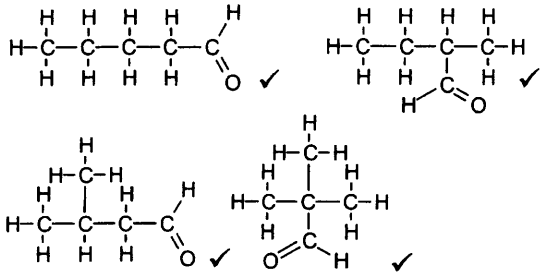
1 (a) (i) (relative) molecular mass / M_r ✓ **[1]**

(ii) right / highest $^m/_e$ / highest mass / second highest mass etc ✓ **AW** **[1]**

(b)



✓ ✓ ✓ ✓ **[4]**

(c) Tollens' reagent / ammoniacal silver nitrate ✓
warm / heat ✓
aldehyde: silver mirror ✓
ketone: no reaction /change ✓

allow use of warm acidified $K_2Cr_2O_7$ to give green or Fehlings/ Benedicts to give red ppt **[4]**

(d) (i) yellow / orange /red ✓
precipitate / solid / crystals ✓ **[2]**

(ii) measure the melting point (of the solid / ppt) ✓

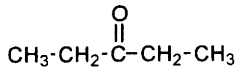
(re)crystallise / purify /
compare result with known compounds / data book ✓ **[2]**

(e) (i) no peak at 9.5 - 10.0 / peak with area 1 ✓ **[1]**

Qu 1 continued overleaf

Q 1 continued

1 (e) (ii)



/ pentan-3-one ✓

1 mark for identifying the correct structure

the peak at 1.1 ...
(is in the range 0.7-1.6 so) is due to CH_3 /R-CH_3 group(s) ✓
is a triplet / 1:2:1 as it is next to a CH_2 /two protons ✓

is due to six protons/two CH_3 (in the same environment) ✓

the peak at 2.4 ...
(is in the range 2.0 – 2.9 so) is due to the CH_2 /-CO-CH_2-R group(s) ✓
is a quartet / 1:3:3:1 as it is next to a CH_3/three protons ✓

is due to four protons/two CH_2 (in the same environment) ✓

the number of peaks ...
(two peaks, so only) two environments/ two types of proton / Ha and Hb on structure /each CH_3CH_2- is identical etc ✓

three environments for methylbutanone so would get 3 peaks/ Ha, Hb, Hc shown on a structure ✓

four environments for for pentan-2-one so would get 4 peaks / Ha, Hb, Hc, Hd shown on a structure ✓

ANY 5 reasoning marks out of **9** **max [6]**

[Total: 21]

2 (a) carbonyl / ketone ✓
phenol ✓

[2]

(b)(i) $C_{14}H_8O_4$
1 for C_{14}... ✓
1 for ...H_8O_4 ✓

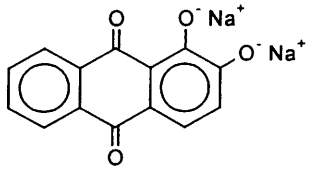
[2]

(ii) moles dissolved = 0.800 x 0.015 = **0.012**
/ conc in gdm^{-3} = 0.015 x 240 = **3.6**(g) ✓

mass dissolved = 0.0120mol x 240 / 3.6gdm^{-3} x 0.800
= **2.88/2.9**(g) ✓ (or ecf)

[2]

(c)



✓

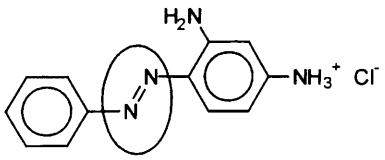
H_2O as product ✓
balanced equation ✓

[3]

(d) C=O / carbonyl ✓
1680 – 1750 ✓
O-H / hydroxy(l) ✓
3230 – 3550 ✓

[4]

(e)



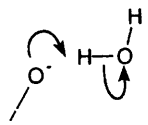
✓

[1]

[Total: 14]

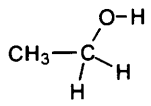
3 (a) $CH_3CHO + 2[H] \longrightarrow C_2H_5OH$
where $CH_3CHO \longrightarrow C_2H_5OH$ gets ✓
and also **2**[H] to give a correct balanced equation ✓ **[2]**

(b)(i)



✓✓ one mark for each curly arrow **[2]**

(ii)



✓ **[1]**

(iii) electron/lone pair donor **[1]**

(iv) nucleophile/hydride is attracted to a positive (charge) centre /δ^+ carbon /area of electron deficiency ✓

(its lone pair of electrons) forms a (covalent/dative) bond ✓

the double/π electron pair goes to the oxygen atom ... ✓

... (causing)the carbonyl/double/π bond to break ✓

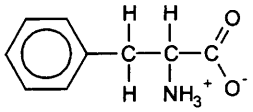
ANY 3 out of **4** marks **[3]**

(c) hydrogen has no lone pair **[1]**

[Total: 10]

4 (a) $RCH(NH_2)COOH$ ✓ **[1]**

(b)

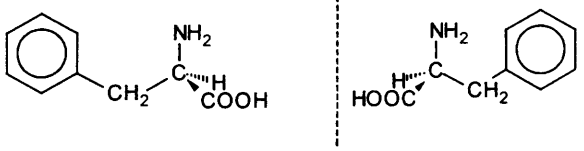


(or shown with delocalised COO^-)

either $-NH_3^+$ or $-COO^-$ shown in the right place ✓
rest of the structure correct ✓ **[2]**

(c) (i) optical (isomerism) **[1]**

(ii)

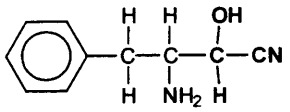


(or shown as zwitterion, or with C_7H_7)

at least one structure correctly drawn ✓
a correct mirror image ✓ **[2]**

(d) difference in position of the NH_2 relative to the COOH ✓
an OH group (in **G**) ✓
extra carbon /longer chain (in **G**) ✓
extra chiral centre (in **G**) ✓
ANY 3 out of **4** **[3]**

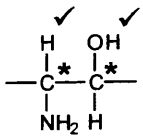
(e) (i)



✓ **[1]**

(ii) for lengthening the carbon chain / increasing the number of carbon atoms ✓ **[1]**

(f) (i)



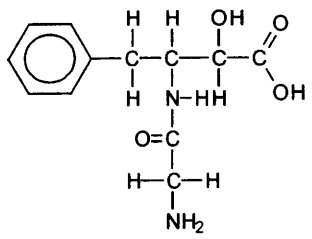
✓ ✓ **[2]**

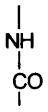
(ii) a mixture of stereoisomers ... because **G** is made synthetically / not naturally /in the laboratory /the HCN can add above or below etc ✓ **[1]**

Qu 4 continued overleaf

Q 4 continued

4 (g)





NH and CO ✓

all bonds displayed correctly ✓ **[2]**

(h) (only) one stereoisomer has the right shape / fits the active site etc / is pharmacologically active ✓

the other stereoisomer may have (harmful) side-effects ✓

increased dose is needed ✓

valid reason for increased costs - eg testing of both isomers (**NOT** just related to increased dosage) ✓

ANY 3 out of **4** marks **[3]**

[Total 19 Marks]

5 (a) addition involves breaking a double bond ✓

condensation involves loss of water / small molecule ✓

correct PE repeat unit (either: -[CH_2-CH_2]- or -[CH_2]-) ✓

equation to form PE from ethene showing 'n' monomers to give a polymer using 'n' / with at least 4 carbons extending on ✓

correct ester link displayed in PET ✓
correct PET repeat unit indicated ✓

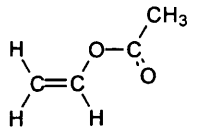
equation to form a correct repeat of PET and H_2O, showing at least one of each monomer ✓

[7]

Quality of written communication
mark for good organisation and a logical response ... examples are linked to the relevant definitions / the response attempts or implies a comparison

[1]

(b)(i)



✓

[1]

(ii) dilute / aq / named concentration ✓
acid / H^+ / alkali / OH^- / suitable named acid or alkali ✓

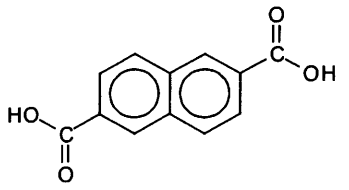
heat / reflux ✓

[3]

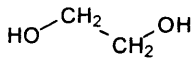
(iii) CH_3COOH (if acid hydrolysis in ***(ii)***) / CH_3COO^- (from alkaline hydrolysis in ***(ii)***)

[1]

(c)



✓



✓

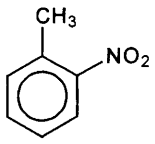
[2]

[Total: 15]

6 (a) (i) CH_3Cl / CH_3Br ✓ **[1]**

(ii) $AlCl_3$ / $FeBr_3$ etc ✓ **[1]**

(b)



✓ **[1]**

(c) **stage 2**
H_2SO_4 ✓
HNO_3 ✓
60°C ✓

$C_6H_5CH_3 + HNO_3 \longrightarrow C_6H_4(CH_3)NO_2 + H_2O$ ✓

stage 3
tin ✓
HCl ✓
heat / reflux ✓

$C_6H_4(CH_3)NO_2 + 6[H] \longrightarrow C_6H_4(CH_3)NH_2 + 2H_2O$
(or with H^+ as well to give the salt $C_6H_4(CH_3)NH_3^+$) ✓

ANY 7 out of **8** **max [7]**

Quality of Written Communication
mark for technical terms ... answer contains at least two of the following terms:

concentrated/conc (for any acid), nitration, nitrating mixture, electrophilic, substitution, reduction, catalyst (for H_2SO_4 or tin), 2-methylnitrobenzene ✓

[1]

[Total 11 Marks]