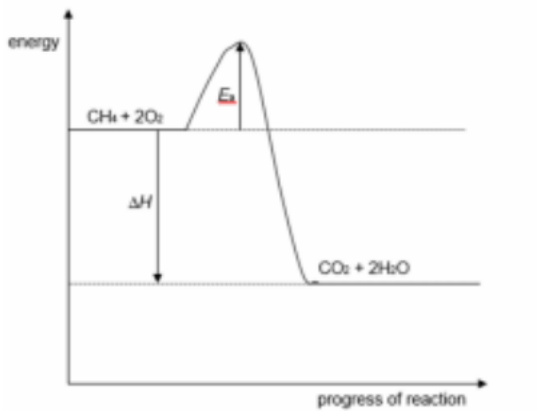
2025 Montfort Secondary School S4 G3 Chem Prelim Answer Key

PAPER 1

Q1	**Q2**	**Q3**	**Q4**	**Q5**
D	D	B	A	C
Q6	**Q7**	**Q8**	**Q9**	**Q10**
C	D	A	B	A
Q11	**Q12**	**Q13**	**Q14**	**Q15**
C	D	D	D	A
Q16	**Q17**	**Q18**	**Q19**	**Q20**
C	D	D	A	A
Q21	**Q22**	**Q23**	**Q24**	**Q25**
B	C	D	B	C
Q26	**Q27**	**Q28**	**Q29**	**Q30**
A	C	B	A	C
Q31	**Q32**	**Q33**	**Q34**	**Q35**
B	D	C	C	B
Q36	**Q37**	**Q38**	**Q39**	**Q40**
C	B	D	D	C

PAPER 2

Q	ANSWER	Mark	REMARK
1ai	C	1	
1aii	A	1	
1aiii	D	1	
1aiv	G	1	
1av	C	1	
1avi	G	1	
1b	bonding pair of electrons between C*l* and H 6 non-bonding electrons on chlorine atom and no extra electrons on the H atom(s) (1)	1	
2a	$Al_4C_3 + 12H_2O \rightarrow 4Al(OH)_3 + 3CH_4$ formula for aluminium hydroxide as product (1) balanced equation (1)	2	
2bi	contains only carbon and hydrogen contains single bonds only	2	
2bii	Any two from: HC*l* (1) CH_3Cl (1) CH_2Cl_2 (1) $CHCl_3$ (1) CCl_4 (1)	2	
2ci	bond breaking endothermic AND bond making exothermic / energy absorbed to break bonds in CH4 & O2 AND energy released on making bonds in CO2 & H2O (1) more energy released than absorbed (1)	2	
2cii	 **M1** products to right of reactants AND reactant level above product level (1) **M2** enthalpy change shown as downward arrow AND labelled as enthalpy change or Δ H (1) **M3** activation energy drawn to maximum of energy hump with an upward arrow AND labelled (1)	3	

<table>
<tr><td>3ai</td><td>Rate doubles as concentration doubles (or reverse argument) (1)</td><td>1</td><td></td></tr>
<tr><td>3aii</td><td>Particles closer together / more particles in a given volume (or reverse argument) (1)
Higher frequency of effective collision / more effective collisions per second (or reverse argument) (1)</td><td>2</td><td></td></tr>
<tr><td>3aiii</td><td>Increasing temperature increases rate (no marks)
Particles move faster / particles have greater kinetic energy (1)
Number of particles with energy greater than the activation energy is increased / higher frequency of effective collisions / more effective
collisions per second (1)</td><td>2</td><td></td></tr>
<tr><td>3bi</td><td>Burning fossil fuels / burning named fossil fuel / volcanoes (1)</td><td>1</td><td></td></tr>
<tr><td>3bii</td><td>It is reformed / it is not used up / it is unchanged at the end of the reaction (1)</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>4ai</td><td>anode (on left) and cathode (on right) correctly labelled (1)
test tubes / measuring cylinders over each electrode with open ends dipping into the electrolyte (1)</td><td>2</td><td></td></tr>
<tr><td>4aii</td><td>positive electrode: chlorine / Cl_2 (1)
negative electrode: hydrogen / H_2 (1)</td><td>2</td><td></td></tr>
<tr><td>4aiii</td><td>platinum (no marks)
inert / unreactive</td><td>1</td><td></td></tr>
<tr><td>4b</td><td>$Cl_2 + 2NaI \rightarrow I_2 + 2NaCl$ (1)

chlorine has displaced iodine in sodium iodide
/ chlorine has taken the place of iodine in sodium iodide (1)</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>5a</td><td>$3MoO_2 + 4Al \rightarrow 2Al_2O3 + 3Mo$ (1)</td><td>1</td><td></td></tr>
<tr><td>5bi</td><td><table><tr><th>element</th><th>oxidation state in reactants</th><th>oxidation state in products</th></tr><tr><td>molybdenum</td><td>+4</td><td>0 (1 for correct row)</td></tr><tr><td>aluminium</td><td>0</td><td>+3 (1 for correct row)</td></tr></table></td><td>2</td><td></td></tr>
<tr><td>5bii</td><td>molybdenum(IV) oxide has been reduced as the oxidation state of molybdenum has decreased from +4 in MoO_2 to 0 in Mo. (1)

aluminium has been oxidised as the oxidation state has increased from 0 in Al to +3 in Al_2O_3. (1)

Since oxidation and reduction occur simultaneously, this is a redox reaction. (no mark)</td><td>2</td><td></td></tr>
<tr><td>5c</td><td>molybdenum is less reactive (no mark)
as it has been displaced from its oxide / molybdenum(IV) oxide has</td><td>1</td><td></td></tr>
</table>

<table>
<tr><td></td><td>been reduced by alumnium (1)</td><td></td><td></td></tr>
<tr><td>5di</td><td>metallic bonding (1)

structure drawn to show cations in a ‘sea’ of delocalised electrons. (1)</td><td>2</td><td></td></tr>
<tr><td>5dii</td><td>stronger electrostatic forces of attraction (1) due to higher number of electrons and protons present in Mo.</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>6a</td><td>
<table>
<tr><th>fertiliser</th><th>formula</th></tr>
<tr><td>ammonium nitrate</td><td>NH_4NO_3 (1)</td></tr>
<tr><td>sodium phosphate</td><td>Na_3PO_4</td></tr>
<tr><td>calcium nitrate (1)</td><td>$Ca(NO_3)_2$</td></tr>
<tr><td>potassium sulfate</td><td>K_2SO_4</td></tr>
</table>
</td><td>2</td><td></td></tr>
<tr><td>6bi</td><td>$H^+ + OH^- \rightarrow H_2O$ (1)</td><td>1</td><td></td></tr>
<tr><td>6bii</td><td>
<table>
<tr><th></th><th>N</th><th>H</th><th>C</th><th>O</th></tr>
<tr><td>% by mass</td><td>46.7</td><td>6.7</td><td>20</td><td>100 – (46.7+6.7+20) = 26.6 (1)</td></tr>
<tr><td>no. of moles / mol (1)</td><td>46.71446.714

= 3.33571</td><td>6.716.71

= 6.7</td><td>20122012

= 1.66667</td><td>26.61626.616

= 1.6625</td></tr>
<tr><td>simplest ratio</td><td>3.335711.662
53.335711.66
25

= 2.01</td><td>6.71.66256
.71.6625

= 4.03</td><td>1.666671.66251.
666671.6625

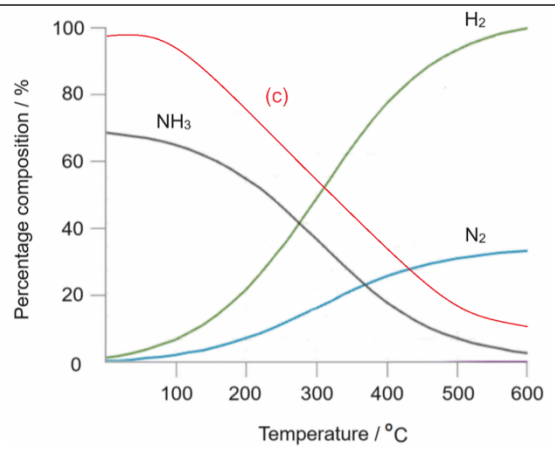
= 1.00</td><td>1.66251.66251.
66251.6625

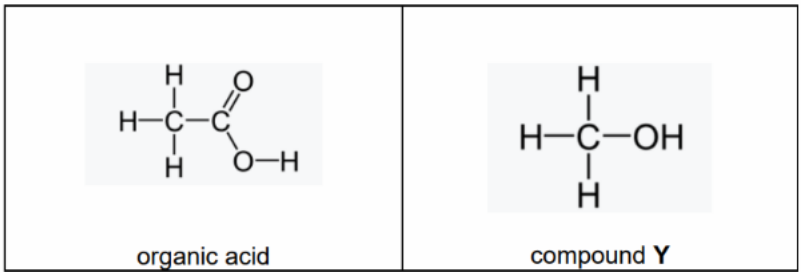
=1.00</td></tr>
<tr><td>empirical formula</td><td colspan="4">N_2H_4CO (1)</td></tr>
</table>
</td><td>3</td><td></td></tr>
<tr><td>6c</td><td>farmer 2 is correct. (no marks)

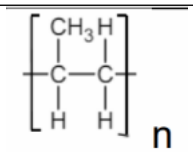
the nitrate ions from calcium nitrate provides the nitrogen content for healthy plant growth. (1)

ammonium nitrate will react with calcium hydroxide to form ammonia gas (1) ;
which will escape from the soil and causes a loss in the nitrogen content (1) required for healthy plant growth</td><td>3</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>7a</td><td>at 150 °C, 60 % of ammonia is formed. at 400 °C, 20 % of ammonia is formed. / any correct evidence data from Fig. 7.1 (1)

as the temperature increases, the percentage of ammonia formed decreases. (1)</td><td>2</td><td></td></tr>
<tr><td>7b</td><td>at high temperature, the ammonia decomposes to form hydrogen and nitrogen. (1)</td><td>1</td><td></td></tr>
<tr><td>7c</td><td></td><td>(1)</td><td></td></tr>
</table>

			
7d	when the pressure of gaseous reactants increases, there are more reacting particles per unit volume. (1) this increases the frequency of collision and hence increases the frequency of effective collision (1) between the reacting particles and thus, the rate of reaction increases. (1)	3	
7ei	there will be unreacted or more or excess nitrogen monoxide released into the atmosphere together with less nitrogen and water vapour/steam produced (1)	1	
7eii	NO will react with air/oxygen to form NO_2 which reacts with moisture and air (or water and oxygen) to form nitric acid (1) which reacts/dissolves in water; to form acid rain which corrodes limestone buildings/kills aquatic life (1) OWTTE;	2	
8ai	has a pungent smell (1)	1	
8aii	when hydrogen sulfide is combusted, it produces sulfur dioxide and sulfuric acid; which will corrode the metal machinery parts. (1) hydrogen sulfide is toxic (1)	2	
8b	environmental: (any three) • if cow dung is not used, the cow dung will also degrade naturally to release methane which is a greenhouse gas; • converting cow dung into biomethane to be used as biofuel instead of letting it degrade naturally cuts down greenhouse gases by 4%. this is because methane has a much greater global-warming power than carbon dioxide; • conserves use of the limited/non-renewable fossil fuels/crude oil or • the fertiliser made on the farm can reduce the synthetic fertilisers made from fossil fuels/ crude oil;	5	

	economical: (any two) • cow dung is produced and/or collected directly on the farm or on-site and biodigester is on-site so farmers save on transportation costs and/or time; (reject easy to use) • also cuts costs on using fossil fuels/crude oil for electricity; • biomethane is a biofuel with high performance and high purity; • the fertiliser produced from the biodigester can be readily used by farmers, saving costs from purchasing synthetic fertilisers;		
8ci	carbon or hydrogen or carbon monoxide	1	
8cii	iron(III) oxide is a solid product which can be collected more easily for recycling than the gaseous (or escaped) product, carbon dioxide, produced from the burning fossil fuels, which easily escapes into the atmosphere.	1	
9a	they have the (any 1 for 1 mark) • same general formula of CnH2n+2COO where n is ≥2 • same functional group of COO • Mr between successive members differ by 14 / molecular formula between successive members differ by a −CH2	2	
9b	the melting point increases then decreases (no clear trend) (1) but the boiling point increases as the molecular size / Mr increases (1)	2	
9c	The melting point is below 25 °C and (1) the boiling point is above 25 °C (1) OR 25 °C is between (1) its melting and boiling point (1)	2	
9di	 (1) correct structural formula of organic acid (1) correct structural formula of compound Y	2	
9dii	no. of moles of acid = 1.20 g / 60 = 0.02 mol no. of moles of methyl ethanoate = 0.02 mol (1) mass of methyl ethanoate = 0.02 x 74 = 1.48 g (1)	2	

10ai		1	
10aii	$2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$ no. of moles of propene = (4.2x1000)/42 = 100 mol volume of carbon dioxide produced = 3 x 100 x 24 = 7200 dm3 (1) percentage yield = 4800/7200 x 100% = 66.7 % (1) ECF allowed for incorrectly balanced equation	2	
10bi	both have the molecular formula C_3H_6 but the arrangement of atoms is different (needs to explain the difference fully in their own words) (1)	1	
10bii	reagent: Br_2 (aq) (1) reddish brown bromine decolourises when added to propene but remains unchanged when added to cyclopropane (1)	2	
10ci	movement: from vibrate about fixed position to move throughout the liquid (1) arrangement: from very close, orderly arrangement to close but disorderly arrangement (1)	2	
10cii	has a giant molecular structure and strong covalent bonds between atoms. (1) a lot of energy is needed to overcome the bonds. (1)	2	