01. 0620_s21_ms_42 Q: 5

Question	Answer	Marks
(a)(i)	$6Li + N_2 \rightarrow 2Li_3N$ N_2 as reactant (1) rest of equation (1)	2
(a)(ii)	new octet of 8 electrons consisting of 5 crosses and 3 dots in second shell (1) charge of 3– (1)	2

Question	Answer	Marks
(b)(i)	bonds broken [945 + (3 × 160)] = 1425 (1) bonds formed (2 × 3 × 300) = 1800 (1) energy change = M1 – M2 = 1425 – 1800 = –375 (1)	3
(b)(ii)	*Answer must reflect answer in **5(b)(i)*** exothermic **and** more energy released (in bond formation) than used/taken in (in bond breaking)	1
(b)(iii)	N with 1 bonding pair with each F (1) 2 non-bonding dots for N (1) 6 non-bonding crosses for F (1)	3
(c)	ionic bonds in Li_3N (1) attraction between molecules in NF_3 (1) weaker attraction (between particles) in NF_3 ORA (1)	3
(d)(i)	rfm of NH_4NO_3 = 80 (1) mass of N = 2 × 14 = 28 and percentage N = 100 × 28 / 80 = 35% (1)	2
(d)(ii)	fertiliser	1
(d)(iii)	calcium hydroxide	1
(e)(i)	proton acceptor	1
(e)(ii)	$7 < x \leqslant 11$	1

02. 0620_w21_ms_42 Q: 2

Question	Answer	Marks
(a)(i)	strong	1
(a)(ii)	$2H^+ + SO_4^{2-}$ H^+ (1) correct equation (1)	2
(a)(iii)	pink / red	1
(b)(i)	$ZnCO_3$**(s)** + $2HNO_3$**(aq)** → $Zn(NO_3)_2$**(aq)** + H_2O**(l)** + CO_2**(g)** reactant states (1) product states (1)	2
(b)(ii)	M1 125 M2 2.5 / 125 = 0.02(00) M3 0.02(00) × 2 = 0.04(00) M4 0.04(00) × 1000 / 20 = 2(.00)	4

03. 0620_s20_ms_41 Q: 4

(a)	(damp) litmus	1
	(turns) blue	1
(b)(i)	proton acceptor	1
(b)(ii)	Above pH 7 up to 11	1
(b)(iii)	blue precipitate	1
	precipitate dissolves	1
	deep blue solution remains	1
(c)(i)	neutralisation	1
(c)(ii)	Na_2SO_4	1
	$2H_2O$	1
(d)(i)	methyl orange	1
(d)(ii)	M1 mol of NaOH $= 0.0400 \times \frac{25.0}{1000} = 0.001(00)$ mol M2 mol of $H_2SO_4 = \frac{M1}{2} = \frac{0.001}{2} = 0.0005(00)$ M3 M2 $\times \frac{1000}{20.0} = 0.0005 \times \frac{1000}{20.0} = 0.025$ (mol / dm^3) allow ecf	3
(d)(iii)	M1 use of 40 g/mol M2 $40 \times 0.04 = 1.6$ (g/dm^3)	2

04. 0620_s19_ms_42 Q: 3

(a)(i)	covalent	**1**
(a)(ii)	forces of attraction between molecules **AND** are weak / need a small amount of energy to break	**1**
(a)(iii)	no **moving** or **flowing** or **mobile charged particles** or **ions** or **electrons**	**1**
(b)(i)	$P_4 + 5O_2 \rightarrow P_4O_{10}$ **M1** all formulae correct (1) **M2** equation correctly balanced (1)	**2**
(b)(ii)	redox / combustion	**1**
(c)	$P_4O_{10} + 12NaOH \rightarrow 4Na_3PO_4 + 6H_2O$ **M1** Na_3PO_4 (1) **M2** equation completely correct (1)	**2**
(d)	**M1** 3 pairs of bonding electrons (1) **M2 only** 1 lone pair on P (1)	**2**
(e)(i)	proton / H^+ / hydrogen ion acceptor	**1**
(e)(ii)	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ **M1** $(NH_4)_2SO_4$ (1) **M2** equation completely correct (1)	**2**

05. 0620_s16_ms_43 Q: 5

(a)	carbon dioxide / a gas is made;	**1**
(b)(i)	red;	**1**
(b)(ii)	0.001;	**1**
(b)(iii)	0.0005;	**1**
(b)(iv)	0.031 (2 marks) **M1 (iii)** / 0.0162;	**2**
(c)	0.48 (dm^3) **M1** moles carbon dioxide = 0.02; **M2** volume carbon dioxide = 0.02 × 24; **M3** = 0.48 (dm^3);	**3** 1 1 1

06. 0620_w14_ms_31 Q: 1

(a) Match the following pH values to the solutions given below.

1 3 7 10 13
The solutions all have the same concentration.

solution	**pH**
aqueous ammonia, weak base	10
dilute hydrochloric acid, a strong acid	1
aqueous sodium hydroxide, a strong base	13
aqueous sodium chloride, a salt	7
dilute ethanoic acid, a weak acid	3

[5]

(b) Hydrochloric acid strong acid **or** ethanoic acid weak acid [1]
OR: hydrochloric acid completely ionised **or** ethanoic acid partially ionised
hydrochloric acid greater concentration of/more H^+ ions (than ethanoic acid) [1]

(c) Rate of reaction with Ca, Mg, Zn, Fe [1]

Strong (hydrochloric) acid bubbles faster **or** more bubbles **or** dissolves faster [1]

OR: rate of reaction with (metal) carbonate [1]
strong (hydrochloric) acid faster **or** more bubbles **or** dissolves faster (only if carbonate insoluble) [1]

OR: electrical conductivity [1]
strong (hydrochloric) acid better conductor [1]

[Total: 9]

07. 0620_w13_ms_31 Q: 6

(a) (i) (attractive force between) positive ions [1]
and (negative) electrons [1]
opposite charges attract ONLY [1]
electrostatic attraction ONLY [1]

(ii) lattice / rows / layers of lead ions / cations / positive ions [1]
NOT: atoms / protons / nuclei
can slide past each other / the bonds are non-directional [1]

(b) (i) anhydrous cobalt chloride becomes hydrated [1]
ACCEPT: hydrous

(ii) carbon dioxide is acidic [1]
sodium hydroxide and calcium oxide are bases / alkalis [1]

(iii) Any two of:
water, calcium carbonate and sodium carbonate [2]
ACCEPT: sodium bicarbonate

(c) number of moles of CO_2 formed = 2.112 / 44 = 0.048 [1]
number of moles of H_2O formed = 0.432 / 18 = 0.024 [1]

x = 2 and y = 1 **NOT:** ecf from this line

formula is $2PbCO_3.Pb(OH)_2$ / $Pb(OH)_2.2PbCO_3$ [1]

[Total:12]