PIONEER JUNIOR COLLEGE, SINGAPORE

JC2 PRELIMINARY EXAMINATIONS
HIGHER 2

CHEMISTRY **9746/01**

Paper 1 Multiple Choice **24 September 2009**

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.

A calculator may be used.

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 A radioactive isotope of thallium, $^{201}_{81}Tl$, is used to assess damage in heart muscles after a heart attack.

Which statement about $^{201}_{81}Tl$ is correct?

A The isotope has a nucleon number of 120.

B The number of electrons in one atom of this isotope is 81.

C The number of neutrons in one atom of this isotope is 201.

D $^{201}_{82}Tl$ is an isotope of $^{201}_{81}Tl$.

2 *Use of the Data Booklet is relevant to this question.*

Oxides of nitrogen are pollutant gases which are emitted from car exhausts.

In urban traffic, when a car travels one kilometre, it releases 0.23 g of an oxide of nitrogen N_aO_b, which occupies 120 cm^3 at room temperature and pressure.

What are the values of a and b?

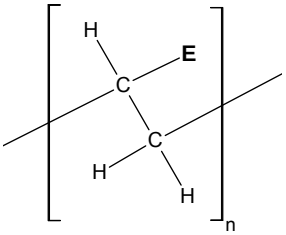
A a = 1, b = 1

B a = 1, b = 2

C a = 2, b = 1

D a = 2, b = 4

3 Plastic bottles for 'fizzy drinks' are made from a polymer with



The ability of the polymer to prevent the escape of carbon dioxide through the wall of the bottle depends on the ability of the group **E** to form hydrogen bonds with the carbon dioxide in the drink.

Which group **E** best prevents the loss of carbon dioxide?

A C*l*

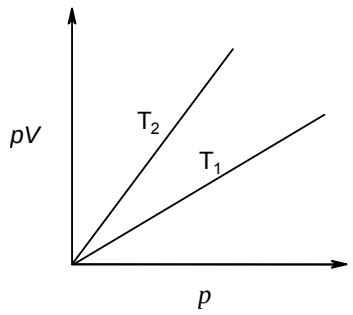
B CN

C CO_2CH_3

D OH

4 Which one of the following graphs below shows the correct plot of pV against p for a fixed mass of ideal gas at two temperatures, T_1 and T_2, in which $T_1 > T_2$?

A



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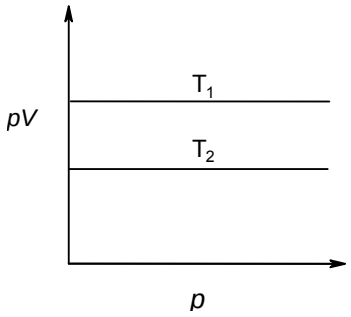

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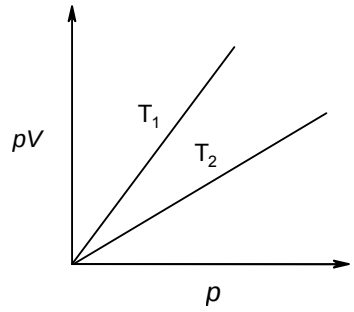

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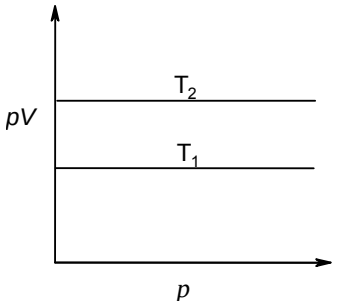


5 The standard enthalpy changes of formation of HC*l* and HI are –92 kJ mol^{-1} and +26 kJ mol^{-1} respectively.

Which statement is **most** important in explaining this difference?

A The bond energy of HI is smaller than the bond energy of HC*l*.

B The bond energy of I_2 is smaller than the bond energy of Cl_2.

C Chlorine is more electronegative than iodine.

D The activation energy for the H_2 / Cl_2 reaction is much less than that for the H_2 / I_2 reaction.

6 Given the following enthalpy changes,

$P_4(s) + 6Cl_2(g) \rightarrow 4PCl_3(l)$ $\quad \Delta H = -1260$ kJ mol^{-1}
$P_4(s) + 10Cl_2(g) \rightarrow 4PCl_5(s)$ $\quad \Delta H = -1820$ kJ mol^{-1}

What is the enthalpy change for the following reaction?

$$PCl_3(l) + Cl_2(g) \rightarrow PCl_5(s)$$

A – 140 kJ mol^{-1}

B – 193 kJ mol^{-1}

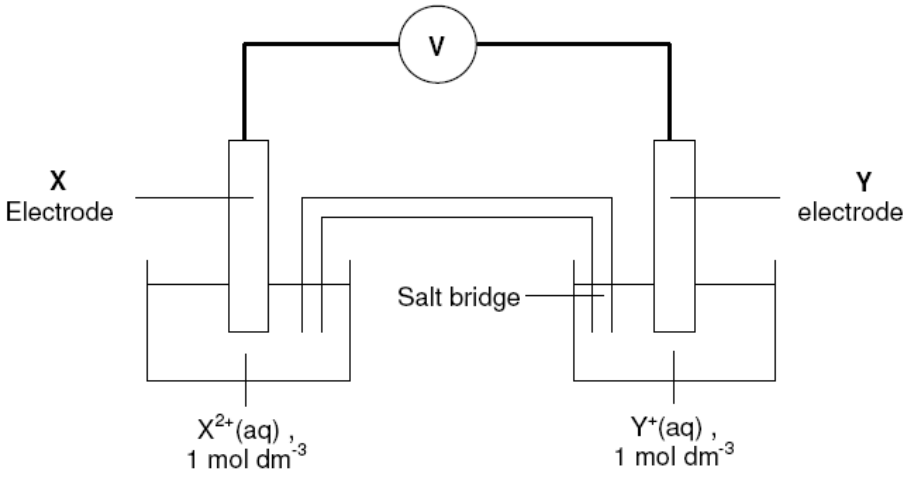
C – 560 kJ mol^{-1}

D – 770 kJ mol^{-1}

7 The standard electrode potential for the metals **X** and **Y** are given below.

X^{2+} (aq) / **X**(s); E^{θ} = -0.25 V
Y^{+} (aq) / **Y**(s); E^{θ} = +0.80 V

The diagram of the cell made up of the above two half-cells is shown below.



Which description is correct for this cell?

	Cathode	E^{θ}_{cell}	Direction of electron flow	Electrode at which positive ions enter the solution
A	**X**	+ 0.55 V	**X** to **Y**	**X**
B	**X**	+ 1.05 V	**Y** to **X**	**Y**
C	**Y**	+ 1.05 V	**X** to **Y**	**X**
D	**Y**	+ 0.55 V	**Y** to **X**	**Y**

8 During electrolysis under suitable conditions, 0.785 g of chromium is deposited on the cathode when 4370 C of electricity is passed into a chromium-containing electrolyte.

Which of the following could have been the electrolyte?

A $CrCl_2$
B $CrCl_3$
C K_2CrO_3
D $K_2Cr_2O_7$

9 The equilibrium constant, K_p, for the following reaction is 4.44 at a temperature, T ^{o}C.

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

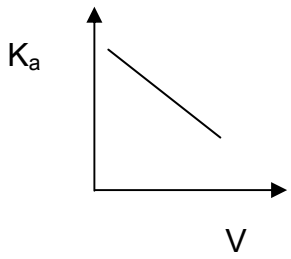
A mixture containing an equal amount of $H_2(g)$ and $I_2(g)$ at a total pressure of 1 atm is allowed to reach equilibrium at T ^{o}C in a vessel with constant volume.

What is the partial pressure of $H_2(g)$ at equilibrium at T ^{o}C?

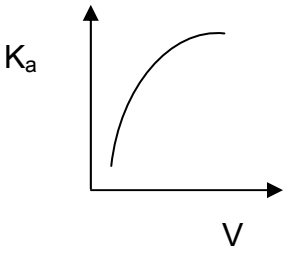
A 0.096 atm
B 0.161 atm
C 0.339 atm
D 0.404 atm

10 1 mol of propanoic acid is diluted at constant temperature to a volume V. Which one of the following diagrams shows how the acid dissociation constant, K_a, varies with V?

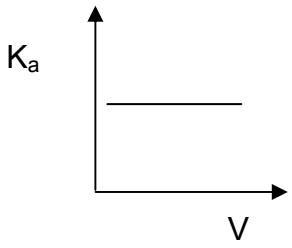
A



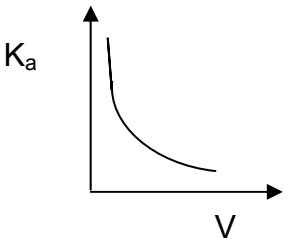
C



B



D



11 What is the pH value of a solution containing 0.10 mol dm^{-3} of aqueous NH_3 and 0.10 mol dm^{-3} of aqueous $(NH_4)_2SO_4$? (pK_b of NH_3 = 4.75)

A 4.75

B 5.05

C 8.95

D 9.25

12 The solubility products of calcium fluoride and calcium carbonate are 4.0 x 10^{-11} mol^3 dm^{-9} and 8.7 x 10^{-9} mol^2 dm^{-6} at 25 ^oC respectively.

Which of the following statements is **not** true?

A When calcium nitrate is added into a 1 dm^3 solution containing 0.01 mol of fluoride and 0.01 mol of carbonate ions, calcium fluoride precipitates out first.

B Calcium fluoride has a higher molar solubility than calcium carbonate

C Addition of hydrochloric acid increases the solubility of calcium carbonate

D Addition of sodium fluoride to a solution containing calcium fluoride decreases the solubility product of calcium fluoride.

13 Which of the following statements about the rate constant, k, of chemical reactions is **not** true?

A The rate constant increases when a catalyst is used.

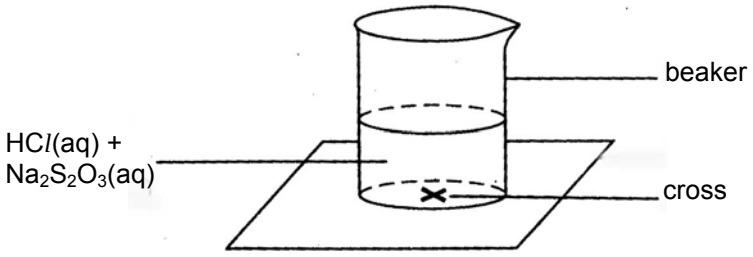
B The rate constant remains the same if the concentration of reactants is increased.

C The rate constant increases if the activation energy is increased

D The rate constant can have different units.

14 The kinetics of the reaction between $H^+(aq)$ and $S_2O_3^{2-}(aq)$ can be investigated experimentally by varying the volumes of HC*l*(aq) and $Na_2S_2O_3(aq)$ used and determining the time taken, t, for the formation of sulphur to completely obscure the cross as shown in the diagram.

$$S_2O_3^{2-}(aq) + 2H^+(aq) \rightarrow S(s) + SO_2(g) + H_2O(l)$$



The table below shows the experimental results obtained.

Experiment	Volume used / cm^3			t / s
	1.0 mol dm^{-3} HC*l*(aq)	0.040 mol dm^{-3} $Na_2S_2O_3(aq)$	$H_2O(l)$	
1	10.0	5.0	25.0	170
2	15.0	5.0	20.0	170
3	15.0	10.0	15.0	85
4	20.0	20.0	0.0	*f*

What is the value of *f* in Experiment 4?

A 21 **C** 85

B 43 **D** 170

15 On adding **G**(aq) to **H**(aq), a brown mixture (white precipitate in brown solution) was obtained. On addition of **J**(aq), a white precipitate and a colourless solution were observed. On further addition of **J**(aq), the white precipitate dissolved.

Which of the following could be **G**, **H** and **J**?

	G	**H**	**J**
A	$CuSO_4$	KI	$Na_2S_2O_3$
B	$Fe_2(SO_4)_3$	NaOH	KI
C	$Fe_2(SO_4)_3$	$NaNO_2$	KI
D	$ZnSO_4$	NaOH	NH_3

16 *Use of the Data Booklet is relevant to this question.*

When 16.4 g of calcium nitrate is heated, what is the volume of gases produced, measured at room temperature and pressure?

A 1.20 dm^3

B 2.40 dm^3

C 4.80 dm^3

D 6.00 dm^3

17 Which of the following is **not** true about Group II compounds?

A The solubility of Group II sulphates decreases down the group.

B The ease of thermal decomposition of Group II carbonates increases down the group.

C Reactivity of Group II oxides with water increases down the group.

D Lattice energy of Group II oxides becomes less exothermic down the group.

18 Which of the following about Group VII chemistry is correct?

A The reaction between chloride ions and concentrated sulphuric acid can result in the oxidation state of sulphur being decreased from +6 to -2.

B Hydrogen chloride is less volatile than hydrogen iodide.

C The magnitude of the lattice enthalpy of three Group I halides decreases in the order NaF > NaC*l* > KC*l*.

D HF is a stronger acid than HI.

19 Which of the following does **not** act as a ligand in the formation of complexes?

A SCN^-

B $H_2NCH_2CH_2NH_2$

C Cl^-

D AlH_4^-

20 Chromium(III) chloride combines with ammonia to form compound **K** in which the co-ordination number of chromium is 6. When solution **K** is treated with an excess aqueous silver nitrate, only two third of the total chloride present is precipitated as AgC*l*.

What is the formula of compound **K**?

A $Cr(NH_3)_6Cl_3$

B $Cr(NH_3)_5Cl_3$

C $Cr(NH_3)_4Cl_3$

D $Cr(NH_3)_3Cl_3$

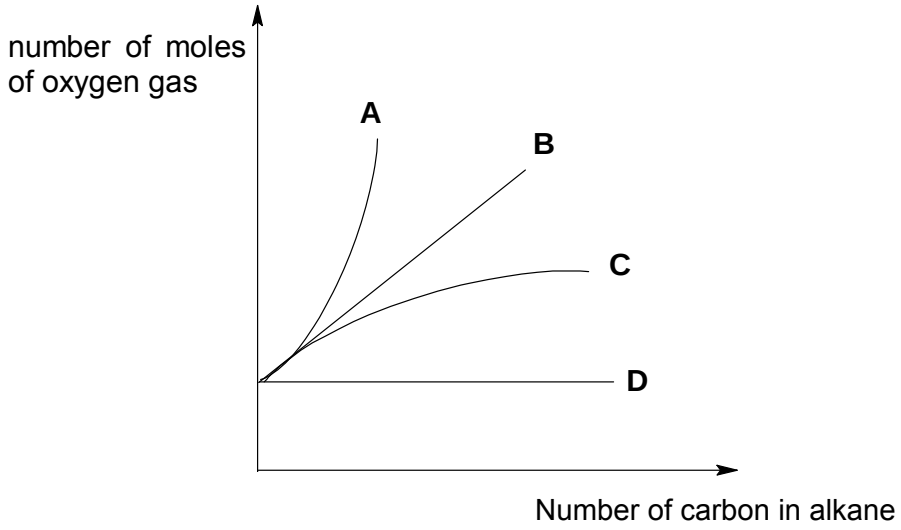
21 An alcohol with molecular formula $C_nH_{2n+1}OH$ has a chiral carbon atom but does not react with MnO_4^- / H^+.

What is the least number of carbon atoms such an alcohol could possess?

A 5 **C** 7

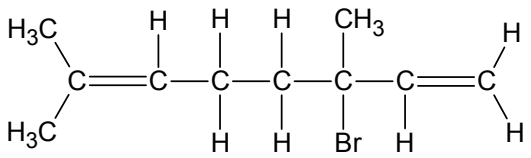
B 6 **D** 8

22 Which line on the graph shows the relationship between the number of carbon atoms in an alkane and the number of moles of oxygen gas needed for complete combustion of the alkane?



23 Deuterium, D, is the $^{2}_{1}H$ isotope of hydrogen.

Considering only the major product, how many deuterium atoms are incorporated into a molecule of *Linalo-ol* when it is reacted with bromine in heavy water, D_2O?



Linalo-ol

A 0 **C** 2

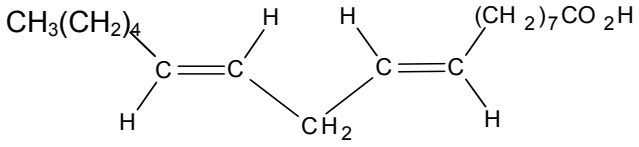
B 1 **D** 3

24 Low fat sunflower butter spreads are high in polyunsaturates, such as *linoleic acid* as shown below.

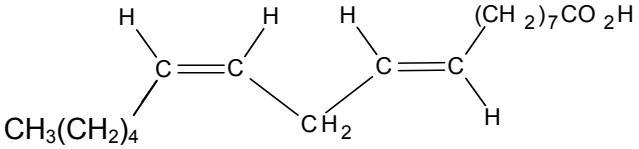
$$CH_3(CH_2)_4CH{=}CHCH_2CH{=}CH(CH_2)_7CO_2H$$
linoleic acid

On the lid of a brand of spread, it is claimed that the spread contains virtually no *trans* fatty acids. Which isomer does **not** contain a *trans* linkage and could be present in the spread?

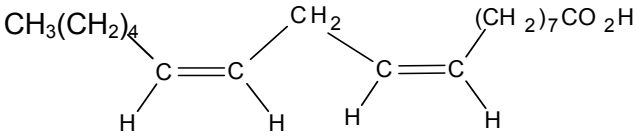
A



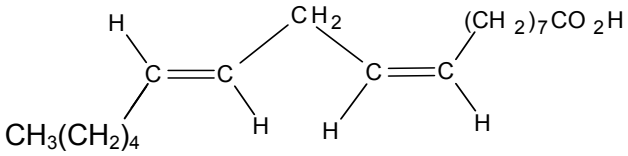
B



C



D



25 Which of the following can behave as an electrophilic reagent?

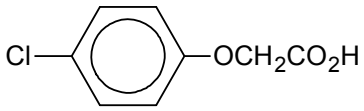
A OH^-

B Na^+

C NH_4^+

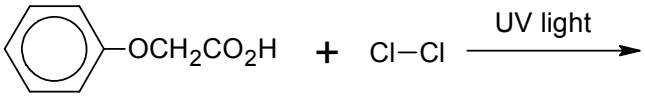
D $BeCl_2$

26 Compound, **L**, below is used to prevent the premature dropping of fruit in tomato plants..

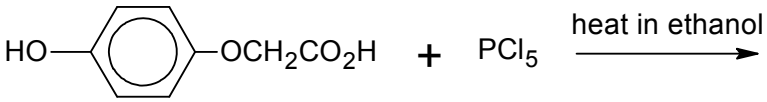


Which one of the following schemes provides a possible synthesis for compound **L**?

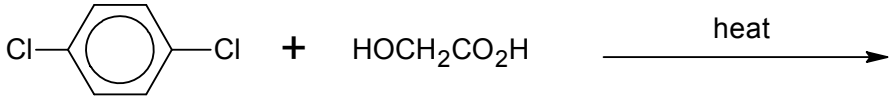
A



B



C



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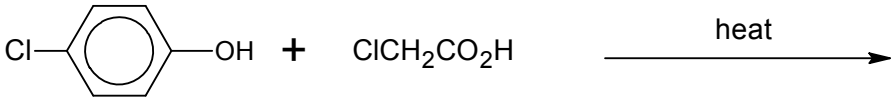
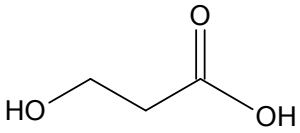
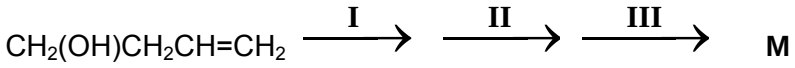


27 Compound **M** can be synthesized as shown below.



Compound **M**



What are the conditions for stage **I**, **II** and **III**?

	I	**II**	**III**
A	Hot, acidified $KMnO_4$(aq)	PCl_5, room temperature	NaOH(aq)
B	Hot, acidified $KMnO_4$(aq)	PCl_5, room temperature	H_2O
C	1. Concentrated H_2SO_4 2. H_2O	NaOH(aq), I_2(aq)	HCl(aq)
D	1. Concentrated H_2SO_4 2. H_2O	Hot, alkaline $KMnO_4$(aq)	HCl(aq)

28 **N**, **P** and **Q** are three different organic compounds. Both **Q** and **P** can react with **N** to form an ester each, but **P** reacts much less readily than **Q**.

Which of the following could be **Q**?

A butan-2-ol

B butanamide

C butanoic acid

D butanoyl chloride

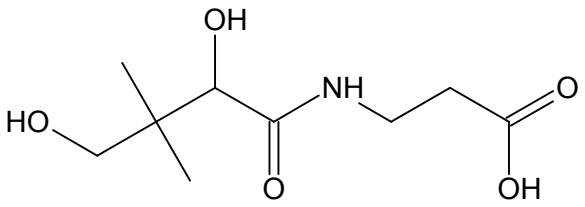
29 When equimolar amounts of organic compounds **R**, **S**, **T** and **U** are added separately to water, solutions of increasing pH values are obtained. The possible identities of the compounds are given below.

CH_3CH_2COOH CH_3CH_2COCl $CH_3CH(Cl)CH_2NH_2$ $CH_3CH_2CONH_2$

Which is the correct set of identities of compounds **R** to **U**?

	R	**S**	**T**	**U**
A	CH_3CH_2COCl	CH_3CH_2COOH	$CH_3CH_2CONH_2$	$CH_3CH(Cl)CH_2NH_2$
B	CH_3CH_2COCl	CH_3CH_2COOH	$CH_3CH(Cl)CH_2NH_2$	$CH_3CH_2CONH_2$
C	CH_3CH_2COOH	CH_3CH_2COCl	$CH_3CH_2CONH_2$	$CH_3CH(Cl)CH_2NH_2$
D	CH_3CH_2COOH	CH_3CH_2COCl	$CH_3CH(Cl)CH_2NH_2$	$CH_3CH_2CONH_2$

30 Vitamin B_5 has the structural formula as shown below.



Which of the following statements about Vitamin B_5 is **not** correct?

A It gives an orange precipitate with 2,4-dinitrophenylhydrazine.

B It reacts with hot, acidified potassium manganate(VII) to give 2 organic products.

C It reacts with sodium metal to give hydrogen gas.

D 1 mol of Vitamin B_5 reacts with PCl_5 to give 3 mol of HCl gas.

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 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 Which of these statements correctly describe an electron shell with the principal quantum number n=2?

1 This shell can accommodate a maximum of eight electrons.

2 Electrons occupy the orbitals starting with that of the lowest energy.

3 An orbital in this shell may have spherical or dumb-bell shape.

32 Which of the following changes represent the oxidation of bromine?

1 $Br_2 \rightarrow BrI$

2 $Br_2 \rightarrow BrF$

3 $Br_2 \rightarrow BrO^-$

33 **V** and **W** are ideal gases that do not react together. The mass of 1 mol of **V** is four times that of **W**.

Which of the following statements about **V** and **W,** at standard temperature and pressure are true?

1 On mixing 1 dm^3 of **V** with 1 dm^3 of **W**, the partial pressure of each gas in the mixture will be approximately 50 kPa.

2 The mass of 1 dm^3 of **V** is four times that of 1 dm^3 of **W**.

3 The average kinetic energy of 1 molecule of **V** is equal to that of a molecule of **W**.

34 Fibre glass can be considered to be a mixture of ionic oxides and giant covalent oxides. Which of the following could be constituents of fibre glass?

1 Al_2O_3

2 SiO_2

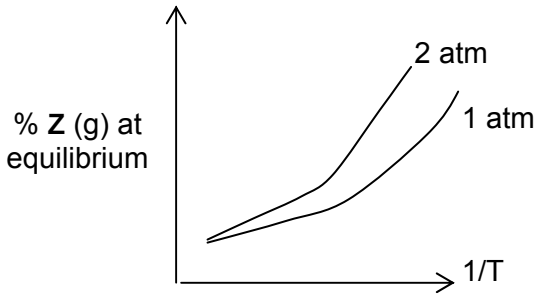
3 P_4O_6

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.

35 The graph below shows how the percentage of reactant **Z**(g) that remained in an equilibrium mixture varies with 1/T at pressures of 1 atm and 2 atm.



Which of the following can be deduced from this information?

1 The forward reaction is endothermic.

2 The equilibrium constant, K_p, increases as pressure increases.

3 The equation for the above reaction could be **Z**(g) $\rightleftharpoons$ **A**(g) + **B**(s).

36 Which of the following properties of Group II elements decreases down the group?

1 ionic radius

2 electronegativity

3 first ionisation energy

37 $(CH_3)_3SiCl + CH_3O^- \rightarrow (CH_3)_3SiOCH_3 + Cl^-$

Which of the following statements, regarding the above reaction, are likely to be true?

1 It involves nucleophilic attack by CH_3O^-.

2 Cl^- is displaced by CH_3O^-.

3 The oxygen-carbon bond remains intact during the reaction.

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.

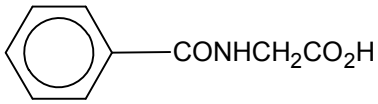
38 The alcohol, $C_4H_{10}O$, may be oxidised by acidified aqueous potassium dichromate(VI) to a compound, C_4H_8O. Which of the following could be the structural formula of the alcohol?

1 $CH_3CH_2CH_2CH_2OH$

2 $CH_3CH_2CH(OH)CH_3$

3 $(CH_3)_3COH$

39 Benzoylglycine (hippuric acid) was first isolated from stallions' urine.



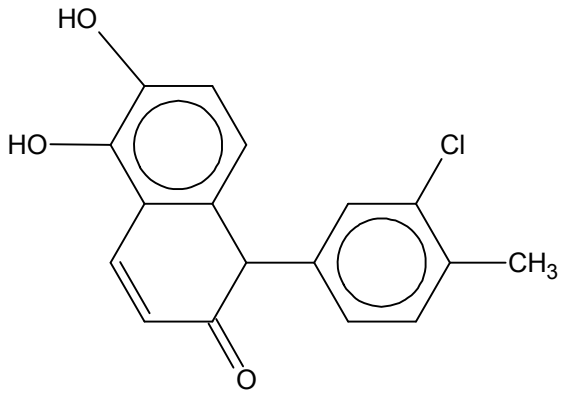
Which properties does this compound possess?

1 It can be hydrolysed to produce an amino acid.

2 It can be made by reacting benzoyl chloride with aminoethanoic acid.

3 It can be neutralised by reaction with cold aqueous sodium hydroxide.

40 The structure of compound **X** is shown below.



What types of reactions will compound **X** undergo?

1 neutralisation

2 electrophilic substitution

3 nucleophilic substitution

PIONEER JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION 2009

H2 CHEMISTRY **9746/01**
PAPER 1

MCQ Answers

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

A: 9
B: 11
C: 11
D: 9