Question	Answer	Marks	Guidance
1(a)(i)	proton acceptor; M2 does not accept (protons) readily **OR** less able to accept protons (than strong bases);	 **2**	**A** alternative words to 'acceptor' e.g. 'receiver' **I** references to pH **A** 'hydrogen ion' or 'H^+' for proton **I** accepts fewer / less protons
(a)(ii)	M1 same <u>concentration</u> of both bases; M2 measure their pH; M3 the higher pH is the stronger base;	 **3**	 **A** suitable method e.g. universal indicator or pH paper or pH meter **I** litmus or methyl orange or phenolphthalein **I** titration methods for M2 and M3 **A** suitable colours of both weak strong bases e.g. ethylamine is (greeny)blue, NaOH is dark**er** blue / purple **A** alternative methods for M2 and M3 e.g. measure conductivity (M2) and high conductivity is the stronger base (M3) e.g.add aluminium / Al (M2) and stronger base gives faster rate of effervescence / more fizzing / more bubbling (M3)
(b)(i)	$_3CH_2NH_2 + H_2SO_4 \rightarrow (CH_3CH_2NH_3)_2SO_4$ species; balancing; the salt is ethylammonium sulfate;	 **3**	**A** multiples **I** state symbols **A** one mark for correct product **A** close spellings **A** diethylammonium sulfate

Question	Answer	Marks	Guidance
(b)(ii)	sodium hydroxide / calcium hydroxide / NaOH / $Ca(OH)_2$;	**1**	any Group 1 or Group 2 hydroxide or oxide
(c)(i)	*Any **two** from:* (particles move in) random motion; (particles) collide; (particles) move from a region of high concentration to low concentration;	**2**	 **A** alternative phrases for collide **A** down a concentration gradient
6(c)(ii)	M2 it has a lower (relative) molecular mass (than HBr); M3 ethylamine diffuses faster (than HBr);	**3**	**A** ethylamine is less dense **A** ethylamine is a lighter molecule but **I** 'ethylamine is lighter' **I** ethylamine is a smaller molecule **A** ethylamine **molecules** or **particles** move faster **A** ECF for M2 and M3 if A is given e.g. HBr diffuses faster for M3 because it is a lighter molecule for M2 **A** ECF for M2 if B is given e.g. they diffuse at same rate for M3 because molecules weigh the same for M2

2 (a) (i) two atoms per molecule [1]

(ii) 7e in outer shell or level / same number of outer electrons / need to gain one electron [1]

(iii) different number of energy levels / different number of electrons [1]

(iv)

halogen	solid, liquid or gas at room temperature	colour
chlorine	gas	yellow / yellow green / green
bromine	liquid	brown / red-brown / orange-brown not: red / orange
iodine	solid	black / grey / silver-grey / purple / violet **NOT**: blue-black

NOTE: one mark for each vertical column [2]

(b) correct formula, AsF_3 [1]
3nbps and 1bp around all 3 fluorine atoms [1]
3bps and 1nbp around arsenic atom [1]

(c) (increased) light increases / causes forward reaction / light causes AgCl reacts with CuCl [1]
(increased) light increases the amount of silver (and so darkens glass) [1]
decrease in light reverses reaction / uses up silver / silver reacts (and so reduces darkness) [1]

[Total: 11]

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3 **(a) (i)** photosynthesis or a photochemical reaction [1]
not an example, question requires a process
not devices which convert light into electricity

(ii) cell [1]
accept battery
not generator

(b) (i) correct formula [1]

cond following marks conditional on correct formula
If covalent mark 1 only
correct charges [1]
6x and 2o around anion [1]
do **NOT** penalise for incorrect coding
ignore electrons around potassium

(ii) correct formula [1]

If ionic mark 1 only
cond
2 bp and 2 nbp around selenium [1]
1 bp and 3 nbp around both chlorine atoms [1]

(iii) the ionic compound
higher melting point / boiling point / less volatile
conducts when molten or aqueous, covalent compound does not
is soluble in water, covalent is not / ionic insoluble in organic solvents, covalent soluble in organic solvents
harder
any **two** [2]
note there has to be comparison between the ionic compound and the covalent compound
not density

(c) base [1]
not alkali
accepts a proton [2]
accepts hydrogen ion / H^+ **only** [1]
proton and H^+ [2]

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4 **(a** 3 bp and 1nbp around phosphorus [1]
1 bp and 3nbp around each chlorine [1]

(b) (i) $PCl_3 + 3H_2O \rightarrow 3HCl + H_3PO_3$ [1]

(ii) acid solutions same concentration [1]
measure pH/pH paper/Universal indicator [1]
hydrochloric acid lower pH [1]

colours of Universal indicator can be given as red<orange<yellow
ignore precise pH values as long as HCl is lower than H_3PO_3

OR Acid solutions same concentration [1]
add magnesium or any named metal above Hydrogen in reactivity series but not above magnesium
calcium carbonate or any insoluble carbonate [1]
hydrochloric acid react faster/shorter time [1]

OR acid solutions same concentration [1]
measure electrical conductivity [1]
hydrochloric acid better conductor/bulb brighter [1]

OR acid solutions same concentration [1]
add sodium thiosulphate [1]
hydrochloric acid forms precipitate faster/less time [1]

(iii) sodium hydroxide/sodium carbonate [1]
titration **cond** on correct reagent [1]
second mark scores for mention of titration /burette/pipette/indicator.
experimental detail not required

any named soluble calcium salt e.g. calcium chloride/nitrate/hydroxide [1]

precipitation/filter/decant/centrifuge

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5 **(a)(i)** boiling **[1]**

(ii) lower temperature **or**
over temperature range or no plateau **[1]**

(iii) direct continuation of E to F **[1]**

(iv) close **or** touching far apart **[2]**
fast and random **[1]**
cannot move apart can move apart **[2]**

(b)(i) calcium ethanoate + hydrogen **[1]**

(ii) zinc oxide **or** hydroxide **[1]**

(c) $CH_3COOH + NaOH \rightleftharpoons CH_3COONa + H_2O$ **[2]**
reactants **[1]** products **[1]**

TOTAL = 12

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