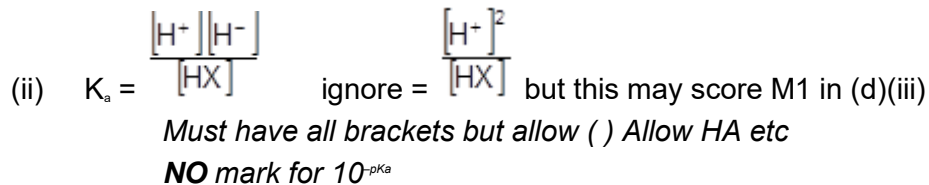


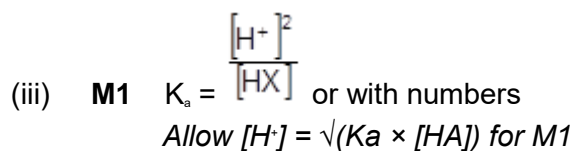
- M1.(a)** Proton donor or H<sup>+</sup> donor  
*Allow donator* 1
- (b) (i) B B  
*Both need to be correct to score the mark* 1
- (ii) A A  
*Both need to be correct to score the mark* 1
- (iii) B A  
*Both need to be correct to score the mark* 1
- (c) **M1** [H<sup>+</sup>] = 10<sup>-1.25</sup> OR 0.05623 1
- M2** mol HCl = (25 × 10<sup>-3</sup>) × 0.0850 (= 2.125 × 10<sup>-3</sup>)  
*Mark for Working* 1
- M3** vol  $\left( = \frac{2.125 \times 10^{-3}}{0.05623} \right) = 0.0378 \text{ dm}^3 \text{ or } 37.8 \text{ cm}^3$   
allow 0.0375 – 0.038 dm<sup>3</sup> or 37.5 – 38 cm<sup>3</sup>  
*Units and answer tied*  
*Lose M3 if total given as (25 + 37.8) = 62.8 cm<sup>3</sup>*  
*Ignore “vol added = 12.8 cm<sup>3</sup>” after correct answer* 1
- (d) (i) 4.52

Must be 2dp

1



1



1

**M2**  $[H^+] = (\sqrt{3.01 \times 10^{-5} \times 0.174}) = \sqrt{5.24 \times 10^{-6}}$   
 $= 2.29 \times 10^{-3} - 2.3 \times 10^{-3}$   
*Mark for answer*

1

**M3** pH = 2.64 (allow more than 2dp but not fewer)  
**Allow 1 for correct pH from their wrong  $[H^+]$**   
*If square root forgotten, pH = 5.28 scores 2 for M1 and M3*

1

(e) **M1** mol OH<sup>-</sup> =  $(10.0 \times 10^{-3}) \times 0.125 = 1.25 \times 10^{-3}$   
*Mark for answer*

1

**M2** orig mol HX =  $(15.0 \times 10^{-3}) \times 0.174 = 2.61 \times 10^{-3}$   
*Mark for answer*

1

**M3** mol HX in buffer = orig mol HX – mol OH<sup>-</sup>  
*Mark for answer*  
 $= 2.61 \times 10^{-3} - 1.25 \times 10^{-3} = 1.36 \times 10^{-3}$

Allow conseq on their (M2 – M1)

$$([\text{HX}] = 1.36 \times 10^{-3} / 25 \times 10^{-3} = 0.0544)$$

If no subtraction, max 3 for M1, M2 & M4 (pH = 4.20)

If  $[\text{H}^+] = [\text{X}^-]$  &  $\sqrt{\quad}$  used, max 3 for M1, M2 & M3 (pH = 2.89)

1

**M4** mol  $\text{X}^-$  in buffer = mol  $\text{OH}^-$  =  $1.25 \times 10^{-3}$

$$([\text{X}^-] = 1.25 \times 10^{-3} / 25 \times 10^{-3} = 0.05)$$

May be scored in M5 expression

1

**M5**  $[\text{H}^+] = \frac{K_a \times [\text{HX}]}{[\text{X}^-]}$

If use  $K_a = \frac{[\text{H}^+]^2}{[\text{HX}]}$  no further marks

$$= \frac{3.01 \times 10^{-5} \times 1.36 \times 10^{-3}}{1.25 \times 10^{-3}} \quad \text{OR} \quad \frac{3.01 \times 10^{-5} \times 0.0544}{0.05}$$

$$(= 3.27 \times 10^{-5})$$

If either value of HX or  $\text{X}^-$  used wrongly or expression upside down, no further marks

1

**M6** pH = 4.48 or 4.49 (allow more than 2dp but not fewer)

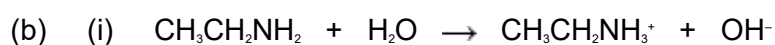
Do **not** allow M6 for correct calculation of pH using their  $[\text{H}^+]$   
- this only applies in (d)(iii) - apart from earlier AE

1

[18]

**M2.(a)** Proton acceptor

1



allow eq with or without  $\rightleftharpoons$   
allow  $C_2H_5NH_2$  and  $C_2H_5NH_3^+$  (plus can be on N or H or 3)  
allow RHS as  $C_2H_5NH_3OH$

1

(ii) Mark independently of (b)(i)

Allow

Ethylamine is only partly/slightly dissociated

OR

Ethylamine is only partly/slightly ionized

reaction/equilibrium lies to left or low  $[OH^-]$  **OR** little  $OH^-$  formed

**OR** little ethylamine has reacted

Ignore "not fully dissociated" or "not fully ionized"

Ignore reference to ionisation or dissociation of water

1

(c) **M1** Ethylamine

If wrong no marks in (c)

1

**M2** alkyl group is electron releasing/donating

**OR** alkyl group has (positive) inductive effect

1

**M3** increases electron density on N(H<sub>2</sub>)

**OR** increased availability of lp

**OR** increases ability of lp (to accept H(+))

Mark M3 is independent of M2

1

(d)  $CH_3CH_2NH_3Cl$

Or any amine hydrochloride

allow name (ethylammonium chloride or ethylamine hydrochloride) or other halide for Cl

or a strong **organic acid**

**NOT**  $NH_4Cl$

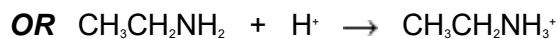
1

(e) Mark independently of (d)

Extra H<sup>+</sup> reacts with ethylamine or OH<sup>-</sup>

*Or makes reference to Equilibrium (in (b)(i)) with amine on LHS*

1

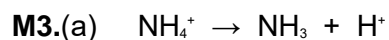


Equilibrium shifts to RHS

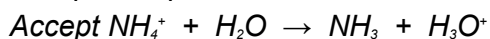
**OR** ratio  $[\text{CH}_3\text{CH}_2\text{NH}_3^+]/[\text{CH}_3\text{CH}_2\text{NH}_2]$  remains almost constant

1

[9]



*Accept multiples.*



*Ignore state symbols, even if incorrect.*

1

(b) Test indicator / conc HCl

*Do not accept 'smell'.*

*Do not accept precipitation reactions of aqueous ammonia.*

1

Observation colour for an alkali / white fumes

*If wrong test then lose second mark.*

1

[3]

**M4.D**

[1]

M5.C

[1]