Junior Chemistry Challenge 2024

Mark Scheme

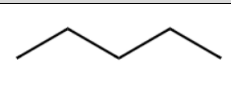
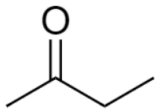
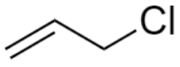
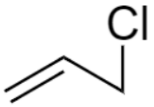
Question 1 – Multiple Choice

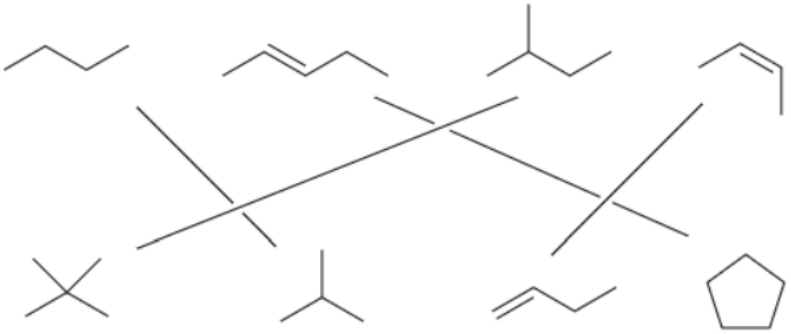
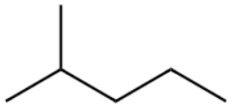
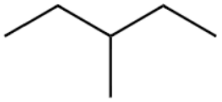
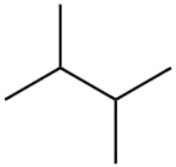
a) **C** – 5
b) **E** – Cs
c) **B** – C_7H_8
d) **C** – $\sqrt{10}$
e) **D** – From Na to Al an additional electron is lost to the delocalised electrons increasing the attraction between the electrons and the metal cations.
f) **A** – ZnS
g) **C** – 3
h) **E** – Reacts vigorously with reducing agents.
i) **B** – 1.8 cm
j) **E** – 0.9%

Question	Answer	Additional Guidance	Mark
2(a)(i)	$Ag^+ + e^- \rightarrow Ag$ **(1)** $Mg \rightarrow Mg^{2+} + 2e^-$ **(1)**	Equations **do not** have to be labelled Reduction/Oxidation. IGNORE even if incorrect. ALLOW multiples. Electrons do not have to be balanced between half-equations IGNORE state symbols	2
2(a)(ii)	$Fe^{3+} + 3e^- \rightarrow Fe$ **(1)** $Al \rightarrow Al^{3+} + 3e^-$ **(1)**		2
2(a)(iii)	$2H_2O + 2e^- \rightarrow 2OH^- + H_2$ **(1)** OR $2H^+ + 2e^- \rightarrow H_2$ **(1)** $Na \rightarrow Na^+ + e^-$ **(1)**		2
2(b)	At least one arrow going from the Zn to the Cu on the wires **(1)**	IGNORE arrows on other parts of the diagram e.g. salt bridge	1

2(c)	Two from: • Cu^{2+} solution/Cu^{2+} (aq)/$CuSO_4$ (aq)/Cu^{2+} decolourises/goes from blue to colourless **(1)** • Zn metal/electrode gets smaller/degrades/disintegrates OWTTE **(1)** • Cu metal/electrode gets bigger/grows/enlarges OWTTE **(1)**	REJECT if an incorrect colour is given. ALLOW gets less blue. REJECT if observation refers to changes in mass/weight. REJECT a generic statement e.g. 'the metals become smaller'	2
2(d)	(-) 2.12 x 10^5 (J) **(1)** OR (-) 212,000 (J) **(1)** OR (-) 212 kJ **(1)**	ALLOW any SF except 1SF ALLOW positive or negative answer ALLOW if no unit given but REJECT incorrect unit. Unit MUST be given if SI prefix used.	1
2(e)	Energy released by the reaction <u>doubles</u> **(1)** Amount of charge/electrons transferred <u>doubles</u> **(1)** Therefore, voltage stays the same **(1)** OR Each electron still transfers the same amount of energy (because the reactants are the same) **(1)** Energy per charge is the same/charge on an electron doesn't change **(1)** Therefore, voltage stays the same **(1)**	REJECT increase for first two points MP3 dependent in MP1 and MP2 (e.g. 'voltage stays the same', alone scores 0) For MP3 ALLOW ECF from MP1/2 (e.g. 'energy doubles, change transferred stays the same, then voltage doubles'. Would score MP1 and MP3)	3

2(f)	Any value greater than +2.00V and less than +3.21V **(1)** Because Mg is less reactive than Ca and more reactive than Al **(1)** OR Because Mg is between Ca and Al in the reactivity series **(1)**	ALLOW without + and/or V ALLOW +3.21V because Mg is in the same group as Ca for 1 mark.	2

Question	Answer	Additional Guidance	Mark
3(a)	 **(1)**  **(1)**  **(1)**	ALLOW chemically correct variations of the skeletal formulae REJECT: 	3
3(b)	C_5H_8 **(1)** C_6H_{12} **(1)** C_3H_8O **(1)** C_5H_9OCl **(1)**	Elements can be listed in any order ALLOW C_3H_7OH ALLOW C_4H_9COCl	4

3(c)			4
3(d)	 **(1)**  **(1)**  **(1)**  **(1)**	Isomers can be listed in any order ALLOW chemically correct variations of the skeletal formulae	4