Gateways School

**Acids & bases**

**Revision PPQ Answers**

76 marks

**Q1.**

(a)     Any **two** from:

Weigh by difference or rinse weighing bottle and add to beaker

Rinse beaker and add washings to graduated flask

Invert flask several times to ensure uniform solution

Use a funnel to transfer to the flask and rinse the funnel

Use a stirrer to prepare the solution and rinse the stirrer

*If more than two answers apply the list rule.*

**Max 2**

(b)     *K*a = [H+]2 / [HA]

*Allow any correct expression relating Ka, [H+] and [HA]*

**1**

[HA] = (10–2.50)2 / 1.07 × 10–3

*M2 also scores M1*

**1**

= 9.35 × 10–3 (mol dm–3)

*Do not allow 9.4 (answer is 9.346).*

*Correct answer only scores 1 mark.*

*Do not penalise precision but must be to at least two significant figures.*

**1**

(c)     (b) × 138.0 / 4

**1**

= 0.322

*Using 8.50 × 10–3 gives 0.293*

*Correct answer scores M1 and M2.*

*Do not penalise precision but must be to at least two significant figures.*

**1**

(d)     (c) × 100 / 0.500 = 64.5%

*Using 0.293 from (c) gives 58.7%*

*Using 0.347 gives 69.4%*

*Do not penalise precision.*

**1**

**[8]**

**Q2.**

(a)     C

**1**

A

**1**

D

**1**

(b)     (i)      Bromocresol green

*Allow wrong spellings*

**1**

(ii)     Purple to yellow

*Must have both colours:*

*Purple start – yellow finish*

**1**

**[5]**

**Q3.**

(a)     Over time / after storage meter does not give accurate readings

*Do not allow ‘to get an accurate reading’ or ‘reading drifts’ on its own.*

*Allow ‘temperature variations affect readings’.*

**1**

(b)     Any **five** from:

*Ignore references to the use of the pipette, the filling of the burette and the calibration of the pH meter.*

•        Measure pH (of the acid)

•        Add alkali in known small portions

*Allow 1 – 2cm3.*

•        Stir mixture

•        Measure pH (after each addition)

•        Repeat until alkali in excess

*Allow 27 – 50cm3.*

•        Add in smaller increments near endpoint

*Allow 0.1 – 0.5cm3.*

*To score full marks, the sequence must follow a logical order.*

**5 max**

**[6]**

**Q4.**

(a)     Proton donor or H+ 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+] = 10–1.25 OR 0.05623

**1**

**M2**    mol HCl = (25 × 10–3) × 0.0850 (= 2.125 × 10–3)

*Mark for Working*

**1**

**M3**    vol   = 0.0378 dm3 or 37.8 cm3

allow 0.0375 – 0.038 dm3 or 37.5 – 38 cm3

*Units and answer tied*

*Lose M3 if total given as (25 + 37.8) = 62.8 cm3*

*Ignore “vol added = 12.8 cm3 ” after correct answer*

**1**

(d)     (i)      4.52 *Must be 2dp*

**1**

(ii)     Ka =        ignore =  but this may score M1 in (d)(iii)

*Must have all brackets but allow ( ) Allow HA etc*

***NO*** *mark for 10–pKa*

**1**

(iii)     **M1**    Ka =  or with numbers

*Allow [H+] = √(Ka × [HA]) for M1*

**1**

**M2**    [H+] = (√(3.01 ×10–5 × 0.174) = √(5.24 ×10–6) )  
= 2.29 ×10–3 - 2.3 ×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– = (10.0 × 10-3) × 0.125 = 1.25 × 10–3

*Mark for answer*

**1**

**M2**    orig mol HX = (15.0 × 10–3) × 0.174 = 2.61 × 10×3

*Mark for answer*

**1**

**M3**    mol HX in buffer = orig mol HX – mol OH–

*Mark for answer*

= 2.61 × 10–3 – 1.25 × 10–3 = 1.36 × 10–3

*Allow conseq on their (M2 – M1)*

([HX] = 1.36 × 10–3/25 × 10–3 = 0.0544)

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

*If [H+] = [X–] & √used, max 3 for M1, M2 & M3 (pH = 2.89)*

**1**

**M4**    mol X– in buffer = mol OH– = 1.25 × 10–3

([X–] = 1.25 × 10–3/25 × 10–3 = 0.05)

*May be scored in M5 expression*

**1**

**M5**    [H+]   

*If use Ka =  no further marks*

*=    OR *

*(= 3.27 × 10–5)*

*If either value of HX or 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 [H+] - this only applies in (d)(iii) - apart from earlier AE*

**1**

**[18]**

**Q5.**

(a)     (i)      [H+][OH−] ***OR*** [H3O+][OH−]

*Ignore (aq)*

*Must have [ ] not ( )*

**1**

(ii)     3.46 × 10−14 (= 1.86 × 10−7)

*If no square root, CE=0*

**1**

pH = 6.73

***Must be 2dp***

**1**

(iii)    [H+] = 10−11.36 (= 4.365 × 10−12 OR 4.37 × 10−12)

*Mark for working*

**1**

*Kw* = [4.365 × 10−12 ***OR*** 4.37 × 10−12 × 0.047] = 2.05 × 10−13

*Allow 2.05 × 10−13 − 2.1 × 10−13*

*Mark for answer*

*Ignore units*

**1**

(b)     (i)      HCOOH    HCOO− +   H+

*Must have  but ignore brackets.*

***OR***   HCOOH + H2O     HCOO− +   H3O+

*Allow HCO2− or CHOO− ie minus must be on oxygen, so penalise COOH−*

**1**

(ii)      

*Must have all brackets but allow ( )*

*Must be HCOOH etc.*

*Allow ecf in formulae from (b)(i)*

**1**

(iii)    M1



*Allow HA or HX etc.*

*Allow [H+] = (Ka × [HA]) for M1*

**1**

M2    [H+] = 3.16 × 10−3

*Mark for answer*

**1**

M3    pH = 2.50     allow more than 2 dp but not fewer

***Allow correct pH from their wrong*** *[H+]* ***here only*** *If square root shown but not taken, pH = 5.00 can score max 2 for M1 and M3*

**1**

(iv)    M1    Decrease     **Mark M1 independently**

**1**

M2    Eqm shifts / moves to RHS  ***OR*** more H+    ***OR***    *Ka* increases      
***OR*** more dissociation

**1**

M3    To reduce temperature or oppose increase / change in temperature

***Only award M3 following correct M2***

**1**

(c)     (i)      M1    

*If [HX]/[X-] upside down, no marks*

**1**

M2    

         (= 2.27 × 10−4)

**1**

M3    pH = 3.64      allow more than 2 dp but not fewer

***pH calc NOT allowed from their wrong [H+] here***

**1**

(ii)     M1    Mol H+ added = 5.00 × 10−4

*Mark on from AE in moles of HCl (eg 5 × 10−3 gives pH = 3.42 scores 3)*

**1**

M2    Mol HCOOH = 2.40 × 10−2 **and**   Mol HCOO– = 1.79 × 10−2

*If either wrong no further marks except AE (−1) OR if ECF in mol acid and / or mol salt from (c)(i), can score all 4*

**1**

M3    

*If [HX]/[X-] upside down here after correct expression in (c)(i), no further marks*



*If [HX]/[X-] upside down here and is repeat error from (c)(i), max 3 (pH = 3.88 after 3.86 in (c)(i))*

**1**

M4    pH = 3.62      allow more than 2 dp but not fewer

***pH calc NOT allowed from their wrong [H+] here***

**1**

**[20]**

**Q6.**

(a)     (i)      –log[H+]

*Penalise missing [ ] here* ***and not elsewhere***

**1**

(ii)     [H+][OH–]

**1**

(b)     (i)      [H+] = 2.34 × 10–7

**1**

pH = 6.63

*Penalise fewer than 3 sig figs but allow more than 2 dp*

**1**

(ii)     [H+] = [OH–]

**1**

(iii)     **M1**    [H+] = Kw/[OH–]

*if upside down or CE, allow M3 only for correct use of their [H+]*

**1**

**M2**    (= 5.48 × 10–14/0.140) = 3.91 × 10–13

**1**

**M3** pH = 12.4(1)

*not 12.40 (AE from 12.407)*

**1**

*Penalise fewer than 3 sig figs but allow more than 3 sfs  
For values above 10, allow 3sfs - do not insist on 2 dp.  
For values below 1, allow 2dp – do not insist on 3 sig figs*

*Not allow pH = 14 – pOH but can award M3 only for pH = 13.1(46)  
Can award all three marks if pKw = 13.26 is used*

(c)     **M1** mol NaOH = mol OH– = (30 × 10–3) × 0.20 = 6.0 × 10–3

*mark for answer*

**1**

**M2**    mol H2SO4 = (25 × 10–3) × 0.15 = 3.75 × 10–3

*mark for answer*

**1**

**M3**    mol H+ = (25 × 10–3) × 0.15 × 2 = 7.5 ×10–3OR XS mol H2SO4 = 0.75 × 10–3

*if factor of 2 missed or used wrongly, CE - lose M3 and next mark gained. In this case they must then use Kw to score any more.  
see examples below*

**1**

**M4**    XS mol H+ = 1.5 × 10–3

**1**

**M5** [H+] = (1.5 × 10–3) × (1000/55) = 0.0273

*if no use or wrong use of volume, lose M5 and M6 except if 1000 missed  
AE –1 (pH = 4.56)*

**1**

**M6** pH = 1.56

*Penalise fewer than 3 sig figs but allow more than 3 sfs  
For values above 10, allow 3sfs - do not insist on 2 dp.  
For values below 1, allow 2dp – do not insist on 3 sig figs*

**1**

**[14]**

**Q7.**

B

**[1]**

**Q8.**

D

**[1]**

**Q9.**

C

**[1]**

**Q10.**

D

**[1]**

**Q11.**

A

**[1]**