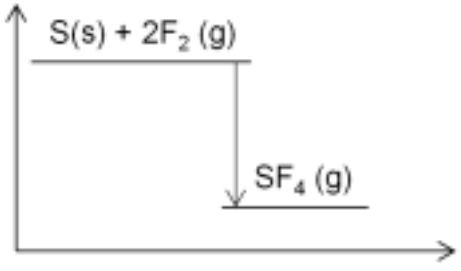
Question	Answer	Marks
1(a)	number of moles of $NaNO_3$ used: 3.40 / 85 = 0.04(00) (mol) **OR** 4.(00) × 10^{-2} (mol); number of moles of O_2 formed: 0.04 / 2 = 0.02(00) (mol) **OR** 2.(00) × 10^{-2} (mol); volume of O_2 formed: 0.02 × 24 = 0.48 (dm^3);	**3**
(b)(i)	(a substance which is) a proton / H^+ / hydrogen ion acceptor;	**1**
(b)(ii)	$Mg(s) + 2H_2O(l) \rightarrow Mg(OH)_2(aq) + H_2(g)$ $Mg(OH)_2$; rest of equation;	**2**
(c)	**M1** add a *named* acid, e.g. HC*l* **and** a named alkali, e.g. NaOH; **M2** Al_2O_3 will react with / neutralises both reagents; **M3** and so it will dissolve into the reagent / form a solution;	**3** 1 1 1
(d)(i)	cov	**1**
(d)(ii)	any 2 from: high melting point / high boiling point; poor conductor (of electricity); hard; insoluble;	**2**
(e)(i)	**M1** (electrostatic) attraction; **M2** between oppositely charged ions;	**2** 1 1
(e)(ii)	$_3(PO_4)_2$;	**1**

Question	Answer	Marks
(f)(i)	 **M1** *exothermic mark*: horizontal product energy line at lower energy than that of reactant energy line; **M2** *label of product mark*: SF_4; **M3** *correct direction of vertical heat of reaction arrow*: arrow must start level with reactant energy and finish level with product energy **and** must have only **one** (correct) arrow-head;	**3** 1 1 1
(f)(ii)	**M1** *bond energy of $2F_2$*: 2 × F–F = 2 × 160 = 320 (kJ/mol); **M2** *bond energy of all bonds in SF_4*: 780 + 320 = 1100 (kJ/mol); **M3** *calculated bond energy of SF_4 divided by 4*: 1100/4 = 275 (kJ/mol);	**3** 1 1 1
(g)(i)	bacteria;	**1**
(g)(ii)	name of compound: cobalt(II) chloride; from: blue; to: pink;	**3** 1 1 1
h)(i)	it has a complete outer shell/a full outer shell/8 electrons in the outer shell;	**1**
(h)(ii)	lamps;	**1**

Question	Answer	Marks
2(a)(i)	a reaction whose rate is influenced by light / reaction which occurs in presence of light;	**1**
(a)(ii)	$CH_3CHClCH_3$;	**1**
(a)(iii)	(both have) same molecular formula; different structural formula or structure;	**2**
(b)	**M1** bonds breaking = (8 × 412) + (2 × 348) + 242 = 4234; **M2** bonds forming = (7 × 412) + (2 × 348) + 338 + 431 = 4349; **M3** 4234 – 4349 = –115 **and** exothermic;	**3**
(c)(i)	$CH_3CH_2CH_2Cl + NaOH \rightarrow CH_3CH_2CH_2Cl + NaCl$ $NaCl$ as product; rest of equation;	**2**
(c)(ii)	p $CH_2=CHCH_3$;	**2**
(c)(iii)	p acid;	**1**
(d)(i)		**1**
4(d)ii)		**1**
(d)(iii)	moles of $CH_3CH_2CH_2OH$ = 0.1; moles of HCOOH = 0.087 (0.09) **and** limiting reagent is methanoic acid;	**2**
(d)(iv)	88 × (mol of limiting reagent in **4(d)(iii)**); expected answer: 88 × 0.087 = 7.65 g;	**1**

3 **(a** faster reaction rate (1)
higher collision rate (1)
greater yield **or** favour RHS (1)
pressure favours products because it has lower volume / fewer product molecules (1) [4]

(b) higher temperature favour endothermic reaction (1)
this is the back reaction / left hand side / reactants (1)
reduce yield (1) [3]

(c) greater surface area (1) [1]

(ii) increase reaction rate (1)
can use a lower temperature to have an economic rate (1)
and not decrease yield (by increasing temperature). [2]

(d) lower the temperature (1)
only ammonia will liquefy (1)
OR
add water (1)
only ammonia will dissolve (1)
OR
increase pressure (1)
only ammonia will liquefy (1) [2]

(e) second line $+3 \times 155 = +465$
third line $-3 \times 280 = (-)840$
fourth line $-3 \times 565 = (-)1695$
all **three** correct (2)
two correct (1)

$1170 + 465 = 1635$
$840 + 1695 = 2535$
both numerically correct (1)
exothermic reaction with some reasoning (1) [4]

[Total: 16]

4 **(a) (i)** any Group 1 metal [1]
ACCEPT: lithium

(ii) $2Pb(NO_3)_2 \rightarrow 2\mathbf{PbO} + 4NO_2 + O_2$ [2]
PbO [1]
COND balancing [1]

(iii) the metal in **a (i)** is **more reactive** than lead [1]
more reactive metals have **more stable** compounds
OR has stronger (ionic) bonding [1]

(b) (i) speed / rate of forward reaction = speed / rate of back reaction [1]
OR macroscopic properties do not change / constant (with time)

(ii) goes darker **OR** goes brown [1]
COND lower pressure favours side with more moles [1]
COND this is NO_2 side **OR** reactant side **OR** goes left [1]

(iii) exothermic [1]

low temperatures favour the exothermic reaction **or**
low temperatures moves equilibrium to right / product side / towards N_2O_4 [1]

(iv) forward reaction is bond forming [1]