M1. B

[1]

M2. B

[1]

M3. A

[1]

M4. D

[1]

M5. D

[1]

M6. A

[1]

M7. (a) (i) Potassium (OR sodium) dichromate(VI) OR <u>correct</u> formula OR potassium manganate(VII)

(Oxidation state not needed, but must be correct if included)

(Penalise errors in the formula or oxidation state, but mark conditions)

1

Acidified OR H_2SO_4 / HCl (*NOT with* $KMnO_4$) / H_3PO_4 / HNO_3

(Ignore heat or reflux)

(Credit "acidified" as part of reagent)

1

Oxidation or redox

1

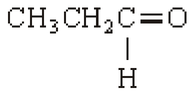
(ii) $NaBH_4$ OR $LiAlH_4$ OR H_2/Ni

1

$CH_3COCH_3 + 2[H] \rightarrow CH_3CH(OH)CH_3$

(Credit H_2 in the equation if H_2 has been chosen as reagent)

1

(b) (i) 

(Structure must show aldehyde structure)

(Credit C_2H_5 as alternative to CH_3CH_2)

(ii)

M1 Tollens' reagent OR ammoniacal silver nitrate OR $AgNO_3 + NH_3$	OR Fehling's solution	OR <u>acidified</u> potassium dichromate	1
M2 stays colourless	stays blue	stays orange	1

(Provided reagent is correct, credit "no reaction", "no change", "nothing", "no observation" for M2)

M3 silver <u>mirror</u> / <u>deposit</u> OR black / grey <u>precipitate</u>	red / brown / orange <u>precipitate / solid</u>	goes green	1

(Credit other correct reagents and observation)

(For M1, penalise $AgNO_3$ alone, penalise $Ag(NH_3)_2^+$, penalise "potassium dichromate", etc., but, in each case, mark on and credit correct M2 and M3)

(If totally wrong reagent or no reagent, CE = no marks for M1,M2 or M3)

1

[9]

M8. (a) M1: $CH_3CH_2CH_2CH_2OH$; **1**

M2: $CH_3CH(OH)CH_2CH_3$;

(penalise incorrect alcohols in part (a), but mark consequentially in part (b) and in part (c), if relevant)
(if three alcohols drawn, award MAX. 1 mark) **1**

(b) M1, M2 and M3: Correct structures for butanal, butanone and butanoic acid;

(award these structure marks wherever the structures appear, but insist that the C=O is shown in each structure and additionally, the C-O in the carboxylic acid **3**

M4: <u>balanced equation</u> for the reaction of butan-1-ol with [O] to produce butanal and water; **1**

M5: <u>balanced equation</u> for the reaction of butan-1-ol with [O] to produce butanoic acid and water

OR

<u>balanced equation</u> for the reaction of butanal with [O] to produce butanoic acid; **1**

M6: <u>balanced equation</u> for the reaction of butan-2-ol with [O] to produce butanone and water;

(Credit condensed structures or molecular formulas in each equation, provided it is obvious to which reaction the equation refers) (Insist that whatever formula is used in each equation that it is a conventional representation of the compound; for example penalise $CH_3CH_2CH_2COH$ for butanal) **1**

(c) M1: Correct structure for 2-methylpropan-2-ol;
M2: 2-methylpropan-2-ol **1**

OR

methylpropan-2-ol;

(penalise on every occasion in parts (a) and (c), structures for the alcohols that are presented with the alcohol functional group as C-H-O)

1

[10]

M9. (a) Compounds with the <u>same molecular formula</u>

1

but different structures due to different positions of the <u>same functional group</u> on the <u>same carbon skeleton/chain</u>

1

(b) Compound A is butan-1-ol <u>only</u>

1

Compound C is butanone or butan-2-one

(penalise but-1-ol, but allow repeat error for but-2-one)
(credit butane-1-ol)

1

(c) (i) oxidation or redox

1

(ii) $K_2Cr_2O_7$ or potassium dichromate(VI)

(penalise the dichromate ion or incorrect oxidation state, but mark on)

1

acidified or H_2SO_4 (or other identified strong acid)

(penalise H^+)

(do not credit the acid unless M1 has been correctly attempted)

1

(iii) (heat under) reflux

OR use excess <u>oxidising</u> agent

1

(iv) correctly drawn structure of 2-methylpropan-2-ol

(insist on clearly drawn C-C and C-0 bonds)

1

(v) correctly drawn structure of methanoic acid

(insist on C-0 and C=O displayed in the formula)

1

(d) (i) Tollens' reagent or this whole reagent specified
(ammoniacal silver nitrate)
OR Fehling's solution
OR <u>acidified</u> potassium dichromate(VI)

1

(ii) correctly drawn structure of methylpropanal

(insist on C-H and C=O of aldehyde displayed in the formula)

1

[12]

M10. (a) (i)

H_3C-C
$\quad\quad\ \ \|$
$\quad\quad\ \ O$ or $RCOCH_3$;

(or description in words)
(ignore trailing bonds)

1

(ii) $H_3C—O$ or $ROCH_3$;

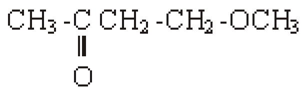
(allow 1 if both (i) and (ii) give CH_3- or H_3C– only)

1

(iii) CH_2CH_2 or two <u>adjacent</u> methylene groups;

1

(iv)

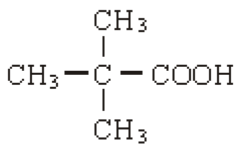


OR

$CH_3COCH_2CH_2OCH_3$; 1

(b) (i) OH <u>in acids</u> or (carboxylic) acid present

(ii)



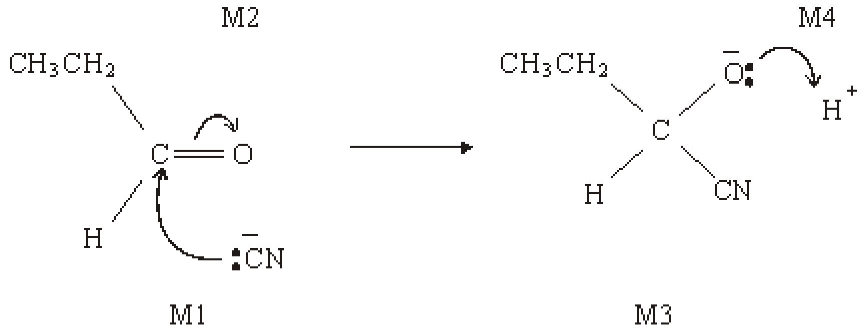
(c)

reagent	$K_2Cr_2O_7$ /H^+	$KMnO_4$ /H^+
Y	no reaction	no reaction
Z	orange to green or turns green	purple to colourless or turns colourless

5

[9]

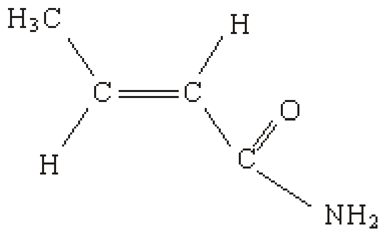
M11. (a) nucleophilic addition 1



4

(b) (i) 2-hydroxybutanenitrile 1

(ii)

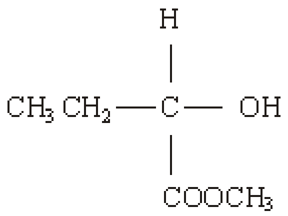


(allow 1 for amide even if not C_4H_7NO, i.e. $RCONH_2$)

(if not amide, allow one for any isomer of C_4H_7NO which shows geometric isomerism)

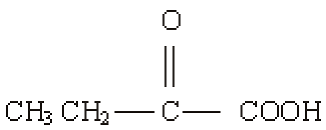
2

(c) (i)



1

(ii)



1

(iii) $CH_3CH{=}CHCOOH$ 1

[11]