Past-paper walk-through

Amides ▪ 34.3

eXercise

Questions in this set

- 9701/41 N25 Q9 ▪ 9 marks
- 9701/41 N25 Q7 ▪ 12 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

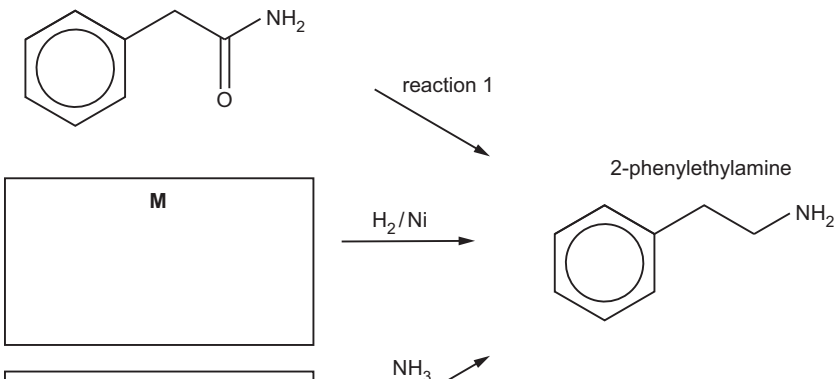
Question 9

9701/41 N25 ▪ Q9 ▪ 9 marks

9 **(a)** Explain why amides are much weaker bases than amines.

Question 9

(b) Fig. 9.1 shows the preparation of 2-phenylethylamine, $C_6H_5CH_2CH_2NH_2$, by three different routes.



Question 9

Fig. 9.1

(i) Suggest structures for compounds **M** and **N** and draw them in the boxes in Fig. 9.1. [2]

(ii) Give the reagents and conditions for reaction 1.

Question 9

(c) Fig. 9.2 shows compound **H** which is a useful starting material in organic synthesis.

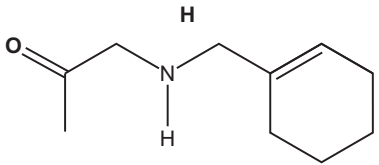


Fig. 9.2

H contains an alkene and an amine functional group.

Name the **other** functional group and give the classification of the amine group in **H**.

Question 9

[1]

(d) Ozonolysis involves the oxidative cleavage of a C=C bond in alkenes using ozone, O_3, as shown in Fig. 9.3.

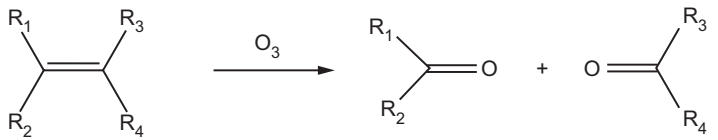


Fig. 9.3

Fig. 9.4 shows the first step in this reaction which involves the formation of an ozonide intermediate.

ozonide

Question 9

Question 9

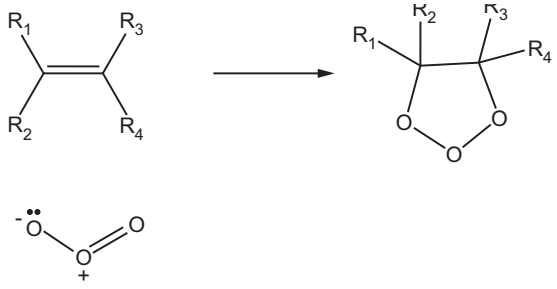


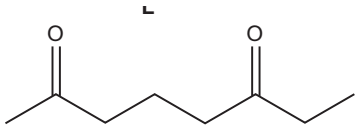
Fig. 9.4

(i) On Fig. 9.4, draw **three** curly arrows to complete the mechanism of this step. [2]

(ii) **L** is formed from alkene **K**, C_8H_{14}, by a similar reaction to that shown in Fig. 9.3.

Question 9

Question 9



Suggest the structure of **K**.

K C_8H_{14}

[1]

Question 9

Question 9

[Total: 9]

Important values, constants and standards

molar gas constant	$R = 8.31\,\text{J K}^{-1}\,\text{mol}^{-1}$
Faraday constant	$F = 9.65 \times 10^{4}\,\text{C mol}^{-1}$
Avogadro constant	$L = 6.02 \times 10^{23}\,\text{mol}^{-1}$
electronic charge	$e = -1.60 \times 10^{-19}\,\text{C}$
molar volume of gas	$V_m = 22.4\,\text{dm}^3\,\text{mol}^{-1}$ at s.t.p. (101 kPa and 273 K) $V_m = 24.0\,\text{dm}^3\,\text{mol}^{-1}$ at room conditions
ionic product of water	$K_w = 1.00 \times 10^{-14}\,\text{mol}^2\,\text{dm}^{-6}$ (at 298 K (25 °C))
specific heat capacity of water	$c = 4.18\,\text{kJ kg}^{-1}\,\text{K}^{-1}$ ($4.18\,\text{J g}^{-1}\,\text{K}^{-1}$)

Question 9

ts

		13	14	15	16	17	
							H he 4
		5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	N n 2
	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	A a 3
J ar 5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	K kr 8
J r 9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	X xe 13
J l 0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium –	85 At astatine –	R ra
J nium	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	C oga

66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0
98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

Question 9

The Periodic Table of Elemen

Group

				1 H hydrogen 1.0			

Key

atomic number
tomic symbol
name
relative atomic mass

	5	6	7	8	9	10	11
	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu coppe 63.5
	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium –	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silve 107.
	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.
m	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgen –

	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium –	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbiu 158.
	91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkeli –

1	2		
3 Li lithium 6.9	4 Be beryllium 9.0		a
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordiu –

lanthanoids	57 La lanthanum 138.9	58 Ce cerium 140.1
actinoids	89 Ac actinium –	90 Th thorium 232.0

Solution 9

(a)

Mark scheme

- M1: (basicity linked to) ability of lone pair / p-orbital to
- AND accept / coordinate with a proton / H+
- M2: (lone pair of) electrons on N is delocalised into C=O group (and make amides neutral)
- 2
- 9701/41
- October/November 2025

Solution 9

(b)(i)

Mark scheme

- M1: M
- M2: N
- 2

Solution 9

(b)(ii)

Mark scheme

- LiAl H4
- 1

Solution 9

(c)

Mark scheme

- ketone / carbonyl AND secondary / 2o
- 1

Solution 9

(d)(i)

Mark scheme

- curly arrow 1: from O lone pair to C atom (in C=C)
- curly arrow 2: from C=C bond to the right-hand O atom in O=O
- curly arrow 3: from O=O bond to O+
- 2
- 9701/41
- October/November 2025

Solution 9

(d)(ii)

Mark scheme

- 1

Question 7

9701/41 N25 ▪ Q7 ▪ 12 marks

7 **(a)** State the relative acidities of bromoethanoic acid, $BrCH_2COOH$, chloroethanoic acid, $ClCH_2COOH$, ethanoic acid, CH_3COOH and ethanol, CH_3CH_2OH.

Explain your answer.

Question 7

most acidic

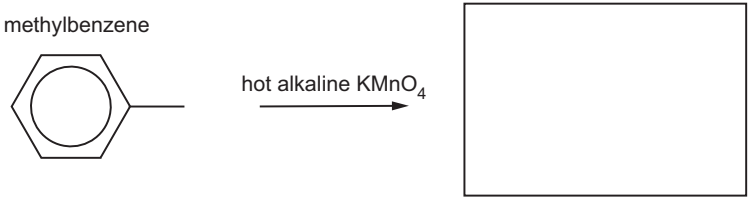
least acidic

Question 7

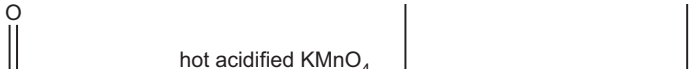
[4]

(b) Fig. 7.1 shows the reaction of methylbenzene and ethanedioic acid with $KMnO_4$.

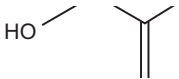
Predict the major carbon-containing product for each of these reactions.



Question 7



Question 7



Question 7

Fig. 7.1

[2]

(c) Polyamide **X** can be synthesised from ethanedioic acid and benzene-1,4-diamine.

benzene-1,4-diamine

(i) Draw the repeat unit of polyamide **X** in the box.

The new functional group formed should be shown displayed.

polyamide **X**

Question 7

polyamide A

Question 7

[2]

(ii) Benzene-1,4-diamine can be formed by reduction of 1,4-dinitrobenzene.

Complete the equation for this reduction.

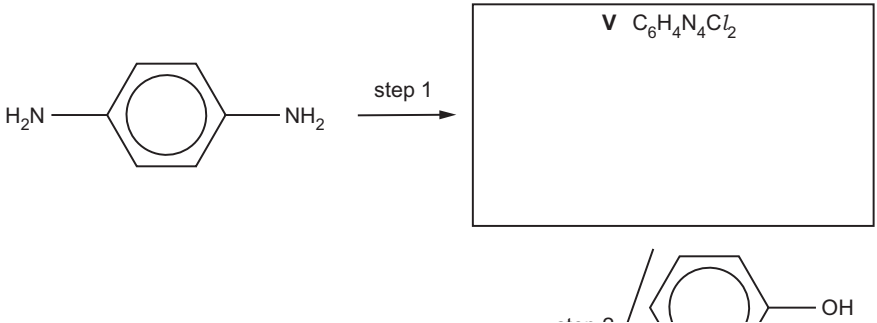
[H] represents one atom of hydrogen from a reducing agent.

Question 7

.....

[1]

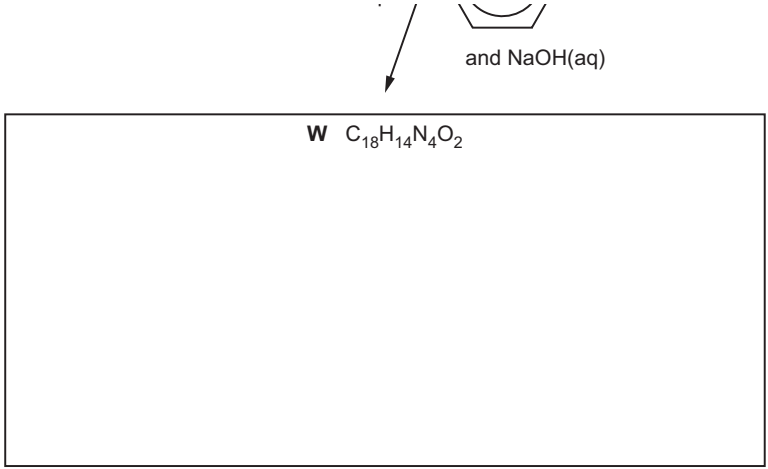
(d) Fig. 7.2 shows the two-step synthesis of the azo compound **W**.



Question 7

step 2 / \\ //

Question 7



Question 7

Question 7

Fig. 7.2

(i) Suggest structures for compounds **V** and **W** and draw them in the boxes in Fig. 7.2. [2]

(ii) Give the reagents and conditions for step 1.

Question 7

[Total: 12]

Solution 7

(a) Mark scheme

- M1: Cl CH2COOH
- BrCH2COOH CH3COOH CH3CH2OH
- most acidic
- least acidic
- M2: electron withdrawing groups / electronegative groups / negative inductive effect
- AND weakens O–H bond / more stable anion
- OR

Solution 7

- electron donating groups / positive inductive effect AND strengthens O-H bond / less stable anion **M3**
- M4:
- ▪
- chlorine is more electron-withdrawing / electronegative than bromine (related to XCH2COOH)
- ▪
- electron withdrawing of C=O / negative inductive effect of C=O (related to COOH)
- ▪

Solution 7

- positive inductive effect / electron donating of alkyl / ethyl / R group (related to ROH)
- any two [1], all three [2]
- 4

Solution 7

(b)

Mark scheme

- M1:
- M2: CO_2
- 2
- 9701/41
- October/November 2025

Solution 7

(c)(i)

Mark scheme

- M1: correct displayed amide bond with C=O, (C6H5)–N and (C–)C=O
- M2: rest of the structure correct with continuation bonds
- 2

(c)(ii)

Mark scheme

- 1

Solution 7

(d)(i)

Mark scheme

- M1:
- M2:
- 2
- 9701/41
- October/November 2025

Solution 7

(d)(ii)

Mark scheme

- HNO2 (and HCl) AND 10 °C
- OR
- NaNO2 AND HCl AND 10 °C
- 1