

**Unit Code:** H432/02

**Qual Name:** A level Chemistry A

**Qual Title:** Synthesis and analytical techniques

Question Set	Q. No	Total Marks	AO	Spec Ref.	Topic	Question Subject	Additional Notes/Comments
1	1	1	AO2	2.1.3e(ii), 2.1.3g, 2.1.3b(ii)	Amount of substance	MCQ	2.1 Atoms and reactions
1	2	1	AO1	2.1.3h(ii), 4.1.3f,	Amount of substance, Alkenes	MCQ	2.1 Atoms and reactions 4.1 Basic concepts and hydrocarbons
1	3	1	AO2	2.1.3h(ii)	Amount of substance	MCQ	2.1 Atoms and reactions
1	4	1	AO2	2.1.3h(i), 2.1.3a(ii)(iv), 2.1.3e(i), 2.1.3g 1.1.3a,b	Amount of substance	MCQ	2.1 Atoms and reactions
2	1	1	AO1	2.2.2g,h	Structure and bonding	MCQ	2.2 Electons, bonding and structure
2	2	1	AO2	2.2.2h,	Structure and bonding	MCQ	2.2 Electrons, structure and bonding
3	1	1	AO1	4.1.1c(v)(vii)	Basic concepts of organic chemistry	MCQ	4.1 Basic concepts and hydrocarbons
3	2	1	AO2	4.1.3c(i)(ii)	Alkenes	MCQ	4.1 Basic concepts and hydrocarbons
3	3	1	AO1	4.1.1b(iv), 2.1.3b(ii)	Basic concepts of organic chemistry, Amount of substance	MCQ	2.1 Atoms and reactions 4.1 Basic concepts and hydrocarbons
3	4	1	AO1	4.1.2f, 4.1.1g,	Basic concepts of organic chemistry	MCQ	4.1 Basic concepts and hydrocarbons
3	5	1	AO2	4.1.1a,e	Basic concepts of organic chemistry	MCQ	4.1 Basic concepts and hydrocarbons
3	6	1	AO1	4.1.1c(v)	Basic concepts of organic chemistry	MCQ	4.1 Basic concepts and hydrocarbons
3	7	1	AO1	4.1.2c	Alkanes	MCQ	4.1 Basic concepts and hydrocarbons
3	8	1	AO2	4.1.2f	Alkanes	MCQ	4.1 Basic concepts and hydrocarbons
3	9	1	AO1	4.1.1a	Basic concepts of organic chemistry	MCQ	4.1 Basic concepts and hydrocarbons
3	10	1	AO1	4.1.3c(i)(ii)	Alkenes	MCQ	4.1 Basic concepts and hydrocarbons
3	11	1	AO2	4.1.2a, 4.1.3a	Alkanes, alkenes	MCQ	4.1 Basic concepts and hydrocarbons
4	1	1	AO1	4.2.2a(ii), 1.1.3a	Haloalkanes	MCQ	4.2 Alcohols, Haloalkanes and analysis
4	2	1	AO1	4.2.2b	Haloalkanes	MCQ	4.2 Alcohols, haloalkanes and analysis
4	3	1	AO1	4.2.2e(ii)	Haloalkanes	MCQ	4.2 Alcohols, haloalkanes and analysis

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4	4	1	AO2	4.2.4d	Analytical techniques	MCQ	4.2 Alcohols, haloalkanes and analysis
4	5	1	AO2	4.2.4(g)	Analytical techniques	MCQ	4.2 Alcohols, haloalkanes and analysis
4	6	1	AO2	4.2.2a(i)	Haloalkanes	MCQ	4.2 Alcohols, haloalkanes and analysis
5	1	1	AO2	6.1.3f	Carboxylic acids and esters	MCQ	6.1 Aromatic compounds, carbonyls and acids
5	2	1	AO2	2.1.3a(ii)(iii), 2.1.3g, 6.1.3b	Amount of substance, Carboxylic acids and esters	MCQ	6.1 Aromatic compounds, carbonyls and acids 2.1 Atoms and reactions
5	3	1	AO2	6.1.3f	Carboxylic acids and esters	MCQ	6.1 Aromatic compounds, carbonyls and acids
5	4	1	AO2	6.1.1d(iii), 6.2.4d	Aromatic compounds, Carbon-carbon bond formation	MCQ	6.1 Aromatic compounds, carbonyls and acids 6.2 Nitrogen compounds, polymers, and synthesis
5	5	1	AO1	6.1.1b	Aromatic compounds	MCQ	6.1 Aromatic compounds, carbonyls and acids
5	6	1	AO1	6.1.1i(i), 6.1.1k,l	Aromatic compounds	MCQ	6.1 Aromatic compounds, carbonyls and acids
5	7	1	AO1	6.1.2b(i), 4.2.1a(ii)	Carbonyl compounds, Alcohols	MCQ	6.1 Aromatic compounds, carbonyls and acids 4.2 Alcohols, haloalkanes and analysis
5	8	1	AO1	6.1.1h, i(i)(ii), 6.1.3f	Aromatic compounds, Carboxylic acids and esters	MCQ	6.1 Aromatic compounds, carbonyls and acids
6	2	1	AO2	6.2.2d	Amino acids, amides and chirality	MCQ	6.2 Nitrogen compounds, polymers and synthesis
6	7	1	AO1	6.2.2d	Amino acids, amides and chirality	MCQ	6.2 Nitrogen compounds, polymers and synthesis
6	8	1	AO2	6.2.3c(ii)	Polyesters and polyamides	MCQ	6.2 Nitrogen compounds, polymers and synthesis
6	9	1	AO1	6.2.5	Organic synthesis	MCQ	6.2 Nitrogen compounds, polymers and synthesis
6	3	1	AO1	6.2.2b	Amino acids, amides and chirality	MCQ	6.2 Nitrogen compounds, polymers, and synthesis
6	4	1	AO2	4.1.1e, 6.2.2d	Basic concepts of organic chemistry, Amino acids, amides and chirality	MCQ	4.1 Basic concepts and hydrocarbons 6.2 Nitrogen compounds, polymers, and synthesis
6	4	1	AO2	4.1.1e, 6.2.2d	Basic concepts of organic chemistry, Amino acids, amides and chirality	MCQ	4.1 Basic concepts and hydrocarbons 6.2 Nitrogen compounds, polymers, and synthesis

Question Set	Q. No	Total Marks	AO	Spec Ref.	Topic	Question Subject	Additional Notes/Comments
6	6	1	AO2	6.1.1d(iii), 6.2.4b(i)	Aromatic compounds, Carbon-carbon bond formation	MCQ	6.1 Aromatic compounds, carbonyls and acids 6.2 Nitrogen compounds, polymers, and synthesis
7	1	1	AO2	6.3.2b(i),	Spectroscopy	MCQ	6.3 Analysis
7	2	1	AO1	6.3.2d(i)	Spectroscopy	MCQ	6.3 Analysis
7	3	1	AO2	6.3.2b(i)	Spectroscopy	MCQ	6.3 Analysis
7	4	1	AO2	6.3.2a(i)(ii)(iii)	Spectroscopy	MCQ	6.3 Analysis
7	4	1	AO2	6.3.2a(i)(ii)(iii)	Spectroscopy	MCQ	6.3 Analysis
7	5	1	AO2	6.3.2a(i)	Spectroscopy	MCQ	6.3 Analysis
8	2(a)	2	AO1, AO2	4.1.2(c)	Alkanes	Alkenes, including stereoisomerism, mechanism and mole calculation	
8	2(b)(i)	1	AO1	4.1.1a	Basic concepts of organic chemistry		
8	2(b)(ii)	1	AO1	4.1.3c(i)	Alkenes		
8	2(b)(iii)	2	AO1, AO2	4.1.3d	Alkenes		
8	2(c)	1	AO1	4.1.3a	Alkenes		
8	2(d)(i)	1	AO1	4.1.3g	Alkenes		
8	2(d)(ii)	2	AO1	4.1.3f(iii), 4.1.3i	Alkenes		
8	2(d)(iii)	3	AO1, AO2	4.1.1i, 4.1.3h	Basic concepts of organic chemistry, Alkenes		
8	2(d)(iv)	1	AO1	4.1.3i	Alkenes		
8	2(e)(i)	2	AO1	4.1.3f(i), 2.1.3e(i)(ii), 2.1.3g	Alkenes, Amount of substance		
8	2(e)(ii)	4	AO2	4.1.3f(i), 2.1.2b, 2.1.3a(iv), 2.1.3e(i)(ii), 2.1.3g	Alkenes, Compounds, formulae and equations		
9	3(a)(i)	5	AO1, AO2	6.1.1d(i), 6.1.1e	Aromatic compounds	Reactions of aromatic compounds, including an experimental preparation	

Question Set	Q. No	Total Marks	AO	Spec Ref.	Topic	Question Subject	Additional Notes/Comments
9	3(a)(ii)	6	AO1, AO2, AO3	2.1.3e(i) 2.1.3h(i) 6.2.5a(i)(ii) 1.1.1a	Amount of substance, Basic concepts of organic chemistry	Organic compounds of nitrogen, including nitriles, amines and polymers	Level of response
9	3(b)(i)	1	AO2	6.1.1j, 1.1.3a,	Aromatic compounds		
9	3(b)(ii)	3	AO1, AO3	6.1.1j,	Aromatic compounds		
9	3(c)(i)	3	AO2	6.1.1d(ii), 6.2.1b(ii)	Aromatic compounds, Amines		
9	3(c)(ii)	3	AO3	6.2.5b(ii), 6.2.5c, 6.1.1k,l	Organic synthesis, Aromatic compounds		
10	4(a)(i)	3	AO1, AO2	6.2.4b(i), 4.2.2c, 4.1.1i	Carbon-carbon bond formation, Haloalkane, Basic concepts of organic chemistry	Organic compounds of nitrogen, including nitriles, amines and polymers	
10	4(a)(ii)	3	AO1, AO2	6.1.2b(ii), 6.2.4b(i), 6.2.4c(i)(ii), 6.2.5b(i)(ii)	Carbonyl compounds, Carbon-carbon bond formation, Organic synthesis		
10	4(a)(iii)	2	AO1, AO2	6.2.1a	Amines		
10	4(a)(iv)	3	AO2	6.2.3c(i), 6.2.3b(i)	Polyesters and polyamides		
10	4(b)(i)	2	AO2	6.2.3a(ii), 6.2.3c(ii)	Polyesters and polyamides		
10	4(b)(ii)	1	AO2	6.2.3a(ii), 2.1.3a(iv), 2.1.3g,	Polyesters and polyamides, Amount of substance		
11	5(a)	1	AO2	4.2.1b, 2.1.2(b),	Alcohols, Compounds, formulae and equations	Properties and reactions of alcohols	
11	5(b)(i)	2	AO1, AO2	4.2.1a(i), 2.2.2l,	Alcohols, Bonding and structure		
11	5(b)(ii)	1	AO3	4.2.1a(i)	Alcohols		
11	5(c)(i)	5	AO1, AO2	6.1.2b(i), 4.2.1d,e	Carbonyl compounds, Alcohols		
11	5(c)(ii)	1	AO1	4.1.1a	Basic concepts of organic chemistry		
11	5d	5	AO2	4.2.1c(i), 1.1.1a,c, 2.1.2b	Alcohols, Compounds, formulae and equations		

Question Set	Q. No	Total Marks	AO	Spec Ref.	Topic	Question Subject	Additional Notes/Comments
12	6a	3	AO1, AO2	2.1.3c, 4.2.4f,	Amount of substance, Analytical techniques	Analysis of an aromatic compound by mass spectrometry and <sup>13</sup> C NMR spectroscopy	
12	6b	3	AO3	6.3.1c(iii)(iv)(v), 1.1.3a	Chromatography and qualitative analysis		
12	6c	3	AO3	6.3.2e(i)(ii)(iv)	Spectroscopy		
13	7	6	AO3	4.2.4c(i)(iii), 4.2.4d, 6.1.3d(i), 6.3.2b, 6.3.2e(iii)(iv), 1.1.3a,	Analytical techniques, Carboxylic acids and esters, Spectroscopy	Analaysis of organic compounds by IR and H NMR spectroscopy	Level of response
14	2(a)(i)	1	AO1	4.1.1a	Basic concepts of organic chemistry	Reactions of alcohols and carboxylic acids	
14	2(a)(ii)	1	AO1	4.1.1b(ii)	Basic concepts of organic chemistry		
14	2(a)(iii)	2	AO2	4.2.1d	Alcohols		
14	2(a)(iv)	2	AO1, AO2	2.1,2b, 4.2.1e	Compounds, formulae and equations, Alcohols		
14	2(b)	2	AO2	2.1,2b, 4.2.1c(i)(ii)(iii)	Compounds, formulae and equations, Alcohols		
14	2(c)	3	AO2	4.1.3f(iv), 4.1.3j(i), 6.1.3c(i)	Alkenes, Carboxylic acids and esters		
15	3(a)	2	AO1	6.2.2c,d	Amino acids, amides and chirality	Stereochemistry and reactions of amino acids	
15	3(b)	2	AO2	6.2.2a(ii)	Amino acids, amides and chirality		
15	3(c)	3	AO2	6.2.3b(ii)	Polyesters and polyamides		
16	4(a)(i)	3	AO3	6.3.2a(iii), 6.3.2c	Spectroscopy	Aromatic compounds, including <sup>13</sup> C NMR analysis and a an unfamiliar mechanism	
16	4(a)(ii)	3	AO1	6.1.1j	Aromatic compounds		

Question Set	Q. No	Total Marks	AO	Spec Ref.	Topic	Question Subject	Additional Notes/Comments
16	4(b)	3	AO2	4.1.1h,i, 6.1.1g	Basic concepts of organic chemistry, Aromatic compounds		
17	5(a)	2	AO1	4.2.2d	Haloalkanes	Hydrolysis of a haloalkane, including a mechanism and mole calculation	
17	5(b)	3	AO1, AO2	4.2.2c, 4.1.1h,i	Haloalkanes, Basic concepts of organic chemistry		
17	5(c)(i)	2	AO1	4.2.3a(i), 1.1.1a	Organic synthesis		
17	5(c)(ii)	3	AO3	2.1.3e(i), 2.1.3g, 3.1.3g, 4.2.2a(i), 4.2.2a(ii), 1.1.3a	Amount of substance, Haloalkanes		
18	6(a)	2	AO1	4.1.3c(ii)	Alkenes	Stereochemistry, qualitative tests and reactions of an unsaturated aldehydes	
18	6(b)(i)	1	AO1	1.1.1.a, 4.1.3f(ii), 6.3.1c(i)	Alkenes, Chromatography and qualitative analysis		
18	6(b)(ii)	1	AO1	1.1.1a, 6.1.2e(i), 6.3.1c(v)	Carbonyl compounds, Chromatography and qualitative analysis		
18	6(b)(iii)	3	AO1	1.1.1a, 6.1.2d(ii), 6.3.1c(iv)	Carbonyl compounds, Chromatography and qualitative analysis		
18	6(c)	5	AO1, AO2	4.1.3f(i), 6.1.2b(i), 6.2.4b(ii), 6.2.4c(i)(ii)	Carbonyl compounds, Carbon-carbon bond formation		
18	6(d)	6	AO1, AO2, AO3	4.1.1h, 4.1.1i, 4.1.3f(ii), 4.1.3h, 4.1.3i	Basic concepts of organic chemistry, Alkenes		Level of response
19	7(a)	3	AO2	6.1.1h, 6.1.1i(i), 6.1.3b	Aromatic compounds, Carboxylic acids and esters	Aromatic carboxylic acids, including reactions, polymers and gas chromatography analysis	
19	7(b)	4	AO1, AO2	6.1.3e, 6.1.3f, 6.2.3c(i), 6.2.5c	Carboxylic acids and esters, Polyesters and polyamides, Organic synthesis		

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19	7(c)(i)	2	AO2, AO3	2.1.3e(i)(iii), 6.3.1b(ii)	Amount of substance Chromatography and qualitative analysis		
19	7(c)(ii)	3	AO2, AO3	6.3.2e(ii)	Spectroscopy		
20	8(a)	1	AO2	2.1.2b, 4.1.2e	Compounds, formulae and equations, Alkanes	Boiling points of alkanes and alcohols, analysis involving mole calculation and H NMR spectroscopy	
20	8(b)	4	AO1, AO2	2.2.2k,l,o 4.1.2c, 4.2.1a(i)	Structure and bonding, Alkanes, Alcohols		
20	8(c)(i)	5	AO3	2.1.3c, 2.1.3e(i)	Amount of substance		
20	8(c)(ii)	2	AO3	2.1.2b	Compounds, formulae and equations		
20	8(d)	6	AO1, AO3	2.1.3c, 4.2.4f, 6.3.2b(i)(ii)(iii)(iv)(v), 6.3.2d(iii), 6.3.2e(i)(ii)(iv)	Amount of substance, Analytical techniques, Spectroscopy		Level of response
21	2a(i)	4	AO1, AO2	4.1.3h,i	Alkenes	Alkenes, including mechanism, chemical tests and stereochemistry	
21	2a(ii)	2	AO1	4.1.3i	Alkenes		
21	2b(i)	2	AO1	6.1.2e(i) 1.1.1a,c	Carbonyl compounds		
21	2b(ii)	2	AO1	4.1.1e	Alkenes		
21	2b(iii)	1	AO1	4.1.3c(i)	Alkenes		
21	2b(iv)	4	AO1, AO2	4.1.3c(i),d 6.2.2c,d	Alkenes, Amino acids, amides and chirality		
22	3a(i)	4	AO2	6.2.2a(i)(ii), 6.1.3f	Amino acids, amides and chirality, Carboxylic acids and esters	Reactions of amino acids and analysis by acid–base titration and TLC	
22	3a(ii)	4	AO2, AO3	2.1.3a(ii)(iv), 2.1.3e(i)(iii), 2.1.4e 1.1.3a,b, 1.1.4a	Amount of substance, Acids		
22	3b(i)	1	AO1	6.3.1a 1.1.3a,b	Chromatography and qualitative analysis		

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22	3b(ii)	2	AO2	6.3.1a 1.1.3a	Chromatography and qualitative analysis		
23	4a(i)	1	AO1	4.1.1a	Basic concepts of organic chemistry	Esters, including reactions, NMR spectroscopy, mass spectrometry and organic synthesis	
23	4a(ii)	5	AO2	6.1.3d(i)(ii), 4.2.2a(i)	Carboxylic acids and esters, Haloalkanes		
23	4a(iii)	1	AO1	6.1.3d(i)	Carboxylic acids and esters		
23	4b	4	AO3	6.3.2b(ii)(iii)(iv)(v)	Spectroscopy		
23	4c	1	AO3	6.3.2a(iii), 4.1.1e	Basic concepts of organic chemistry		
23	4d	2	AO2	6.2.3a(i), 2.1.3a(ii)(iv), 2.1.3e(i) 2.1.3g	Polyesters and polyamides, Amount of substance		
23	4e(i)	6	AO3	2.1.2b, 2.1.3a(i)(iv), 2.1.3e(i), 6.1.2a 6.1.3c(i) 1.1.1a,b, 1.1.3a,b	Compounds, formulae and equations Amount of substance, Carboxylic acids and esters		Level of response
23	4e(ii)	2	AO2	4.2.4g	Analytical techniques		
24	5a(i)	3	AO1	6.1.1a	Aromatic compounds	Aromatic compounds (structure and mechanism), polymerisation and synthetic routes from an aromatic ketone	
24	5a(ii)	2	AO1	6.1.1b	Aromatic compounds		
24	5b(i)	3	AO1, AO2	4.1.3j(i), 6.2.3a(i)(ii), 6.2.3a(ii),c(i)	Alkenes, Polyesters and polyamides		
24	5b(ii)	1	AO1	4.1.3j, 6.2.3c(iii)	Alkenes, Polyesters and polyamides		
24	5b(iii)	5	AO1, AO2, AO3	4.1.1h, 6.1.1d(iii) 6.1.1g, 6.2.4d	Basic concepts of organic chemistry, Aromatic compounds, Carbon-carbon bond formation		



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24	5b(iv)	7	AO1	6.2.5c, 6.1.2b(i)(ii), 4.2.1d, 6.2.4a,b(ii), 4.2.1e, 6.2.1b(i), 6.2.4c(ii)	Organic synthesis, Carbonyl compounds, Alcohols, Carbon-carbon bond formation, Amines		
25	6a(i)	1	AO1	4.1.1h,i	Basic concepts of organic chemistry	Unfamiliar reaction mechanisms	
25	6a(ii)	2	AO3	4.1.1i	Basic concepts of organic chemistry		
25	6a(iii)	2	AO1	4.1.1f(ii)	Basic concepts of organic chemistry		
25	6b(i)	4	AO3	4.1.1i	Basic concepts of organic chemistry		
25	6b(ii)	1	AO1	4.2.2b	Haloalkanes		
26	7	6	AO1, AO3	4.2.4c(iii), 6.3.2e(i)(ii)(iii)(iv), 6.3.2b(i)(ii)(iii)(iv)(v)	Analytical techniques, Spectroscopy	Analysis using elemental composition data and IR and H NMR spectroscopy	Level of response