IB Chemistry – SL

Topic 8 Answers

1. B

2. B

3. B

4. D

5. D

6. D

7. D

8. A

9. D

10. D

11. D

12. C

13. D

14. B

15. D

16. D

17. D

18. B

19. B

20. A

21. D

22. A

23. (a) $3Ag^{+}(aq) + XO_4^{3-}(aq) \rightarrow Ag_3XO_4(s)$;
states; 2

[1] *for balanced equation and* ***[1]*** *for states.*

(b) (i) $n_{Ag^+} = cV = 0.2040 \text{ mol dm}^{-3} \times 0.04118 \text{ dm}^3$
$= 0.008401/8.401\times10^{-3} \text{ mol}$ (*–1 SF*) 1

Ignore units even if wrong, do not award mark unless 4 sig fig.

(ii) $n_{Ag_3XO_4} = \frac{1}{3} n_{Ag^+} = \frac{1}{3} \times 0.008401 \text{ mol}$

= 0.002800/2.800×10^{-3} mol 1

ECF from (a) and (b)(i)

(iii) 0.002800 mol weighs 1.172 g

1 mol weighs $\frac{1.172\text{g}}{0.002800\,\text{mol}}$ = 418.6 g mol^{-1} 2

418.6;
Accept answer in range 418 to 419.
No penalty for too many sig figs.
ECF from (b) (ii)
g mol^{-1}
Do not accept g.

(iv) (3×107.87) + *x* + 4 (16.0) = 418.6
therefore, *x* = 30.99 *(accept 31.0/31)*;
P/phosphorous; 2

[8]

24. (a) (i) 0.0010 / 1.0×10^{-3} (mol dm^{-3});

pH = 3; 2

(ii) HCl: strong acid/fully dissociated;
CH_3COOH : weak acid/partially dissociated;
HCl less concentrated/CH_3COOH more concentrated;
only one molecule in 100 dissociates in ethanoic acid so $[H^+]$
1/100/*OWTTE* 3

(b) measure electrical conductivity;
strong acids are good conductors/weak acids are poor conductors;

OR

react with magnesium or a named active metal/(metal) carbonate;
hydrogen carbonate/bicarbonate;
strong acids have a faster reaction/more gas bubbles (per unit time) /more heat produced/weak acids have a slower reaction/less gas bubbles (per unit time)/less heat produced; 2

titration curves: namely strong acid and strong base will have an equivalence point pH of 7 and a weak acid and strong base will have an equivalence point pH of >7.
OR
temperature change: on neutralization for temperature change: namely, neutralization ($H^+ + OH^-$) is exothermic, weak acid is partially dissociated so some energy used up in dissociation of weak acid – net result, weak acid would produce less energy/less temperature increase compared to neutralization of strong acid.

[7]

25. strong acid completely dissociated/ionized;

weak acid only partially dissociated/ionized;

$HCl(aq) \rightarrow H^+(aq) + Cl^+(aq)$;
$CH_3COOH(aq) \rightleftharpoons CH_3COO^-(aq) + H^+(aq)$; 4

Insist on both arrows as shown, state symbols not needed.
Also accept $H_2O(1)$ *and* $H_3O^+(aq)$ *in equations*

[4]

26. (i) bubbling/effervescence/dissolving of $CaCO_3$/gas given off (*do not accept* CO_2 *produced*);
more vigorous reaction with HCl/*OWTTE*; 2

(ii) $2HCl(aq) + CaCO_3(s) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(1)$; 2

[1] *for correct formulas,* ***[1]*** *for balanced, state symbols not essential.*

(iii) amount of $CaCO_3 = \frac{1.25}{100.09}$ (*no penalty for use of 100*);
amount of HCl = 2×0.0125 = 0.0250 mol (*allow ECF*);
volume of HCl = 0.0167 dm^3/16.7 cm^3 (*allow ECF*); 3

(iv) 1:1 ratio of $CaCO_3$ to CO_2 /use 0.0125 moles CO_2 (*allow ECF*);
(0.0125×22.4) = 0.28 dm^3/280 cm^3/2.8×10^{-4} m^3 (*allow ECF*); 1

Accept calculation using pV=nRT.

[9]

27. (i) X; 1

(ii) greater in Y/smaller in Z;
by a factor of 10; 2

(iii) Y > Z > X;
most ions/greatest concentration of ions in Y/*OWTTE*; 2

[5]

28. *Brønsted-Lowry acid*
proton donor/*OWTTE*;
CH_3COOH and H_3O^+;

Lewis base
electron pair donor/*OWTTE*;
H_2O and CH_3COO^-; 4

[4]

29. $HCl/H_2SO_4/HNO_3$/any strong acid;
CH_3COOH/H_2CO_3/any weak acid;
Measure pH – the strong acid has the lower pH;

Accept universal indicator and two correct colours.

Measure (electrical) conductivity – this is greater for the stronger acid;
Add magnesium/carbonate – more gas bubbles with the stronger acid/Mg or carbonate would disappear faster with stronger acid;

[5]

30. vinegar and factor of 10^5;

[1]

31. *Brønsted-Lowry acid*
a proton donor;

Lewis acid
electron pair acceptor;

Brønsted-Lowry acid
Any suitable equation;

Lewis acid – BF_3/$AlCl_3$/transition metal ions that form complex ion with ligands;

For example
$BF_3 + NH_3 \rightarrow BF_3NH_3$/$Cu^{2+} + 4NH_3 \rightarrow [Cu(NH_3)_4]^{2+}$/$AlCl_3 + Cl^- \rightarrow AlCl_4^-$; 5

Or any suitable equation.

[5]

32. (i) HCl/X is strong and CH_3COOH/Z is weak;
HCl/X is fully dissociated and CH_3COOH is slightly dissociated;
$[H^+]$ is greater in HCl/X than in CH_3COOH/Z; 2

*Any two for **[1]** each.*

(ii) a factor of 100; 1

[3]

33. conductivity;
nitric acid will contain more ions and have a higher conductivity/ethanoic acid will have fewer ions and have a lower conductivity;

rate of reaction with metal/carbonate/hydrogencarbonate;
nitric acid will react more rapidly/produce bubbles faster/ethanoic acid will react less rapidly/produce bubbles more slowly;

reaction with alkali;
temperature change will be less for ethanoic acid; 4

Accept any two methods and explanations from above.

[4]

34. (a) an acid that partially dissociates/ionizes/doesn't fully dissociate/ionize; 1

(b) conductivity - propanoic acid will be lower because lower ion concentration /less dissociated;
reaction with metal/metal carbonate/metal hydrogencarbonate - propanoic acid will react slower/less vigorously because lower $[H^+]$/less dissociated;
reaction with alkali - temperature change will be less for propanoic acid because lower $[H^+]$/less dissociated; 2

*Award **[1]** mark each for two.*

[3]

35. $CH_3CH_2COOH + H_2O \rightleftharpoons CH_3CH_2COO^- + H_3O^+ / CH_3CH_2COOH \rightleftharpoons CH_3CH_2COO^- + H^+$;

$\rightleftharpoons$ required for mark.

CH_3CH_2COOH and $CH_3CH_2COO^-/H_3O^+$ and H_2O; 2

[2]