NATIONAL JUNIOR COLLEGE
PRELIMINARY EXAMINATIONS
Higher 1

CANDIDATE NAME			
SUBJECT CLASS		REGISTRATION NUMBER	

CHEMISTRY

8872/01
Paper 1 Multiple Choice
22 September 2009
Additional Materials: Multiple Choice Answer Sheet
50 minutes

READ THE INSTRUCTION FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, Centre number and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** 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.

1. MnO_2 can react with concentrated hydrochloric acid to give chlorine gas as shown by the following equation.

$$MnO_2 + 4\ HCl \rightarrow MnCl_2 + Cl_2 + 2\ H_2O$$

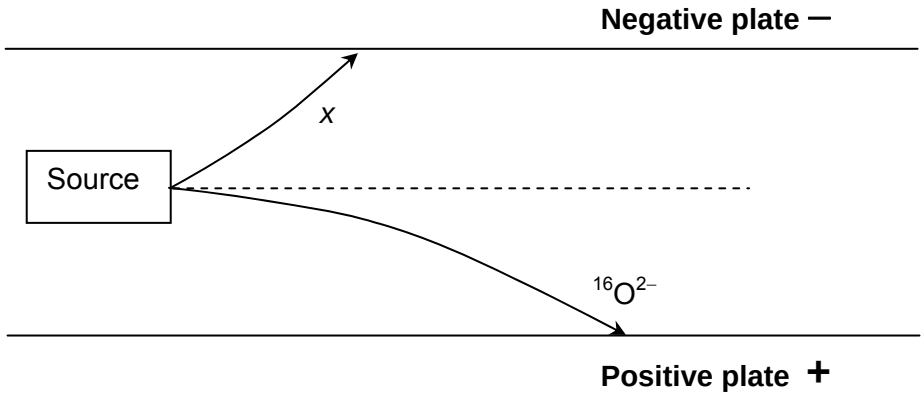
Given that 1 mole of gas occupies 24 dm^3 at room temperature, calculate the volume of 6 mol dm^{-3} HCl required to generate 500 cm^3 of chlorine gas.

A 3.50 cm^3
B 8.00 cm^3
C 13.90 cm^3
D 125.00 cm^3

2. Which of the following has more protons than electrons and more neutrons than protons?

A H_3O^+
B OH^-
C Na^+
D F^-

3. The following shows how two ions are deflected in an electric field.



Which of the following could be *x*?

A $^{6}Li^+$
B $^{10}B^+$
C $^{27}Al^{3+}$
D $^{23}Na^+$

4. The number of ions in 10 cm^3 of 0.200 mol dm^{-3} aqueous calcium chloride is the same as

A The number of atoms in 0.426 g of chlorine gas.

B The number of protons in 0.041 g of lithium metal.

C The number of neutrons in 0.0116 g of aluminium metal.

D The number of hydrogen atoms in 0.192 g of methane gas.

5. Ethanamide, CH_3CONH_2 was boiled with 100 cm^3 of 1.0 mol dm^{-3} aqueous NaOH and the NH_3 evolved was passed into 30.00 cm^3 of 1.0 mol dm^{-3} HCl. The excess acid required 18.25 cm^3 of 0.1 mol dm^{-3} aqueous NaOH solution for neutralization. Given that ethanamide reacts with NaOH in the following equation.

$$CH_3CONH_2 + NaOH \rightarrow CH_3COONa + NH_3$$

Calculate the mass of ethanamide used in the reaction.
(M_r of CH_3CONH_2 = 59.0)

A 1.66 g

B 3.05 g

C 4.13 g

D 5.90 g

6. Which of the following shows the correct order of the four elements in increasing ionisation energies?

A Ga, K, Ca, Ar

B Ar, K, Ca, Ga

C K, Ga, Ca, Ar

D K, Ca, Ga, Ar

7. Which statement about the properties associated with ionic and covalent substances is correct?

A Ionic bonds and covalent bonds cannot occur in the same compound.

B All covalent compounds are more volatile compared to ionic compounds.

C Some ionic and covalent compounds can be electrolytes when dissolved in water.

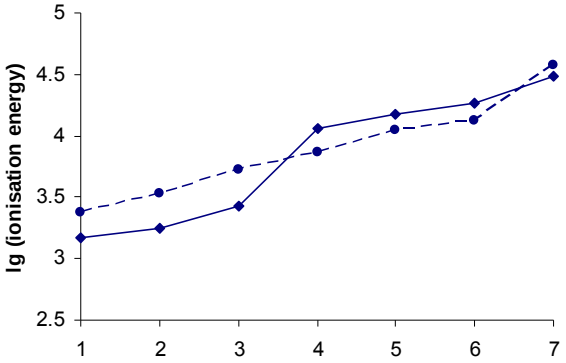
D A covalent compound can form intermolecular hydrogen bonds if it contains hydrogen and either oxygen, nitrogen or fluorine.

8. Which of the following molecule is **not** planar?

A H_2S **C** PH_3

B BF_3 **D** C_2H_4

9. **X** and **Y** are elements with the following successive ionization energies are plotted on the same axis.



Element X: ———— Element Y: - - - - - - - - - - -

X and **Y** are likely to form a compound of formula:

A X_3Y_2 **C** XY_4

B X_2Y_3 **D** X_4Y

10. The second ionisation energy of calcium is 1150 kJ mol^{-1}.

Which of the following correctly represents this statement?

A $Ca(g) \rightarrow Ca^{2+}(g) + 2e^-$ $\Delta H^\theta = +1150$ kJ mol^{-1}

B $Ca^+(g) \rightarrow Ca^{2+}(g) + e^-$ $\Delta H^\theta = +1150$ kJ mol^{-1}

C $Ca^+(g) \rightarrow Ca^{2+}(g) + e^-$ $\Delta H^\theta = -1150$ kJ mol^{-1}

D $Ca(s) \rightarrow Ca^{2+}(g) + 2e^-$ $\Delta H^\theta = +1150$ kJ mol^{-1}

11. *Use of the Data Booklet is relevant to this question.*
Given that the enthalpy of the following reaction is –92 kJ mol^{-1}, calculate the value for the average bond energy of N–H bond in ammonia to the nearest whole number.

$$N_2\ (g) + 3\ H_2\ (g) \rightarrow 2\ NH_3\ (g)$$

A 368 kJ mol^{-1}
B 399 kJ mol^{-1}
C 737 kJ mol^{-1}
D 798 kJ mol^{-1}

12. The following equation illustrates the decomposition of H_2O_2.

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

If the rate equation is rate = k $[H_2O_2]$ and the rate constant is 0.05 min^{-1}, determine the time taken for the sample of 3.60 mol dm^{-3} H_2O_2 to decrease to 0.45 mol dm^{-3}.

A 13.9 min
B 27.7 min
C 41.6 min
D 55.6 min

13. Given the following equilibrium,

$$2\ CrO_4^{2-}\ (aq) + 2\ H^+\ (aq) \rightleftharpoons Cr_2O_7^{2-}\ (aq) + H_2O\ (l)$$
Yellow — Orange

Which of the following is true about the above reaction?

A CrO_4^{2-} act as a Bronsted acid.
B Chromium in CrO_4^{2-} is oxidised.
C The units of the equilibrium constant for the above reaction is mol^{-2} dm^6.
D When the pH is increased on the equilibrium mixture, the solution turns yellow.

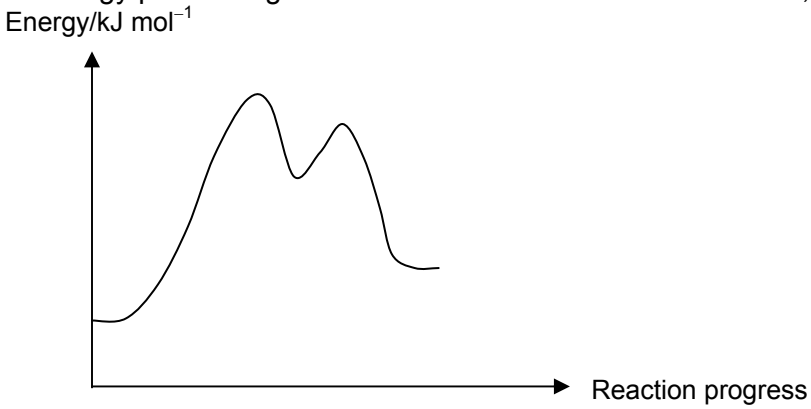
14. A dilute solution of hydrofluoric acid, HF is a weak acid and dissociates as follows:

$$HF\ (aq) \rightleftharpoons H^+\ (aq) + F^-\ (aq)$$

Given that only 8% of HF is dissociated into ions, calculate the pH of 20 cm^3 of 0.1 mol dm^{-3} HF.

A 1.0
B 2.1
C 2.7
D 3.8

15. Given that the energy profile diagram for a chemical reaction is as follows,



Which of the following can be deduced from the energy profile diagram?

A The reaction involves the formation of two intermediates.

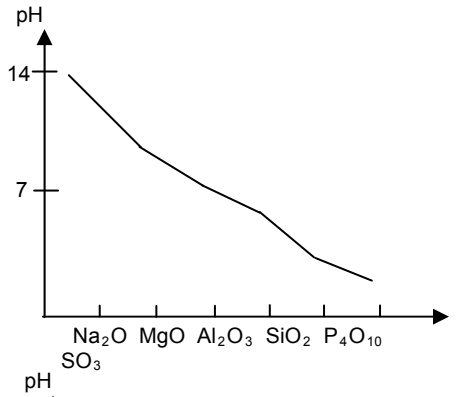
B The rate constant of the second step is larger than the first.

C When the reaction is carried out, temperature of the surroundings will increase.

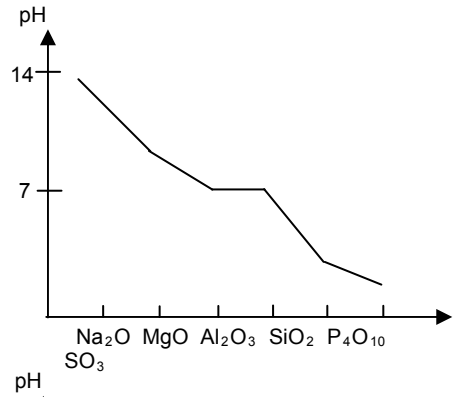
D The difference between the values of the activation energies of the first and second step is the enthalpy of reaction.

16. Which of the following shows the correct graph for the pH value when the same amount of each oxide is added to 500 cm^3 of water?

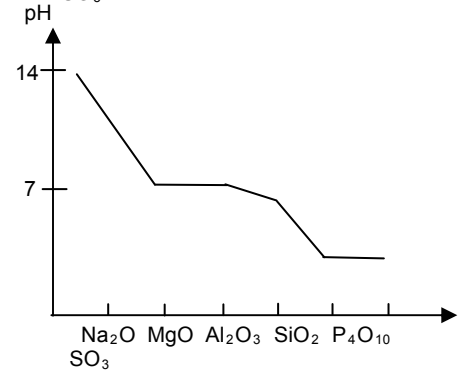
A



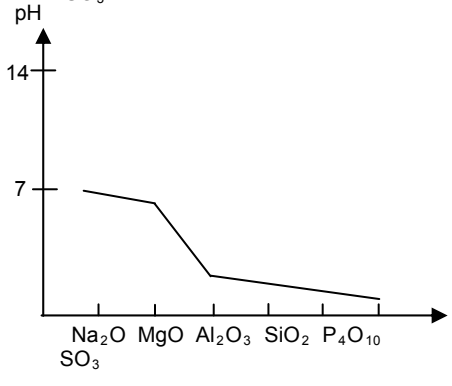
C



B



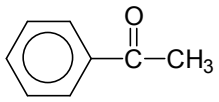
D



17. Which of the following is the number of structural isomers for a compound with molecular formula C_4H_9Cl, excluding cyclic structures?

A 3
B 4
C 5
D 6

18. Which of the reactions does the following molecule **NOT** undergo?



A Reduction
B Condensation
C Electrophilic addition
D Electrophilic substitution

19. Which of the following shows a possible synthetic pathway for butanoic acid?

A $CH_3CH_2CH_2Cl \xrightarrow[\text{heat}]{\text{KOH (aq),}} CH_3CH_2CH_2OH \xrightarrow[\text{heat}]{MnO_4^-/H^+,} CH_3CH_2CH_2COOH$

B $CH_3CH_2CH_2Cl \xrightarrow[\text{heat}]{\text{HCN (aq),}} CH_3CH_2CH_2CN \xrightarrow[+]{Cr_2O_7^{2-}/H} CH_3CH_2CH_2COOH$

C $CH_3CH_2CH_2CH_2Cl \xrightarrow[\text{heat}]{\text{KOH, ethanol}} CH_3CH_2CH{=}CH_2 \xrightarrow[\text{heat}]{MnO_4^-/H^+,} CH_3CH_2CH_2COOH$

D $CH_3CH_2CH_2Cl \xrightarrow[\text{heat}]{\text{KCN, ethanol}} CH_3CH_2CH_2CN \xrightarrow[\text{heat}]{H^+(aq),} CH_3CH_2CH_2COOH$

20. An ester, **D** with an odour of bananas has the following formula.

$$CH_3CO_2CH_2CH(CH_3)CH_2CH_3$$

Which of the following shows the products when ester **D** is heated with aqueous hydrochloric acid?

A CH_3COOH and $CH_3CH_2CH(CH_3)CH_2Cl$

B CH_3CH_2OH and $CH_3CH_2CH(CH_3)COOH$

C CH_3COOH and $CH_3CH_2CH(CH_3)CH_2OH$

D CH_3CH_2Cl and $CH_3CH_2CH(CH_3)COOH$

21. The oxo reaction is an important industrial process in which an alkene combines directly with carbon monoxide and hydrogen under suitable conditions. The reaction with ethene is shown below.

$$CH_2{=}CH_2 + CO + H_2 \xrightarrow[\text{High T, p}]{\text{Catalyst}} CH_3CH_2CHO$$

Which of the following structural formulae correctly represents the product of the oxo reaction starting with but-2-ene?

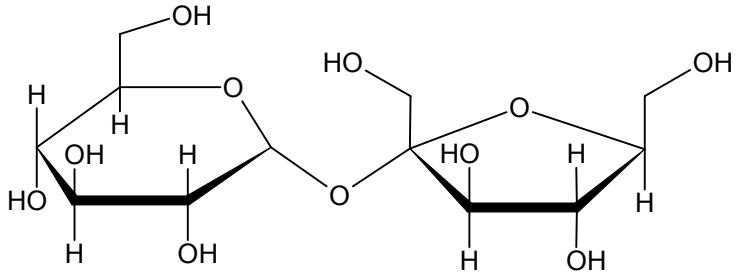
A $CH_3CH_2CH(CH_3)CHO$

B $CH_3CH_2CH_2CH_2CHO$

C $CH_3CH_2COCH_2CH_3$

D $CH_3COCH_2CH_2CH_3$

22. The following shows the structure of the sugar, sucrose.



How many secondary alcohol groups are there in sucrose?

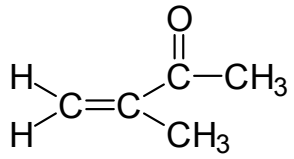
A 4

B 5

C 6

D 7

23. Compound **F** is a derivative of a compound used to make the hard outer covering of golf balls.



Which of the following is true about compound **F**?

A It can exist as cis-trans isomers.

B One mole of compound **F** reacts exactly with 2 moles of hydrogen gas.

C Compound **F** can be oxidized by hot acidified potassium dichromate(VI).

D Compound **F** has no reaction with potassium bromide and concentrated sulfuric acid.

24. Which pairs of reactions *could* have the same common intermediate?

G $CH_3CO_2CH(CH_3)_2 \longrightarrow$ intermediate $\longrightarrow CH_3CHBrCH_3$
H $CH_3CH{=}CH_2 \longrightarrow$ intermediate $\longrightarrow CH_3CH(NH_2)CH_3$
J $CH_3CH{=}CH_2 \longrightarrow$ intermediate $\longrightarrow CH_3COCH_3$
K $CH_3CH_2CH_2Cl \longrightarrow$ intermediate $\longrightarrow CH_3COOH$

A **G** and **J**
B **H** and **J**
C **G** and **K**
D **H** and **K**

25. Which of the following reagents could be used to distinguish between butanoic acid and ethyl ethanoate?

A Aqueous NaOH
B Thionyl chloride
C Aqueous alkaline iodine
D Aqueous diammine silver(I) ions

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 these statements is or not correct (you may find it helpful to put 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.

26. Which of the following contain 3 unpaired electrons?

1 Cl^{2+}

2 Cr^{3+}

3 Co^{2+}

27. Which of the following enthalpy changes is endothermic?

1 $\frac{1}{2} Br_2$ (l) → Br (g)

2 O (g) + e → O^- (g)

3 Na^+ (g) + e → Na (g)

28. Which of the following statements are true about the Contact Process involving the oxidation of sulfur dioxide by oxygen?

$$2\ SO_2\ (g) + O_2\ (g) \rightleftharpoons 2\ SO_3\ (g) \quad \Delta H = -197\ kJ\ mol^{-1}$$

1 When temperature increases, the activation energy is unchanged.

2 When temperature is increased, rate of production of SO_3 decreases.

3 In the presence of vanadium oxide catalyst, the amount of SO_3 formed increases.

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

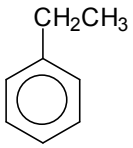
29. 0.1 mole of each of the following was added to 100 cm^3 of water. Which of the following shows the pH values of the resulting solutions in increasing value?

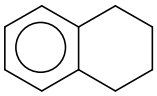
1 $SiCl_4$, $AlCl_3$, $MgCl_2$

2 H_2SO_4, HCl, CH_3COOH

3 CH_3NH_2, NaOH, $Ba(OH)_2$

30. Which of the following would give effervescence when heated with acidified potassium manganate(VII)?

1 

2 

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