<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Marks</th>
<th>Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)(i)</td>
<td>proton acceptor; M2 does not accept (protons) readily <strong>OR</strong> less able to accept protons (than strong bases);</td>
<td>2</td>
<td>A alternative words to ‘acceptor’ e.g. ‘receiver’ I references to pH I ‘hydrogen ion’ or ‘H$^+$’ for proton I accepts fewer/less protons</td>
</tr>
<tr>
<td>(a)(ii)</td>
<td>M1 same <strong>concentration</strong> of both bases; M2 measure their pH; M3 the higher pH is the stronger base;</td>
<td>3</td>
<td>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 I suitable colours of both weak strong bases e.g. ethylamine is (greeny)blue, NaOH is darker 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)</td>
</tr>
<tr>
<td>(b)(i)</td>
<td>$\text{CH}_3\text{CH}_2\text{NH}_2 + \text{H}_2\text{SO}_4 \rightarrow (\text{CH}_3\text{CH}_2\text{NH}_3)_2\text{SO}_4$ species; balancing; the salt is ethylammonium sulfate;</td>
<td>3</td>
<td>A multiples I state symbols A one mark for correct product A diethylammonium sulfate</td>
</tr>
<tr>
<td>Question</td>
<td>Answer</td>
<td>Marks</td>
<td>Guidance</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>(b)(ii)</td>
<td>sodium hydroxide / calcium hydroxide / NaOH / Ca(OH)₂;</td>
<td>1</td>
<td>any Group 1 or Group 2 hydroxide or oxide</td>
</tr>
</tbody>
</table>
| (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

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

(iii) different number of energy levels / different number of electrons

(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

(b) correct formula, AsF$_3$

3 nbps and 1 bp around all 3 fluorine atoms

3 bps and 1 nbp around arsenic atom

(c) (increased) light increases / causes forward reaction / light causes AgCl reacts with CuCl

(increased) light increases the amount of silver (and so darkens glass)

decrease in light reverses reaction / uses up silver / silver reacts (and so reduces darkness)

[Total: 11]
3. (a) (i) photosynthesis or a photochemical reaction
   not an example, question requires a process
   not devices which convert light into electricity

   (ii) cell
       accept battery
       not generator

(b) (i) correct formula

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

   (ii) correct formula

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

   (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
       note there has to be comparison between the ionic compound and the covalent compound
       not density

(c) base
   not alkali
   accepts a proton
   accepts hydrogen ion / H\(^+\) only
   proton and H\(^+\)
4. (a) 3 bp and 1nbp around phosphorus
    1 bp and 3nbp around each chlorine

(b) (i) \[ \text{PCl}_3 + 3\text{H}_2\text{O} \rightarrow 3\text{HCl} + \text{H}_3\text{PO}_3 \]

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

colours of Universal indicator can be given as red<orange<yellow
ignore precise pH values as long as HCl is lower than H$_3$PO$_3$

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

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

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

(iii) sodium hydroxide/sodium carbonate
    titration **cond on correct reagent**
    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
preparation/filter/decant/centrifuge
5 (a)(i) boiling

(ii) lower temperature or over temperature range or no plateau

(iii) direct continuation of E to F

(iv) close or touching far apart
     cannot move apart can move apart

(b)(i) calcium ethanoate + hydrogen

(ii) zinc oxide or hydroxide

(c) \[ \text{CH}_3\text{COOH} + \text{NaOH} \rightleftharpoons \text{CH}_3\text{COONa} + \text{H}_2\text{O} \]
reactants [1] products [1]

TOTAL = 12