

Chemical Equilibria

Mark Scheme

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Chemistry Lab Skills 2
Sub Topic	Chemical Equilibria
Booklet	Mark Scheme

Time Allowed: 26 minutes
Score: /21
Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

Question Number	Acceptable Answers	Reject	Mark
1(a)	<p>Na⁺</p> <p>OR</p> <p>Na⁺¹</p> <p>OR</p> <p>Na¹⁺</p> <p>IGNORE sodium or sodium ion</p>	<p>Na</p> <p>Any charge other than +1</p>	1

Question Number	Acceptable Answers	Reject	Mark
1(b)(i)	<p>Measure pH/Use of alkaline buffer solution (1)</p> <p>and acidic buffer solution (1)</p> <p>ALLOW</p> <p>Measure pH of a (alkaline) buffer solution... (1)</p> <p>with known pH (1)</p> <p>ALLOW</p> <p>Use of acid /alkali / (de-ionized/ distilled / pure) water / specified neutral solution (e.g. NaCl(aq)) (1)</p> <p>of known pH (1)</p> <p>OR</p> <p>Several solutions of known pH (1)</p> <p>Plot graph of meter reading against (known) pH (to give a calibration curve) (1)</p>	<p>Neutral for pH=7</p>	2

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1(b)(ii)	<p>Universal / full range indicator (paper / solution) (1)</p> <p>Colour changes to (dark) green / blue</p> <p>IGNORE</p> <p>Initial colour (1)</p> <p>Comment</p> <p>ALLOW for 1 mark</p> <p>Any named indicator from list below and its colour in alkali</p> <table border="1"> <thead> <tr> <th></th> <th>$pK_{in}(298\text{ K})$</th> <th colspan="2">pH range</th> </tr> <tr> <th></th> <th></th> <th>acid</th> <th>alkaline</th> </tr> </thead> <tbody> <tr> <td>1 Methyl violet</td> <td>0.8</td> <td>yellow</td> <td>0.0–1.6 blue</td> </tr> <tr> <td>2 Malachite green</td> <td>1.0</td> <td>yellow</td> <td>0.2–1.8 blue/green</td> </tr> <tr> <td>3 Thymol blue (acid)</td> <td>1.7</td> <td>red</td> <td>1.2–2.8 yellow</td> </tr> <tr> <td>4 Methyl yellow (in ethanol)</td> <td>3.5</td> <td>red</td> <td>2.9–4.0 yellow</td> </tr> <tr> <td>5 Methyl orange–xylene cyanole soln.</td> <td>3.7</td> <td>purple</td> <td>3.2–4.2 green</td> </tr> <tr> <td>6 Methyl orange</td> <td>3.7</td> <td>red</td> <td>3.2–4.4 yellow</td> </tr> <tr> <td>7 Bromophenol blue</td> <td>4.0</td> <td>yellow</td> <td>2.8–4.6 blue</td> </tr> <tr> <td>8 Congo red</td> <td>4.0</td> <td>violet</td> <td>3.0–5.0 red</td> </tr> <tr> <td>9 Bromocresol green</td> <td>4.7</td> <td>yellow</td> <td>3.8–5.4 blue</td> </tr> <tr> <td>10 Methyl red</td> <td>5.1</td> <td>red</td> <td>4.2–6.3 yellow</td> </tr> <tr> <td>11 Azolitmin (litmus)</td> <td></td> <td>red</td> <td>5.0–8.0 blue</td> </tr> <tr> <td>12 Bromocresol purple</td> <td>6.3</td> <td>yellow</td> <td>5.2–6.8 purple</td> </tr> <tr> <td>13 Bromothymol blue</td> <td>7.0</td> <td>yellow</td> <td>6.0–7.6 blue</td> </tr> <tr> <td>14 Phenol red</td> <td>7.9</td> <td>yellow</td> <td>6.8–8.4 red</td> </tr> <tr> <td>15 Thymol blue (base)</td> <td>8.9</td> <td>yellow</td> <td>8.0–9.6 blue</td> </tr> <tr> <td>16 Phenolphthalein (in ethanol)</td> <td>9.3</td> <td>colourless</td> <td>8.2–10.0 red</td> </tr> <tr> <td>17 Thymolphthalein</td> <td>9.7</td> <td>colourless</td> <td>8.3–10.6 blue</td> </tr> <tr> <td>18 Alizarin yellow R</td> <td>12.5</td> <td>yellow</td> <td>10.1–13.0 orange/red</td> </tr> </tbody> </table>		$pK_{in}(298\text{ K})$	pH range				acid	alkaline	1 Methyl violet	0.8	yellow	0.0–1.6 blue	2 Malachite green	1.0	yellow	0.2–1.8 blue/green	3 Thymol blue (acid)	1.7	red	1.2–2.8 yellow	4 Methyl yellow (in ethanol)	3.5	red	2.9–4.0 yellow	5 Methyl orange–xylene cyanole soln.	3.7	purple	3.2–4.2 green	6 Methyl orange	3.7	red	3.2–4.4 yellow	7 Bromophenol blue	4.0	yellow	2.8–4.6 blue	8 Congo red	4.0	violet	3.0–5.0 red	9 Bromocresol green	4.7	yellow	3.8–5.4 blue	10 Methyl red	5.1	red	4.2–6.3 yellow	11 Azolitmin (litmus)		red	5.0–8.0 blue	12 Bromocresol purple	6.3	yellow	5.2–6.8 purple	13 Bromothymol blue	7.0	yellow	6.0–7.6 blue	14 Phenol red	7.9	yellow	6.8–8.4 red	15 Thymol blue (base)	8.9	yellow	8.0–9.6 blue	16 Phenolphthalein (in ethanol)	9.3	colourless	8.2–10.0 red	17 Thymolphthalein	9.7	colourless	8.3–10.6 blue	18 Alizarin yellow R	12.5	yellow	10.1–13.0 orange/red		2
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1(b)(iii)	<p>A pH meter because...</p> <p>... difficult to match colour of indicator to pH</p> <p>OR</p> <p>...the colour of universal indicator covers a range of pH</p> <p>ALLOW</p> <p>pH meters measure to at least one decimal place (after calibration)</p> <p>OR</p> <p>pH meter with any reasonable attempt at an explanation e.g. indicators cover a range pH meters give exact values</p>	<p>pH meter alone</p> <p>Any untrue statement about pH meters or indicators</p>	1

Question Number	Acceptable Answers	Reject	Mark
1(c)(i)	<p>First mark - Observation</p> <p>Effervescence / bubbles (of gas) (1)</p> <p>IGNORE</p> <p>Test for carbon dioxide</p> <p>Gas evolved</p> <p>(Solid) sodium carbonate dissolves</p> <p>Second mark - Explanation</p> <p>because the sodium carbonate reacts with / neutralises acid(s) present (to form carbon dioxide)</p> <p>ALLOW</p> <p>carbon dioxide is formed (1)</p>	<p>Incorrect observations e.g. Solid/precipitate forms</p> <p>Negates first mark</p>	2

Question Number	Acceptable Answers	Reject	Mark
1(c)(ii)	Ester OR Methyl ester IGNORE compound (of carboxylic acid and alcohol)		1

Question Number	Acceptable Answers	Reject	Mark
1(d)	S $\text{CH}_3\text{COOCH}_3$ (1) R CH_3COOH (1) P $\text{CH}_3\text{COO}^{(-)}\text{Na}^{(+)}$ (1) ALLOW displayed/skeletal formulae ALLOW TE as below: TE from 2(a) TE for R and P based on their formula for S TE for P based on their formula for R Ignore names even if incorrect	$\text{CH}_3\text{COO}-\text{Na}$	3

(Total for Question 1 = 12 marks)

Question Number	Acceptable Answers	Reject	Mark
2(a)(i)	<p>Use of nichrome/platinum wire/rod</p> <p>ALLOW Nickel chromium wire (1)</p> <p>Dip wire into (concentrated) hydrochloric acid and then the solid</p> <p>ALLOW Mixing hydrochloric acid with salt then dipping in wire</p> <p>IGNORE References to cleaning wire (1)</p> <p>Place in/on (hot/roaring/blue cone of) Bunsen flame (and observe flame colour)</p> <p>This mark is consequential on first and second mark unless wire/salt placed in/on (hot/roaring/blue cone of) Bunsen flame (and observe flame colour) (1)</p>	<p>Nichrome / platinum alone</p> <p>Nickel / chromium wire</p> <p>Deflagrating / combustion spoon</p> <p>Sulfuric acid</p> <p>Any reference to burn/burning/burned</p> <p>Use of yellow Bunsen flame</p> <p>Under Bunsen flame</p> <p>In/on Bunsen burner</p>	3

Question Number	Acceptable Answers	Reject	Mark
2(a)(ii)	Na ⁺ (ions)	a alone Sodium (ion) Na ²⁺ /Fe ²⁺ /Cr ³⁺	1

Question Number	Acceptable Answers	Reject	Mark
2(b)(i)	<p>sulfur/S/S₈ (1)</p> <p>C sulfur dioxide/SO₂/sulfur(IV) oxide (1)</p>	Hydrogen sulfide / H ₂ S	2

Question Number	Acceptable Answers	Reject	Mark
2(b)(ii)	(Pale/light) yellow/straw ALLOW (light/pale) brown/red-brown	Orange/Red Correct colour 'to colourless' Also colourless to correct colour	1

Question Number	Acceptable Answers	Reject	Mark
2(b)(iii)	Thiosulfate	$S_2O_3^{2-}$	1

Question Number	Acceptable Answers	Reject	Mark
2(b)(iv)	$Na_2S_2O_3$ ALLOW Na_2SO_3 if sulfite/sulfite(IV)/ sulfate(IV) given in (b)(iii) Any number of H_2O 's in the formula COMMENT Any Group 1 or Group 2 metal ion with correct formula	Any additional salt formulae even if with correct answer.	1

Total for Question 2 = 9 marks