FACTFILE:
GCE CHEMISTRY

ANSWERS TO AS 1 FACTFILE QUESTIONS

Rewarding Learning

ANSWERS

1.1 Formulae, equations and amounts of substance

1. Answer is B

Moles of H_2SO_4 = $\frac{60000}{98}$ = 612.24 mol

Moles of $Ca_3(PO_4)_2$ = $\frac{60000}{310}$ = 193.55 mol

612.25 mol of H_2SO_4 reacts with $\frac{612.24}{3}$ = 204.08 mol of $Ca_3(PO_4)_2$

So $Ca_3(PO_4)_2$ is limiting reactant
Moles of H_3PO_4 formed = 193.55 × 2 = 387.1 mol
Mass of H_3PO_4 formed = 387.1 × 98 = 37935.8 g = 38 kg

2.(a)
(i) hydrated sodium carbonate contains water of crystallisation [1]

(ii) crucible containing hydrated sodium carbonate [1]
pipeclay triangle on a tripod [1]
heatproof mat [1]

(b)(i) mass of the empty crucible [1]
mass of the crucible and the hydrated sodium carbonate [1]

(ii) heat and weigh [1]
repeat until two consecutive mass measurements are the same [1]

(iii) allow to cool [1]

(c)(i) 11.44 – 4.24 = 7.2 g [1]

(ii) $\frac{7.2}{18}$ = 0.4 mol [1]

(iii) $\frac{4.24}{106}$ = 0.04 mol [1]

(iv) $\frac{0.4}{0.04}$ = 10 [1]

3. Answer is B [1]

Moles of C_3H_8 = $\frac{4.4}{44}$ - 0.1 mol

Moles of CO_2 formed = 0.3 mol

Number of CO_2 molecules = $0.3 \times 6.02 \times 10^{23} = 1.81 \times 10^{23}$

1.2 Atomic Structure

1. Answer is B [1]

2.(a)

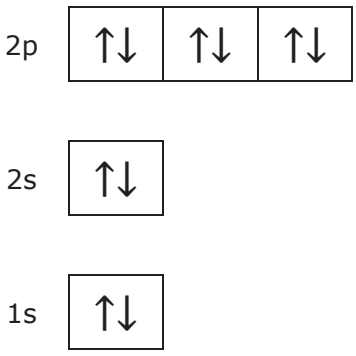
	Number of protons	Number of electrons	Number of neutrons
Neon-20	10	10	10
Neon-21	10	10	11
Neon-22	10	10	12

[2]

(b) $\frac{90.92 \times 20 + 0.26 \times 21 + 8.82 \times 22}{100}$ [1] = 20.18 [1]

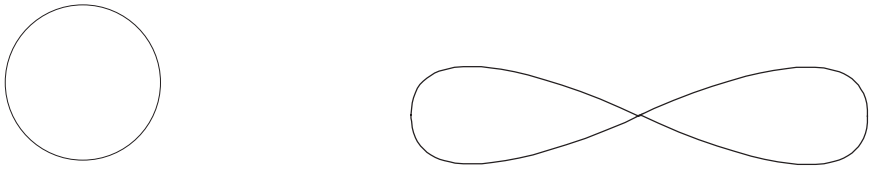
(c) carbon-12 [1]

(d)



[1] for labels
[1] for correct arrangement of electrons

(e)



s orbital p orbital

3. Answer is D [1]

4.(a) 14 [1]

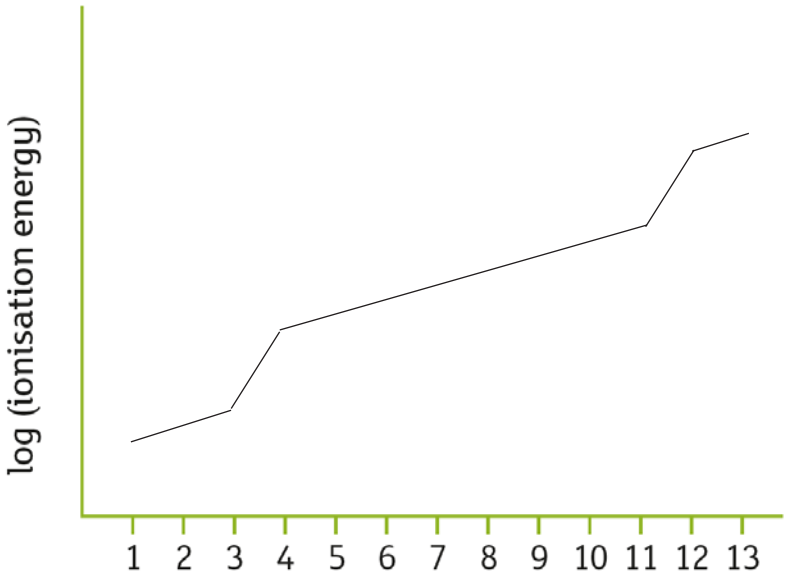
(b)(i) $Al(g) \rightarrow Al^{+}(g) + e^{-}$
[1] for equation and [1] for correct state symbols

(ii) outer electrons are closer to the nucleus [1]
less shielding by inner electrons [1]

(iii) filled subshell ($3s^2$) in magnesium more stable than $3p^1$ of aluminium [1]
outer 3s electrons closer to nucleus in magnesium [1]

(iv) $1s^2\ 2s^2\ 2p^5$ [1]

(v)

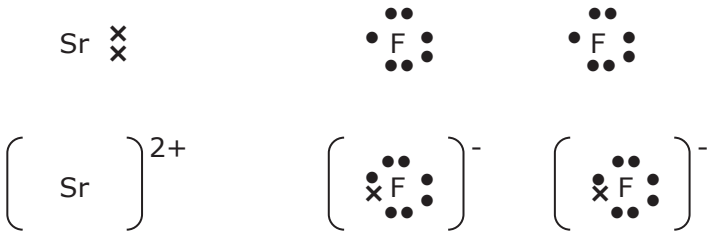


increasing [1] with larger increases after 3 and 11 electrons removed [1]

1.3 Bonding

1. Answer is A [1]

2.

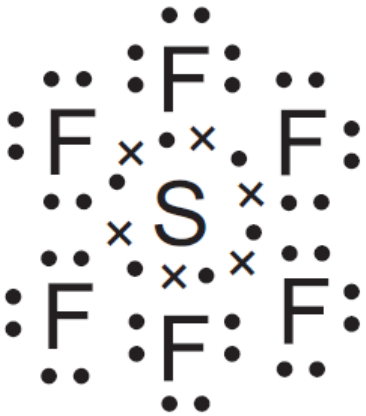


[4] marks
each error -1

3.(i) Electronegativity is the extent to which an atom attracts the bonding electrons in a covalent bond [1]

(ii) $\delta+$ $\delta-$
S—F [1]

(iii)



[1]

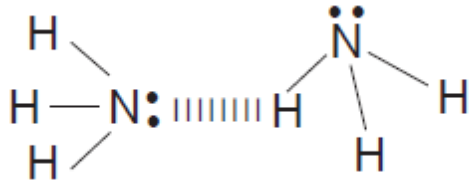
(iv) no as 12 electrons in outer shell of the sulfur atom [1]

4. Answer is A [1]

1.4 Intermolecular Forces

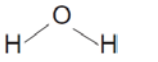
1. Answer is D [1]

2.(i)



[2]

(ii) lone pair removed/forms a co-ordinate bond [1]

(iii) N: forms hydrogen bonds with  [1]

and N—H forms hydrogen bonds with  [1]

3. Answer is D [1]

1.5 Structure

1. Answer is C [1]

2.(a)
(i) The electrostatic attraction between a shared pair of electrons and the nuclei of bonded atoms [1]

(ii) Diamond:
each carbon atom bonded covalently to four other carbon atoms [1]
tetrahedral arrangement/bond angle 109.5° [1]

Graphite:
each carbon atom bonded covalently to thee other carbon atoms [1]
in hexagonal layers with delocalised electrons between the layers [1]

(iii) delocalised electrons [1] (between the layers) can move and carry charge [1]

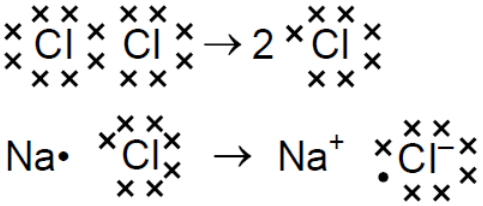
(iv) rigid 3D structure with many strong covalent bonds [1]

3.(a)
(i) regular arrangement of positives/Na^+ [1]
random delocalised electrons [1]
electrostatic forces/attractive forces [1]

(ii) aluminium has more delocalised electrons [1]
which can move and carry charge [1]

(b) molecular/simple covalent [1]

(c)(i)



[3]

(ii) ionic [1]

(iii) regular/repeated [1] structure of ions/particles [1]

(iv) soluble in water/polar solvents [1]
high melting point/boiling point [1]
conducts electricity when molten/aqueous [1]

4. Answer is D [1]

5. Answer is C [1]

1.6 Shapes of molecules

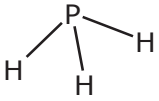
1. Answer is D [1]

2. Answer is D [1]

3.(a)(i)

[2]

(ii)



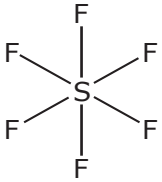
[1]

pyramidal [1]

(iii) phosphine has 1 lone pair and 3 bonding pairs and electron pairs repel to be as far apart as possible [1]
repulsion between the lone pair and the bonding pairs is greater than the repulsion between the bonding pairs [1]

(iv) 107° [1] less than 109.5° due to greater repulsion of lone pair [1]

4.(i)



[1]

octahedral [1]
bonding pairs of electrons repel each other [1]
to be as far apart from each other as possible [1]

(ii) molecule is symmetrical [1] dipoles/polarity of bonds cancel [1]

1.7 Redox

1. Answer is C [1]

2.(a)
(i) oxidation is loss of electrons [1]

(ii) reduction is a decrease in oxidation state [1]

(b)(i) +5 [1]

(ii) +2 [1]

(c)(i) $2I^- \rightarrow I_2 + 2e^-$ [1]

(ii) $2HNO_3 + 6H^+ + 6I^- \rightarrow 2NO + 4H_2O + 3I_2$ [2]

3.(a) chlorine(VII) oxide [1]

(b)(i) oxidation and reduction of the same element in the same reaction [1]

(ii) In ClO_2 oxidation state of Cl = +4
In $HClO_3$ oxidation state of Cl = +5
In HCl oxidation state of Cl = -1
[2] for all oxidation states correct
Cl has been oxidised from +4 to +5 and reduced from +4 to -1 in the same reaction [1]

4. Answer is C [1]

1.8 The halogens

1. Answer is D [1]

2.(a)

	sodium iodide (aq)	sodium bromide (aq)	sodium chloride (aq)
iodine solution		X	X
bromine solution	✓		X
chlorine solution	✓	✓	

[-1] for each error

(b)(i) yellow/orange/brown solution changes to darker brown solution [2]

(ii) $Br_2 + 2I^- \rightarrow 2Br^- + I_2$ [1]

(c)(i) colourless solution [1]
orange/yellow/brown solution produced [1]

(ii) $Cl_2 + 2NaBr \rightarrow 2NaCl + Br_2$ [2]

3.(a)
(i) As the Group is descended there are more energy levels [1]

(ii) Going down the Group the molecules get heavier/there are more electrons [1]
causing van der Waals forces between the molecules [1]

(iii) The extent to which an atom attracts the bonding electrons in a covalent bond [1]

(iv) Fluorine has the smallest radius [1]
greatest attraction between its nucleus and the bonding electrons [1]

(v) $F(g) \rightarrow F^+(g) + e^-$
[1] for equation
[1] for state symbols

(vi) Going down the Group the outer electrons are further from the nucleus [1]
Increased shielding (from inner electrons) [1]

(b)(i) $Cl_2 + H_2O \rightarrow HOCl + HCl$ [1]

(ii) $Cl_2 = 0$
$HOCl = +1$
$HCl = -1$
[2] for all oxidation states correct
Cl is both oxidised, $0 \rightarrow +1$, and reduced, $0 \rightarrow -1$ [1]

4.(a)
(i) $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$ [2]

(ii) $H_2SO_4 + \mathbf{8}H^+ + \mathbf{8e}^- \rightarrow H_2S + \mathbf{4}H_2O$ [2]

(iii) $8I^- + 8H^+ + H_2SO_4 \rightarrow 4I_2 + H_2S + 4H_2O$ [2]

(iv) rotten egg smell [1]

(v) sulfur [1] sulfur dioxide [1]

(vi) outer electrons in the iodide ion are further from the nucleus/more shielded [1]
iodide ions lose electrons more easily (than chloride ions) [1]

5. Answer is A [1]

1.9 Acid-Base Titrations

1.(a)
(i) A solution for which the concentration is known [1]

(ii) $Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$ [1]

(b) moles of HCl used = $\frac{22.4 \times 0.1}{1000}$ = 0.00224 mol

moles of Na_2CO_3 in 25 cm^3 = $\frac{0.00224}{2}$ = 0.00112 mol

moles of Na_2CO_3 in sample = 0.00112 × 10 = 0.0112 mol

mass of Na_2CO_3 = 0.0112 × 106 = 1.1872 g
mass of water = 2.80 – 1.1872 = 1.6128 g

moles of water = $\frac{1.6128}{18}$ = 0.0896 mol

x = 0.0896/0.0112 = 8 [5]

2.(a)
(i) phenolphthalein [1]

(ii) colourless [1] to pink [1]

(b)(i) $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$ [2]

(ii) 21.4
21.3 [1]
average titre = 21.35 cm^3 [1]

(iii) $\frac{21.35 \times 0.1}{1000}$ = 0.002135 mol [1]

(iv) $0.002135 \times 40 = 0.0854$ mol dm^{-3} [1]

(v) $0.0854 \times 10 = 0.854$ mol dm^{-3} [1]

(c) using a pipette filler draw up undiluted vinegar until the bottom of the meniscus is on the line [1]
transfer into a 250 cm^3 volumetric flask and make up the volume with deionised water until the bottom of the meniscus is on the line [1]
invert to mix [1]
rinse pipette with deionised water and the diluted vinegar solution [1]
using a pipette filler draw up diluted vinegar solution until bottom of the meniscus is on the line and released into a conical flask [1] max [4]

3. Answer is C [1]
moles of $Na_2CO_3 = \frac{2.65}{106} = 0.025$ mol
$0.025 \times 4 = 0.1$ mol dm^{-3}

4. Answer is B [1]

1.10 Qualitative Tests

1. Answer is D [1]

2.(i) W = concentrated hydrochloric acid [1]
X = nichrome/platinum [1]
Y = blue [1]
Z = blue-green [1]

(ii) clean the wire [1]
make the solid stick to the wire/dissolve the solid [1]

3. Answer is C [1]

4.

AgCl	white	ionic	yes	yes	
AgBr	cream	ionic	no	yes	
AgI	yellow	ionic	no	no	[4]