decreases (with age) ;	**1**
1(b)(iii)	*any **three** from:* **muscles** require more energy (for contraction) ; more oxygen (and glucose) transported (to muscle) ; reference to increases (rate of) respiration ; **remove** more carbon dioxide (from lungs) / increased carbon dioxide in the, blood / muscle / more carbon dioxide released (from respiration) ;	**3**

Question	Answer	Marks
2(a)	**A** (cold) water (out) (at top) **B** condenser **C** (cold) water (in) (at bottom of condenser) **D** heat/(Bunsen) burner **E** salt and water / mixture / solution ;;; *5 correct = (3)* *3–4 correct = (2)* *1–2 correct = (1)*	**3**
2(b)	heat (the solution) ; to remove the **water** ;	**2**

Question	Answer	Marks
2(c)	6 Na and 6 Cl ; alternating Na^+ and Cl^- both horizontally and vertically ;	**2**
2(d)	sodium (atom) loses **an / one** electron (to give +1 charge) OR sodium (ion) has **one** electron fewer than the proton number ; chlorine (atom) gains **an / one** electron (to give –1 charge) OR chloride (ion) has **one** electron more than the proton number ;	**2**

Question	Answer	Marks
3(a)(i)	convection ;	**1**
3(a)(ii)	*any **two** from:* water expands on heating ; density decreases ; warmer / lower density, water rises ;	**2**
3(b)(i)	boiling ;	**1**
3(b)(ii)	in the air / vapour (above the boiling water) ;	**1**
3(c)(i)	drawing of lower part of thermometer at an angle to the upper part AND angle bent shallower, but still below horizontal ;	**1**
3(c)(ii)	3×10^8 m / s / 3×10^5 km / s ;	**1**
3(c)(iii)	infrared / microwave / radio ;	**1**
3(c)(iv)	<u>speed</u> (of light) increases ;	**1**

Question	Answer	Marks
4(a)	**B** ; **E** ;	**2**
4(b)(i)	*any **two** from:* **energy** store ; jelly coating OR a coating that changes after fertilisation ; AVP ;	**2**
4(b)(ii)	*any **two** from:* have a cell membrane ; contain cytoplasm ; have a nucleus ;	**2**
4(c)(i)	protect from mechanical shock ;	**1**
4(c)(ii)	idea that placenta, obtains / exchanges / passes / diffuses nutrients **from mother**('s blood) ; idea that the umbilical cord, passes / transports, nutrients / glucose / oxygen (to fetus) ;	**2**

Question	Answer	Marks
5(a)(i)	activation energy shown as a maximum between reactants and products ; activation energy labelled correctly ; energy change of reaction labelled with upwards arrow ;	**3**
5(a)(ii)	products are at a higher energy level than reactants / products have more energy than reactants / ORA ;	**1**
5(a)(iii)	$N_2(g) + O_2(g) \rightarrow 2NO(g)$; ; *correctly balanced equation = (1)* *state symbols (g) (g) (g) = (1)*	**2**

Question	Answer	Marks
5(b)	buildings: the idea of (chemical) reaction with, metal / building materials ; health: adverse effect on, heart / lungs / breathing ;	2

Question	Answer	Marks
6(a)(i)	unit mass / 1 kg ;	1
6(a)(ii)	(resultant force) = 15 000 – 14 750 (= 250 N) ;	1
6(b)(i)	5.0 (m / s) ;	1
6(b)(ii)	$a = v \div t$ / evidence of use of formula ; = 0.20 ; m / s^2 ;	3
6(b)(iii)	use of area under graph seen, i.e. ½ × 25 × 5 ; (= 62.5 m)	1
6(b)(iv)	(increase in KE =) ½ mv^2 OR ½ × 1475 × 5 × 5 OR 18437.5 ; (increase in PE =) mgh OR 1475 × 10 × 62.5 OR 921875 ; 18437.5 AND 921875 ; 940 000 (J) ;	4

Question	Answer	Marks
7(a)(i)	**P** photosynthesis ; **Q** gas exchange ;	**2**
7(a)(ii)	gradient **and** atmosphere ; diffusion ; decrease ;	**3**
7(b)(i)	one / 1 ;	**1**
7(b)(ii)	*any **three** from:* vulture is on trophic level 5 ; energy is lost at each trophic level ; named example of energy lost, e.g., heat / respiration / excretion / protein synthesis / metabolism / not all organism is eaten ; not enough energy (for quaternary consumer) ;	**3**

Question	Answer	Marks
8(a)(i)	cracking ;	**1**
8(a)(ii)	*any **two** from:* high temperature ; high pressure ; catalyst ;	**2**
8(b)(i)	*similarity:* both, have two carbon atoms / are hydrocarbons / contain carbon and hydrogen **only** / both are covalent / both are simple molecules ; *differences (any **two** from):* ethane has (two) more hydrogen atoms / 6 hydrogen not 4 ; ethene / alkene, has a (carbon to carbon) double bond **and** ethane / alkane, has only (carbon to carbon) single bonds ; ethene / alkene, is unsaturated **and** ethane / alkane, is saturated ;	**3**

Question	Answer	Marks
8(b)(ii)	$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$; ; *CO_2 **and** H_2O as products = (1)*	**2**
8(c)	five / 5 ;	**1**

Question	Answer	Marks
9(a)	**F** ; **J** ;	**2**
9(b)	correct symbol for voltmeter ; connected in parallel with lamps ;	**2**
9(c)(i)	(difference between e.m.f. and p.d. across lamps = 5.5 – 3.0 =) 2.5 (V) ;	**1**
9(c)(ii)	(*R* =) *V* ÷ *I in any form* OR 0.3 seen OR 3.0 ÷ 0.6 OR 5(.0) ; 10 (Ω) ;	**2**