Unit *Test* 6241/01A

1 (a) (i) $(1s^2)\ 2s^2 2p^6$
OR $2s^2 2px^2 2py^2 2p,^2$

$2s^2 2p^6 3s^2 3p^6 3d^{1\circ} 4s^2 4p^6$ / $2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

(b) Krypton because **greater/ stronger** *(NOT* **more)** van der Waals' / London/ dispersion/ temporary or induced dipole forces / attractions (**1**)

Because of larger number of **electrons** / extra shell(s) of

(2 marks)

electrons (**1**)

(c) (i) Sample bombarded/ fired at by electrons/ electron gun (**1**)

Knocks out/ loses/ removes electrons from the sample
Or equation **(1)**

(2 marks)

(ii) Electric/electrostatic field / (negatively) charged plates/ potential difference

(iii) Magnetic field/ (electro)magnet

(Total 8 marks)

2 (a) Weighted/ reference to abundance **average mass** of **atoms/ isotopes** (in sample) (**1**)

Relative to (mass of one atom of) ^{12}C **(1)**

(2 marks)

(b) $^{19}_{9}F$

F and atomic no.9 (**1**) mass no.19 (**1**)

(2 marks)

(b) Any (named) group 3 element (1) —

Big jump between 3rd and 4th I.E. /1St three electrons removed easily./ 4th electron in lower energy level/ gained stable octet after 3 e" removed(1)

(2 marks)

(Total 6 marks)

3(a) (i) $4Li + 0_2 \longrightarrow 2Li_2O$ (1 **mark)**

(ii) $2Na + 0_2 \rightarrow Na_20_2$ (1 **mark)**

(iii) $K + 0_2 \rightarrow K0_2$ (1 **mark)**

IGNORE state symbols

(b) Bubbles/ effervescence/ fizzing (1) *NOT* "see a gas"
floats / moves (on surface)(1) *Any two*
melts / forms a sphere (1)
gets smaller/ disappears (1)

(2 marks)

(c) Outer / the electron being removed further from nucleus (1)
More shielding/ screening/ explanation of shielding e.g. extra shell reduces attraction of nucleus **(1)**
Even though/ but more protons/ greater nuclear charge **(1)** **(3 marks)**

(Total 8 marks)

4 (a) Moles = 2.20 / 101 (**1**)
Concentration = 0.0218 / 0.05 = 0.436 (mol dm^{-3})*but must be in mol dm* ^{3} **(1)** **(2 marks)**

(b) (i) Mass = (0.0218 x) **85 (1)**

= 1.85 (g) (1)
Answer could be in kg but units must be quoted **(2 marks)**

(ii) Vol = (24 x) 0.01089 (1)
= 0.261 (dm^3) (1)
Can quote volume in any feasible unit
In (a) and (b) intermediate values (if stated) and final answers to calculations must be given to 2 - 4 s.f. **(2 marks)**
Penalise SF once

(c) Stability increases followed by an attempt at an explanation (**1**)

because charge density of cation/ metal ion/ group 1 ion decreases OR size increases but charge stays the same (**1**)

so polarises/distorts/ weakens bonds within nitrate/ negative ion/ anion less (**1**) **(3 marks)**

(d) $\frac{56.5}{39}$ $\frac{8.77}{12}$ $\frac{34.8}{16}$ (1)

$\frac{1.45}{0.725}$ $\frac{0.725}{0.725}$ $\frac{2.18}{0.725}$ (1)

(2 : 1 : 3) ie K_2CO_3 (1) **(3 marks)**
If = 19 in first step ie K_4CO_3 **2 (out of 3)**

(Total 12 marks)

5 (a) (i) +7 / 7+ / VII **(1 mark)**

(ii) +7 / 7+ / VII **(1 mark)**

(i) $Sn^{2+} \rightarrow Sn^{4+} + 2e^{(-)}$ OR $Sn^{2+} - 2e^{(-)} \rightarrow Sn^{4+}$ (1)

$I_2 + 2e^{(-)} \rightarrow 2I^-$ (1) **(2 marks)**

(ii) $Sn^{2+} + I_2 \rightarrow Sn^{4+} + 2I^-$
IGNORE state symbols **(1 mark)**

(Total 5 marks)

6 (a) Substance that accepts I removes/ takes electrons
or gains electrons from ... (1)
fluorinel F/ F_2 (1) **(2 marks)**

(b) (i) $Cl_2 + 20H^- \rightarrow Cl^- + ClO^- + H_2O$
Formulae (1)
Balancing (1) - *dependent on 1st mark*
Balanced molecular equation (1) only **(2 marks)**

(ii) Disproportionation **(1 mark)**

(c) (i) $NaCl + H_2SO_4 \rightarrow NaHSO_4 + NCl$ **(1 mark)**
Or $2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$
IGNORE state symbols

(ii) Mistyl steamy fumes/ gas/ vapour
OR bubbles/ effervescence/ fizzing
OR gets I feels hot / heat comes out **(1 mark)**

(d) (i) Trigonal planar diagram (1)
120 marked on diagram (1)
(2 marks)

(ii) Trigonal bipyramidal diagram including an attempt at 3-D (1)
120' marked on diagram (1)
90^0 / mathematical right angle sign marked on diagram (1)
in (i) and (ii) correct name can rescue a poor but not an incorrect diagram **(3 marks)**

(Total 12 marks)

7 (a) Si: giant molecular/ atomic/ structure
OR macro molecular/ atomic/ structure
OR Lattice
OR network
OR diagram with a minimum of 5 atoms shown with continuation (1)

P: **molecular** OR exists as P_4 *(1)*

Si: covalent bonds to break (1)

P: intermolecular forces/ van der Waals' forces between molecules to overcome (1)

Therefore more energy to separate silicon atoms (1) - *dependent on a reasonable explanation for Si and P*

(5 marks)

(b) Na: delocalised/ sea of electrons (1)

Na: which are mobile/ (free to) move/ flow (1)

NaCl: ions/ ionic (1)

NaCl: ions not mobile/ in fixed positions (1)

(4 marks)

(Total 9 marks)

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(a) (i) Electron pair/ lone pair acceptor
Or accepts electrons to form a (dative) covalent bond

(1 mark)

(ii) Particle with an unpaired electron

(1 mark)

(iii) Electron pair/ lone pair donor Or donates electrons to form a (dative) covalent bond

(1 mark)

(b) (i) Nucleophilic (1)
Substitution (1)

(2 marks)

(ii) (Free) radical (1)
Substitution (1)

(2 marks)

(iii) Electrophilic (1)
Addition (1)

(2 marks)

(Total 9 marks)

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2. (a) 5; 4; 6;

(1 mark)

(b) cooled (to lower temperature) (1)
oxygen / air reacts with NO (1)
to give NO_2 / N_2O_4 / name (1)
passed into water (with excess air) (1)

(4 marks)

(c) 4 x 17 **- 4 x 63 -** both molar masses (1) 50 gives 185 (tonnes) (1) if answer given in grams, unit must be given

(2 marks)

(d) Fertiliser/ explosives (production)

(1 mark)

(Total 8 marks)

3 (a) (i) E (1 **mark)**

(ii) A **(1 mark)**

(b) Sodium bromide AND conc sulphuric acid / 50% sulphuric acid / cone phosphoric acid
OR
Phosphorus tribromide
OR
Bromine AND red phosphorus (1)
Heat (1) **(2 marks)**

(c) 4 **(1 mark)**

(d) (i) $\frac{69.6}{12} : \frac{10.1}{1} : \frac{20.3}{14}$ (1)

= 5.8 : 10.1: 1.45

divide by 1.45 (1)

ratio 4 : 7 : 1

formula $C4H_7N$ (1)

(ii) Potassium cyanide

(i) Relative molar mass of C = 60 (1)

(-) 33.4 (kJ g^{-1}) (1)

(ii) (-286)/24000 = (-) 0.0119 or 0.012

(iii) C produces (carbon dioxide,) a greenhouse gas AND hydrogen produces water only / does not produce a greenhouse gas
Or

/''..44.,1 4 t .... ~...

C produces carbon monoxide which is toxic AND hydrogen does not produce carbon monoxide/ produces water only **(1 mark)**

(iv) Liquids are easier to transport or store (than gases) / gas needs to be stored under pressure / gas needs a larger fuel tank (1)
Energy produced from hydrogen **per unit volume** less than for C (1) **(2 marks)**

(Total 15 marks)

4 (a) F F Allow one carbon atom but not three or more unless
-C—C- two are bracketed together
F F **(1 mark)**

(b) Resistant/ inert/ unreactive to foods/ cleaning materials
high melting/softening point/ non-flammable/ non-toxic/ stable at high temperatures **(1 mark)**

(c) Persists in the environment / occupies sites for long time / many sites needed **(1 mark)**
Allow non-biodegradable

(d) **must be related to (c)** **(1 mark)**

C—F bond strong so difficult to break chemically / biologically
If `non-biodegradable' used in (c), must refer to biological breakdown

(Total 4 marks)

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5 (a) (i) Enthalpy/ heat (energy) **change** on formation of 1 mole of a compound (1)
from its elements (1)
in their standard states! at 1 atm pressure and stated temperature (298 K) (1)

(ii) (2 x 34) - (2 x 90) (1) $\Delta H = -112 kJmol^{-1}$ (1)
+112 kJ mol^{-1} or -56 kJ moi^{-1}(1) **(3 marks)**

(iii) enthalpy change consequential on (ii) (1)
activation hump shown (1)
diagram properly labelled - ΔH with arrows, named reactants and products (1) **(2 marks)**

(iv) Products thermodynamically more stable than reactants ! exothermic

(3 marks)

(v) Reaction has a high activation energy / reactants are kinetically stable

(1 mark)

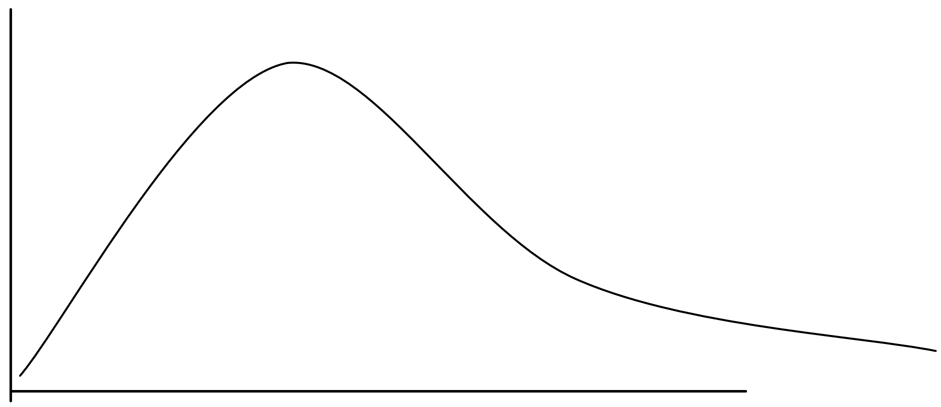
(b) (i) Dynamic - constantly moving ! still reacting /
Rate of forward reaction equals rate of reverse reaction (1)
Equilibrium — concentrations/ amounts constant (1) **(1 mark)**

(ii) position of equilibrium moves right (1)
fewer moles/ molecules on R.H.S. (1) **(2 marks)**

(iii) products removed from reaction system/ not in the system for long enough **(1 mark)**

(Total 15 marks)

6 (a) (i) correct shape:
starting at/ near origin, not crossing axes, not symmetrical (1)



labels:
energy AND number/ fraction of molecules **(1)** **(2 marks]**

Ea for the uncatalysed reaction shown well to the right of the peak and Ea for catalysed reaction to the left of this, still to the right of the peak (1)
Some comment concerning the areas under the curve to the right of the Ea lines or labelled shading (1)
Greater number of collisions (or particles) have energy greater than the activation energy/ have enough energy to react **(1)** **(4 marks)**
Therefore greater number of successful/ effective collisions (1)

(b) The explanation must refer to molecules or particles:

increase temperature (1)
molecules have more energy (1)
greater proportion of collisions successful / more effective collisions per unit time / more frequent effective collisions (1)

OR
increase pressure/ concentration (1)
more molecules per unit volume or molecules closer together (1)
more frequent collisions / more collisions per unit time (1) **(3 marks)**

(Total 9 marks)

(a) Barium I **Ba**$^{t+}$ **(1 mark)**

(b) $BaSO_4$ / barium sulphate **(1 mark)**

(c) Nitrogen dioxide / NO_2 **(1 mark)**

(d) Ammonia / NH_3 (1) Nitrate / NO_3^- (1) stand *alone mark* **(2 marks)**

(e) $Ba(NO_3)_2$ **(1 mark)**

<u>(Total 6 marks)</u>

2.

(a) C=C **/** alkene **/** carbon-carbon double bond
NOT "unsaturated hydrocarbon" **(1 mark)**

(b) Agi / silver iodide **(1 mark)**

<u>*Penalise missing Hs on (c) and (d) once only*</u>

(c) **Full** structure including C=C and C—I and all other atoms and bonds correct.
I can be on any C atom
halogen atom *consequential on (b)* ***(1** **mark)***

(d) Structure from (c) with Br atoms added across C=C **(1 mark)**

<u>**Total 4 marks'**</u>

3 (a) 20 g plus some working and must have units **(2)** e.g. 40 (1) x 5 x 0.100 = 20 **g (1)**

(2 marks)

(b) $\frac{\underline{23.50 \times 0.0500 \times 2}}{25.0}$ = 0.0940 (mol dm^{-3})

correct use of 2:1 mole ratio (1)
method (1)
answer (1)

(3 marks)

c(i) Adds 5 dm^3 of water not makes up to 5 dm^3 solution. *ALLOW* NaOH container was not re-weighed OR solid/NaOH left in its container

NOT "use volumetric flask"

NOT "NaOH lost"

NOT " failure to wash out NaOH container"

(1 mark)

(ii) Reference to absorbing moisture and/or (named) acidic gas(es)

(1 mark)

d (i) Causes burns / damage to / destroys living tissue OR damage to work bench

NOT just "harmful"

NOT "corrodes"

(1 mark)

(ii) Wear gloves

(1 mark)
(Total 9 marks)

4 (a) Density = 1.0 g cm^{-3} **(1 mark)**
OR 1 cm^3 (of water) weighs 1 g

(b) (AT = 38.1 — 19.5 =) 18,6 *(°C) calculated or correctly used (1)*

$\frac{200 \times 4.18 \times 18.6}{1000}$ = 15.5/15.55 (kJ) (1)
*Correct answer with some working **(2)***

***(2** marks)**

(c) (Mass used = 198.76 — 197.68 =) 1.08 *calculated or correctly used* (1) **(2 marks)**
Moles = $\frac{1.08}{46.0}$ = 0.0235 / 0.02348 (1)

(d) $\frac{\text{Answer to (b)}}{\text{Answer to (c)}}$ (1)

e.g. $\frac{15.5}{0.0235}$

negative sign and kJ mol^{-1} (1)
answer correct to 3sf (1) **(3 marks)**

(e) (i) Ethanol vaporises/evaporates **(1 mark)**

(ii) Carbon/soot (1)
Incomplete combustion/insufficient oxygen so reaction does not go to completion (1) **(2 marks)**

(Total 11 marks)

5(a) (Heating under) reflux (1)
Distillation/simple distillation (1)
NOT fractional distillation **(2 marks)**

(b) (i) $\frac{137 \times 3.70}{74}$ (1) = 6.9/6.85(g) (1)

(2 marks)

(ii) $\frac{4.60}{\text{answer to (i)}} \times 100 = 67/66.67/66.7\%$

(1 mark)

(iii) Slow/reaction takes a long time / high activation energy. (1 **mark)**

(iv) Measure boiling temperature/point (1)
Compare with data book/literature/known value (1) **(2 marks)**

(c) (i) Orange to green **(1 mark)**

(ii) **Oxidation** continues (1)
carboxylic acid formed (1) **(2 marks)**

(iii) Aldehyde/first product distilled off as it forms/removed from reaction mixture **(1 mark)**

(Total 12 marks)

6. READ THE WHOLE PLAN THROUGH FIRST **<u>Procedure and measurements</u>**

- Weigh test tube empty
- Weigh test tube + QCO_3

✓P 1

- Heat QCO_3 **to constant mass**

✓P 2

<u>Results and Identification</u>

✓P 3

- <u>loss in mass</u> (= moles CO_2) = moles QCO_3 Mr co,
- <u>Mass of QCO_3</u> = Mr QCO_3 Moles Qco_3 v
- Mr Qco_3 — 60 = Ar Q *<u>ALLOW credit via QO route</u>*

✓R 1

- <u>loss in mass</u> (= moles CO_2) = moles QO Mr co_2

✓R 2

- <u>mass QO</u> = Mr QO moles QO

✓R 3

- MrQO—16=Ar0

Alternative correct methods can score up to three marks.

✓R 1

<u>Errors and significance</u>

✓R 2

- Incomplete decompositionlreaction OR impure sample of QCO_3lcarbonate

✓R 3

- Not significant since need only match Arto nearest Group 2 element

✓E 1

✓E 2 **(8 marks)**

(Total 8 marks]