CATHOLIC JUNIOR COLLEGE

PRELIMINARY EXAM 2008

CHEMISTRY **9746/01**
Higher 2

Paper 1 Multiple Choice **11 September 2008**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Write your name, class and NRIC number on the Multiple Choice Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in soft pencil on the separate Answer Sheet.

Read the instructions on the Multiple Choice Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

Section A

For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider to be correct.

1 Which of the following expression correctly defines the term *relative atomic mass* of an element?

A The mass of one atom of an element relative to the mass of one atom of ^{12}C.

B The mass of one mole of atoms of an element relative to the mass of one atom of ^{12}C.

C The mass of one mole of atoms of an element relative to the mass of one mole of ^{12}C atoms.

D The mass of one mole of atoms of an element divided by Avogadro's constant.

2 How many atoms are there in 500 cm^3 of carbon dioxide under room conditions?

A 1.25×10^{22} **B** 1.34×10^{22} **C** 3.76×10^{22} **D** 9.0×10^{26}

3 When 10 cm^3 of a gaseous hydrocarbon **X** were burned in 70 cm^3 of oxygen, the final gaseous mixture contained 30 cm^3 of carbon dioxide and 20 cm^3 of unreacted oxygen. [All gaseous volumes measured under identical conditions.]

What is the formula of hydrocarbon **X**?

A C_2H_6 **B** C_3H_6 **C** C_3H_8 **D** C_4H_{10}

4 20.0 cm^3 of 0.02 mol dm^{-3} bromate(V), BrO_3^-, was found to react completely with 80.0 cm^3 of 0.01 mol dm^{-3} hydroxylamine, NH_2OH. BrO_3^- ions are reduced as follows:

$$BrO_3^- + 6e^- + 6H^+ \rightarrow Br^- + 3H_2O$$

Which of the following could be the half-equation for the oxidation of hydroxylamine?

A $NH_2OH \rightarrow ½\ N_2O + 2H^+ + ½\ H_2O + 2e^-$

B $NH_2OH + H_2O \rightarrow NO_2^- + 5H^+ + 4e^-$

C $NH_2OH \rightarrow NO + 3H^+ + 3e^-$

D $NH_2OH + 2H_2O \rightarrow NO_3^- + 7H^+ + 6e^-$

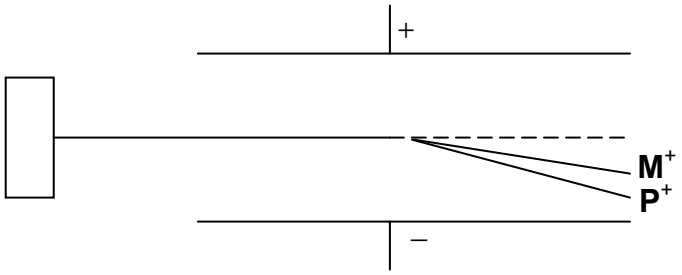
5 The table below gives the successive ionisation energies, in kJ mol^{-1}, of an unknown element **X**.

	First	Second	Third	Fourth	Fifth	Sixth
Ionisation energy	800	1550	7700	10500	13600	18000

Which of the following statements about **X** is correct?

A The aqueous ion $\mathbf{X}^+$ is likely to be coloured.
B **X** is a Group III element in the Periodic Table.
C **X** is able to exhibit more than one oxidation state.
D The oxide of **X** reacts readily with H^+ to form a salt and water.

6 In an experiment, an ore sample containing phosphorus and an unknown element **M** is vapourised, ionised and passed through an electric field.



Based on the diagram above, what is the likely identity of the unknown element **M**?

A Sulphur
B Silicon
C Sodium
D Nitrogen

7 Which of the following best describes the geometry of the following chlorides formed by the elements Al, Si and P?

	$\mathbf{AlCl_3}$	$\mathbf{SiCl_4}$	$\mathbf{PCl_3}$
A	Trigonal planar	Square planar	Trigonal planar
B	Trigonal planar	Tetrahedral	Trigonal pyramidal
C	Trigonal planar	Tetrahedral	T-shaped
D	Trigonal pyramidal	Square planar	Distorted tetrahedral

8 The values of the ionic radii, in nm, of several ions are given below:

Li^+	0.060	F^-	0.136
Na^+	0.095	Cl^-	0.181
Mg^{2+}	0.065	O^{2-}	0.140
Ca^{2+}	0.099		

Which of the following compounds, all of which have the same crystal structure, has the greatest lattice energy?

A LiF **B** NaCl **C** MgO **D** CaO

9 When 0.2 mol of zinc dust was added to 250 cm^3 of 1.0 mol dm^{-3} aqueous copper(II) sulphate (an excess), the temperature of the solution rose by 15 °C. The specific heat capacity of the final solution is 4.20 J g^{-1} K^{-1}.

What is the enthalpy change for the reaction $Cu^{2+} + Zn \rightarrow Zn^{2+} + Cu$?

A -78.8 kJ mol^{-1} **C** -15.8 kJ mol^{-1}

B -39.4 kJ mol^{-1} **D** -3.15 kJ mol^{-1}

10 Given the following enthalpy changes:

$C_6H_4(OH)_2$ (aq) $\rightarrow C_6H_4O_2$ (aq) + H_2 (g) ΔH^{θ} = +177 kJ mol^{-1}

H_2O_2 (aq) $\rightarrow H_2O$ (l) + ½ O_2 (g) ΔH^{θ} = -95 kJ mol^{-1}

H_2 (g) + ½ O_2 (g) $\rightarrow H_2O$ (l) ΔH^{θ} = -286 kJ mol^{-1}

What is the enthalpy change for the following reaction?

$C_6H_4(OH)_2$ (aq) + H_2O_2 (aq) $\rightarrow C_6H_4O_2$ (aq) + 2H_2O (l)

A -490 kJ mol^{-1} **C** -204 kJ mol^{-1}

B -368 kJ mol^{-1} **D** -82 kJ mol^{-1}

11 Which of the following reactions will have a negative ΔS value?

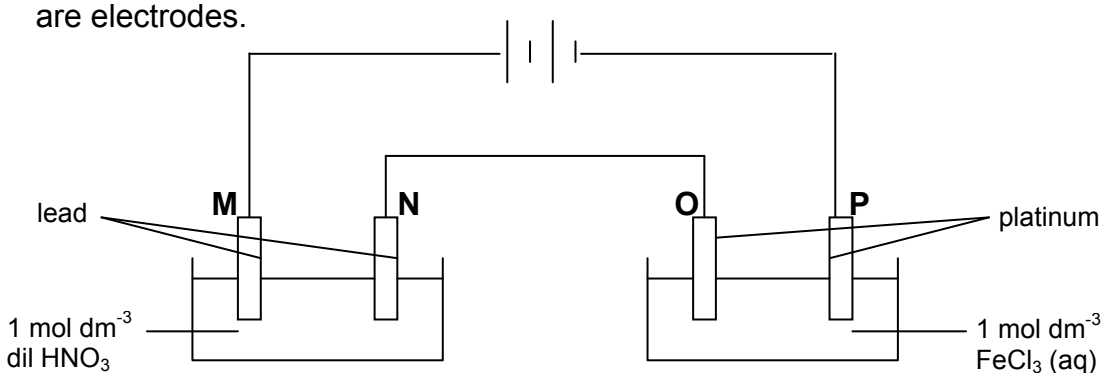
A CO_2 (g) + C (s) $\rightarrow$ 2 CO (g)

B NH_4NO_3 (s) $\rightarrow$ N_2O (g) + 2 H_2O (g)

C 2 H_2O_2 (aq) $\rightarrow$ 2 H_2O (l) + O_2 (g)

D PH_3 (g) + HI (g) $\rightarrow$ PH_4I (s)

12 Two cells are connected in series as shown in the diagram where **M**, **N**, **O** and **P** are electrodes.



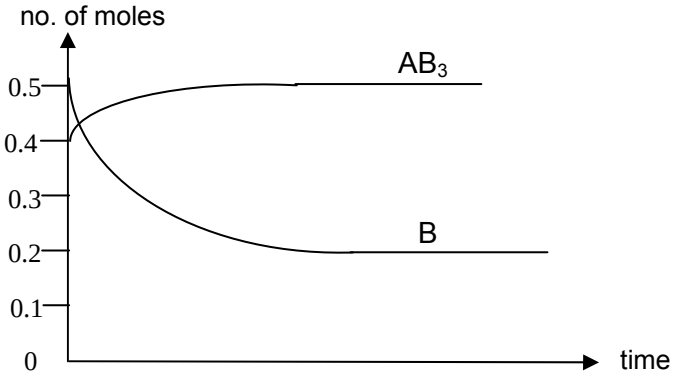
Which of the following correctly shows the products formed at each electrode?

	M	**N**	**O**	**P**
A	O_2	H_2	O_2	Fe^{2+}
B	O_2	Pb	Cl_2	H_2
C	Pb^{2+}	H_2	Cl_2	H_2
D	Pb^{2+}	H_2	O_2	Fe^{2+}

13 Consider the reversible reaction:

$$A\ (g) + 3B\ (g) \rightleftharpoons AB_3\ (g)$$

Equilibrium was established in a 0.2 dm^3 vessel at a temperature of 900 K. The diagram below shows the change in number of moles of AB_3 and B with time. The initial number of moles of A was 0.2.



What is the equilibrium constant K_c for the reaction in $mol^{-3}\ dm^9$?

A $\frac{0.5}{0.1 \times (0.2)^3}$ **B** $\frac{0.5}{(0.2)^4}$ **C** $\frac{0.5}{0.1}$ **D** $\frac{0.5}{0.2 \times (0.1)^3}$

14 Silver chromate(VI), Ag_2CrO_4, is sparingly soluble in water. In its saturated solution, the concentration of Ag_2CrO_4 is 6.5×10^{-5} mol dm^{-3}. What is the numerical value of the K_{sp} of Ag_2CrO_4?

A 2.75×10^{-13} **B** 1.10×10^{-12} **C** 4.23×10^{-9} **D** 8.45×10^{-9}

15 In which of the following sequences is the value of pK_a decreasing?

A $C_6H_5OH > CH_3CH_2CH_2CHClOH > CH_3CH_2CH_2CH_2OH > (CH_3)_3COH$

B $(CH_3)_3COH > CH_3CH_2CH_2CH_2OH > CH_3CH_2CH_2CHClOH > C_6H_5OH$

C $CH_3CH_2CH_2CH_2OH > (CH_3)_3COH > CH_3CH_2CH_2CHClOH > C_6H_5OH$

D $CH_3CH_2CH_2CHClOH > (CH_3)_3COH > CH_3CH_2CH_2CH_2OH > C_6H_5OH$

16 A piece of zinc foil dissolved completely in 20 cm^3 of a dilute sulphuric acid solution and the volume of hydrogen evolved was noted at equal, short time intervals. Another piece of zinc foil of the same surface area and mass was added to 40 cm^3 of the same solution of sulphuric acid.

How will the initial rate of reaction and the total volume of hydrogen evolved in this second experiment compare to the first experiment?

	initial rate of reaction	**total volume of hydrogen evolved**
A	no change	decrease
B	no change	no change
C	increase	no change
D	increase	increase

17 How do the following properties of Group II elements vary down the group?

(i) the standard electrode potential of $E^{\theta}_{M^{2+}/M}$
(ii) the first ionisation energy, 1st I.E.
(iii) the electronegativity

	$E^{\theta}_{M^{2+}/M}$	1st I.E.	Electronegativity
A	more negative	decreases	decreases
B	less negative	decreases	increases
C	more negative	increases	decreases
D	more negative	increases	increases

18 An element **Y** has the electronic configuration $[Ar]3d^2 4s^2$. Which of the following species of **Y** is **not** likely to be formed?

A YO
B YO_2
C YO_3^-
D Y_3O_5

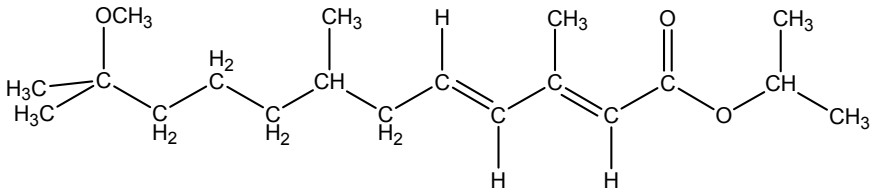
19 Which of the following is least likely to act as a ligand?

A CO
B CH_3CH_3
C C_6H_5OH
D NH_2NH_2

20 Two cells, one containing a molten compound of chromium and the other containing iron(II) chloride were connected in series. 11.20 g of iron and 6.97 g of chromium were obtained. What is the oxidation state of chromium in the compound?

A +2 **B** +3 **C** +5 **D** +6

21 Methoprene, which has the structure shown below, is reacted with hydrogen gas in the presence of nickel metal.



methoprene

How many stereoisomers will the **product** have?

A 2^1 **B** 2^2 **C** 2^3 **D** 2^4

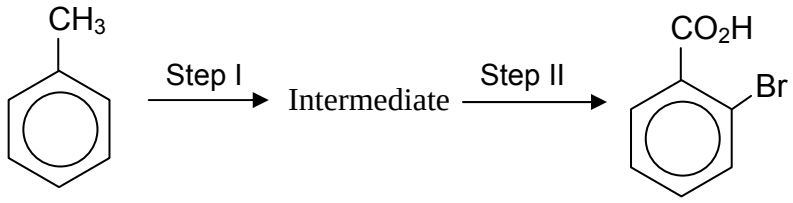
22 A sample of ethene was added to a solution of Br_2 (aq) and NaCl (aq). Which of the following products is **not** likely to be found in the reaction mixture?

A $CH_2(OH)CH_2Br$
B CH_2BrCH_2Cl
C $CH_2(OH)CH_2Cl$
D CH_2BrCH_2Br

23 What will be observed when the following compounds are added to hot acidified potassium manganate(VII)?

	$C_6H_5CH_3$	$CH_3CH=CH_2$	$CH_3CH_2CH_2Cl$
A	Solution turns colourless. No effervescence.	Solution turns colourless. Effervescence occurs.	Solution remains purple. No effervescence.
B	Solution remains purple. No effervescence.	Solution turns colourless. Effervescence occurs.	Solution turns colourless. No effervescence.
C	Solution turns colourless. Effervescence occurs.	Solution remains purple. No effervescence.	Solution remains purple. Effervescence occurs.
D	Solution remains purple. Effervescence occurs.	Solution remains purple. Effervescence occurs.	Solution turns colourless. No effervescence.

24 Which of the following sets of reagent and conditions is used for the reaction scheme shown below?



	Step I	Step II
A	$KMnO_4$, H^+, heat	Aqueous Br_2
B	$KMnO_4$, H^+, heat	Br_2, Ultraviolet light
C	Aqueous Br_2	$KMnO_4$, H^+, heat
D	Br_2, $FeBr_3$	$KMnO_4$, H^+, heat

25 Compound **X**, C_4H_9Br, undergoes the following reactions:

$$\underset{\textbf{X}}{C_4H_9Br} \xrightarrow[\text{heat}]{\text{NaOH (aq)}} C_4H_{10}O \xrightarrow[\text{reflux}]{Cr_2O_7^{2-},\ H^+\text{ (aq)}} C_4H_8O \text{ only}$$

What is **X** likely to be?

A	1-bromobutane	**C**	1-bromo-2-methylpropane
B	2-bromobutane	**D**	2-bromo-2-methylpropane

26 Which of the following reactions does **not** occur when $CH_3CH(OH)CH_3$ is warmed with an alkaline solution of iodine?

A Oxidation

B Halogenation

C Condensation

D Precipitation

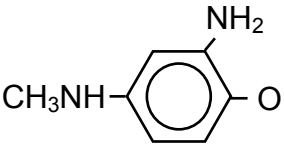
27 Which of the following methods is most appropriate for preparing 3-oxo-butanoic acid, $CH_3COCH_2CO_2H$?

A $CH_3CH_2CH(OH)CH_2OH$ refluxed with acidified potassium manganate(VII).

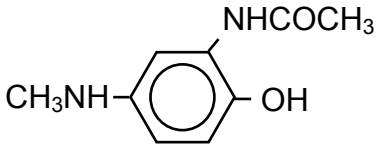
B $CH_3CH(OH)COCH_2OH$ distilled with acidified potassium dichromate(VI).

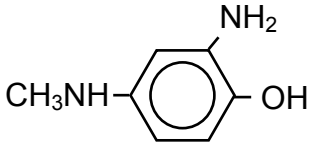
C $CH_2=C(CH_3)CH_2CH=CH_2$ heated with acidified potassium manganate(VII).

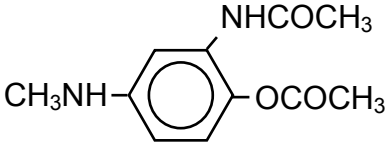
D $CH_3COCH_2OCOCH_3$ refluxed with aqueous sodium hydroxide followed by acidification.

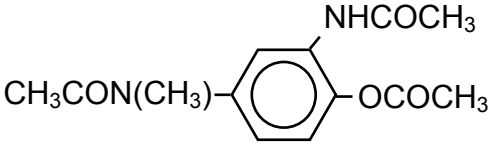
28 What is the product formed when ethanoyl chloride reacts with 

?

A


B


C


D


29 Compound **X** is an alkene containing the nitrile functional group. Upon heating with hydrogen in the presence of nickel, compound **Y**, $CH_3CH_2CH_2NH_2$, is formed. If **X** was hydrolysed in dilute hydrochloric acid and subsequently reacted with **Y**, what is the most likely product formed?

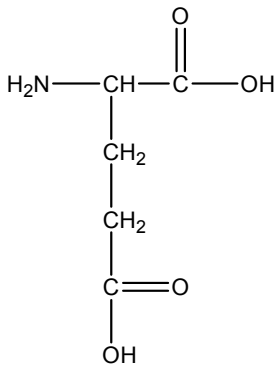
A $CH_2=CHCONHCH_2CH_2CH_3$

B $CH_3CHClCONHCH_2CH_2CH_3$

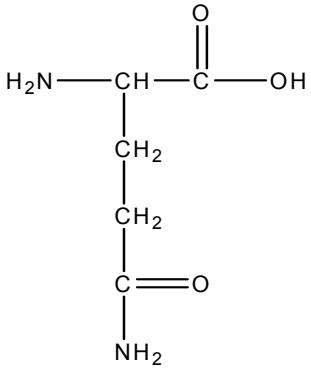
C $(CH_3CHClCO_2)^-(CH_3CH_2CH_2NH_3)^+$

D $(CH_2=CHCO_2)^-(CH_3CH_2CH_2NH_3)^+$

30 Glutamic acid and glutamine can react with each other to form amide linkages.



glutamic acid



glutamine

If one molecule of glutamic acid reacts with one molecule of glutamine, what is the maximum number of different compounds containing amide linkages that can be formed?

A 2 **B** 3 **C** 5 **D** 7

Section B

For each of the following questions in this section, one or more of the three numbered statements **1** to **3** may be correct. Decide whether each of the statements is or is not correct. The responses **A** to **D** should be selected on the basis of:

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

31 Which of the following statements about BCl_3 is true?

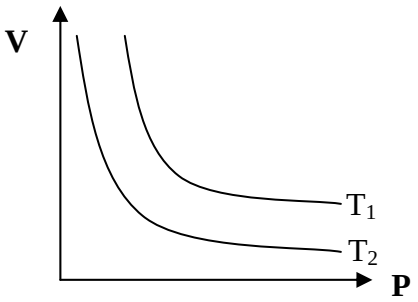
1 It can form a dative bond with NH_3.

2 It is planar in shape.

3 It has more covalent character than B_2O_3.

32 Which of the following graphs shows the behaviour of a fixed mass of an ideal gas at two constant temperatures, T_1 and T_2 where $T_1 > T_2$?
(P = total pressure; V = volume of vessel; T = temperature)

1



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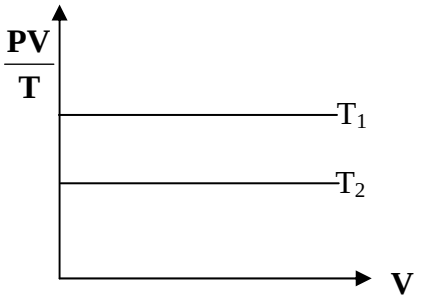
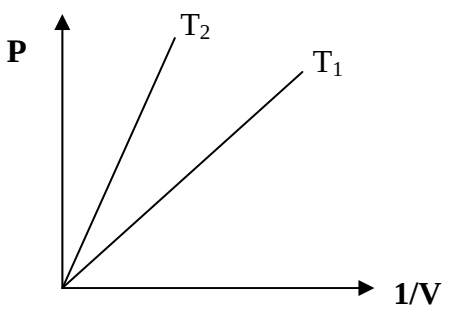


3



A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

33 In which of the following pairs of compounds is the boiling point of the second compound higher than the first compound?

1 $NH_2CH_2CO_2H$ and $CH_3CH_2CONH_2$

2 CH_3CHO and CH_3CH_2OH

3 trans-1,2-dichloroethene and cis-1,2-dichloroethene

34 A voltaic cell is made up of Mg^{2+}/Mg half-cell and the Fe^{3+}/Fe^{2+} half-cell. Which of the following statements are correct?

1 Addition of water to the Fe^{3+}/Fe^{2+} half-cell has no effect on the cell e.m.f.

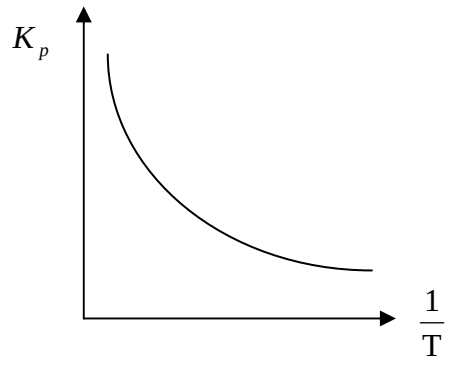
2 Addition of aqueous sodium hydroxide to the Mg^{2+}/Mg half-cell increases the cell e.m.f.

3 Increasing temperature has no effect on the cell e.m.f.

35 The equilibrium constant K_p for the reaction

$$2X\,(g) + Y\,(g) \rightleftharpoons Z\,(g)$$

varies with temperature T as shown in the diagram below.



What conclusions can be drawn regarding the above reaction?

1 The equilibrium mixture contains a higher proportion of Z at lower temperatures.

2 The equilibrium mixture contains a higher proportion of Z at higher pressures.

3 The reverse reaction is exothermic.

36 The addition of which compound would lower the solubility of calcium carbonate?

1 sodium carbonate

2 calcium sulphate

3 water

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

37 Bromine and methanoic acid react as follows.

$$Br_2(aq) + HCO_2H(aq) \longrightarrow 2Br^-(aq) + 2H^+(aq) + CO_2(g)$$

The rate of reaction is found to be first order with respect to both bromine and methanoic acid.

What deductions can be made for the above reaction?

1 Doubling the concentration of methanoic acid doubles the rate of evolution of gas.

2 Halving the concentration of both reactants simultaneously will halve the reaction rate.

3 The overall order of the reaction is one.

38 Which of the following statements is true about the elements in Period 3 of the Periodic Table?

1 Melting points generally decrease across the period.

2 First ionisation energies generally increase across the period.

3 The chlorides of the elements change from ionic to covalent across the period.

39 Which of the following chemical tests can distinguish between 1-chlorobutane and 2-chlorobutane?

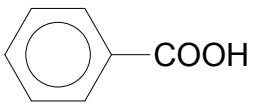
1 Heating with excess NaOH (aq), followed by adding aqueous iodine.

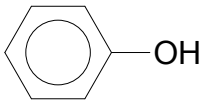
2 Heating with limited NaOH (aq), followed by adding aqueous silver nitrate.

3 Heating with NaOH (aq), followed by refluxing with acidified aqueous potassium manganate(VII).

40 Which pair of substances gives water as one of the products when reacted together?

1 $CH_3CH(OH)CH_3$ and concentrated H_2SO_4

2  and CH_3CH_2OH

3  and $CH_3CH_2CO_2H$

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