PIONEER JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION 2008

CHEMISTRY   **9746/01**
Higher 2

Paper 1 Multiple Choice   **18 September 2008**

1 hour

Additional materials: Data Booklet
                        Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, CT Group and index number on the answer sheet in the spaces provided unless this has already been done for you.

There are **forty** questions in this paper. Answer **all** questions. For each question, there are four possible answers labelled **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.

This document consists of **14** printed pages.

Section A

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

1   25.0 cm³ of 0.05 mol dm⁻³ $KClO_4$(aq) required 50.0 cm³ of 0.20 mol dm⁻³ $TiCl_3$ (aq) to reach end-point.

Given that titanium(III) is oxidised to titanium(IV) in this reaction, which one of the following formulae correctly represents the reduction product of the ClO_4^- ion?

A Cl^- **B** ClO_2^- **C** ClO_3^- **D** OCl^-

2   Which of the following is **not** true about P^{3-} ion?

A It is very polarisable.
B It is isoelectronic with argon.
C Its p-orbitals are completely filled.
D It is smaller than a phosphorus atom.

3   **X** and **Y** are elements with the following successive ionisation energies in kJ mol⁻¹.

X	580	1800	2700	11600	14800	18400	23300
Y	1310	3400	5300	7500	11300	13300	20300

What is the compound that is formed from element X and Y?

A XY_4
B X_2Y_3
C X_3Y_2
D X_4Y

4   In which of the following pairs is the bond angle of the second molecule / ion greater than that of the first?

A NO_2^+, NO_2^-
B SO_4^{2-}, SO_3^{2-}
C BrF_3, ClF_3
D PH_3, AsH_3

**5**   A 2 g sample of hydrogen at temperature T and of volume V exerts a pressure p. Deuterium, ^2_1H, is an isotope of hydrogen.

Which of the following would also exert a pressure of p at the same temperature T?

A a mixture of 1 g of hydrogen and 1 g of deuterium of total volume V
B a mixture of 1 g of hydrogen and 2 g of deuterium of total volume V
C a mixture of 1 g of hydrogen and 2 g of deuterium of total volume $2V$
D a mixture of 2 g of hydrogen and 2 g of deuterium of total volume $2V$

6   The enthalpy change of formation of $H_2S(g)$ and $H_2O(l)$ are -21 kJ mol^{-1} and -286 kJ mol^{-1} respectively and the enthalpy change of vaporisation of water is +41 kJ mol^{-1}.

What is the enthalpy change of reaction for the following process?

$$H_2S(g) + \tfrac{1}{2}O_2(g) \rightarrow H_2O(g) + S(s)$$
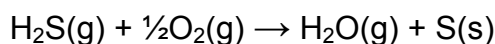
A -224 kJ mol^{-1}.
B -266 kJ mol^{-1}.
C -306 kJ mol^{-1}.
D -348 kJ mol^{-1}.

7   The lattice energies of rubidium fluoride, RbF, and caesium chloride, CsCl, are -760 kJ mol^{-1} and -650 kJ mol^{-1}, respectively.

What is the lattice energy of caesium fluoride, CsF, likely to be?

A -520 kJ mol^{-1}
B -580 kJ mol^{-1}
C -720 kJ mol^{-1}
D -920 kJ mol^{-1}

8   In an attempt to determine a value for Avogadro constant, a current I was passed for a time of t s into an aqueous solution of copper(II) sulphate using two copper electrodes of mass m_1 g each. At the end of the experiment, the mass of the copper anode was found to be m_2 g. The charge on one electron is e C.

What is the value for Avogadro constant, L?

A $L = \dfrac{63.5 \times I \times t}{2 \times e \times (m_1 - m_2)}$

B $L = \dfrac{63.5 \times I \times t}{e \times (m_2 - m_1)}$

C $L = \dfrac{2 \times e \times (m_1 - m_2)}{63.5 \times I \times t}$

D $L = \dfrac{e \times (m_2 - m_1)}{63.5 \times I \times t}$

9 A voltaic cell is made up of the Mg^{2+}/Mg half-cell and the Fe^{3+}/Fe^{2+} half-cell.

Which one of the following statements is correct?

A Addition of water to the Fe^{3+}/Fe^{2+} half-cell decreases the e.m.f. of the cell.
B Addition of aqueous sodium hydroxide to the Mg^{2+}/Mg half-cell increases the e.m.f. of the cell.
C Increasing the temperature has no effect on the e.m.f. of the cell.
D The Mg^{2+}/Mg half-cell is the positive electrode.

10 Gaseous hydrogen iodide dissociates on heating to set up the equilibrium shown below.

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

A quantity of gaseous hydrogen iodide was heated at constant pressure p at a certain temperature. The equilibrium partial pressure of HI (g) was found to be $\frac{1}{7}p$.

What is the value of the equilibrium constant, K_p, at this temperature?

A $\dfrac{6}{7}$ **B** $\dfrac{9}{7}$ **C** 9 **D** 36

11 What is the final pH of the solution formed by mixing equal volumes of two sulphuric acid solutions, one with pH 1.0 and the other with pH 3.0?

A 0.7 **B** 1.0 **C** 1.3 **D** 2.0

12 Which of the following statements about acids, bases and salts is correct?

A 10 cm^3 of 0.10 mol dm^{-3} of ethanoic acid reacts with 5 cm^3 of 0.10 mol dm^{-3} sodium hydroxide to produce an alkaline buffer.
B 10 cm^3 of 0.10 mol dm^{-3} of hydrochloric acid reacts with 5 cm^3 of 0.10 mol dm^{-3} aqueous ammonia produces an acidic buffer.
C 0.10 mol dm^{-3} of aqueous sodium ethanoate has higher pH than 0.10 mol dm^{-3} of aqueous ammonium chloride.
D 0.10 mol dm^{-3} of ethanoic acid has higher pH than 0.10 mol dm^{-3} of aqueous sodium ethanoate.

13 Which statement explains the observations that magnesium hydroxide dissolves in aqueous ammonium chloride, but not in aqueous sodium chloride?

A Ammonium hydroxide is first formed, and then acts through a common ion effect.
B The ammonium ion changes the solubility product of $Mg(OH)_2$.
C NH_4Cl dissociates less fully than $NaCl$.
D The NH_4^+ ion acts as an acid.

14 The following is the reaction for compound XY,

$$XY(g) \rightarrow X(g) + Y(g)$$
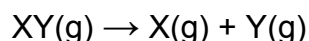
If the rate constant for the reaction is 5.78×10^{-3} s^{-1}, what is the time taken for the concentration of a sample of XY to decrease from 1.80 mol dm^{-3} to 0.225 mol dm^{-3}.

A   120 s   **B**   240 s   **C**   360 s   **D**   480 s

15 Using a colorimeter, the following reaction is studied by finding the time taken for a coloured reactant, P, to decolourise. The reaction is catalysed by Y.

$$P + Q \xrightarrow{\text{Y}} R + S$$

The following results are obtained:

Experiment	Vol of P added / cm³	Vol of Q added / cm³	Vol of Y added/ cm³	Vol of H₂O added/ cm³	Time taken / s
1	10	20	10	10	20
2	10	10	10	20	40
3	10	20	5	15	40
4	5	20	10	15	10

What is the rate equation for the reaction?

A Rate = k[Q][Y]
B Rate = k[P][Y]
C Rate = k[P][Q]
D Rate = k[P][Q][Y]

16 Which of the following sets contains an oxide with giant molecular structure and a chloride with simple molecular structure?

A MgO $MgCl_2$
B Al_2O_3 $AlCl_3$
C SiO_2 $SiCl_4$
D P_4O_{10} PCl_5

17 Magnesium oxide is used in the making of the lining of blast furnace. It is extracted from seawater as follows.

Aqueous calcium hydroxide is added to seawater.

$Ca(OH)_2(aq) + MgCl_2(aq) \rightarrow Mg(OH)_2(s) + CaCl_2(aq)$
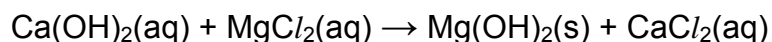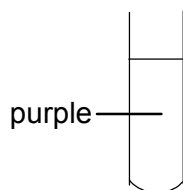
The magnesium hydroxide is then filtered off and roasted.

Which of the following comparisons between calcium and magnesium explains why magnesium hydroxide forms?
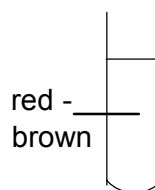
A Magnesium is lower than calcium in the reactivity series.
B The solubility product for $Mg(OH)_2$ is lower than that for $Ca(OH)_2$.
C The enthalpy change of hydration for Mg^{2+} is less exothermic than for Ca^{2+}.
D The magnitude of the lattice energy of $Mg(OH)_2$ is less than that of $Ca(OH)_2$.

18 Aqueous chlorine is added to aqueous sodium bromide and the mixture is shaken with an equal volume of trichloroethane.
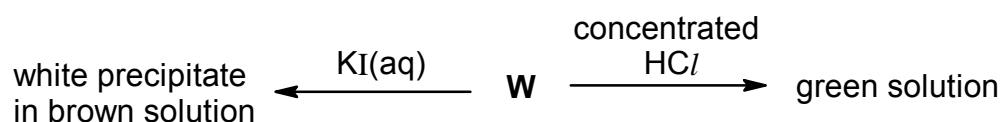
Which observation would be made?

A

purple

B

red - brown

C

yellow

purple

D

yellow

red - brown
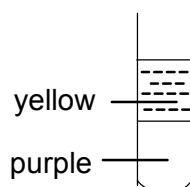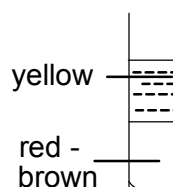
19 A compound **W** reacts in the following ways.

white precipitate in brown solution $\xleftarrow{\text{KI(aq)}}$ **W** $\xrightarrow[\text{HC}l]{\text{concentrated}}$ green solution

What could compound **W** be?

A Cu_2SO_4
B $CuSO_4$
C $FeSO_4$

D $Fe_2(SO_4)_3$

20 An aqueous solution containing a mixture of Cu^{2+}, Fe^{2+} and Al^{3+} ions is treated with an excess of aqueous sodium hydroxide. What precipitate is left by this reaction?

A $Cu(OH)_2$ and $Fe(OH)_2$
**B** $Fe(OH)_2$ and $Al(OH)_3$
C $Cu(OH)_2$ and $Al(OH)_3$
D $Fe(OH)_2$ only

21 How many isomers (including both structural isomers and stereoisomers) with molecular formula $C_4H_{10}O$ liberates hydrogen on reaction with sodium?

A 2 **B** 3 **C** 4 **D** 5

**22** Which of the following structures does **not** exhibit optical isomerism?
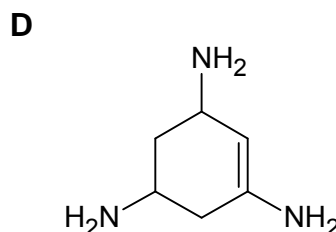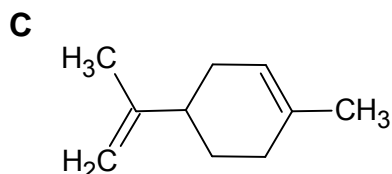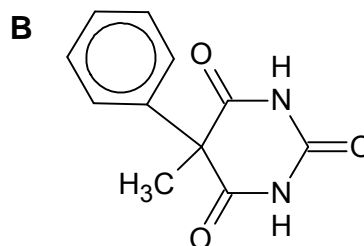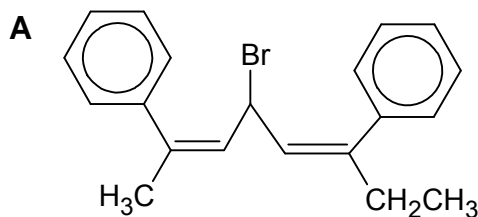
23 When organic compounds **P**, **Q**, **R** and **S** are added separately to water, solutions of **increasing** pH values are obtained. The possible identities of the compounds **P** to **S** (not necessarily in that order) are given below.

$CH_3CH_2CO_2H$ CH_3CH_2COCl $(CH_3)_2CHNH_2$ $H_2NCH_2CH_2CO_2H$
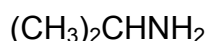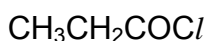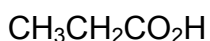
Which is the correct set of identities of compounds **P**, **Q**, **R** and **S**?

	P	Q	R	S
A	$CH_3CH_2CO_2H$	CH_3CH_2COCl	$H_2NCH_2CH_2CO_2H$	$(CH_3)_2CHNH_2$
B	$CH_3CH_2CO_2H$	CH_3CH_2COCl	$(CH_3)_2CHNH_2$	$H_2NCH_2CH_2CO_2H$
C	CH_3CH_2COCl	$CH_3CH_2CO_2H$	$(CH_3)_2CHNH_2$	$H_2NCH_2CH_2CO_2H$
D	CH_3CH_2COCl	$CH_3CH_2CO_2H$	$H_2NCH_2CH_2CO_2H$	$(CH_3)_2CHNH_2$

24 Why does the reaction between propane and chlorine **not** give a high yield of 2-chloropropane?

   A A mixture of chlorine and propane cannot be prevented from exploding.
   B Disubstitution by chlorine takes place preferentially to monosubstitution.
   C The central carbon atom of propane is too weakly nucleophilic.
   D The chlorine replaces any of the hydrogen atoms in propane.

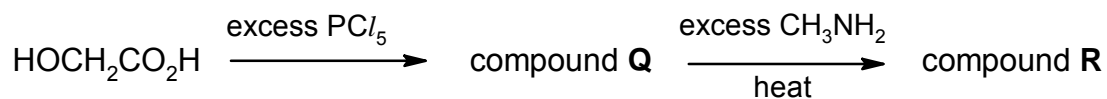25 The compound **X** was heated with ethanolic potassium hydroxide.

X
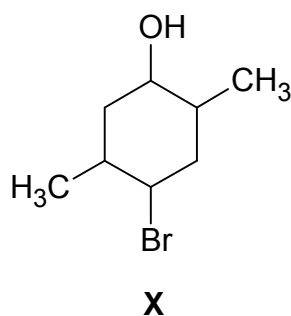
Which of the following would be the major product?
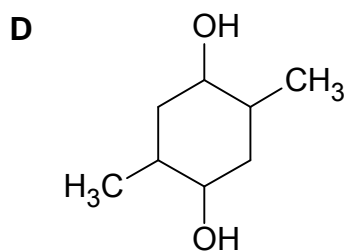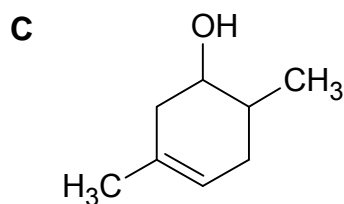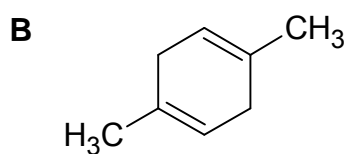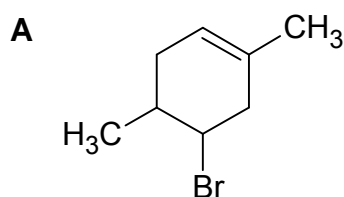
26 Which of the following statements about the reaction between ethanal and hydrogen cyanide is true?

   A The product obtained is a mixture of isomers which shows no net optical activity.
   B The type of reaction involved is nucleophilic substitution.
   C The geometry of the carbon atom bearing the oxygen atom in the product is trigonal planar.
   D The nucleophile involves in the rate-determining step of the reaction is hydrogen cyanide.

27 Hydroxyethanoic acid reacts as shown.

$$HOCH_2CO_2H \xrightarrow{\text{excess } PCl_5} \text{compound } \mathbf{Q} \xrightarrow[\text{heat}]{\text{excess } CH_3NH_2} \text{compound } \mathbf{R}$$

What are the formulae for compounds **Q** and **R**?

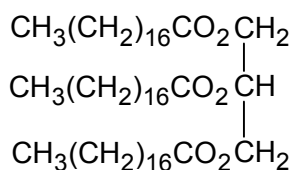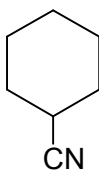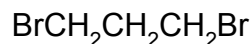|	Compound **Q**	Compound **R**
A	$HOCH_2COCl$	$HOCH_2CONHCH_3$
B	$ClCH_2CO_2H$	$CH_3NHCH_2CO_2H$
C	$ClCH_2COCl$	CH_3NHCH_2COCl
D	$ClCH_2COCl$	$CH_3NHCH_2CONHCH_3$

28 Tyrosine is one of the 20 amino acids that is used by cells to synthesise proteins, and was first discovered in cheese.
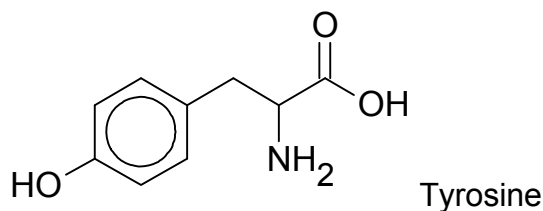
Tyrosine

Which of the following types of reaction will Tyrosine **not** undergo?

A reduction
B nucleophilic addition
C nucleophilic substitution
D electrophilic substitution

29 Experiments are carried out on three compounds **X**, **Y**, and **Z**.

$CH_3(CH_2)_{16}CO_2CH_2$
$CH_3(CH_2)_{16}CO_2CH$
$CH_3(CH_2)_{16}CO_2CH_2$

$BrCH_2CH_2CH_2Br$

CN

X   **Y**   **Z**

A sample of 0.01 mol of each compound is heated under reflux with 50 cm^3 of 1 mol dm^{-3} NaOH (in excess) until hydrolysis is complete and any ammonia produced is expelled from solution. The excess NaOH is then titrated in each case and is found to require 20 cm^3, 30 cm^3 and 40 cm^3 of 1 mol dm^{-3} HC*l* for neutralisation.
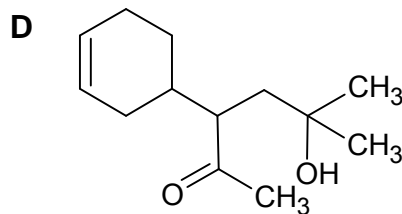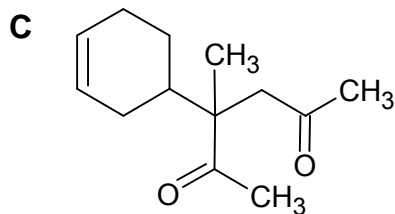
Which sequence of compounds matches these results?

	20 cm^3	30 cm^3	40 cm^3
A	X	Y	Z
B	X	Z	Y
C	Y	Z	X
D	Z	Y	X

30 Compound **Z**

- decolourises aqueous bromine,
- gives brisk effervescence with metallic sodium,
- changes the colour of hot acidified potassium dichromate(VI)

Which of the following could compound **Z** be?

A HO— [structure with CH$_3$, CH$_3$, O, OH]

B HO— [structure with CH$_3$, CH$_3$, O]

C [cyclohexene structure with CH$_3$, CH$_3$, O, O, CH$_3$]

D [cyclohexene structure with CH$_3$, CH$_3$, OH, O, CH$_3$]
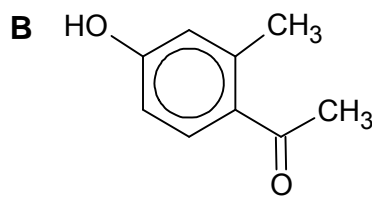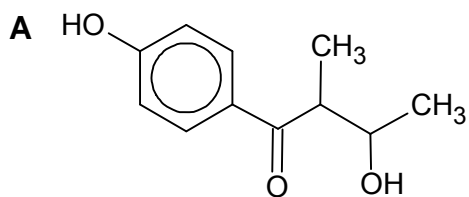
Section B

For each question 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 put a tick against the statements which 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 The use of *Data Booklet* is relevant to this question.

Consider the following reaction:

$SF_4(g) + F_2(g) \rightarrow SF_6(g)$ $\Delta H_{reaction}$ = -440 kJ mol^{-1}

Which of the following statements are true?

1 The molecule SF_4 has a see-saw shape.
2 The average value of the S-F bond energy is 299 kJ mol^{-1}.
3 F_2 acts as an oxidising agent.

32 Which of the following processes are exothermic?

1 $H_2O(l) \rightarrow H_2O(g)$
2 $Li^+(g) + aq \rightarrow Li^+(aq)$
3 $O(g) + e^- \rightarrow O^-(g)$

33 Consider the following standard electrode potentials.

$E^\theta(P^+/P)$ = +1.8 V $E^\theta(Q^{2+}/Q)$ = +0.3 V $E^\theta(R^+/R)$ = -0.9 V $E^\theta(S^{2+}/S)$ = -0.3 V

Which of the following statements are correct?

1 A cell consisting of P^+/P half cell and Q^{2+}/Q half-cell has an e.m.f. of +1.5 V.
2 S could be oxidised by R^+
3 P^+ is the strongest reducing agent among all the species listed.

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 Ammonium carbamate, $NH_4CO_2NH_2$, decomposes as follows:

$$NH_4CO_2NH_2(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$$
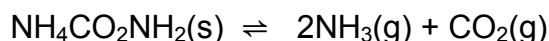
Which of the following statement about this system in equilibrium is correct?

1 Increasing the volume of the system will shift the equilibrium to the right.
2 Increasing the pressure of the system will increase the equilibrium constant, K_p.
3 The use of a catalyst will increase the rate of the reaction by increasing the equilibrium constant, K_c.

35 Which properties of hydrogen halides increase as Group VII is descended?

1 bond length
2 reducing power
3 thermal stability

36 The conversion of $CrO_4^{2-}(aq)$ into $Cr_2O_7^{2-}(aq)$ is represented by the following equation.

$$2CrO_4^{2-}(aq) + 2H^+(aq) \rightleftharpoons Cr_2O_7^{2-}(aq) + H_2O$$
$$\text{yellow} \qquad\qquad\qquad \text{orange}$$
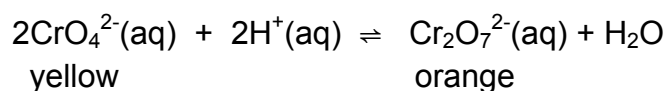
Which statements are true of this reaction?

1 Addition of $OH^-(aq)$ to $Cr_2O_7^{2-}$ causes a change in colour.
2 $CrO_4^{2-}(aq)$ acts as a base.
3 The conversion of $CrO_4^{2-}(aq)$ to $Cr_2O_7^{2-}(aq)$ is a redox reaction.

37 Which of the following properties are identical for the two optical isomers of   2-hydroxypropanoic acid, $CH_3CH(OH)CO_2H$?

1 ΔH^θ_f
2 pK_a
3 melting point

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.

38 A 'sleep factor', isolated from animal tissues, acts as a signal to the brain that it is time to sleep. It has been identified as *cis*-octadec-9-enamide.
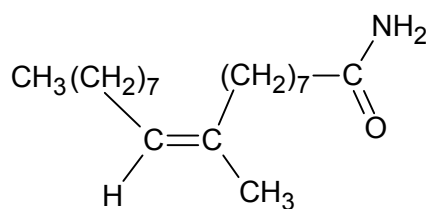

cis-octadec-9-enamide

Which properties does cis-octadec-9-enamide possess?

1 It undergoes acid-base reaction with dilute hydrochloric acid.
2 It undergoes hydrolysis with aqueous sodium hydroxide.
3 It undergoes electrophilic addition with aqueous bromine.

39 Which of the following tests can be used to distinguish between CH_3COCH_3 and $CH_3CH_2C(OH)(CH_3)_2$?

1 sodium
2 alkaline aqueous iodine
3 hot acidified aqueous potassium manganate(VII)

40 Which of the following statements are correct about compound **H** shown below?

H
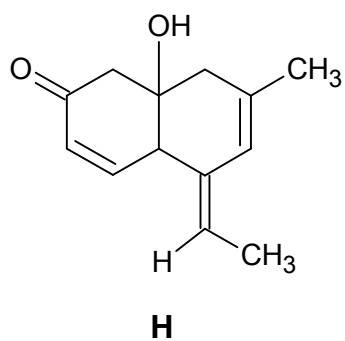
1 1 mole of **H** reacts with 1 mole of sodium hydroxide.
2 1 mole of **H** reacts with 1 mole of phosphorus(V) chloride.
3 1 mole of **H** reacts with 4 moles of H_2 in presence of platinum catalyst.

End of Paper

PIONEER JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION 2008

H2 CHEMISTRY   **9746/1**
PAPER 1

<u>MCQ Answers</u>

1	A	**11**	C	**21**	D	**31**	A
2	D	**12**	C	**22**	B	**32**	C
3	B	**13**	D	**23**	D	**33**	D
4	C	**14**	C	**24**	D	**34**	D
5	B	**15**	A	**25**	C	**35**	B
6	A	**16**	C	**26**	A	**36**	B
7	C	**17**	B	**27**	D	**37**	A
8	A	**18**	D	**28**	B	**38**	C
9	B	**19**	B	**29**	B	**39**	B
10	C	**20**	A	**30**	A	**40**	C