PART 2 (70 marks = 35% of paper)

Answer ALL questions in Part 2 in the spaces provided below.

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1. Write equations for any reactions that occur in the following procedures. If no reaction occurs write 'no reaction'.

   In each case describe **in full** what you would observe, including any
   - colours
   - odours
   - precipitates (give the colour)
   - gases evolved (give the colour or describe as colourless).

   If no change is observed, you should state this.

(a) Chromium metal is added to dilute sulfuric acid.

Equation _____

Observation

_____

_____

[3 marks]

(b) Aluminium metal is added to a solution of sodium hydroxide.

Equation

_____

Observation

_____

_____

[3 marks]

(c) Solid sodium sulfite is added to warm hydrochloric acid.

Equation

_____

Observation

_____

_____

[3 marks]

2. For each species listed in the table below draw the structural formula, representing All valence shell electron pairs as : and indicate the shape of the species by either a sketch or a name.

Species	**Structural formula** (showing all valance electrons)	**Shape** (sketch or name)
Oxygen difluoride, OF_2		
Carbon disulfide CS_2		
Azide ion, N_3^-		

[6 marks]

3. The electron configuration of a lithium atom is $1s^2\ 2s^1$. Using the same notation, give the electron configuration of

a) a fluorine atom F _____

b) a calcium ion Ca^{2+} _____

[2 marks]

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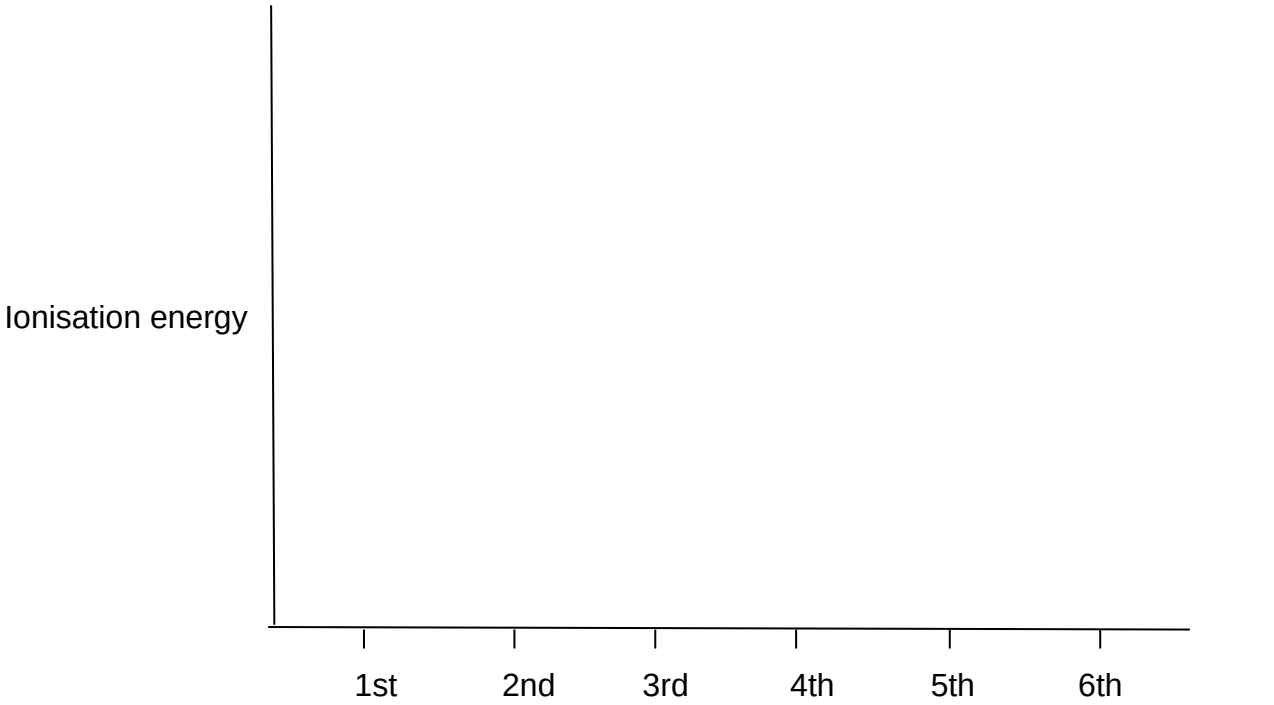
4. On the Axes below sketch a graph to show the following

a) How the melting points of the elements of the third period vary from left to right.

[3 marks]

b) The first six successive ionisation energies of Germanium. (3 marks)



[2 marks]

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5. In the presence of nitric acid, sulfur is oxidised to sulfur dioxide and nitric acid is reduced to nitrous oxide (NO). Write two half equations and a full balanced equation for this reaction.

Reduction half-equation
Oxidation half-equation
Full equation

[6 marks]

6. A student performed a neutralisation reaction outlined as followed: She took care to ensure complete neutralisation had occurred, with neither acid nor base in excess. She then used an indicator to measure the pH of the final reaction mixture. When she did this procedure with hydrochloric acid that was neutralised with sodium carbonate solution the final pH was approximately 10. She thought the pH would have been 7. Account for the observed pH value she found and suggest a possible acid/base combination which would lead to these observations.

[4 marks]

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7. Briefly explain each of the following. Where appropriate, use examples to illustrate your answer.

a) Metals are excellent conductors of electricity but ionic solids are non-conductors.

[4 marks]

b) Iodine is a solid at room temperature while chlorine is a gas.

[4 marks]

c) The ionisation energies of alkali metals decrease with increasing atomic number.

[4 marks]

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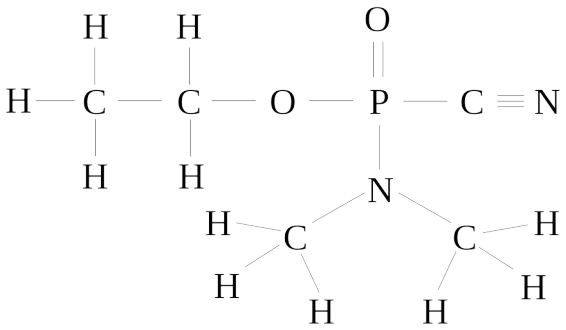
8. In 1937, while carrying out research on organo-phosphorus insecticides, a scientist in Germany discovered the nerve gases. The first of these gases was called Tabun. A splash of 0.0002g of Tabun on the skin of a person is fatal in a few minutes through paralysis and respiratory failure.

Tabun has the structural formula:



(a) Write down the empirical formula of Tabun.

_____ [1 mark]

(b) Calculate the percentage of phosphorus in Tabun:

(i) by mass.

_____

_____

_____

_____

_____

[3 marks]

(ii) by number of atoms per molecule.

_____

_____

_____

_____

_____

[2 marks]

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9. What are the characteristics of a primary standard, and explain why sodium carbonate is a good primary standard whilst sodium hydroxide is not. [4 marks]

10. During a titration, you should rinse the burette, pipette, and conical flask with certain solutions. If you are doing a standard acid base titration, how would you rinse each instrument and why?

a) Burette

[3 marks]

b) Pipette

[3 marks]

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c) Conical flask

[3 marks]

11. The first eight ionisation energies (in eV) for a certain element are:

10.49 19.72 30.18 51.37 65.02 220.43 263.21 309.41

a) Account for:

(i) the general increase in these values. [2 marks]

(ii) any discontinuities in the general trend. [2 marks]

(b) Identify the group to which this element most probably belongs. [1 mark]

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12. Given the following equation

$$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$$

Which is the

Acid _____ Base _____

Conjugate acid _____ Conjugate base _____

[2 marks]

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