

**Q16.**

Which one of the following pairs of reagents reacts to form an organic product that shows only 2 peaks in its proton n.m.r. spectrum?

- A butan-2-ol and acidified potassium dichromate(VI)
- B ethanoyl chloride and methanol
- C propanoic acid and ethanol in the presence of concentrated sulphuric acid
- D ethene and hydrogen in the presence of nickel

(Total 1 mark)

Q17.

Which one of the following pairs reacts to form an organic product with only 2 singlets in its proton n.m.r. spectrum?

- A ethene and bromine
- B propan-2-ol and acidified potassium dichromate(VI)
- C ethanol and concentrated sulphuric acid
- D epoxyethane and water in the presence of dilute sulphuric acid

(Total 1 mark)

Q18.

(a) Describe how propanal, $\text{CH}_3\text{CH}_2\text{CHO}$, and propanone, CH_3COCH_3 , can be distinguished using

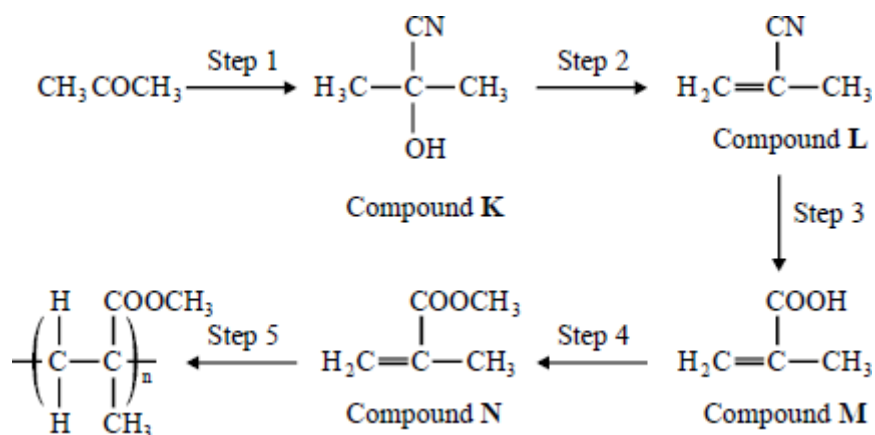
- (i) a chemical test and

(3)



Q20.

This question concerns the preparation of the plastic poly(methyl 2-methylpropenoate) (*Perspex*), starting from propanone.



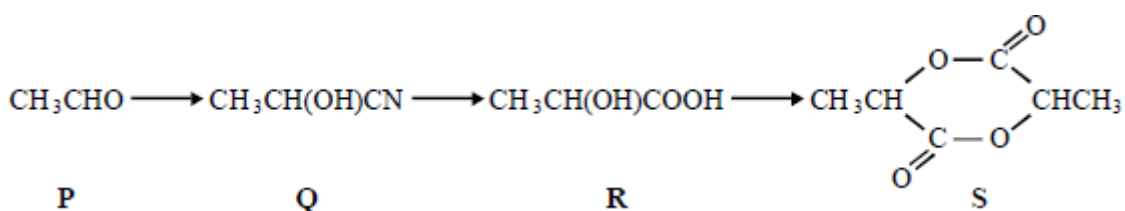
Which one of the following sets of reagents is **not** suitable for the step indicated?

- A Step 1 HCN (NaCN then dilute HCl)
- B Step 2 hot ethanolic KOH
- C Step 3 warm aqueous H_2SO_4
- D Step 4 CH_3OH with an acid catalyst

(Total 1 mark)

Q21.

This question refers to the reaction sequence below.



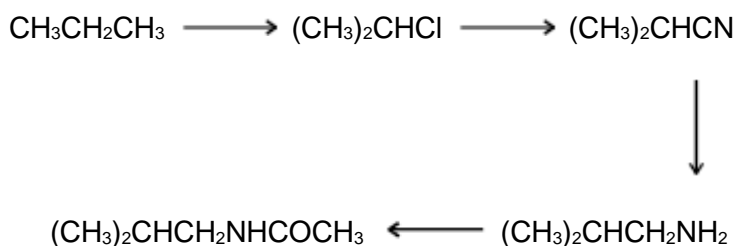
Which one of the following is **not** involved in the reaction sequence?

- A esterification
- B hydrolysis
- C nucleophilic addition
- D reduction

(Total 1 mark)

**Q24.**

Which one of the following types of reaction is **not** involved in the above sequence?

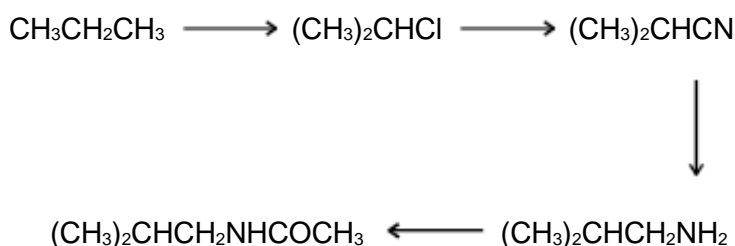


- A halogenation
- B acylation
- C reduction
- D oxidation

(Total 1 mark)

Q25.

Which one of the following types of reaction mechanism is **not** involved in the above sequence?



- A free-radical substitution
- B nucleophilic substitution
- C elimination
- D nucleophilic addition-elimination

(Total 1 mark)



Mark Scheme

Q16.

B

[1]

Q17.

D

[1]

Q18.

(a) (i)

Reagent	Tollens	Fehlings or Benedicts	$K_2Cr_2O_7/H^+$ or acidified	$KMnO_4/H^+$	$I_2/NaOH$
Propanal	silver (mirror)	red ppt or goes red (<i>not red solution</i>)	goes green	goes colourless	No reaction
Propanone	no reaction	no reaction	no reaction	no reaction	Yellow (ppt)

(penalise incomplete reagent e.g. $K_2Cr_2O_7$ or $Cr_2O_7^{2-}/H^+$ then mark on)

3

(ii) propanal 3 peaks

ignore splitting even if wrong

1

propanone 1 peak

1

(b) X is CH_3CH_2COOH or propanoic acid if both name and formula given, both must be correct, but

1

Y is $CH_3CH(OH)CH_3$ or propan-2-ol allow propanol with correct formula

1

**Mark the type of reaction and reagent/condition independently.
The reagent must be correct or close to score condition**

Step 1 Oxidation

$K_2Cr_2O_7/H^+$ or other oxidation methods as above
allow $Cr_2O_7^{2-}/H^+$ if penalised above (ecf)
reflux (not Tollens/Fehlings) or heat or warm

1

Step 2

reduction or nucleophilic	reduction or	reduction or
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1



addition	nucleophilic addition	hydrogenation
NaBH ₄	LiAlH ₄	H ₂
in (m)ethanol or water or ether or dry	ether or dry	Ni / Pt etc

Step 3	esterification or (nucleophilic) addition-elimination or condensation	1
	(conc) H ₂ SO ₄ or HCl	1
	warm (allow without acid reagent if X and Y given as reagents)	1
	or reflux or heat	1

[15]

Q19.

X is CH₃CN or ethanenitrile or ethanonitrile or methyl cyanide or cyanomethane or ethyl nitrile or methanecarbonitrile

Not ethanitrile

but contradicton of name and structure lose marks

1

Y is CH₃CH₂NH₂ or ethylamine or aminoethane or ethanamine

1

Step 1: reagent KCN not HCN/HCl
 condition (aq)/alcohol - only allow condition if reagent
 correct or incomplete

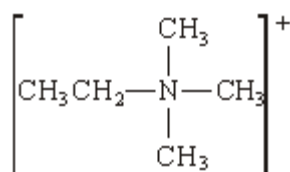
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Step 2: reagent H₂ LiAlH₄ Na Zn/Fe/Sn Not NaBH₄
 condition Ni/Pt/Pd ether ethanol HCl

2

Z is an amine or aminoalkane or named amine even if incorrect name for **Z**
 secondary (only award if amine correct)

1



(Br⁻) + can be on N or outside brackets as shown

1

nucleophilic substitution

1

[9]



Q20.

B

[1]

Q21.

D

[1]

Q22.

(a) X contains $>C=O$ (1)*if X and Y reversed lose this mark but allow remaining max 6/7* \therefore X is CH_3CH_2COOH (1) \therefore Y is $CH_3CH_2CH_2OH$ (1)

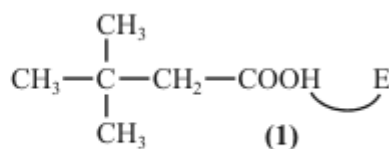
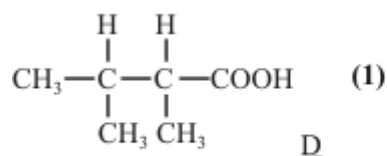
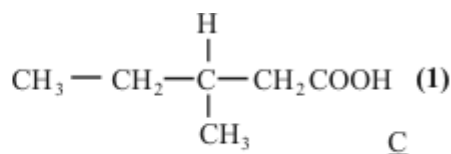
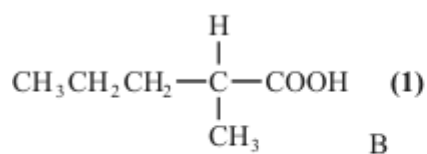
\therefore A is $CH_3CH_2C(=O)OCH_2CH_2CH_3$ (1)

Propanol $\begin{cases} \nearrow \text{X reagent: acidified } K_2Cr_2O_7 & (1) \\ \searrow \text{Y reagent: } NaBH_4 & (1) \end{cases}$

Conc H_2SO_4 : catalyst (1)

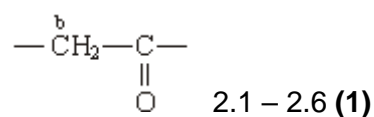
7

(b)




in any order


4

(c) $-O\overset{a}{C}H_2-$ 3.1 – 3.9 (1)a: quartet (1) \curvearrowright 3 adjacent H (1)



b: triplet (1)  2 adjacent H (1)

6

(d) 3269 cm⁻¹ ∴ OH  alcohol (1)



2

Notes

(a) first mark for C=O stated or shown in **X**
Ignore wrong names

Y CH₃CH₂CH₂OH

allow C₃H₇ in **A** if **Y** correct or vice versa

Allow (1) for **A** if correct conseq to wrong **X** and **Y**

other oxidising agents: acidified KMnO₄; Tollens; Fehlings

other reducing agents: LiAlH₄; Na/ethanol; Ni/H₂; Zn or Sn or Fe/HCl

(b) give (1) for carboxylic acid stated or COOH shown in each suggestion
(1) for correct **E**

any 2 out of 3 for **B**, **C** or **D**

allow C₃H₇ for either the **B** or **D** shown on the mark scheme

i.e. a correct structure labelled **B**, **C** or **D** or **E** will gain 2.

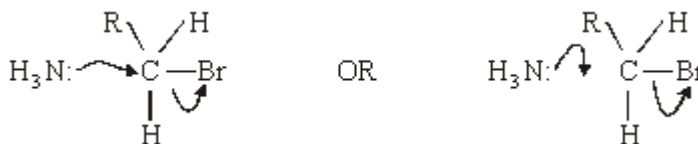
(c) protons a – *quartet* must be correct to score 3 *adjacent H* mark. Same for b

(d) allow (1) for any OH (alcohol) shown correctly in any structure – ignore extra functional groups. Structure must be completely correct to gain second mark


[19]

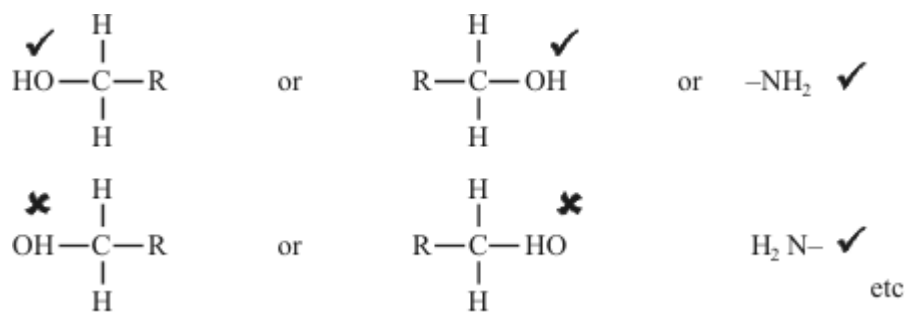
Organic points

(1) Curly arrows: must show movement of a pair of electrons,
i.e. from bond to atom or from lp to atom / space
e.g.



(2) Structures

penalise sticks (i.e. ) once per paper



Penalise once per paper

allow CH_3- or $-\text{CH}_3$ or $\begin{array}{c} \text{CH}_3 \\ | \end{array}$ or CH_3
or $\text{H}_3\text{C}-$

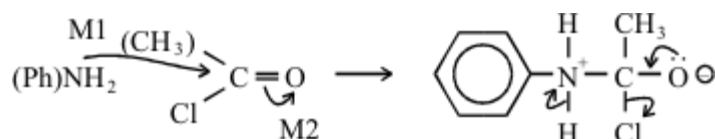
Q23.

- (a) CH_3COCl or $(\text{CH}_3\text{CO})_2\text{O}$ (1)

AlCl_3 or H_2O or CH_2SO_4 loses this mark

CH_3COOH loses reagent and M3, M4 = max 3

nucleophilic addition-elimination (1)



M3: structure

M4: 3 correct arrows

Allow M1 for attack on $\text{CH}_3\text{-C}^+=\text{O}$

Penalise Cl⁻ removing H⁺

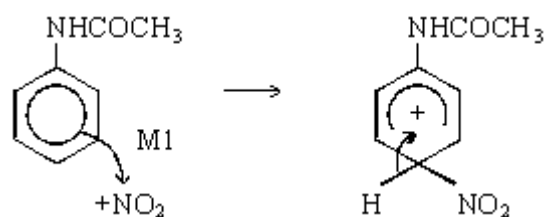
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- (b) Conc HNO_3 (1)
Conc H_2SO_4 (1)
 $\text{HNO}_3 + 2 \text{H}_2\text{SO}_4 \rightarrow \text{NO}_2^+ + \text{H}_3\text{O}^+ + 2 \text{HSO}_4^-$ (2)
(or H_2SO_4) (or $\text{H}_2\text{O} + \text{HSO}_4^-$)

$\text{HNO}_3 / \text{H}_2\text{SO}_4$ scores 1

Any 2

electrophilic substitution (1)



M2 structure

M3 arrow

6

- (c) Sn (or Fe) / HCl or Ni / H_2 (1)

