CANDIDATE'S NAME: ______________________________ **CTG:** _________

YISHUN JUNIOR COLLEGE

PRELIMINARY EXAMINATION 2009

CHEMISTRY 9746/01
HIGHER 2

MONDAY 31 AUGUST 2009
0800hrs − 0900hrs
(1 hour)

Additional materials:

Multiple Choice Answer Sheet and Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil

Do not use paper clips, highlighters, glue or correction fluid.

Write your Centre number, index number, name and CTG on the Answer Sheet.

There are forty questions on 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 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 and shade your choice on the OMS provided.

1 What volume of CO_2 will be formed when y cm^3 of a 50:50 mixture of methane and propane is completely burnt?

A 2y cm^3 **B** 5y/2 cm^3 **C** 4y cm^3 **D** 5y cm^3

2 Which of the following ions has the smallest ionic radius?

A F^- **B** Ne **C** Mg^{2+} **D** Al^{3+}

3 Which of the following statements describes a phenomenon which **cannot** be explained by hydrogen bonding?

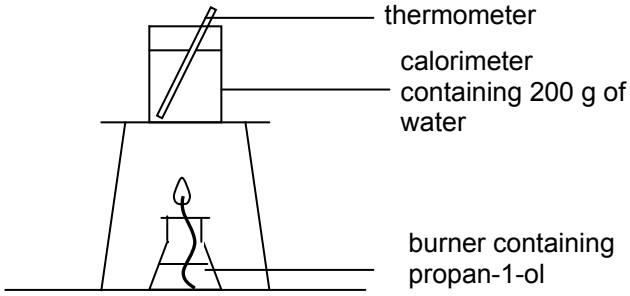
A Ice has a lower density than water at 0 °C.

B The boiling point of alcohols increases with increasing relative molecular mass.

C 2−nitrophenol is more volatile than 4−nitrophenol.

D Ethanoic acid molecules form dimers when dissolved in benzene.

4 A student used the apparatus below to determine the enthalpy change of combustion of propan-1-ol.



The following results were obtained:

mass of propan-1-ol burnt = 0.60 g
mass of water heated = 200 g
initial temperature of water = 21.0 °C

Given that the enthalpy change of propan-1-ol is −2021 kJ mol^{-1} and the heat capacity of water is 4.17 J K^{-1} g^{-1}, what would be the final temperature of the water?

A 24.2 °C **B** 29.1 °C **C** 45.2 °C **D** 48.4 °C

5 Which treatment is frequently used to protect aluminium articles from subsequent corrosion?

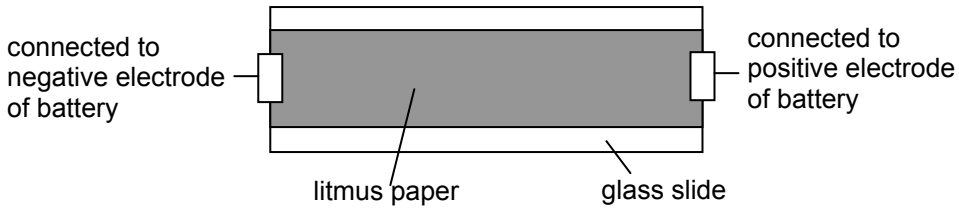
A Making the aluminium the anode during electrolysis.

B Dipping the aluminium in hot aqueous sodium hydroxide.

C Dipping the aluminium in molten cryolite.

D Coating the aluminium with zinc.

6 A piece of litmus paper was soaked in saturated NaC*l* solution and supported on a glass slide. The paper was connected to a battery as shown in the diagram below.



Which of the following gives the observations near the negative electrode and positive electrodes after the current has flowed for some time?

	negative electrode	**positive electrode**
A	no change	bleached
B	bleached	no change
C	red	bleached
D	blue	bleached

7 The pK_b value for aqueous ammonia at 25 °C is 4.8.

What is the pK_a value for the ammonium ion at this temperature?

A 2.2 **B** 4.8 **C** 9.2 **D** 11.8

8 The rate of reaction of a strip of magnesium and 50 cm^3 of 1.0 mol dm^{-3} HC*l* is determined at 25 °C. In which of the following cases would both new conditions contribute to an increase in the rate of reaction?

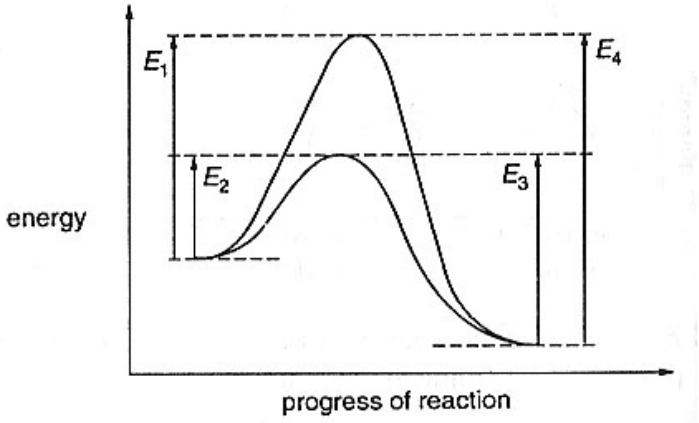
A Mg powder and 100 cm^3 of 1.0 mol dm^{-3} HC*l*

B Mg powder and 50 cm^3 of 0.8 mol dm^{-3} HC*l*

C 100 cm^3 of 1.0 mol dm^{-3} HC*l* at 30 °C

D 50 cm^3 of 1.2 mol dm^{-3} HC*l* at 30 °C

9 The energy diagram represents the reaction occurring with and without a catalyst.



Which of the following statements is correct?

A E_4 is the activation energy for the reverse catalysed reaction.

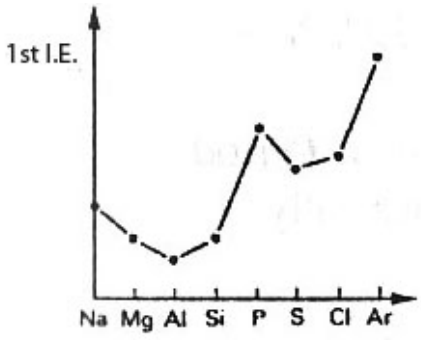
B The forward reaction, with catalyst, is endothermic.

C The enthalpy change of reaction is ($E_2 - E_3$).

D The enthalpy change of reaction is reduced by using a catalyst.

10 Which graph best shows the variation of first ionisation energy of the third period elements?

A



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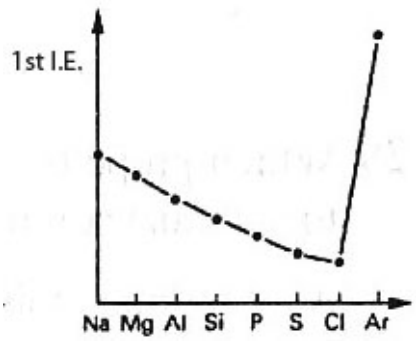

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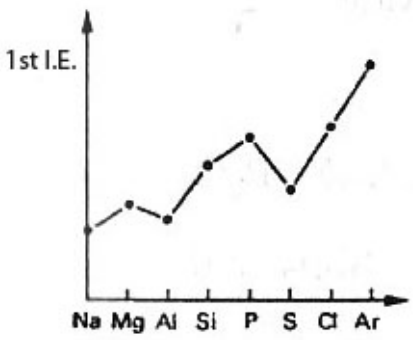
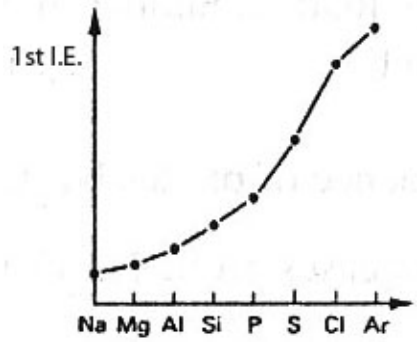


D



11 Which of the following sets contains a basic, an acidic, and an amphoteric oxide?

A	Al_2O_3	SiO_2	P_4O_{10}
B	Na_2O	MgO	P_4O_{10}
C	Na_2O	P_4O_{10}	SO_3
D	MgO	Al_2O_3	SO_3

12 It may be dangerous to put Group II metals in dilute acids since there is a possibility that explosion may occur. Which of the following best accounts for the above statement?

A Ionic radius increases down the group.

B Ionisation energy increases down the group.

C Charge density increases down the group.

D Reducing power increases down the group.

13 Which of the following statements is most likely to be true for astatine, the element below iodine in Group VII of the Periodic Table?

A Astatine and aqueous potassium chloride react to form aqueous potassium astatide and chlorine.

B Silver astatide and dilute aqueous ammonia react to form a solution of a soluble complex.

C Sodium astatide and hot concentrated sulphuric acid react to form astatine.

D Astatine is a coloured liquid at room temperature.

14 Both aqueous bromine and aqueous iodine appear as yellow solutions. Which of the following reagents can be used to distinguish the two solutions?

A Aqueous chlorine

B Aqueous sodium chloride

C Aqueous sodium thiosulphate

D Aqueous iron(II) sulphate, followed by aqueous sodium hydroxide

15 Which of the following statements concerning the transition metals is correct?

A They are the only metals which have more than one oxidation state.

B They are the only metals which give coloured ions in an aqueous solution.

C They are only metals of which the anhydrous chlorides have covalent bonds.

D They are the only metals which form complex ions.

16 A dilute solution of nickel(II) chloride is pale green at room temperature. When a test tube containing nickel(II) chloride solution is immersed in liquid nitrogen (−196 °C), the pale green solution solidifies and become colourless.

Which of the following statements best explains the observation above?

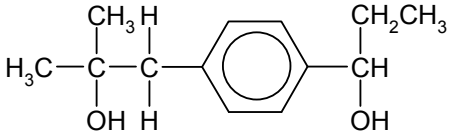
A Chloride ion has been substituted by a stronger ligand.

B The oxidation state of nickel has changed from +2 to 0.

C The probability of d−d* transition was greatly reduced.

D The solution does not contain complex ions at −196 °C.

17 The compound shown below is a derivative of ibuprofen which is used as a pain killer.



How many isomers (including stereoisomers) would be formed when the compound reacts with hot concentrated sulphuric acid?

A 4 **B** 6 **C** 8 **D** 12

18 On combustion, 10 cm^3 of the vapour of a hydrocarbon Q produces 60 cm^3 of CO_2 measured under similar conditions of temperature and pressure.

When Q reacts with hydrogen over platinum catalyst, a compound of relative molecular mass 84 is formed.

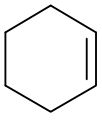
What is the formula of Q?

A $(CH_3)_2CHCH_2CH_2CH_3$

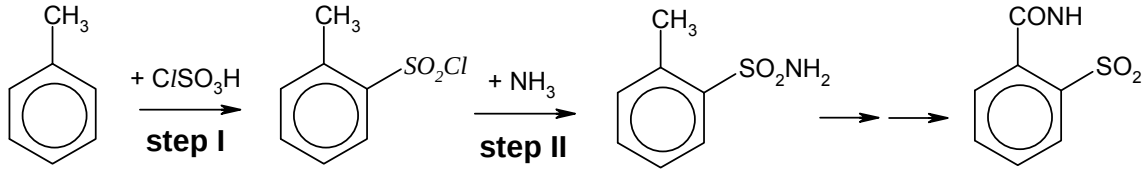
B $CH_3CH{=}CHCH_2CH_2CH_3$

C $CH_3CH_2CH_2COCH_3$

D



19 Saccharin is an artificial sweetening agent used in some soft drinks and is manufactured from methylbenzene through a four-step synthesis. Part of the reaction scheme is shown below.



What type of reaction do steps **I** and **II** illustrate?

	Step I	**Step II**
A	Electrophilic addition	Nucleophilic addition
B	Electrophilic substitution	Nucleophilic substitution
C	Nucleophilic addition	Elimination
D	Free radical substitution	Electrophilic substitution

20 Why does the reaction $C_2H_5X + OH^- \rightarrow C_2H_5OH + X^-$ take place more rapidly in aqueous solution when *X* is I than when *X* is Br?

A The I^- ion is less hydrated in solution than the Br^- ion.

B The I^- ion is a weaker nucleophile than the Br^- ion.

C The C−Br bond is more polar than the C−I bond.

D The C−Br bond is stronger than the C−I bond.

21 Some bromobutanes were separately treated with hot ethanolic sodium hydroxide. Two of them gave the same hydrocarbon, C_4H_6.

From which pair of bromobutanes was this hydrocarbon obtained?

A $CH_3CH_2CH_2CH_2Br$ and $CH_3CH_2CH_2CHBr_2$

B $CH_3CHBrCHBrCH_3$ and $BrCH_2CH_2CH_2CH_2Br$

C $CH_3CH_2CH_2CH_2Br$ and $BrCH_2CH_2CH_2CH_2Br$

D $CH_3CH_2CH_2CH_2Br$ and $CH_3CH_2CHBrCH_3$

22 It has been estimated that for every atom of chlorine generated from a fluorohalogenoalkane in the stratosphere, one hundred thousand molecules of ozone may be destroyed.

Which statement about the chlorine atom gives an explanation of this?

A They are regenerated in a chain-propagation reaction with ozone.

B They achieve high activation energies by absorbing ultraviolet radiation.

C They initiate the ionisation of oxygen molecules.

D They remove ozone from the ozone-oxygen equilibrium.

23 Compounds **X**, **Y**, **Z** react with sodium, but only one of them reacts with aqueous alkaline iodine. Which of the following combinations is likely to be **X**, **Y**, and **Z** respectively?

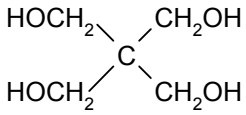
A C_6H_5OH, CH_3COOH, $(CH_3)_3OH$

B CH_3COOH, CH_3COCH_3, CH_3COOCH_2OH

C $HOCH_2CH_2OH$, $HOCH(CH_3)CH_2COOH$, CH_3COCH_2OH

D CH_3COOH, $(CH_3)_3COH$, $(CH_3)_2CHOH$

24 *Pentaecrythritol* is an intermediate in the manufacture of paint.



Pentaecrythritol

What deduction can be made from this structure?

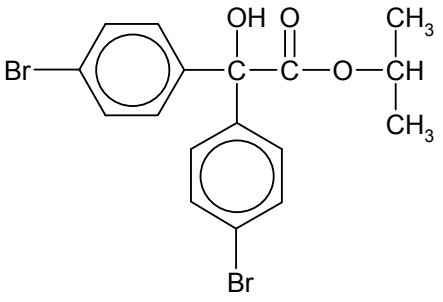
A It gives a precipitate with Fehling's reagent.

B It is soluble in water.

C It is optically active.

D It is dehydrated to an alkene by concentrated sulfuric acid.

25 *Acarol* is sold as an insecticide for use on fruit and vegetables.



Acarol

The final stage in its manufacture is an esterification.

Which alcohol is used to form the ester?

A di(4-bromophenyl)methanol **B** methanol

C propan-1-ol **D** propan-2-ol

26 Aldehydes and ketones are produced industrially by the catalytic oxidation of alkenes. For instance, ethanal is manufactured from ethene as shown below.

$$2\ H_2C{=}CH_2 + O_2 \xrightarrow{\text{catalyst}} 2\ CH_3CHO$$

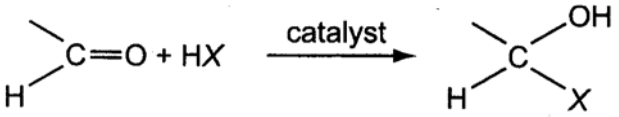
This process is also used industrially with but-2-ene.

Which of the following represents the structure of the compound produced from but-2-ene?

A $CH_3CH_2CH_2CHO$ **B** $(CH_3)_2CHCHO$

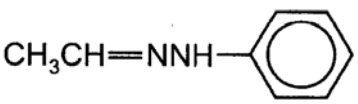
C $CH_3COCH_2CH_3$ **D** CH_3CH_2CHO

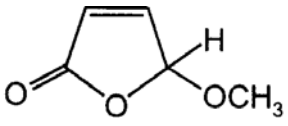
27 Aldehydes can undergo addition reactions with a variety of compounds of the form HX according to the following equation:

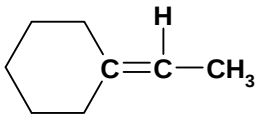


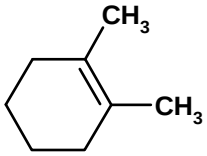
An example of such a reaction is the formation of a cyanohydrin, where *X* = CN.

Which of the following compounds **cannot** be obtained by such an addition reaction to an aldehyde, followed by dehydration?

A 

B 

C 

D 

28 Which of the following, in aqueous solutions of equal concentration, has the lowest pH?

A chlorethanoic acid

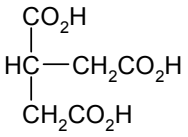
B ethanoic acid

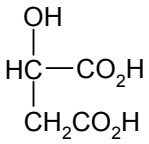
C ethylamine

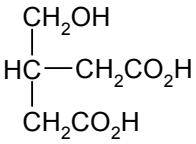
D phenol

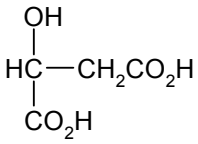
29 One industrial preparation of ethanoic acid is the direct carbonylation of methanol using a rhodium catalyst.

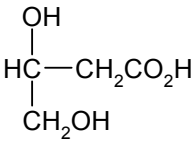
$$CH_3OH + CO \xrightarrow[\text{catalyst}]{\text{rhodium}} CH_3CO_2H$$

Which compound could be used to produce  by this method?

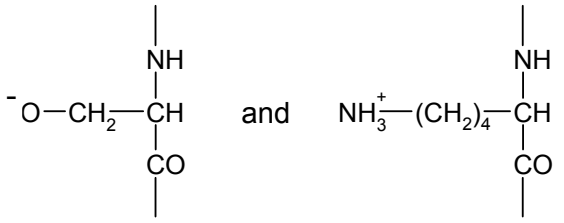
A 

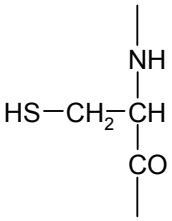
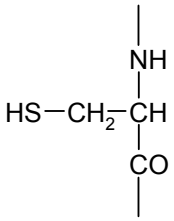
B 

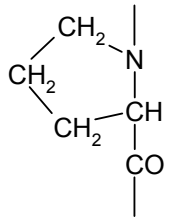
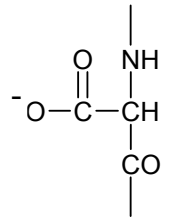
C 

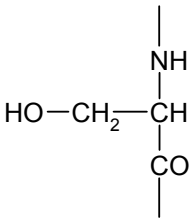
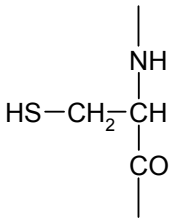
D 

30 Which of the following pairs of protein segments has an interaction which is likely to be broken due to a change in pH?

A  and

B  and 

C  and 

D  and 

Section B

For each of the 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 (you may find it helpful to pick a tick against the statements that you consider to be 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 molecules are polar?

1 CH_3COCH_3 **2** SF_4 **3** CO_2

32 The conversion of graphite into diamond is a non-spontaneous reaction at 298 K. The entropy change of this reaction of this reaction is negative at 298 K.

$$C(\text{graphite}) \rightarrow C(\text{diamond}),\ \Delta G = +3.08\ \text{kJ mol}^{-1}$$
$$\Delta S = -3.3\ \text{J mol}^{-1}\ \text{K}^{-1}$$

With reference to the enthalpy change, ΔH, of the reaction above, which of the following statements are correct?

1 The enthalpy change of atomisation of diamond is less endothermic than that of graphite.

2 The enthalpy change of combustion of diamond is more exothermic than that of graphite.

3 The bond energy of the carbon−carbon bonds in graphite is greater than that in diamond.

33 An electrochemical cell is made up of Mg^{2+} / Mg half-cell and the Fe^{2+} / Fe^{3+} 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.

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.

34 Which of the following can affect the magnitude of the equilibrium constant, K_p, of a reversible gaseous reaction?

1 temperature **2** pressure **3** catalyst

35 Which of the following statements are correct for the sequence of compounds below considered from left to right?

NaF MgO AlN SiC

1 The bonding becomes more covalent.

2 The difference in electronegativity between the elements in each compound decreases.

3 The formula-units of these compounds are isoelectronic.

36 A catalytic converter is fitted into the exhaust system of a car. Surfaces in a catalytic converter are coated with platinum and rhodium catalyst.

Which of the following reactions could take place on the surface of the catalyst?

1 hydrocarbons + oxides of nitrogen → carbon dioxide + water + nitrogen

2 carbon monoxide + oxides of nitrogen → carbon dioxide + nitrogen

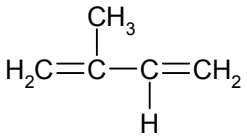
3 carbon monoxide + hydrocarbons → carbon dioxide + water

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.

37 2-methylbuta-1,3-diene can be polymerised to make synthetic rubbers. The structure of this monomer is shown below.



Which of the following statements about 2-methylbuta-1,3-diene are correct?

1 It is exhibits stereoisomerism.

2 It decolourises aqueous bromine.

3 It undergoes electrophilic addition reactions.

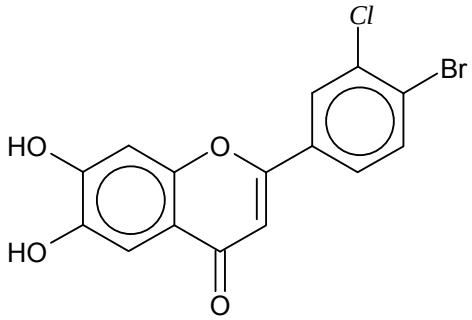
38 Which of the following are properties of fluoroalkanes?

1 They are likely to contribute to the depletion of the ozone layer.

2 They are less reactive than the corresponding chloroalkanes.

3 They may be used as aerosol propellants.

39 The structure of compound **A** is shown below.



What types of reactions will compound A undergo?

1 neutralisation

2 electrophilic substitution

3 nucleophilic substitution

The responses **A** to **D** should be selected on the basis of

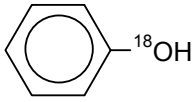
A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

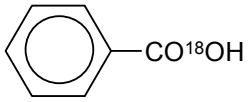
No other combination of statements is used as a correct response.

40 Phenyl ethanoate undergoes acid hydrolysis in the presence of water labelled with the ^{18}O isotope.

Which of the following products are formed?

1 $CH_3CO^{18}OH$

2 

3 

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