

CONFIDENTIAL*/ SULIT*

962/1

**TRIAL STPM 2012
(PEPERIKSAAN PERCUBAAN STPM 2012)**

CHEMISTRY (KIMIA)

PAPER 1 (KERTAS 1)

MULTIPLE-CHOICE (ANEKA PILIHAN)

One hour and forty-five minutes (Satu jam empat puluh lima minit)

Instructions to candidates:

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

There are fifty questions in this paper. For each question, four suggested answers are given. Choose one correct answer and indicate it on the multiple-choice answer sheet provided.

Read the instructions on the multiple-choice answer sheet very carefully. Answer all questions. Marks will not be deducted for wrong answers.

Arahan kepada calon:

JANGAN BUKA BUKU SOALAN INI SEHINGGA ANDA DIBENARKAN BERBUAT DEMIKIAN.

Ada lima puluh soalan dalam kertas ini. Bagi setiap soalan, empat cadangan jawapan diberikan. Pilih satu jawapan yang betul dan tandakan jawapan itu pada helaian jawapan aneka pilihan yang dibekalkan.

*Baca arahan pada helaian jawapan aneka pilihan itu dengan teliti.
Jawab semua soalan. Markah tidak akan ditolak bagi jawapan yang salah.*

This question paper consists of 10 printed pages.

(Kertas soalan ini terdiri daripada 10 halaman bercetak.)

Section A

Four suggested answers labelled **A**, **B**, **C** and **D** are given for each question. Choose **one** correct answer.

1. ${}^{78}_{34}\text{Se}$ and ${}^{80}_{34}\text{Se}$ are isotopes of selenium. Which of the following properties is common for both the isotopes?

A. Nuclear charge B. Nucleon number C. Stability D. Relative isotopic mass

2. Methanethiol, CH_3SH undergoes combustion according to the equation shown below.



15 cm^3 of methanethiol was exploded with 60 cm^3 of oxygen. What would be the final volume(cm^3) of the gas mixture obtained at room temperature?

A. 15 B. 30 C. 45 D. 60

3. How many different orbitals are there in the $3s$, $3p$ and $3d$ sub-shells respectively?

A. 1, 3, 5 B. 1, 4, 9 C. 2, 6, 10 D. 2, 8, 18

4. Under what conditions would a gas at low pressure behave more ideally?

A. Molecules at low temperature collide elastically.
 B. Molecules at high temperature collide elastically.
 C. Molecules at low temperature collide non-elastically.
 D. Molecules at high temperature collide non-elastically.

5. Ice is the crystalline form of water. Which of the following statements is **not** true about ice?

A. Ice does not conduct electricity.
 B. Ice has a giant covalent structure.
 C. The bond angle of $\text{H}-\text{O}-\text{H}$ in ice is 109.5°
 D. Ice has a lower density than water at 0°C due to its open structure.

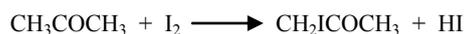
6. Compounds are either ionic or covalent. Which of the following statements is **not** true about ionic bonding?

A. Ionic bonding forms solid compounds.
 B. Ionic bonding involves ions with stable electronic configurations.
 C. Ionic bonding involves electron transfer from s , p and d -orbitals.
 D. Ionic bonding's strength is proportional to the ionic size of ions involved.

7. Which of the following statements is true about the Modern Periodic Table?

A. The arrangement of elements is based on the nucleon number.
 B. There are 5 main blocks of elements.
 C. There are 8 groups in the Periodic Table.
 D. There are 7 periods in the Periodic Table.

8. The iodine and propanone reaction is catalysed by acids as shown in the equation below.



Which of the following statements about the reaction is correct if the rate equation is given by $\text{rate} = k [\text{CH}_3\text{COCH}_3][\text{H}^+]$?

- A. The rate determining step does not include the hydrogen ion.
 B. Product yield is independent of $[\text{I}_2]$.
 C. The rate of reaction increases if the $[\text{I}_2]$ increases.
 D. k remains constant although the $[\text{CH}_3\text{COCH}_3]$, $[\text{H}^+]$ and $[\text{I}_2]$ are increased.
9. Which of the following is a correct statement about the effect of a catalyst?
- A. It increases the equilibrium constant for the forward reaction.
 B. It provides an alternative route for the reaction.
 C. It increases the rate constant for the forward reaction only.
 D. It increases the speed of the reactant particles.
10. The table below shows the values of the ionic product of water, K_w at two temperatures.

Temperature/ $^{\circ}\text{C}$	$K_w / \text{mol}^2\text{dm}^{-6}$
25	1.00×10^{-14}
62	1.00×10^{-13}

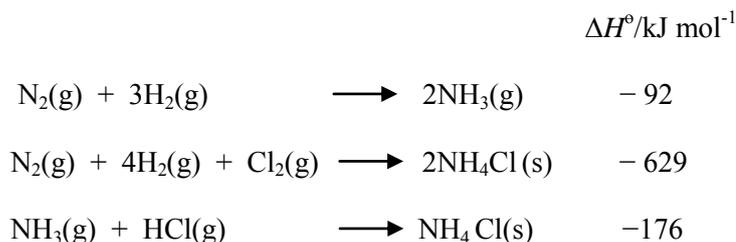
Which of the following statements is true about pure water?

- A. At 62°C , $\text{pH} < 7$
 B. At 62°C , $\text{pH} < \text{pOH}$
 C. At 62°C , $\text{pH} = 14 - \text{pOH}$
 D. The ionic dissociation of water is an exothermic process.
11. A sealed flask with a capacity of 2.0 dm^3 contains 0.50 mol of SO_2 , 0.010 mol of O_2 and 4.6 mol of SO_3 at equilibrium. Calculate K_c ($\text{dm}^3\text{mol}^{-1}$) for the following equilibrium at $T^{\circ}\text{C}$.



- A. 5.9×10^{-5} B. 9.2×10^2 C. 8.5×10^3 D. 1.7×10^4
12. Buffer solutions are an important component of biological systems. Calculate the pH of a buffer solution formed by mixing 100 cm^3 of $0.050 \text{ mol dm}^{-3}$ ethanoic acid and 50 cm^3 of 0.20 mol dm^{-3} of sodium ethanoate.
 [K_a of ethanoic acid is $1.7 \times 10^{-5} \text{ mol dm}^{-3}$]
- A. 4.1 B. 4.5 C. 5.1 D. 5.4
13. A current of 8A is passed for 100 minutes through molten aluminium oxide using inert electrodes. What will be the approximate volume of gas liberated, measured at stp?
 [The Faraday constant is $9.65 \times 10^5 \text{ Cmol}^{-1}$, 1 mole of gas occupies 22.4 dm^3 at stp]
- A. 2.8 dm^3 B. 5.6 dm^3 C. 8.4 dm^3 D. 11.2 dm^3

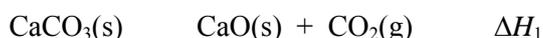
14. What is the standard enthalpy change of formation of hydrogen chloride (kJ mol^{-1}) that can be deduced from the following enthalpy changes shown below?



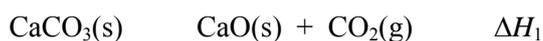
- A. -46.3 B. -92.5 C. -180 D. -361

15. In industry, limestone is used to make slaked lime. This preparation involves two stages.

Stage 1: Limestone decomposes at 1000°C as follows:



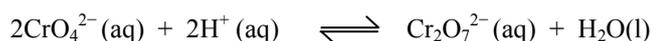
Stage 2: Calcium oxide is then treated with water:



What are the enthalpy changes of these reactions?

- | | ΔH_1 | ΔH_2 |
|----|--------------|--------------|
| A. | - | - |
| B. | - | + |
| C. | + | - |
| D. | + | + |

16. Which statement about the following equilibrium given below is correct?



- A. It is a redox reaction.
 B. The solution remains yellow throughout the experiment.
 C. A decrease in pH will result in the increase intensity of orange coloured solution.
 D. The addition of a suitable catalyst will shift the equilibrium to the left.

17. Which of the following species has the most number of unpaired electrons?

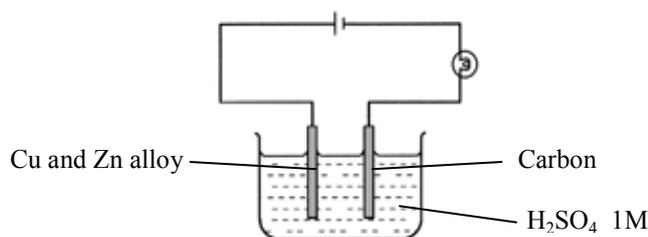
- A. ${}_{7}\text{N}^{2-}$ B. ${}_{8}\text{O}$ C. ${}_{12}\text{Mg}^+$ D. ${}_{21}\text{Sc}$

18. The vapour pressure of pure liquids P and Q at 30°C are 48 kPa and 36 kPa respectively. The total vapour pressure of a liquid mixture of P and Q containing 0.70 mole fraction of Q at 30°C is 39.6 kPa.

Which of the following statements is true of the liquid mixture?

- A. The vapour pressure of Q in the mixture at 30°C is 10.8 kPa.
 B. Fractional distillation of the mixture yields Q as the distillate.
 C. The mixture shows a negative deviation from Raoult's law.
 D. P and Q have almost the same strength intermolecular forces.

19. The circuit for an electrolysis experiment was set up as shown below.



What are the reactions at the electrodes?

- | Anode | Cathode |
|-----------------------|-------------------------|
| A. Cu dissolves | Cu deposited |
| B. Cu dissolves | H ₂ released |
| C. Cu and Zn dissolve | Cu deposited |
| D. Zn dissolves | H ₂ released |

20. Iron is used as a catalyst in the Haber process to prepare ammonia because the iron

- A. has empty *d*-orbitals.
 B. has a low activation energy.
 C. has many valence electrons.
 D. can change its oxidation state

21. Which of the following is the strongest reducing agent?

- A. Ba B. Ba²⁺ C. Mg D. Mg²⁺

22. An experiment was carried out to investigate the action of concentrated sulphuric acid and phosphoric acid on sodium halides and the observations recorded as follows.

Concentrated acid	NaCl	NaI
Sulphuric acid	white fumes	purple vapour
Phosphoric acid	white fumes	white fumes

Which of the following statements can be deduced from the observations?

- A. Concentrated phosphoric acid is a stronger oxidising agent than sulphuric acid.
 B. Concentrated phosphoric acid is a weaker acid than sulphuric acid.
 C. The reducing power of HI is stronger than HCl.
 D. The bond energy of HI is greater than HCl.

23. A soluble salt sample contains two cations, one of which is Fe²⁺. The identity of the second cation was determined by heating the solid salt with solid NaOH and a colourless gas was released. The gas forms dense white fumes on contact with HCl gas. The residue is grey-green and is insoluble in water.

The identities of the gas and residue are probably

- | Gas | Residue |
|--------------------|---|
| A. H ₂ | FeSO ₄ |
| B. CO ₂ | Fe(OH) ₃ |
| C. NH ₃ | Fe(OH) ₂ |
| D. SO ₂ | Fe ₂ (SO ₄) ₃ |

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24. Which of the following elements has an oxide with a giant structure and a chloride that is readily hydrolysed?

- A. Barium B. carbon C. phosphorus D. silicon

25. The data below refers to calcium as an *s*-block element and copper as a *d*-block element. Which of the following property is matched correctly?

Property	Ca	Cu
A. Density	1.54	8.92
B. Melting point	1083	810
C. Atomic radius	0.117	0.197
D. Electrical conductivity	85	9.6

26. In black and white photographic film, light converts silver chloride into metallic silver. After the film has been developed, the unexposed silver chloride is removed by reaction with sodium thiosulphate to produce a negative.



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

- A. $\text{S}_2\text{O}_3^{2-}$ ion acts as a ligand.
 B. A complex ion is produced.
 C. $[\text{Ag}(\text{S}_2\text{O}_3)_2]^{3-}$ ion is linear.
 D. Ag undergoes a change in oxidation state.

27. P, Q, R, S are elements of Period 3 in the Periodic Table. The properties of their oxides are as follows.

- (i) Oxide of P is not soluble in both acid and water but dissolves in concentrated NaOH.
 (ii) Oxide of Q is soluble in both aqueous acid and alkali.
 (iii) Oxide of R is soluble in aqueous NaOH.
 (iv) Oxide of S dissolves readily in water to produce an alkaline solution.

Arrange P, Q, R and S in ascending proton number.

- A. P, Q, R, S B. S, P, Q, R C. S, Q, P, R D. S, R, P, Q

28. Which of the following statements is true about the chlorides MgCl_2 , SiCl_4 and PCl_3 ?

- A. All are liquids at room temperature.
 B. MgCl_2 is the only chloride with a giant structure.
 C. All the chlorides are hydrolysed completely in water.
 D. The oxidation states of chlorine in the chlorides are -2 , -4 and -3 respectively.

29. Which of the following best explains the role of I^- as a nucleophile?

- A. It is a halide.
 B. It is negatively charged.
 C. It has lone pair electrons.
 D. I is an electronegative atom.

30. Which sequence shows the compounds in the order of increasing acidity?

- A. CH_3COOH , CF_3COOH , $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_6\text{H}_5\text{OH}$ C. CF_3COOH , CH_3COOH , $\text{C}_6\text{H}_5\text{OH}$, $\text{C}_2\text{H}_5\text{OH}$
 B. $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_6\text{H}_5\text{OH}$, CH_3COOH , CF_3COOH D. $\text{C}_6\text{H}_5\text{OH}$, $\text{C}_2\text{H}_5\text{OH}$, CH_3COOH , CF_3COOH ,

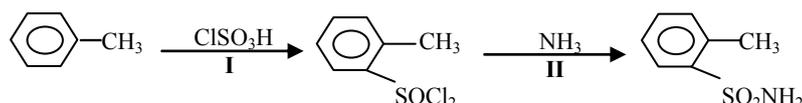
31. Benzene undergoes Friedel-Crafts acylation with ethanoyl chloride to form phenyl ethanoate as shown in the following reaction.



Which of the following statements is **not** true about the mechanism.

- A. AlCl_3 acts as a Lewis acid.
- B. The overall order of reaction is 1.
- C. The mechanism involves an electrophile.
- D. It occurs at room temperature.

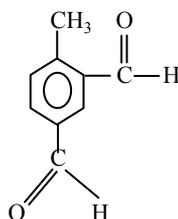
32. Saccharine can be manufactured from methylbenzene by a two step reaction as shown below.



Steps I and II follows the following mechanism shown below.

- | I | II |
|-------------------------------|----------------------------|
| A. Nucleophilic substitution | electrophilic substitution |
| B. Nucleophilic substitution | nucleophilic addition |
| C. Electrophilic substitution | electrophilic addition |
| D. Electrophilic substitution | nucleophilic substitution |

33. What are the expected observation obtained if the following compound



is warmed separately for 10 minutes with Fehling's and Tollens' reagents?

- | Fehling's reagent | Tollen's reagent |
|--------------------------|------------------|
| A. Brick-red precipitate | silver mirror |
| B. No precipitate | silver mirror |
| C. Brick-red precipitate | no silver mirror |
| D. No precipitate | no silver mirror |

34. Oxidation of an alkene, R produces a diol. On further oxidation, a diketone is formed. R is probably

- A. $(\text{C}_6\text{H}_5)_2\text{C} = \text{CH}_2$ B. $(\text{CH}_3)_2\text{C} = \text{C}(\text{CH}_3)_2$ C. $\text{C}_6\text{H}_5\text{CH} = \text{CHC}_6\text{H}_5$ D. $\text{CH}_3\text{CH} = \text{C}(\text{CH}_3)_2$

35. Which reagent produces a colourless mixture when added to phenol?

- A. $\text{Br}_2(\text{aq})$ B. $\text{NaOH}(\text{aq})$ C. $\text{FeCl}_3(\text{aq})$ D. Universal indicator

36. Which reagent does **not** react with propanamine?

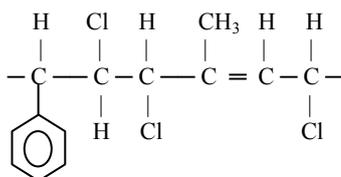
- A. HNO_2 B. NaOH C. CH_3COCl D. $\text{CH}_3\text{CH}_2\text{Cl}$

37. When separate samples of R and S are respectively heated with concentrated ammonia and then reacted with LiAlH_4 in dry ether, the same product is formed.

R and S are probably

- | R | S |
|---|--|
| A. $\text{C}_6\text{H}_5\text{Br}$ | $\text{C}_6\text{H}_5\text{CN}$ |
| B. $\text{CH}_3\text{CH}(\text{Br})\text{CH}_3$ | $\text{CH}_3\text{CH}(\text{CN})\text{CH}_3$ |
| C. $\text{CH}_3\text{CH}(\text{Br})\text{CH}_3$ | $\text{CH}_3\text{CH}_2\text{CN}$ |
| D. $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ | $\text{CH}_3\text{CH}_2\text{CN}$ |

38. The repeating unit of a polymer is shown below.



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

- A. It can be vulcanised.
 B. It is elastic.
 C. It is stable to heat.
 D. One of its monomers is $\text{CHCl} = \text{C}(\text{CH}_3)\text{CH} = \text{CHCl}$.

39. An ester W was refluxed with $\text{NaOH}(\text{aq})$ and the mixture distilled. The residue gave a white solid on acidification and the distillate gives a positive triiodomethane test.

Which of the following substance is W?

- A. $\text{CH}_3\text{COOC}_6\text{H}_5$
 B. $\text{C}_6\text{H}_5\text{COOCH}_3$
 C. $\text{C}_6\text{H}_5\text{COOCH}_2\text{CH}_3$
 D. $\text{C}_6\text{H}_5\text{COOCH}_2\text{CH}_2\text{CH}_3$

40. 2-aminoethanoic acid is not optically active. Which of the following compounds is formed not because of the acid-base property of 2-aminoethanoic acid?

- A. $\text{H}_2\text{NCH}_2\text{COONa}$
 B. $\text{CH}_2\text{OOCCH}_2\text{NH}_2$
 C. $\text{HOOCCH}_2\text{NH}_3\text{Cl}$
 D. $\text{HOOCCH}_2\text{NH}_3\text{OOCCH}_3$

Section B

For each of the questions in this section, one or more of the three numbered statements 1 to 3 may be correct. The responses A to D should be selected based on the following.

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

41. Gas particle S has a proton number of n and a charge of $+1$. Gas particle T has a proton number of $(n + 1)$ and is isoelectronic with S. Which of the following statement(s) is/are true about S and T?

- 1 S has a larger atomic size than T.
- 2 The ionisation energy of S is larger than T.
- 3 S releases more energy than Y when an electron is added to each particle.

42. A gas behave ideally and is described by the gas equation $pV = nRT$. Which of the following statements is(are) correct about the gas?

- 1 One mole of any ideal gas occupies the same volume under the same temperature and pressure.
- 2 The density of an ideal gas at constant pressure is inversely proportional to the temperature.
- 3 Intermolecular forces exists between particles of the gas.

43. Which of the following process have occurred in the following reaction?



- 1 Neutralisation
- 2 Formation of ionic bond
- 3 Formation of coordinate bond

44. A mixture of two oxides of Period 3 elements is added to water. The solution formed is almost neutral. The oxides may be

- 1 Na_2O and P_4O_{10}
- 2 MgO and SiO_2
- 3 P_4O_{10} and SO_3

45. The charge density of Be^{2+} ion is similar to Al^{3+} ion. Which of the following statements is/are true?

- 1 BeO is basic
- 2 BeCl_2 is covalent.
- 3 $\text{Be}(\text{NO}_3)_2(\text{aq})$ is acidic.

46. Which of the following properties decreases gradually from HCl to HBr to HI ?

- 1 Thermal stability
- 2 Polarity of the $\text{H}-\text{X}$ bond
- 3 Boiling point

47. Which of the following reactions occur(s) in a catalytic converter?

- 1 $2\text{CO}(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{CO}_2(\text{g})$
- 2 $2\text{NO}(\text{g}) + 2\text{CO}(\text{g}) \longrightarrow \text{N}_2(\text{g}) + 2\text{CO}_2(\text{g})$
- 3 $2\text{C}_8\text{H}_{18}(\text{g}) + 25\text{O}_2(\text{g}) \longrightarrow 16\text{CO}_2(\text{g}) + 18\text{H}_2\text{O}(\text{g})$

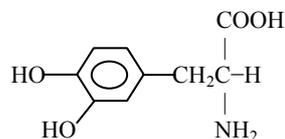
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A	B	C	D
1 only is correct	1 and 2 only are correct	2 and 3 only are correct	1, 2 and 3 are correct

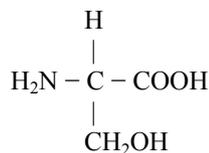
48. The structure of *dopamine* is shown below.



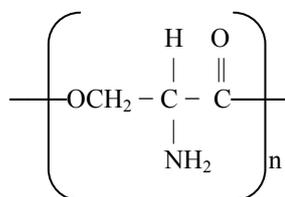
Which of the following statements is(are) correct about *dopamine*?

- 1 mole of *dopamine* reacts with 1 mole of HCl(aq).
- 1 mole of *dopamine* reacts with 3 moles of Br₂(aq).
- 1 mole of *dopamine* reacts with 3 moles of Na₂CO₃(aq).

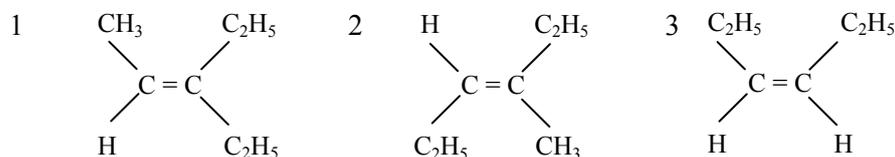
49. Which of the following statements is(are) true about the amino acid *serine* with the structure shown below?



- Nitrogen gas is released when HNO₂ solution is added to *serine*.
- NH₃ gas is released when *serine* reacts with NaOH solution.
- The repeating unit of the polypeptide of *serine* has the structure shown below.



50. Which of the following compound(s) does **not** have geometrical isomers?



Identity card number..... Centre number/index number:
(Nombor kad pengenalan) (Nombor pusat/angka giliran)

962/2

TRIAL STPM 2012
(PEPERIKSAAN PERCUBAAN 2012)

CHEMISTRY (KIMIA)

PAPER 2 (KERTAS 2)

Two and a half hours (Dua jam setengah)

Instructions to candidates:

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

Answer **all** questions in section A. Write your answers in the spaces provided. All working should be shown. For numerical answers, units should be quoted wherever they are appropriate.

Answer any **four** questions in section B. Write your answers on the answer sheets provided. Begin each answer on a fresh sheet of paper and arrange your answers in numerical order. Tie your answer sheets to this question paper.

For examiner's use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

This question paper consists of 11 printed pages.

Section A

Answer all question in this section.

1. (a) The rate equation for a reaction between substances **C** and **D** is:

$$\text{rate} = k[\text{C}]^2 [\text{D}]^2$$

The initial rate is found to be $7.5 \times 10^{-3} \text{ mol dm}^{-3} \text{ s}^{-1}$ when the initial concentration of **C** is of 0.25 mol dm^{-3} and the initial concentration of **D** is 0.50 mol dm^{-3} .

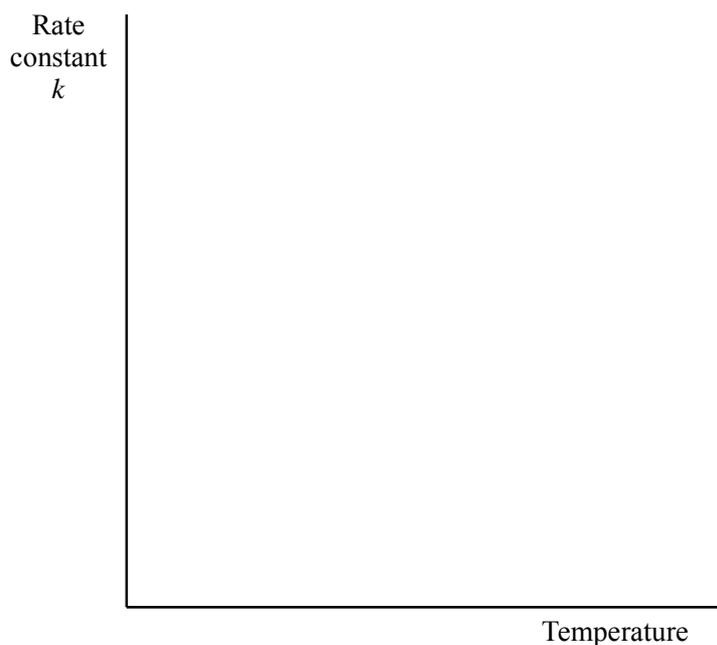
- (i) Calculate the value of the rate constant, k , at this temperature and deduce its units.

Calculation

Units

.....

- (ii) On the axes below sketch a graph to show how the value of k varies as temperature is increased over a considerable range.



(4 marks)

(b) The table give data on some solubilities and solubility products. Some of the data entries are missing. [C=12, O=16, Cl=35.5, Ca=40, Ag=108]

(i) Fill in the missing data in the table:

Compound	K _{sp} , mol ² dm ⁻⁶	Solubility, mol dm ⁻³	Solubility, g dm ⁻³
AgI	8.30 x 10 ⁻¹⁷	9.11 x 10 ⁻⁹	2.14 x 10 ⁻⁶
AgCl	1.8 x 10 ⁻¹⁰		
CaCO ₃			0.03

[4 marks]

(ii) Fill in the table below, state and explain what will happen to the solubility products of the silver chloride if the salts mentioned are dissolved in a saturated solution of silver chloride. (Give the effect on the solubility as increase, decrease or no change).

Salt	Sodium nitrate	Sodium chloride
Effect		
Explanation		

[2 marks]

2. Use the data below, where appropriate, to answer the questions which follow.

Standard electrode potentials	E^\ominus/V
$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$	0.00
$\text{Br}_2(\text{aq}) + 2\text{e}^- \rightarrow 2\text{Br}^-(\text{aq})$	+1.09
$2\text{BrO}_3^-(\text{aq}) + 12\text{H}^+(\text{aq}) + 10\text{e}^- \rightarrow \text{Br}_2(\text{aq}) + 6\text{H}_2\text{O}(\text{l})$	+1.52

Each of the above can be reversed under suitable conditions.

- (a) State the hydrogen ion concentration and the hydrogen gas pressure when, at 298 K, the potential of the hydrogen electrode is 0.00 V.

Hydrogen ion concentration

Hydrogen gas pressure

[2 marks]

- (b) The electrode potential of a hydrogen electrode changes when the hydrogen ion concentration is reduced. Explain, using Le Chatelier's principle, why this change occurs and state how the electrode potential of the hydrogen electrode changes.

Explanation of change

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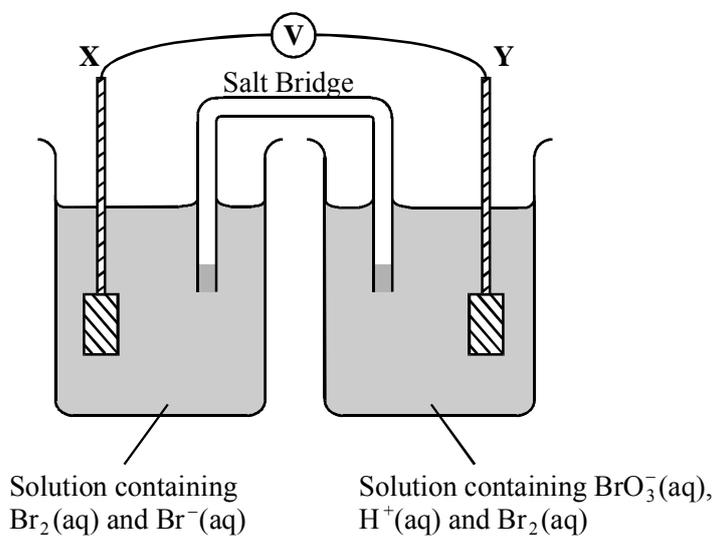
.....

Change in electrode potential

.....

(3)

- (c) A diagram of a cell using platinum electrodes **X** and **Y** is shown below.



- (i) Use the data above to calculate the e.m.f. of the above cell under standard conditions.
- (ii) Write a half-equation for the reaction occurring at electrode **X** and an overall equation for the cell reaction which occurs when electrodes **X** and **Y** are connected.

Half-equation

.....

Overall equation

.....

- (iii) Write down the cell diagram to represent the overall reaction in the cell.

.....

[5 marks]

(Total 10 marks)

3. (a) The tetrachlorides of Group 14 elements, example CCl_4 , SiCl_4 , GeCl_4 , SnCl_4 and PbCl_4 are liquids at room temperature. All the tetrachlorides, with the exception of CCl_4 , are hydrolysed in aqueous solution to form acidic solutions.

(i) State the molecular shape of all the Group 14 tetrachlorides.

.....

(ii) Write a balanced equation for the hydrolysis of SiCl_4 .

.....

(iii) Explain why CCl_4 does not undergo hydrolysis.

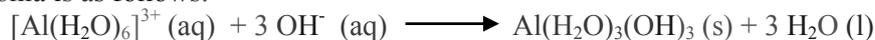
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.....

[4 marks]

(b) Aqueous aluminium sulphate contains $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$. Aqueous ammonia is added to aqueous aluminium sulphate until in excess. The reaction that occurs in limited aqueous ammonia is as follows.



(i) Describe one observation in the above reaction.

.....

(ii) What chemical nature of the aluminium ion is shown in (b) (i)?

.....

(iii) What happens when excess aqueous ammonia is added to the solution? Write an equation for the reaction involved.

.....

.....

.....

(iv) What chemical nature of the aluminium ion is shown in (b) (iii)?

.....

[6 marks]

4. (a) Ethylamine $C_2H_5NH_2$ is a foul smelling liquid that reacts with dilute hydrochloric acid at room temperature.

(i) Write a balanced equation for the reaction between ethylamine and dilute hydrochloric acid.

.....

(ii) Name the type of reaction taking place between ethylamine and dilute hydrochloric acid.

.....

(iii) State two observable changes for the reaction between ethylamine and dilute hydrochloric acid.

.....

.....

[4 marks]

(b) State the reagents and write balanced equations for the preparation of ethylamine from the following compounds.

(i) CH_3CH_2Br

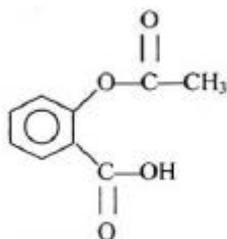
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(ii) CH_3CN

.....

[4 marks]

(c) Aspirin has the following structure.



Give the products formed when aspirin is heated with aqueous potassium hydroxide solution.

[2 marks]

Section B

Answer any four (4) questions in this section.

5. (a) Draw sketch graphs of

- a. P against V
- b. P against $1/V$
- c. PV against P
- d. PV against V

for a constant number of moles of an ideal gas at a constant temperature.

[4 marks]

(b) Plot on separate sketch graphs,

- (i) V against T ($^{\circ}\text{C}$)
- (ii) V against T (K)

for a constant number of moles of an ideal gas at constant pressure. [2 marks]

(c) 0.50 g of volatile liquid was introduced into a globe of 1000 cm^3 capacity. The globe was heated to 91°C so that all the liquid vaporized. Under these conditions the vapour pressure exerted a pressure of 0.25 atm. What is the relative molecular mass of the liquid? [R = 8.31 or 0.0821] [3 marks]

(d) A balloon can hold 1000 cm^3 of air before bursting. The balloon contains 975 cm^3 of air at 5°C . Will it burst if it is taken into a house at 29°C ? Assume the pressure of the gas in the balloon remain constant. [3 marks]

(e) Knowing that the density of ice is less than that of water, explain why the slope of the solid-liquid equilibrium line in the phase diagram of water is in accord with Le Chatelier Principle. [3 marks]

6. Interpret each of the following observations as fully as you can.

(a) The first ionisation energy of nitrogen is higher than that of either of the elements immediately preceding or following it in the Periodic Table. [3 marks]

(b) The boiling point of ammonia, $\text{NH}_3(-33^\circ\text{C})$ is higher than that of phosphine, $\text{PH}_3(-87^\circ\text{C})$ [3 marks]

(c) The bond energy of the nitrogen-nitrogen bond in the nitrogen molecule is 944 kJ mol^{-1} whereas the bond energy of the carbon-oxygen in carbon monoxide molecule which is isoelectronic with nitrogen is 1074 kJ mol^{-1} . [3 marks]

(d) the equilibrium constant K_c , for the reaction
$$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$$
decreases as the temperature rises whereas K_c for the reaction
$$\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g})$$
increases as the temperature rises. [2 marks]

(e) A solution containing $\text{NH}_3(\text{aq})$ and $\text{NH}_4\text{Cl}(\text{aq})$ acts as buffer solution, resisting changes in pH when acids or alkalis are added.

Explain the help of equations how this mixture acts as a buffer. [4 marks]

7 (a) The oxides of the Period 3 elements include the following:



(i) The melting points of Al_2O_3 , SiO_2 and P_4O_{10} are 2040°C , 1610°C and 24°C respectively. Explain the differences in their melting points in terms of structure and bonding. [6 marks]

(ii) Describe the solubilities of the oxides in water and write balanced equations for the reaction of the oxides (if any) with water. [4 marks]

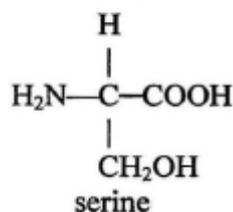
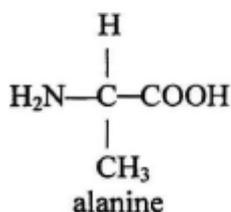
(b) $[\text{CrCl}_2(\text{C}_2\text{O}_4)_2]^{3-}$ is a complex ion.

(i) Draw all the structural formulae of the isomers of this complex ion [3 marks]

(ii) State the types of isomerism exhibited by the isomers [2 marks]

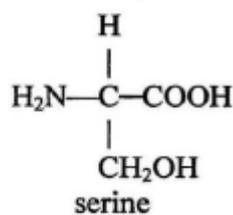
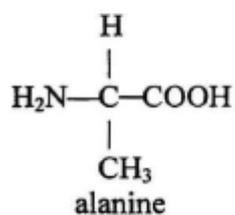
- 8 (a) Platinum (II) forms square planar complexes such as $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ where as platinum (IV) forms octahedral complexes such as $[\text{Pt}(\text{NH}_3)_4\text{ClBr}]^{2+}$.
- (i) Explain what is meant by "complex Ion". [2 marks]
- (ii) Give the IUPAC name for $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ and $[\text{Pt}(\text{NH}_3)_4\text{ClBr}]^{2+}$. [2 marks]
- (iii) Both these complexes exhibit geometrical isomerism. Draw the *trans*-isomer for both of them. [2 marks]
- (b) A neutral compound **H**, has the empirical formula, $\text{Co}(\text{Cl})_x(\text{NH}_3)_y$. The percentage by mass of cobalt, nitrogen and hydrogen in the complex is as follows: Co, 23.52%; N, 28.00%; Cl, 42.53%.
- When an aqueous solution containing 12.52 g **H** is reacted with excess AgNO_3 solution, 14.35 g of silver chloride is precipitated. Deduce the structural formula of the complex. Explain if you expect **H** to be coloured. [9 marks]

9. (a) (i) Write the mechanism of the reaction when 1-chloropropane is refluxed with aqueous sodium hydroxide. Name of the type of reaction involved [3 marks]
- (ii) State and explain how the rate of this reaction changes when 1-chloropropane is replaced by 1-bromopropane. [3 marks]
- (iii) Write equations to show how you would change 1-chloropropane to 2-chloropropane [5 marks]
- (b) The amino acids *alanine* and *serine* are shown below.



- (i) Draw the structures of the two dipeptides formed by the reaction of *alanine* with *serine*.
- (ii) Name one of the dipeptides formed in b(i).
- (iii) Draw the structure of the organic compound formed when one molecule of *serine* reacts with two molecules of ethanoyl chloride. [4 marks]

10. (a) (i) Write the mechanism of the reaction when 1-chloropropane is refluxed with aqueous sodium hydroxide. Name of the type of reaction involved [3 marks]
- (ii) State and explain how the rate of this reaction changes when 1-chloropropane is replaced by 1-bromopropane. [3 marks]
- (iii) Write equations to show how you would change 1-chloropropane to 2-chloropropane [5 marks]
- (b) The amino acids *alanine* and *serine* are shown below.



- (i) Draw the structures of the two dipeptides formed by the reaction of *alanine* with *serine*.
- (ii) Name one of the dipeptides formed in b(i).
- (iii) Draw the structure of the organic compound formed when one molecule of *serine* reacts with two molecules of ethanoyl chloride. [4 marks]