PIONEER JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION 2008

H1 CHEMISTRY **8872/01**

PAPER 1 **18 September 2008**

50 minutes

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 **thirty** 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.

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 Chlorine gas is a severe irritant to the eyes and respiratory system. The maximum safe toleration level of chlorine gas in air is 0.005 mg dm^{-3}.

How many chlorine atoms are present in 500 cm^3 of air at this toleration level?

A $\frac{0.005}{35.5} \times 6 \times 10^{23}$

B $\frac{0.005}{1000} \times \frac{1}{71} \times 2 \times 6 \times 10^{23}$

C $\frac{0.005}{71} \times \frac{1}{2} \times 6 \times 10^{23}$

D $\frac{0.005}{1000} \times \frac{1}{71} \times 6 \times 10^{23}$

2 Bones contain a complex mixture calcium salts, protein and other material. When a bone is strongly heated in a current of air, the only residue is calcium oxide.

From a sample of 50.0 g of bone, 14.0 g of calcium oxide were obtained.

What is the percentage by mass of calcium in the bone?

A 10.0%

B 14.0%

C 20.1%

D 23.3%

3 To identify an oxide of nitrogen, 0.10 mol of the oxide is mixed with an excess of hydrogen and passed over a catalyst at a suitable temperature.

$$N_xO_y \xrightarrow[H_2 \text{ gas}]{\text{catalyst}} xNH_3 + yH_2O$$

The water produced weighs 7.20 g. The ammonia produced is neutralised by 200 cm^3 of 1.0 mol dm^{-3} HC*l*.

What is the formula of the oxide of nitrogen?

A N_2O

B NO

C NO_2

D N_2O_4

4 Gaseous particle **X** has proton number *n* and a charge of +1.
Gaseous particle **Y** has proton number (*n*+1). It is isoelectronic (has the same number of electrons) with **X**.

Which of the following statements correctly describe **X** and **Y**?

A **X** has a larger radius than **Y**.

B **X** has a greater nuclear charge than **Y**.

C **X** releases more energy than **Y** when an electron is added to each particle

D **X** requires more energy than **Y** when a further electron is removed from each particle.

5 In which of the following does ionic bonding occur between the named atoms?

A aluminium and chlorine in aluminium chloride

B hydrogen and sodium in sodium hydride

C boron and fluorine in boron fluoride

D silicon and chlorine in silicon tetrachloride

6 A solid **E** has the following physical properties.

- It is insoluble in hydrocarbon solvents.
- It melts at 1290°C.
- It conducts electricity in both aqueous and molten states.

What is the likely structure of **E**?

A an ionic structure

B a simple molecular structure

C an atomic structure

D a giant molecular structure

7 The enthalpy change of neutralisation of aqueous sodium hydroxide by hydrochloric acid is -57.2 kJ mol^{-1}, but the enthalpy change of neutralisation of aqueous sodium hydroxide by aqueous ethanoic acid is -55.2 kJ mol^{-1}.

Which best explains the numerical difference in these values?

A Aqueous ethanoic acid contains fewer hydrogen ions than hydrochloric acid of the same concentration.

B The process $CH_3CO_2H\ (aq) \rightarrow CH_3CO_2^-\ (aq) + H^+\ (aq)$ is endothermic.

C The process $CH_3CO_2H\ (aq) \rightarrow CH_3CO_2^-\ (aq) + H^+\ (aq)$ is exothermic.

D A smaller volume of aqueous ethanoic acid is required for the neutralisation compared to that of hydrochloric acid of the same concentration.

8 The bond dissociation energy of H-Br is 362 kJ mol^{-1}.

Which one of the following processes will release 362 kJ of energy?

A $H(g) + Br(g) \rightarrow HBr(g)$

B $HBr(g) \rightarrow H(g) + Br(g)$

C $\frac{1}{2}H_2(g) + \frac{1}{2}Br_2(g) \rightarrow HBr(g)$

D $HBr(g) \rightarrow \frac{1}{2}H_2(g) + \frac{1}{2}Br_2(g)$

9 Methanol is manufactured industrially by the catalytic reaction shown:

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g) \quad \Delta H = -92\ kJmol^{-1}$$

The operating conditions are 250°C, a pressure 75 atm and a copper based catalyst.

Which factor influences the choice of these conditions?

A The catalyst increases the equilibrium yield of methanol.

B At lower pressures, the rate of formation of methanol increases.

C At lower temperatures, the equilibrium yield of methanol increases.

D At lower temperatures, the rate of formation of methanol increases.

10 For which equilibrium does K_c have no units?

A $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$

B $Cu^{2+}(aq) + 4NH_3(aq) \rightleftharpoons [Cu(NH_3)_4]^{2+}(aq)$

C $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

D $CH_3OH(l) + CH_3CO_2H(l) \rightleftharpoons CH_3CO_2CH_3(l) + H_2O(l)$

11 Stomach juices have a pH of 1.0.

Aspirin is a monobasic acid represented by HA ($K_a = 10^{-4}$ mol dm^{-3}) which dissociates into ions H^+ and A^-.

What are the relative concentrations of H^+, A^- and HA when aspirin from a tablet enters the stomach?

A $[HA] > [H^+] = [A^-]$

B $[H^+] = [A^-] > [HA]$

C $[H^+] > [A^-] > [HA]$

D $[H^+] > [HA] > [A^-]$

12 One important buffer that exists in blood is composed of $H_2PO_4^-(aq)$ and $HPO_4^{2-}(aq)$. What is the ionic equation that represents the reaction of hydrochloric acid with this buffer?

A $HCl(aq) + H_2PO_4^-(aq) \rightarrow Cl^-(aq) + H_3PO_4(aq)$

B $H_3O^+(aq) + HPO_4^{2-}(aq) \rightarrow H_2O(l) + H_2PO_4^-(aq)$

C $H_3O^+(aq) + H_2PO_4^-(aq) \rightarrow H_2O(l) + H_3PO_4(aq)$

D $HCl(aq) + HPO_4^{2-}(aq) \rightarrow Cl^-(aq) + H_2PO_4^-(aq)$

13 Lead is the final product formed by a series of changes in which the rate determining step is the radioactive decay of uranium-238. This radioactive decay is a first order reaction with a half life of 4.5×10^9 years.

What would be the age of a rock sample, originally lead free, in which the molar proportion of uranium to lead is now 1:3?

A 1.5×10^9 years

B 2.25×10^9 years

C 4.5×10^9 years

D 9.0×10^9 years

14 It is often said that the rate of a typical reaction is roughly doubled by raising the temperature by 10°C.

Which of the following explains this observation?

A Raising the temperature by 10°C doubles the number of molecules having energy more than a certain minimum energy.

B Raising the temperature by 10°C doubles the average energy of each molecule.

C Raising the temperature by 10°C doubles the average speed of each molecule.

D Raising the temperature by 10°C doubles the number of molecular collisions in a given time.

15 The ionic radius of the elements in Period 3 (Na to C*l*) changes across the period.

Which of the following statements does **not** explain the trend of the ionic radius across the period?

A Across the period, there is an increase in the nuclear charge.

B The anions have greater shielding effect than the cations.

C There is a constant screening effect among the cations.

D The effective nuclear charge decreases from P^{3-} to Cl^{-}.

16 Consider the sequence of compounds NaBr, A*l*C*l*$_3$, SiC.

Which of the following statement that best describes the above sequence?

A The formula units of these compounds are isoelectronic.

B Bonding becomes increasingly covalent.

C Bonding becomes increasingly ionic.

D The electronegativity difference between these elements in each compound increases.

17 Which of the following elements has an oxide with a giant molecular structure and a chloride which is readily hydrolysed?

A sodium

B aluminium

C silicon

D phosphorus

18 Which molecules have isomers that exhibit *cis-trans* isomerism?

I	II	III	IV
C_3H_6BrI	C_3H_5I	$C_3H_4I_2$	C_3H_4BrI

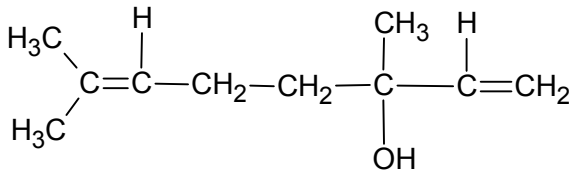
A I, II and III only

B II, III and IV only

C II and IV only

D III and IV only

19 Which of the following is **not** a product of the vigorous oxidation of linalo-ol?



Linalo-ol

A CO_2

B CH_3COCH_3

C $HO_2CCH_2CH_2COCO_2H$

D $HO_2CCH_2CH_2C(CH_3)(OH)CO_2H$

20 Which of the following reagents **cannot** be used to convert $CH_3CH(OH)CH_3$ to $CH_3CHCICH_3$?

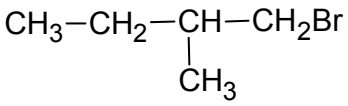
A PCI_5

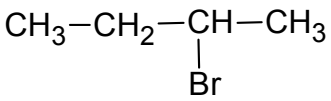
B $SOCI_2$

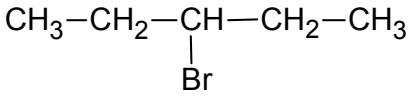
C CI_2, $AICI_3$

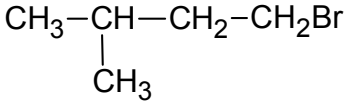
D concentrated HCI, $ZnCI_2$

21 Which of the following isomers of $C_5H_{11}Br$ give, on treatment with hot ethanolic KOH, the greatest number of different alkenes?

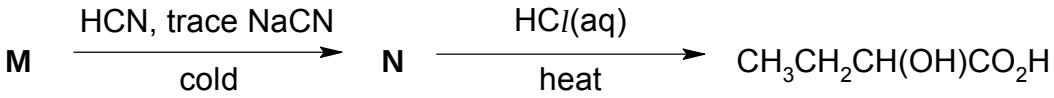
A 

B 

C 

D 

22 2-hydroxybutanoic acid can be prepared by the following reaction scheme starting with compound **M**.



Which one of the following structures represents **M**?

A $CH_3CH_2CH_2Br$

B $CH_3CHBrCHO$

C CH_3CH_2CHO

D CH_3COCH_3

23 Which of the following reagents will give similar results for both propanone and benzaldehyde?

A acidified aqueous potassium dichromate(VI)

B alkaline aqueous iodine

C Fehling's solution

D Tollens' reagent

24 An ester with the odour of pineapples has the formula $CH_3CH_2CH_2CO_2CH_2CH_3$.

What are the products of hydrolysis by boiling the ester with aqueous sodium hydroxide?

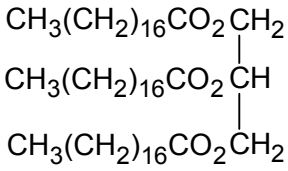
A $CH_3CH_2CH_2CO_2H$ and $CH_3CH_2O^-Na^+$

B $CH_3CH_2CH_2CO_2^-Na^+$ and CH_3CH_2OH

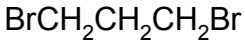
C $CH_3CH_2CO_2H$ and $CH_3CH_2CH_2O^-Na^+$

D $CH_3CH_2CO_2^-Na^+$ and $CH_3CH_2CH_2OH$

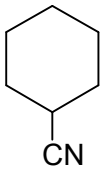
25 Experiments are carried out on three compounds **X**, **Y**, and **Z**.



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**

Section B

For each of the next 5 questions, 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.

26 In which sequences are the molecules quoted in order of increasing bond angle within the molecule?

1 H_2O NH_3 CH_4

2 H_2O BF_3 CO_2

3 CH_4 CO_2 SF_6

27 Which of the following compounds are miscible with water?

1 CH_3CO_2H

2 $CH_3CH_2NH_2$

3 $CH_3CO_2CH_3$

28 Why is a solution of aluminium chloride acidic?

1 Chloride ions react with water to form hydrochloric acid.

2 Aluminium ions have a high charge density.

3 The H-O bonds are weaker in $[Al(H_2O)_6]^{3+}$ than in H_2O.

29 Which one of the following are correct descriptions of a weak acid?

1 It has a higher K_a value than strong acids.

2 A dilute solution of the weak acid can conduct electricity.

3 It produces a strong conjugate base.

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.

30 Which of the following reagents can be used to distinguish between methanol and ethanal?

1 sodium

2 alkaline aqueous iodine

3 acidified potassium manganate(VII)

End of Paper

PIONEER JUNIOR COLLEGE
JC2 Preliminary Examination 2008

CHEMISTRY H1 **8872/1**
PAPER 1

MCQ Answers

1	**D**	11	**D**	21	**B**
2	**C**	12	**B**	22	**C**
3	**D**	13	**D**	23	**C**
4	**A**	14	**A**	24	**B**
5	**B**	15	**D**	25	**A**
6	**A**	16	**B**	26	**B**
7	**B**	17	**C**	27	**B**
8	**A**	18	**B**	28	**C**
9	**C**	19	**C**	29	**C**
10	**D**	20	**C**	30	**A**