

Q1.

- 1 (a) $\text{Mg}^{2+} + 2\text{e}^{-} \longrightarrow \text{Mg}$ [1]
- (b) chlorine/ Cl_2 [1]
- (c) smaller A_r [1]
larger (atomic/ionic) radius/size [1]
- (d) (i) the energy change when 1 mol of solid compound [1]
is formed from its gaseous ions [1]
- (ii) $\text{Mg}^{2+}(\text{g}) + 2\text{Cl}^{-}(\text{g}) \longrightarrow \text{MgCl}_2(\text{s})$ [1]
charges + balancing [1]
state symbols [1]
- (e) (i) LE (MgCl_2) is greater than LE (NaCl) [1]
(because) Mg^{2+} has higher charge / smaller radius than Na^{+} [1]
- (ii) LE (MgCl_2) is greater than LE (CaCl_2) [1]
(because) Mg^{2+} is smaller than Ca^{2+} [1]
- (f) $\text{LE} = 349 - 122 - 494 - 107 - 411$
 $= -785 \text{ (kJ mol}^{-1}\text{)}$ [3]

correct answer = [3], with – [1] for one error. OR mark as follows:

use of all 5 ΔH values, with x1 multipliers [1]
correct signs for all ΔH values [1]
negative sign in answer [1]

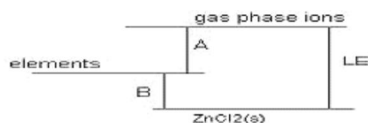
Total = [15]

Q2.

- 3 (a) (i) It is an endothermic reaction, **or** taking in heat [1]
 It has a high activation energy/ E_a [1]
- (ii) MgCO_3 will decompose at a **lower** temperature/needs less energy [1]
 Mg^{2+} is a smaller (ion) than Ca^{2+} **or** Mg^{2+} has high charge density [1]
 So polarises/distorts the anion CO_3^{2-} ion more easily
 [or $\text{LE}(\text{MgO}) > \text{LE}(\text{CaO})$] [1]
- Part (a): [5]**
- (b) $\Delta H = 82 - 178 = -96 \text{ (kJ mol}^{-1}\text{)}$ [1]
- Part (b): [1]**
- (c) $[\text{CaMg}(\text{CO}_3)_2 \longrightarrow \text{CaO} + \text{MgO} + 2\text{CO}_2]$
- $M_r(\text{CaMg}(\text{CO}_3)_2) = 40.1 + 24.3 + 24 + 96 = 184.4$ [1]
 $M_r(2\text{CO}_2) = 2 \times 44 = 88$
- $\therefore \% \text{ loss in mass} = 100 \times \frac{88}{184.4} = 47.7\%$ (e.c.f. in 184.4) [1]
 Allow 48%. Also allow 48.8% if $M_r = 184$
- Part (c): [2]**
- Total: [8]**

Q3.

(c)



$$\begin{aligned} \text{LE} &= B - A \\ &= -415 - (131 + 908 + 1730) - \{244 + 2(-349)\} \\ &= -415 - 2315 \quad [1] \quad [1] \\ &= -2730 \text{ (kJ mol}^{-1}\text{)} \end{aligned}$$

[1]
 (correct answer = [3]: deduct [1] for each error) [3]

Q4.

- 2 (a) less soluble down group (1)
 lattice energy and hydration energies both decrease (i.e. become less negative) (1)
 but H.E. decreases more (than L.E.) or change in H.E. outweighs L.E. (1)
 so ΔH_{sol} becomes more endothermic / less exothermic (1) [4]
- (b) (i) for Mg: $\Delta H = 2993 - 1890 - (2 \times 550) = (+)3$ (kJ mol⁻¹) (1)
 for Sr: $\Delta H = 2467 - 1414 - (2 \times 550) = -47$ (kJ mol⁻¹) (1)
- (ii) Sr(OH)₂ should be **more** soluble in water, **and** ΔH is more exothermic / negative (1)
 Assuming "other factors" (e.g. ΔS , or temperature etc.) are the same (1)
- (iii) Sr(OH)₂ should be **less** soluble in hot water, **because** ΔH is negative / exothermic (1) [5]
- (c) (i) $K_{\text{sp}} = [\text{Ca}^{2+}][\text{OH}^-]^2$ (needs the charges) units: mol³dm⁻⁹ (1) + (1)
- (ii) $n(\text{H}^+) = n(\text{OH}^-) = 0.05 \times 21/1000 = 1.05 \times 10^{-3}$ mol in 25 cm³
 $[\text{OH}^-] = 1.05 \times 1000/25 = 4.2 \times 10^{-2}$ (mol dm⁻³) (1)
 $[\text{Ca}^{2+}] = 2.1 \times 10^{-2}$ (mol dm⁻³) (1)
 $K_{\text{sp}} = 2.1 \times 10^{-2} \times (4.2 \times 10^{-2})^2 = 3.7 \times 10^{-5}$ (1)
- (iii) **less** soluble in NaOH due to the common ion effect or equilibrium is shifted to the l.h.s. by high $[\text{OH}^-]$ (NOT just a mention of Le Chat' on its own) (1) [6]

[Total: 15]

Q5.

- 1 (a) N≡N triple bond is (very) strong
or the N₂ molecule has no polarity [1]
- (b) $3\text{Mg(s)} \rightarrow 3\text{Mg}^{2+}\text{(g)} \quad \Delta H_1 = 3 \times 148 + 3 \times 2186 = 7002$
 $\text{N}_2\text{(g)} \rightarrow 2\text{N}^{3-}\text{(g)} \quad \Delta H_2 = 994 + 2 \times 2148 = 5290$
 $\text{LE} = -\Delta H_1 - \Delta H_2 - 461 = -12,753 \text{ (kJ mol}^{-1}\text{)}$ (-[1] for each error) [3]
- (c) (i) $\text{Li}_3\text{N} + 3\text{H}_2\text{O} \rightarrow \text{NH}_3 + 3\text{LiOH}$ (balanced equation) [1]
- (ii) advantage: no high pressure/temperature/catalyst needed/standard conditions used [1]
 disadvantage: Li is expensive
or Li would need to be recycled/removed
or LiOH by-product is corrosive/strongly basic
or this would be a batch, rather than continuous process [1]
- (d) (i) $\text{Li}_3\text{N: } 100 \times 14/35 = 40\% \text{ N}$ [1]
 $\text{urea: } 100 \times 28/60 = 47\% \text{ N}$ [1]
- (ii) amide [1]
- (iii) $\text{NH}_2\text{CONH}_2 + \text{H}_2\text{O} \rightarrow 2\text{NH}_3 + \text{CO}_2$
or $\rightarrow \text{NH}_2\text{CO}_2\text{H} + \text{NH}_3$
or $\text{NH}_2\text{CONH}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{NH}_3 + \text{H}_2\text{CO}_3$ [1]
- (iv) The LiOH would be strongly alkaline
or would increase the pH of the soil
or would 'burn' the crops/reduce plant growth/stunt plants
or would contaminate the environment [1]

[Total: 12]

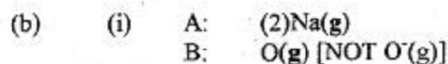
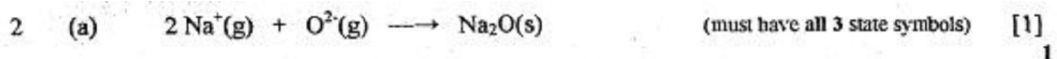
Q6.

- 1 (a) (i) the enthalpy change/released when **1 mole is formed** [1]
of ionic lattice **from the gas phase ions** [1]
- (ii) $\text{Mg}^{2+} + \text{O}^{2-} \longrightarrow \text{MgO}$ [1]
[3]
- (b) measurements needed: [1]
volume/mass/weight of water (in calorimeter) [1]
initial + final temperature/temperature change/temperature rise (of the water) [1]
mass of Mg (used)/mass MgO [1]
Not volume/moles/mass of oxygen used [3]
- (c) $\Delta H = 148 + 736 + 1450 + 496/2 - 141 + 798 - 3791$
 $= \underline{-552 \text{ kJ mol}^{-1}}$ [3]
[3]
- (d) $\text{Na}_2\text{O}(\text{s}) + \text{H}_2\text{O}(\text{aq/l}) \longrightarrow 2\text{NaOH}(\text{aq})$ [1]
 $\text{MgO}(\text{s}) + \text{H}_2\text{O}(\text{aq/l}) \longrightarrow \text{Mg}(\text{OH})_2(\text{s}) \text{ or } \text{Mg}(\text{OH})_2(\text{aq})$ [1]
pH 12.5-14 [NaOH] **AND** 8-10.5 [Mg(OH)₂] respectively [1]
[3]
- [Total: 12]**

Q7.

- 1 (a) (i) enthalpy/energy change/released when 1 mol of ions... [1]
in the gas phase (are dissolved in) water [1]
- (ii) $\text{Mg}^{2+}(\text{g}) + \text{aq (or H}_2\text{O)} \rightarrow \text{Mg}^{2+}(\text{aq}) \text{ or } [\text{Mg}(\text{H}_2\text{O})_6]^{2+}$ [1]
- (iii) Mg^{2+} has a smaller radius/size or greater charge density than Ca^{2+} (**ions** required) [1]
- (iv) O^{2-} reacts with water to give OH^- or equation: $\text{O}^{2-} + \text{H}_2\text{O} \rightarrow 2\text{OH}^-$ [1]
[5]
- (b) (apparatus: "insulated" calorimeter, water and thermometer)
- measure (known volume/mass of) water or stated volume of water (into calorimeter)
 - take the temperature (of the water – NOT the MgCl_2)
 - weigh out known mass of MgCl_2 or stated mass of MgCl_2
 - take final/highest/constant temperature or record temperature change/rise 4 × [1]
[4]
- (c) (i) $\Delta H_{\text{sol}}^{\ominus} = 641 - 801 = -160 \text{ kJ mol}^{-1}$ [1]
- (ii) $\Delta H_{\text{hyd}}^{\ominus} = (1890 - 2526 - 160)/2 = -398 \text{ kJ mol}^{-1}$ [2]
[3]
- (d)
- solubility: $\text{MgSO}_4 > \text{BaSO}_4$ or decreases down the group
 - because ΔH_{sol} is more endothermic for BaSO_4 or more exothermic for MgSO_4
 - due to larger r_{ion} or smaller charge density of Ba^{2+} (ion has to be mentioned)
 - leading to smaller LE and HE or LE and HE decrease
 - but difference in HE (between Mg^{2+} and Ba^{2+}) is larger than the difference in LE (between MgSO_4 and BaSO_4)
or HE is dominant or HE decreases more than LE any 4 points [4]
[4]
- [Total: 16]**

Q8.



- (ii) 1: - (first) ionisation energy (of sodium) *or* IE *or* ΔH_i
 2: first **and** second electron affinities (of oxygen) *or* $\text{EA}_1 + \text{EA}_2$
 (if B was stated as O(g) rather than O(g), allow ½-mark for EA_2 only)
 3: lattice energy (of Na_2O) *or* LE *or* ΔH_{lat}
 4: enthalpy change of formation *or* ΔH_f (of Na_2O) *or* $2\Delta H_c$
 [for parts (i) and (ii) award ½ mark for each correct answer. Total the halves and round down]

[3]
3

(c) $(\Delta H_f = 2\Delta H_{\text{at}}(\text{Na}) + 2 \text{IE}_1(\text{Na}) + \Delta H_{\text{at}}(\text{O}) + (\text{EA}_1 + \text{EA}_2)(\text{O}) + \text{LE})$

$-414 = 2(107) + 2(494) + 496/2 + (-141 + 798) + \text{LE}$

$\therefore \text{LE} = -2521 \text{ (kJ mol}^{-1}\text{)}$

correct answer, including sign [3]

allow [1] for use of the 6 correct values, i.e. the 4 on the question paper and 2 obtained from the data book: 496 and 494 (be aware that the "494" may appear as "988" and the "496" as "248" and the "798-141" as "657")

allow [1] for use of the correct multipliers for the values used, (i.e. if $\text{IE}(\text{Na})$ has been omitted, don't penalise for not multiplying 494 by 2). There are three multipliers: $\times 2$, $\times 2$ and $\times 1/2$. Some candidates are using the bond energy of O-O rather than O=O, in which case you can allow 150/2 for this mark (they will have forfeited the previous mark)

allow [2] for a correctly calculated answer from just one incorrect piece of data.

3

(d) (i) higher/bigger/more (i.e. more negative) [1]

doubly charged cation *or* bigger charge (density) of cation *or* smaller cation [1]

(ii) furnace linings *or* refractory material *or* crucibles [1]

high melting point [1]

4

Total: 11

Q9.

			Total: 12
6	(a)	(i) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$	(1)
		(ii) $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$	(1) [2]
	(b)	to reduce acidity/raise the pH of soil/neutralize acid soils	(1) [1]
	(c)	more stable down the group	(1)
		(due to) larger cations	(1)
		(hence) less polarization/distortion of CO_3^{2-}	(1) [3]
			Total: 6

Q10.

3	solubilities decrease down the group	[1]
	hydration energy of the cation decreases	[1]
	lattice energy stays the same, or decreases less than H.E.	[1]
	making $\Delta H_{\text{solution}}$ more endothermic or H.E. no longer able to overcome -L.E.	[1] 4
		Total 4

Q11.

(c)	(i) $\text{Ag}^+(\text{g}) + \text{Br}^-(\text{g}) \longrightarrow \text{AgBr}(\text{s})$	[1]
	(ii) LE = ΔH_f° - (all the rest)	
	= $-100 - (731 + 285 + 112 - 325)$	
	(= $-100 - 731 - 285 - 112 + 325$)	
	= -903 kJ mol⁻¹ (-[1] for each error of sign or maths)	[2]
	(iii) LE(AgCl) should be higher/more negative, due to size/radius of Cl ⁻ being less than that of Br ⁻ (both)	[1]
		4
(d)	more energy needed, since $r_{\text{Cl}^-} < r_{\text{Br}^-}$ or ionised electron nearer to nucleus or less shielding etc. or in terms of I.E.(Cl) > I.E.(Br)	1

Q12.

- 3 (a) (i) $2\text{Ca}(\text{NO}_3)_2 \longrightarrow 2\text{CaO} + 4\text{NO}_2 + \text{O}_2$ (or x ½) (1)
- (ii) (Down the group the nitrates)
- become more stable or are more difficult to decompose
- or need a higher temperature (to decompose) (1)
- because the radius of cation/Group II ion/ M^{2+} increases
or charge density of the cation decreases (1)
- thus causing less polarisation/distortion of the anion/ NO_3^- /nitrate (1) [4]
- (b) "molar mass" of mixture = $211.6 + 3 \times 12 = 247.6$ (1)
- 10 g is thus $10/247.6 = 0.040(4)$ moles (allow ecf for 0.047(3), from $M_r = 211.6$) (1)
- no of moles of gas produced = $0.0404 \times 4 = 0.162$ moles (ecf: 0.189 mol)
- \therefore volume = $0.1616 \times 24 = 3.88$ or 3.9 dm^3 (allow ecf for 4.54 dm^3) (1)
(correct ans = (3) marks)
- (alternative method:
- 1 mole/247.6g of mixture will produce $4 \times 24 = 96 \text{ dm}^3$ of gas (1)
- \therefore 10g of mixture will produce $96 \times 10/247.6 = 3.88$ or 3.9 dm^3) (1) [3]
- (c) (CO is poisonous...)
- due to complexing/ligand exchange with (Fe of) haemoglobin (1)
(NOT redox involving $\text{Fe}^{2+}/\text{Fe}^{3+}$)
- stopping O_2 being transported around body/in blood/to tissues/from lungs (1) [2]
- [Total: 9 max 8]

Q13.

- 2 (a) solubility **decreases** (down Group II) [1]
 lattice energy decreases [1]
 solvation/hydration energy (of cation) decreases [1]
 but more so than does lattice energy/is not able to overcome LE [1]
 ΔH_{soln} becomes more endothermic/positive/less exothermic [1]
[max 4]
- (b) identities of **A** and **B** 2 x [1]
 $\text{Mg(OH)}_2 + \text{H}_2\text{C}_2\text{O}_4 \longrightarrow \text{MgC}_2\text{O}_4(\text{aq}) + 2\text{H}_2\text{O}$ [1]
(A)
- $\text{MgC}_2\text{O}_4(\text{aq}) + \text{Ca(NO}_3)_2 \longrightarrow \text{Mg(NO}_3)_2 + \text{CaC}_2\text{O}_4(\text{s})$ [1]
(B)
[max 3]
- (c) (i) $(K_{\text{sp}} =) [\text{Mg}^{2+}][\text{OH}^-]^2$ [1]
 units are $\text{mol}^3\text{dm}^{-9}$ ecf from K_{sp} [1]
- (ii) (call $[\text{Mg(OH)}_2(\text{aq})] = [\text{Mg}^{2+}] = x$) $\therefore K_{\text{sp}} = 2 \times 10^{-11} = 4x^3$ [1]
 $\therefore x = 1.71 \times 10^{-4} \text{ mol dm}^{-3}$ ecf [1]
- (iii) less soluble because of the common ion effect [1]
 or the equilibrium $\text{Mg(OH)}_2(\text{s}) = \text{Mg}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq})$ is moved to the left [1]
[5]
[Total: 12]

Q14.

- 3 (a) (i) carbonates become more stable down the Group/higher decomposition temperature [1]
 cation/ M^{2+} radius/size increases down the group/ M^{2+} charge density decreases [1]
 anion/carbonate ion/ CO_3^{2-} suffers less polarisation/distortion [1]
- (ii) ionic radii quoted: Ca^{2+} : 0.099 nm
 Zn^{2+} : 0.074 nm
 Pb^{2+} : 0.120 nm [1]
- thus we expect ZnCO_3 to be less stable, but PbCO_3 to be more stable [1]
 if candidate states PbCO_3 is more stable than ZnCO_3 (or converse) with no reference
 to CaCO_3 give [1] as salvage.

Q15.

- 2 (a) $\text{Ca}^{2+}(\text{g}) + 2\text{Cl}^{-}(\text{g}) \longrightarrow \text{CaCl}_2(\text{s})$ [1]
[1]
- (b) CaF_2 and CaS both have larger lattice energies (than CaCl_2) [1]
- (i) F^{-} is smaller than Cl^{-} [1]
- (ii) S^{2-} is more highly charged than Cl^{-} [1]
[3]
- (c) $\text{LE} = -[178 + 590 + 1150] - [244 - 2 \times 349] - 796$ signs✓
 $= -2260 \text{ (kJ mol}^{-1}\text{)}$ [3]
[3]
- (d) (i) $\text{Ca} = 28.2/40.1 = 0.703 \Rightarrow 1$
 $\text{C} = 25.2/12 = 2.10 \Rightarrow 3$
 $\text{H} = 1.4/1 = 1.4 \Rightarrow 2$ (1 mark for initial step of calc'n)
 $\text{O} = 45.1/16 = 2.82 \Rightarrow 4$
- formula is $\text{CaC}_3\text{H}_2\text{O}_4$ (1) [2]
- (ii) malonic acid must be $\text{C}_2\text{H}_4\text{O}_4$, i.e. $\text{CH}_3(\text{CO}_2\text{H})_2$ (must be structural) [1]
[3]
- [Total: 10]

Q16.

- 1 (a) Sulfates become **less soluble** down the group [1]
 both lattice energy and hydration (are involved) [1]
 but hydration energy decreases more than lattice energy [1]
 or HE becomes less than LE or HE decreases whereas LE is almost constant [1]
 (due to cationic radius increasing) [3]
- (b) (i) $n(\text{CO}) = pV/RT = 1.01 \times 10^5 \times 140 \times 10^{-3} / (8.31 \times 450) = 3.78$
 or $= 140 \times (273/450) / 22.4 = 3.79$
 allow $= 140 \times (298/450) / 24.0 = 3.86$ [1]
- (ii) $n(\text{BaSO}_4) = n(\text{CO})/4 = 0.945$ moles (or 0.9475) [1]
 If RTP used answer is **0.966**
- (iii) $M_r = 233$, [1]
 so $0.945 \text{ mol} = 0.945 \times 233 = 220\text{g} \Rightarrow 100 \times 220/250 = 88(.07)\%$ [1]
 (or $0.9475 \text{ mol} \Rightarrow 220.8\text{g} \Rightarrow 88(.3)\%$) [1]
 If RTP used answer is **90(.0)%** [4]
- (c) (i) from data booklet, 1st IE = 502; 2nd IE = 966; sum = 1468 kJ mol^{-1}
 so $-460 = 1468 + 180 + 279 - 200 + 640 + \text{LE}$
 $-460 = 2367 + \text{LE}$
 $\text{LE} = -2827 \text{ kJ mol}^{-1}$
 (-1 for each error) [3]
- (ii) LE of BaS should be smaller than that of BaO, since S^{2-} is bigger than O^{2-} . [1]
 [4]
- [Total: 11]

Q17.

- 4 (a) The energy required to break... [1]
1 mole of bonds in the gas phase [1]
 [2]
- (b) HCl: nothing happens AND HI: purple fumes (at a low temperature) [1]
 purple is **iodine** formed (or in an equation: $2\text{HI} \longrightarrow \text{H}_2 + \text{I}_2$) [1]
 H-X bond energy becomes smaller/weaker down the group [1]
 [3]
- (c) data needed: F-F = 158
 Cl-Cl = 244
 $6 E(\text{Cl-F}) - 328 = 3 \times 158 + 244$
 $E(\text{Cl-F}) = +174 \text{ (kJ mol}^{-1}\text{)}$ [2]
 [2]
- [Total: 7]

Q18.

1 (a) (i) *either* burn or shine light/uv on mixture of $H_2 + Cl_2$ *but* NOT heat [1]

(ii) red/orange/brown colour of bromine decolourises/disappears
steamy/misty/white fumes produced
container gets warm/hot [2]

(iii) $H-H = 436$ $Cl-Cl = 244$ $H-Cl = 431$
 $\Delta H = 436 + 244 - 2(431) = -182 \text{ kJ mol}^{-1}$ [2]

$H-H = 436$ $Br-Br = 193$ $H-Br = 366$
 $\Delta H = 436 + 193 - 2(366) = -103 \text{ kJ mol}^{-1}$ [2]

(iv) H-Br bond is weaker than the H-Cl bond – allow converse. [1]
[8]

(b) (i) light [1]

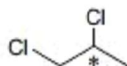
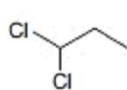
(ii) bonds broken = C-H & I-I = $410 + 151 = 561$
bonds made = C-I & H-I = $240 + 299 = 539$
 $\Delta H = 561 - 539 = +22 \text{ kJ mol}^{-1}$ [2]

(iii) The overall reaction is endothermic or no strong bonds/only weak bonds are formed or high E_{act} [1]
[4]

(c) (i) homolytic fission is the breaking of a bond to form (two) radicals/neutral species/odd-electron species [1]

(ii) $\bullet CH_2Cl$ [1]
the C-Br bond is the weakest or needs least energy to break/breaks most easily [1]
[3]

(d)



4 structures: [2]
2 or 3 structures: [1]

Correct chiral atom identified [1]
[3]

[Total: 18]

Q19.



(b) (down the group) nitrates become **more stable** or require a higher temperature to decompose [1]
as size/radius of (cat)ion increases or charge density of ion decreases [1]
so polarisation/distortion of anion/nitrate decreases [1]
[3]

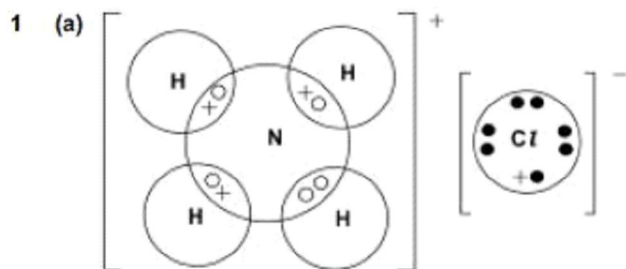


(ii) radius of Li ion/ Li^+ is less than that of Na ion/ Na^+ (or polarising power of M^+ is greater) [1]

(iii) Brown/orange fumes/gas would be evolved or glowing splint relights [1]
Since the nitrate is likely to be thermally unstable or decomposes (just like the carbonate) or the balanced equation: $2\text{LiNO}_3 \longrightarrow \text{Li}_2\text{O} + 2\text{NO}_2 + \frac{1}{2}\text{O}_2$ [1]
[4]

[Total: 8]

Q20.



8 e⁻ around chlorine

1 H-electron (+) on the Cl⁻ ion

3 covalent (ox) and one dative (oo) around N

[1]

[1]

[1]

[3]

(b) (i) it would react (with H₂SO₄)

[1]

(ii) $\text{CaO} + \text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2$

[1]

(iii) CaO absorbs more water or CaO has greater affinity for water

[1]

[3]

(c) (i) $2\text{Ca(NO}_3)_2 \longrightarrow 2\text{CaO} + 4\text{NO}_2 + \text{O}_2$

[1]

(ii) (Down the group, the nitrates)

become more stable/stability increases

[1]

because the size/radius of ion (M²⁺) increases

[1]

thus causing less polarisation/distortion
of the anion/NO₃/N-O bond

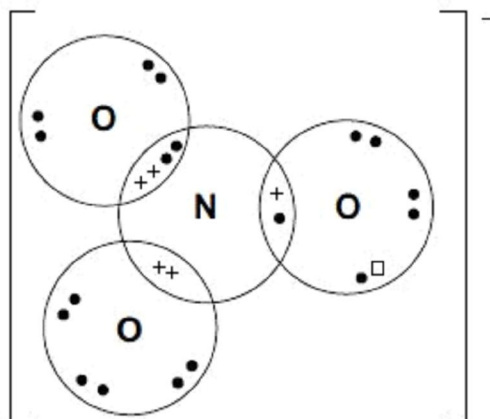
[1]

[4]

[Total: 10]

Q21.

1 (a)



dative bond to an oxygen using two N electrons
 8 electrons around N in 1 double + 2 single bonds
 a total of 24 electrons, including one, and *only* one "□"
 (the extra electron, "□", can be in a bond or a lone pair)

[1]

[1]

[1]

[3]



[1]

(ii) (down the group)

nitrate becomes more stable *or* are more difficult to decompose *or* need a higher temperature to decompose

[1]

because there is less polarisation of the anion/nitrate ion/N-O bonds

[1]

as radius of M^{2+} / metal ion increases *or* charge density of the cation decreases

[1]

[4]



species [1]

balancing [1]

[2]

[Total: 9]

