JABchem

Past Papers

Standard Grade

Credit

Chemistry

2013

Marking Scheme

2013 Credit	KU		PS	
	/30	%	/30	%
1	24+	80%	25+	83%
2	19+	63%	16+	53%
See general	<19	<63%	<16	<53%

2013 Standard Grade Chemistry Credit Marking Scheme

Question	Answer	Chemistry Covered
1a	B	see table 1a
1b	D	Iron metal is made when iron oxide is reduced by carbon monoxide in a blast furnace: $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
1c	A	see table 1c
2a	C	see table 2a
2b	A+F Both for 1 mark	Positive ions will only form compounds with negative ions ∴ Any combination with two positive ions or two negative ions can be discounted. Aluminium Hydroxide $Al(OH)_3$ is the only insoluble combination on page 8 of data booklet
2c	F	H^+ ions are found in all acids and OH^- ions are found in all alkalis
3a	C	No voltage is obtained when the same metal is attached to itself in a cell
3b	B+D Both for 1 mark	Gold and lead are being investigated by attaching them to the same metal (tin) in a circuit with the same electrolyte (potassium nitrate solution). The results obtained would show that the direction of electron flow is the same from tin to the lead/gold so both metals are below tin in the electrochemical series. The voltage obtained from the tin/gold cell will be greater than the tin/lead cell so lead must be nearer tin on the electrochemical series and therefore higher up the electrochemical series.
4a	D	see table 4
4b	C+E Both for 1 mark	see table 4
4c	A+B Both for 1 mark	see table 4
5	B+E Both for 1 mark	☒ A The pH of acids will increase to 7 as water dilutes the acid ☑ B Acidity decreases as water is added as concentration of H^+ ions decrease ☒ C The pH of acids will increase to 7 as water dilutes the acid ☒ D Acidity decreases as water is added as concentration of H^+ ions decrease ☑ E The solution becomes less concentrated as water dilutes the acid
6a	F	see table 6a
6b	E	see reaction 6b
6c	B+D Both for 1 mark	Isomers have same molecular formula but different structural formula: see table 6c
6d	A+C Both for 1 mark	Monomer 1 has $-CH_3$ groups on either side of C=C in monomer ∴ Monomer 1 = Structure C Monomer 2 has $-CN$ group on either side of C=C in monomer ∴ Monomer 2 = Structure A

1a

Answer	A	B	C	D	E	F
Element	Hydrogen	Copper	Oxygen	Iron	Magnesium	Iodine
Melting Pt	-259°C	1085°C (1083°C in old data booklet)	-219°C	1538°C	650°C	114°C

1c

Gas	Hydrogen	Oxygen	Carbon Dioxide
Test	burns with a pop	relights a glowing splint	turns lime water milky

2a

Answer	A	B	C	D	E	F
Ion	Al^{3+}	Cl^-	Li^+	H^+	Br^-	OH^-
Electron Arrangement of Ion	2,8	2,8,8	2	0	2,8,18,8	n/a

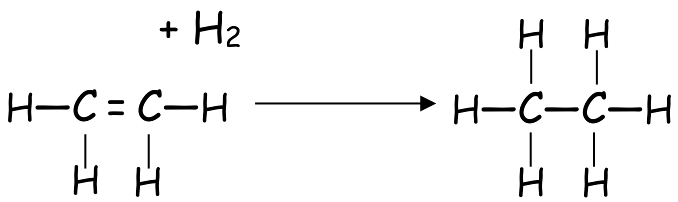
4a, 4b, 4c

Carbohydrate	fructose	glucose	maltose	starch	sucrose
Formula	$C_6H_{12}O_6$	$C_6H_{12}O_6$	$C_{12}H_{22}O_{11}$	$(C_6H_{10}O_5)_n$	$C_{12}H_{22}O_{11}$
Type	monosaccharide	monosaccharide	disaccharide	polysaccharide	disaccharide
Status	monomer	monomer	dimer	condensation polymer	dimer
Result of Hydrolysis	no hydrolysis	no hydrolysis	Hydrolyses to two glucose units	Hydrolyses to many glucose units	Hydrolyses to glucose and fructose

6a

Polymer	poly(ethene)	poly(propene)	poly(chloroethene)	polystyrene
Monomer	ethene	propene	chloroethene	styrene

6b



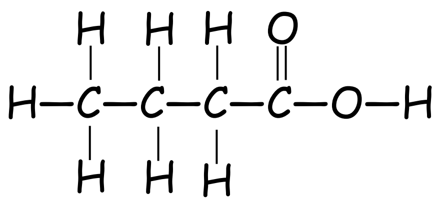
ethene → ethane

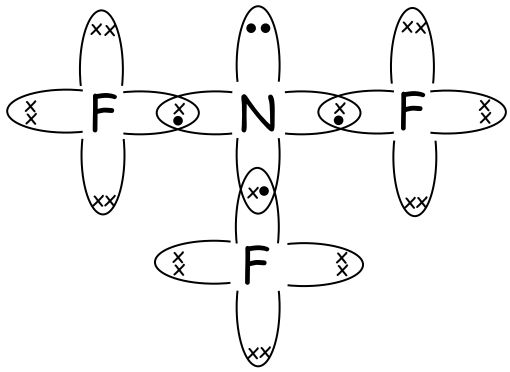
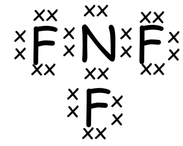
6c

Structure	A	B	C	D	E	F
Formula	C_3H_3N	$C_2H_2Cl_2$	C_4H_8	$C_2H_2Cl_2$	C_2H_4	C_3H_6

<table>
<tr>
<td>7</td>
<td>D,E
1 mark each</td>
<td>
<table>
<tr><th>Particle</th><th>Location</th><th>Charge</th><th>Mass</th></tr>
<tr><td>Proton</td><td>in nucleus</td><td>+1</td><td>1 amu</td></tr>
<tr><td>Neutron</td><td>in nucleus</td><td>0</td><td>1 amu</td></tr>
<tr><td>Electron</td><td>outside nucleus</td><td>−1</td><td>approx zero</td></tr>
</table>
</td>
</tr>
<tr>
<td>8</td>
<td>C,E
1 mark each</td>
<td>
☒ A Glucose $C_6H_{12}O_6$ solution is covalent and is a non-conductor
☒ B potassium nitrate is an ionic compound and does not conduct in the solid state
☑ C metals in the liquid state can conduct electricity
☒ D hexane C_6H_{14} is covalent and does not conduct electricity
☑ E ionic compounds in both the liquid and solution states can conduct electricity
<table>
<tr><th>Bonding</th><th>Solid</th><th>Liquid</th><th>Solution</th></tr>
<tr><td>Metallic
(metals only)</td><td>✓</td><td>✓</td><td>-</td></tr>
<tr><td>Covalent
(non-metals only)</td><td>×</td><td>×</td><td>×</td></tr>
<tr><td>Ionic
(metals + non-metals)</td><td>×</td><td>✓</td><td>✓</td></tr>
</table>
</td>
</tr>
</table>

<table>
<tr><td>9a</td><td>Fe^{2+}</td><td>Ferroxyl Indicator turns blue in presence of Fe^{2+} ions
turns pink in presence of OH^- ions</td></tr>
<tr><td>9b</td><td>OH^-</td><td>From data booklet page 7: $2H_2O_{(l)} + O_{2(g)} + 4e^- \longrightarrow 4OH^-_{(aq)}$</td></tr>
<tr><td>9c</td><td>Mg provides electrons to Fe</td><td>Magnesium protects iron from corroding by sacrificial protection because magnesium is more reactive than iron. Magnesium corrodes and supplies the attached iron metal with the electrons to prevent it from corroding.</td></tr>
<tr><td>9d</td><td>covalent</td><td>Ionic compounds speed up corrosion by providing the ions needed to act as an electrolyte which completes the circuit. Covalent compounds, like ethylene glycol, contain no ions and will not speed up corrosion.</td></tr>
<tr><td>10a(i)</td><td>$^{63}_{29}Cu$</td><td>mass number →
atomic number → Cu</td></tr>
<tr><td>10a(ii)</td><td>34</td><td>Number of neutrons = mass number – atomic number = 63 – 29 = 34</td></tr>
<tr><td>10b</td><td>64</td><td>The relative atomic mass is the average of the masses of the different isotopes
relative atomic mass $= \frac{63+65}{2} = 64$</td></tr>
<tr><td>11a(i)</td><td>Sodium phosphate</td><td>Metal comes first in the name: sodium
Non-metal comes second in the name: phosph-
3^{rd} element is oxygen = -ate: -ate</td></tr>
<tr><td>11a(ii)</td><td>Restore essential elements to soil</td><td>Fertilisers are
soluble compounds
containing at least one element from potassium, phosphorus or nitrogen
added to soil to restore the essential element compounds to the soil to aid growth of plants.</td></tr>
<tr><td>11b</td><td>Iron</td><td>Nitrogen + Hydrogen $\xrightarrow{\text{iron}}$ Ammonia</td></tr>
<tr><td>11c</td><td>(nitrifying) bacteria</td><td>Nitrifying bacteria are found in root nodules in leguminous plants which fix atmospheric nitrogen into nitrogen compounds in plants.
e.g. Bean family, Pea family and clover are leguminous plants.</td></tr>
<tr><td>12a</td><td>36°C to 126°C</td><td>Information found on 9 of data booklet
<table>
<tr><td>Alkane</td><td>methane</td><td>ethane</td><td>propane</td><td>butane</td><td>pentane</td><td>hexane</td><td>heptane</td><td>octane</td></tr>
<tr><td>Formula</td><td>CH_4</td><td>C_2H_6</td><td>C_3H_8</td><td>C_4H_{10}</td><td>C_5H_{12}</td><td>C_6H_{14}</td><td>C_7H_{16}</td><td>C_8H_{18}</td></tr>
<tr><td>Boiling Point</td><td>-162°C</td><td>-89°C</td><td>-42°C</td><td>-1°C</td><td>36°C</td><td>69°C</td><td>98°C</td><td>126°C</td></tr>
</table></td></tr>
<tr><td>12b</td><td>0.718</td><td>
<table>
<tr><td>Percentage</td><td>Pentane</td><td>Hexane</td><td>Heptane</td><td>Octane</td><td>Nonane</td></tr>
<tr><td>Formula</td><td>C_5H_{12}</td><td>C_6H_{14}</td><td>C_7H_{16}</td><td>C_8H_{18}</td><td>C_9H_{20}</td></tr>
<tr><td>Density</td><td>0.626</td><td>0.659</td><td>0.684</td><td>0.703</td><td>-</td></tr>
<tr><td>Difference</td><td></td><td>0.033</td><td>0.025</td><td>0.019</td><td>(0.015)</td></tr>
<tr><td>Prediction</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0.718</td></tr>
</table></td></tr>
<tr><td>12c(i)</td><td>Carbon and Hydrogen</td><td>Carbon in carbon dioxide must have come from fuel D
Hydrogen in water must have come from fuel D
Oxygen in carbon dioxide and water might have come from fuel D or from air</td></tr>
<tr><td>12c(ii)</td><td>Hydrogen</td><td>Water is the only product of the combustion of fuel B
∴ the fuel is likely to be hydrogen as the hydrogen in water must have come from the fuel and not the air.</td></tr>
<tr><td>13a</td><td>Neutralisation</td><td>Neutralisation reactions involve the reaction of H^+ ions to form water.</td></tr>
<tr><td>13b</td><td>Increase in temp increases the rate</td><td>The reaction rate is inversely proportional to the time taken for the reaction.
As the time decreases in the table, the rate of reaction must increase.</td></tr>
<tr><td>14a</td><td>SO_4^{2-}</td><td>$Zn_{(s)} + Cu^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)} + SO_4^{2-}{}_{(aq)}$
Cancel out any spectator ions which appear on both sides
$Zn_{(s)} + Cu^{2+}_{(aq)} + \cancel{SO_4^{2-}{}_{(aq)}} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)} + \cancel{SO_4^{2-}{}_{(aq)}}$
Re-write equation omitting spectator ions
$Zn_{(s)} + Cu^{2+}_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$</td></tr>
</table>

<table>
<tr><td>14b</td><td>$Zn \rightarrow Zn^{2+} + 2e^-$</td><td>$Zn_{(s)} + Cu^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$
Split the redox reaction into its component halves
$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)}$
$Cu^{2+}_{(aq)} \rightarrow Cu_{(s)}$
Balance equations by adding electrons into ion-electrons equations
$Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$
$Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$
Oxidation reactions have electrons <u>after</u> the arrow
Reduction Reactions have electrons <u>before</u> the arrow</td></tr>
<tr><td>14c(i)</td><td>zinc copper
zinc sulphate solution</td><td>The metals in a cell should be placed in solutions of that metal
• Copper electrode is placed in copper sulphate solution
• Zinc electrode is placed in a zinc sulphate solution
(any soluble zinc compound can be used as the electrolyte in the zinc electrode beaker)</td></tr>
<tr><td>14c(ii)</td><td>To complete the circuit</td><td>The ion bridge contains an ionic solution which allows ions to move through the ion bridge to balance the movement of charge from zinc to copper</td></tr>
<tr><td>15a</td><td>$C_nH_{2n+1}OH$
or
$C_nH_{2n+2}O$</td><td><table>
<tr><th colspan="2">Ethanol</th><th colspan="2">Propan-2-ol</th></tr>
<tr><td>If formula written as:
C_2H_5OH</td><td>Molecular formula:
C_2H_6O</td><td>If formula written as:
C_3H_7OH</td><td>Molecular formula:
C_3H_8O</td></tr>
<tr><td>If n=2 then 2n+1=5</td><td>If n=2 then 2n+2=6</td><td>If n=3 then 2n+1=7</td><td>If n=3 then 2n+2=8</td></tr>
<tr><td>$\therefore C_nH_{2n+1}OH$</td><td>$\therefore C_nH_{2n+2}O$</td><td>$\therefore C_nH_{2n+1}OH$</td><td>$\therefore C_nH_{2n+2}O$</td></tr>
</table></td></tr>
<tr><td>15b(i)</td><td>Carbon dioxide</td><td>glucose $\xrightarrow[\text{(no air)}]{\text{yeast enzymes}}$ ethanol + carbon dioxide
$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$</td></tr>
<tr><td>15b(ii)</td><td>Distillation</td><td>Distillation is used to produce alcoholic drinks with an alcohol content above 16%.
Yeast makes alcohol by anaerobic fermentation but at around 16% alcohol the yeast cannot survive.
Distillation separates alcohol from water as ethanol and water have different boiling points and the ethanol is then collected and used in spirit drinks like whisky, vodka, rum, etc.</td></tr>
<tr><td>15c</td><td>Diagram showing:</td><td></td></tr>
<tr><td>15d</td><td>pentylbutanoate</td><td><table>
<tr><th colspan="3">First name comes from alkanol</th><th colspan="3">Second name comes from alkanoic acid</th></tr>
<tr><td>methanol</td><td>→</td><td>methyl</td><td>methanoic acid</td><td>→</td><td>methanoate</td></tr>
<tr><td>ethanol</td><td>→</td><td>ethyl</td><td>ethanoic acid</td><td>→</td><td>ethanoate</td></tr>
<tr><td>propanol</td><td>→</td><td>propyl</td><td>propanoic acid</td><td>→</td><td>propanoate</td></tr>
<tr><td>butanol</td><td>→</td><td>butyl</td><td>butanoic acid</td><td>→</td><td>butanoate</td></tr>
<tr><td>pentanol</td><td>→</td><td>pentyl</td><td>pentanoic acid</td><td>→</td><td>pentanoate</td></tr>
</table></td></tr>
<tr><td>16a</td><td><table><tr><td>heat alone</td></tr><tr><td>reacting with carbon</td></tr><tr><td>electrolysis</td></tr></table></td><td><table>
<tr><th>Method</th><th>Electrolysis</th><th>Heat With Carbon</th><th>Heat Alone</th></tr>
<tr><td>Metals Made This Way</td><td>Potassium, Sodium
Lithium, Calcium
Magnesium, Aluminium</td><td>Zinc, Iron
Tin, Lead
Copper</td><td>Mercury, Silver
Gold, Platinum</td></tr>
<tr><td>Reason</td><td>most reactive metals</td><td>medium reactive metals</td><td>least reactive metals</td></tr>
</table></td></tr>
<tr><td>16b(i)</td><td>86.2%</td><td>gfm HgS = (1x200.5) + (1x32) = 200.5 + 32 = 232.5g
$\%Hg = \frac{\text{mass of Hg}}{\text{total mass}} \times 100 = \frac{200.5}{232.5} \times 100 = 86.2\%$</td></tr>
</table>

16b(ii)	Hg^{2+}	Hg (mercury) is a transition metal and does not have a set valency to work out the charge on the metal ion. • The sulphide ion has a negative charge as it is a non-metal ion • The sulphide ion has a two negative charge as sulphur is in group 6 and has a valency of 2 $\therefore$ S^{2-} ion • The mercury ion must have a positive charge as it is a metal ion • The mercury ion has a two positive charge to balance the two negative charge of the S^{2-}ion $\therefore$ Hg^{2+}
17a	Diagram showing:	 or 
17b	positive electrons	A covalent bond is a shared pair of electrons between two atoms. As the positive nuclei would repel each other, it is the attraction of the positive nuclei for the shared pair of electrons holds the molecule together.
17c	35.5g	1mol N_2 = 2x14 = 28g **n**o. of mol = $\frac{\textbf{mass}}{\textbf{gfm}}$ = $\frac{7g}{28g\ mol^{-1}}$ = 0.25mol $N_2 + 3F_2 \longrightarrow 2NF_3$ 1mol 2mol 0.25mol 0.5mol 1mol NF_3 = (1x14)+(3x19) = 14+57 = 71g **m**ass = **n**o. of mol x **gfm** = 0.5mol x 71g mol^{-1} = 35.5g
18a(i)	Line graph showing:	½mark labelling axes; ½mark correct scales; ½mark plotting points; ½mark drawing line
18a(ii)	37	Increasing the temperature will increase the rate of reaction and the gas will be given off quicker. However, the final volume of gas given off will be $37cm^3$ as the volume of gas given off is fixed by the quantities of reactants used (which are the same in both experiments)
18b(i)	0.001	**n**o. of moles = **v**olume x **c**oncentration = 0.02litres x 0.05 mol l^{-1} = 0.001 mol
18b(ii)	0.04	concentration = $\frac{\textbf{no. of mol}}{\textbf{volume}}$ = $\frac{0.001\ mol}{0.025\ litres}$ = 0.04 mol l^{-1}
18c	sodium sulphate	ACID + METAL CARBONATE ⟶ SALT + WATER + CARBON DIOXIDE sulphuric acid + sodium carbonate ⟶ sodium sulphate + water + carbon dioxide