

Mearns Castle HS

NATIONAL 5 CHEMISTRY

Unit 3

Chemistry in Society



ANSWERS

EX. Questions

Metals

1. C (1)
2. B (1)
3. D (1)
4. B (1)
5. C (1)
6. D (1)
7. D (1)
8. D (1)
9. C (1)
10. D (1)
11. D (1)
12. C (1)
13. A (1)
14. A (1)
15. A (1)
16. A (1)
17. D (1)
18. Delocalised (free) electrons (1)
Electrons are free to move
Electrons can pass through

19.	(a)	d.c. or direct current 1	Not acceptable : Battery, lab pack
	(b)	Chlorine gas Bubbles of gas Gas given off Fizzing/effervescence Green/yellow gas Cl ₂ (g) 1	

20.	(a)	<p>A ← B</p> <p>On or close to the wires</p> <p style="text-align: right;">1</p>	<p>Not acceptable : Arrow in solution or arrow continues into solution or ion bridge → Negates: Also negates if arrow also drawn on wire correctly.</p>
	(b)	<p>$Au^+(aq) + e^- \longrightarrow Au(s)$</p> <p>State symbols not needed. Negative sign on electron not needed.</p> <p style="text-align: right;">1</p>	
	(c)	<p>Ion bridge/salt bridge Filter paper soaked in salt solution/electrolyte.</p> <p style="text-align: right;">1</p>	<p>Not acceptable: Ion-electron bridge Electrolyte or bridge on its own.</p>

21.	<p style="text-align: center;">(MgSO₄)</p> <p style="text-align: right;">1</p>	<p style="text-align: center;">(SO₄)</p>
-----	--	---

22.	(a)	<p>displacement redox</p> <p style="text-align: right;">1</p>	<p>Not acceptable: Oxidation/reduction</p>
	(b) (i)	<p>B/negative</p> <p style="text-align: right;">1</p>	
	(b) (ii)	<p>$2Cl^- \longrightarrow Cl_2 + 2e^-$</p> <p>As per data booklet, ignore state symbols.</p> <p>$2Cl^- - 2e^- \longrightarrow Cl_2$</p> <p>$Cl^- \rightarrow \frac{1}{2} Cl_2 + e^-$</p> <p style="text-align: right;">1</p>	<p>$Cl^- \longrightarrow Cl + e^-$</p>

23.	<p>FM = 232.5 (1) 200.5/232.5 x 100 = 86.2% or 86% (1)</p> <p>86.2% or 86% on its own 2 marks Use of atomic numbers max 1 mark, must have working to gain the mark, 83.3% Metal other than Hg max 1 mark</p>	
-----	--	--

35	(a)	2^+ two positive $+2$ positive 2	1
	(b)	$gfm = 239$ (1) mark $207/239 \times 100 = 86.6$ (1) mark Allow follow through error 86.6% (87%) on its own (2) marks Max 1 mark if atomic numbers used 83.7/84% but nothing if on its own. Sulphur $13.39/13.4 = 1$ mark Chemical error -1	2

Properties of Plastics

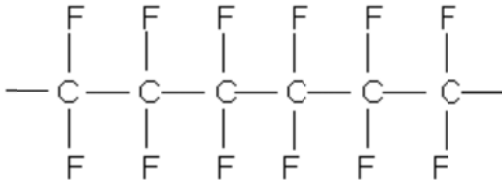
1. A (1)
2. C (1)
3. B (1)
4. A (1)
5. D (1)
6. D (1)
7. C (1)

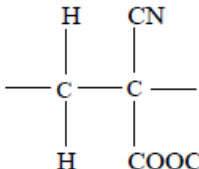
8.		$ \begin{array}{c} \text{H} & \text{Cl} \\ & \\ \text{C} & = & \text{C} \\ & \\ \text{H} & \text{Cl} \end{array} \quad \text{or} \quad \begin{array}{c} \text{Cl} & \text{H} \\ & \\ \text{C} & = & \text{C} \\ & \\ \text{Cl} & \text{H} \end{array} $	<p>Not acceptable:</p> $ \begin{array}{c} \text{Cl} & \text{H} \\ & \\ \text{C} & = & \text{C} \\ & \\ \text{H} & \text{Cl} \end{array} $
		1	

9.		<p>Diagram must show three monomer units linked together One end bond missing no penalty</p>	<p>Not acceptable: If molecule closed at both ends zero marks.</p>
		1	

10.		D 1	
------------	--	------------	--

11.	(a)	$ \begin{array}{c} \text{H} & \text{COOH} \\ & \\ \text{C} & = & \text{C} \\ & \\ \text{H} & \text{H} \end{array} $ <p>allow one slip – missing H atom OR missing C – H bond but not C=O or – O – H ignore brackets around correct monomer. 1</p>	<p>Not acceptable: COOH if expanded must be correct. Repeating unit and monomer shown with no indication of steps involved (professional judgement).</p>
	(b)	<p>Polar covalent 1</p>	<p>Not acceptable: Covalent Any reference to networks Hydrogen bonding</p>

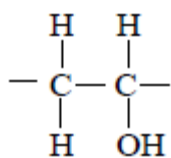
12	(a)	 <p>both end bonds must be present, dotted lines, squiggles / allow one missing C to F bond/ allow one missing F don't penalise for size/shape of F must have 6 carbons ignore brackets 1</p>	<p>Not acceptable: missing C to C bond/ end bonds Carbon to carbon double bond not end</p>
	(b)	Addition/ additional 1	

13	(a)	 <p>Ignore one missing end bond</p>	1
	(b)	Carbon = 8 hydrogen = 17	1
	(c)	Carbon monoxide or CO Hydrogen cyanide or HCN	1

14	(a)	Human made Man made/unnatural/not natural Made in lab/factory/chemical industry Made by scientists Made not found Made by men/women	1	
	(b)	(i)	Allow one end bond to be missing without penalty Ignore brackets, ignore bond to wrong element in group	1
		(ii)	Addition/Additional	1
	(c)	Carbon monoxide/CO	1	

15. (a) hydroxyl (1)

(b)



Allow shortened formula but must show bonds (1)

(c) Soluble in water/dissolves (1)

Breaks down in water

Degrades in water

Disintegrates in water

Fertilisers

1. C (1)

2.	(a)	Arrows drawn from unreacted gases to hydrogen and nitrogen box or catalyst box or between these two	1	
	(b) (i)	Platinum, Pt	1	
	(b) (ii)	It is an exothermic reaction The reaction produces heat	1	

3.		Speed up reaction, too slow at 200°C	1	Not acceptable: Any mention of decomposition Cost Negates: Faster & produces more ammonia
----	--	--------------------------------------	---	---

4.		FM = 174g (1 mark) $78/174 \times 100 = 44.8$ (1 mark) 44.8 or 45 on its own 2 marks Using atomic numbers 44% (max 1 mark) 44 must have working If use mass of one potassium max 1 mark If use S or O max 1 mark		Not acceptable: 44 on its own zero If use element not in potassium
----	--	--	--	---

5	(a)	Both scales correct Both labels correct	1 mark	
		Plots correct Joining points	1 mark	
		Allow ½ box tolerance Allow 1 plotting error		
		Bar graph max 1 mark Straight line graph max 1 mark		
		Axes can be reversed		2
	(b)	60 ± 1 – if no graph drawn If graph drawn answer should be checked against candidate's graph (allow ½ box tolerance)		1
	(c)	Alkali/a hydroxide/base		1

6	(a)	Lightning	1
	(b)	Bacteria/nitrogen – fixing/nitrifying bacteria	1
	(c)	Ammonia/NH ₃	1
	(d)	As the temperature ^{increases} <i>decreases</i> solubility ^{decreases} <i>increases</i> The solubility decreases as the temperature increases	1

7	(a)	(i)	Ostwald	1
		(ii)	Reaction is exothermic/gives out heat It is exothermic	1
		(iii)	Water/H ₂ O	1
	(b)	FM = 80 (1 mark) $\% = \frac{28 \times 100}{80} = 35$ (1 mark) 35 with no working (2 marks) Chemical error deduct 1 mark Atomic numbers used maximum 1 mark	2	

Nuclear Chemistry

1.		A	
----	--	---	--

2.	(a)	${}^{131}_{53}\text{I} \rightarrow {}^{131}_{54}\text{Xe} + {}^0_{-1}\text{e} \quad (1)$ ${}^{131}_{53}\text{I} \rightarrow {}^{131}_{54}\text{Xe} + {}^0_{-1}\text{e}^- \quad (1)$ ${}^{131}\text{I} \rightarrow {}^{131}\text{Xe} + \text{e}^- \quad (1)$ ${}^{131}\text{I} \rightarrow {}^{131}\text{Xe} + \text{e} \quad (1)$ ${}^{131}\text{I} \rightarrow {}^{131}\text{Xe} + \beta \quad (1)$	1 or 0
	(b)	8 days	1

3	(a)	${}^{89}\text{Sr} \rightarrow {}^{89}\text{Y} + \beta$ <p style="text-align: center;">or</p> ${}^{89}_{38}\text{Sr} \rightarrow {}^{89}_{39}\text{Y} + {}^0_{-1}\text{e}$ <p style="text-align: right;">1</p> <p>Atomic numbers not required- if shown, they must be correct Mass numbers shown top left as in question paper</p>	
	(b)	No effect/no change	1
	(c)	¼ or 0.25 or 25%	1

4	(a)	proton	90	1
		neutron	144	
	(b)	84		1

5	(a)	${}^3_1\text{H} \rightarrow {}^3_2\text{He} + {}^0_{-1}\text{e}$ or e^- or e or β	1
		or ${}^3_1\text{H} \rightarrow {}^3_2\text{He} + {}^0_{-1}\text{e}$ or e^- or e or β	
		(Ignore any charge on He; accept numbers on rhs)	
	(b)	(i) Rate of formation of tritium = rate of (beta) decay of tritium or tritium is being replaced as fast as it decays or tritium is in (dynamic) equilibrium or similar	1
		(ii) $3 \times 12.3 = 36.9$ years	1

6	a	$20 \rightarrow 10 \rightarrow 5 \rightarrow 2.5 \rightarrow 1.25$ MBq 4 half lives = 52 hours (1)	2
		half life = 13 hours (1) for answer (unit required)	
	b	it is a beta emitter and it is absorbed within the body gamma emitter required to pass through body	1

7 (a) time for the activity (or number of nuclei) (of a radioactive source) to reduce to half the original number/activity/its value (1)

(b) Activity 160 to 80 kBq \Rightarrow 6 hours (1)

(c) $160 \rightarrow 80 \rightarrow 40 \rightarrow 20 \rightarrow 10$
1 2 3 4

So activity is 10 (kBq) (unit not required) (1)

8	(a)	β or ${}^0_{-1}\text{e}$ or e^- or e or beta (particle)	1
	(b)	(i) curve down through points: Time/hours 0 6 12 18 24 Mass/g 0.5 0.25 0.125 0.06 0.03	1
		(ii) short half-life (or little will remain in the body after a short time) or not as ionising (as other radiation) or can pass right through the body (or can escape from the body)	1

9. C (1)

10. C (1)

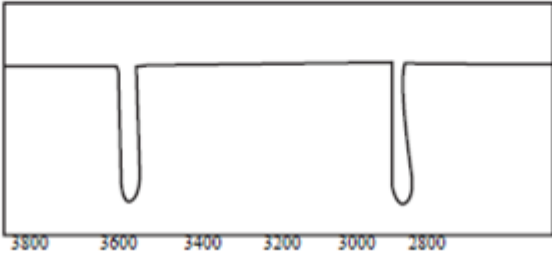
Chemical Analysis

1. D (1)
2. C (1)
3. B (1)
4. C (1)

5.	(a)	Indicator/named acid/base indicator pH/universal indicator	1	Not acceptable: Ferroxyl indicator Bicarbonate indicator
	(b)	Apply mole ratio 0.002 : 0.004 1 mark 0.004 on its own 1 mark		

6.		Apply mole ratio 1:1 0.001: 0.001 1 mark 0.001 = c x 0.025 c = 0.04 1 mark		
----	--	---	--	--

7.	(a)	16.0/ 16	1	
	(b)	moles of Br ₂ = 0.5 × 0.016 = 0.008 1 mark moles of C ₁₀ H ₁₆ = $\frac{0.008}{2}$ = 0.004 1 mark concentration of C ₁₀ H ₁₆ = $\frac{0.004}{0.02}$ = 0.2 1 mark Or 0.2025 (if 16.2 used) = 0.20/0.203 if rounded Allow follow through for incorrect answer above. $\frac{20 \times c_1}{1} = \frac{16 \times 0.5}{2}$ $40 \times c_1 = 8$ $c_1 = 0.2$		

8	(a)	Carbon-carbon double bond; C=C Double covalent bond
	(b)	Absorption at 2800-3000 and at 3600 

Question	Acceptable Answer
9 (a)	The reading on the pH probe shows 7/neutral (pH probe) turns green/becomes neutral/goes to 7 pH turns to 7 End point of neutralisation/complete neutralisation
(b)	<p>Moles of acid = $C \times V$ $= 0.1 \times 0.02$ $= 0.002$</p> <p>1 mole to 2 moles moles of NaOH = $0.002 \times 2 = 0.004$ $c = n/v$ $= 0.004/0.05$ $= 0.08$</p> <p>OR</p> <p>$H \times C \times V = OH \times C \times V$ $2 \times 0.1 \times 20 = 1 \times C \times 50$ $4 = 50C$</p> <p>$C = 4/50$ $= 0.08$</p> <p>OR</p> <p>$\frac{C_A V_A}{C_B V_B} = \frac{b}{a}$</p> <p>$\frac{0.1 \times 20}{C_B \times 50} = \frac{1}{2}$</p> <p>$C_B = \frac{0.1 \times 20 \times 2}{50}$</p> <p>$= \frac{4}{50}$</p> <p>$= 0.08$</p>

10 (a)	moles = C x V ½ mark $= 4 \times 0.05$ $= 0.2$ ½ mark 0.2 on its own – 1 mark If 50cm ³ used Max ½ mark	1
(b) (i)	0.1 Follow through applies - half of answer a	1
(b) (ii)	CaCO ₃ (100 ½ mark) $\text{mass} = 0.1 \times 100$ $= 10$ ½ mark Follow through Answer should be 100 × the answer given in part b(i)	1

11 (a)	25 cm ³	1
(b)	$n = c \times v$ $= 0.1 \times 0.025$ $= 0.0025 \text{ mol HCl}$ 1 : 1 0.0025 : 0.0025 mol NaOH follow through $c = \frac{n}{v}$ $= \frac{0.0025}{0.01}$ $= 0.25 \text{ mol/l NaOH}$ $c = \frac{n/m}{v} = \text{zero}$ OR $\text{OH}^- \times v \times c = \text{H}^+ \times v \times c$ $1 \times 10 \times \text{conc} = 1 \times 25 \times 0.1$ $\text{conc} = \frac{1 \times 25 \times 0.1}{1 \times 10}$ $= 0.25 \text{ mol/l}$ 0.25 on its own (2) marks No need for units Allow for follow through	2

Problem Solving Questions

1.	(a)	As the percentage increases...the density decreases As the percentage decreases...the density increases Density increases as percentage decreases Density decreases as percentage increases etc	1	Not acceptable: As the density increases percentage decreases eg wrong cause and effect
	(b)	20	1	

2.	(a)	Red, pink, orange, yellow	1	
	(b)	Line must be increasing Line stops at pH7 or below	1	

3.	(a)	Ionic Ionic lattice Ionic network	1	Not acceptable: Ionic molecular Lattice on its own Network on its own Sodium to chlorine bonds
	(b)	As concentration increases/decreases freezing point decreases/increases The freezing point decreases/increases as concentration increases/decreases As concentration increases freezing point gets colder	1	Not acceptable: Wrong cause & effect eg: As freezing point decreases concentration increases.
	(c)	-1.8 to -2.0 inclusive	1	Not acceptable: Statement Less than -1.5

4.	(a)	$\frac{9 \times 1.25}{3.8}$ $= 2.96$	1	2.9 or 3.0 or 3 without working – zero marks
		2.96/2.9605/2.961/2.9605263 on its own – 1 mark 3.0 or/3 with working		

5.	(a)	B	1	
----	-----	---	---	--

6.	(a)	(solution) C Last one/bottom one	1	
	(b)	any value above 4.4 and below 6.0 (not inclusive) must acknowledge both parameters number within range	1	Not acceptable: value below 6.0 value above 4.4

7.	(a)	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{C}=\text{O} \\ \quad \\ \text{H} \quad \text{H} \end{array} \quad \text{and} $ $ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}=\text{O} \\ & & & \\ \text{H} & \text{H} & \text{H} & \end{array} $ <p>both required for 1 mark allow one missing H or one missing C to H bond</p>		Not acceptable: No 5 bonded carbons
----	-----	---	--	---