

**MARKING SCHEME**

TABLE I

	I	II	III
Final burette reading (cm <sup>3</sup> )	25.0	25.0	35.0
Initial burette reading (cm <sup>3</sup> )	0.0	0.0	10.0
Volume of solution A used (cm <sup>3</sup> )	25.0	25.0	25.0

Complete table ( converted )  $\sqrt{1}$

Correct arithmetic  $\sqrt{1}$

Decimal place  $\sqrt{1}$

Consistency  $\sqrt{1}$

Accuracy  $\sqrt{1}$

5m

(ii) Average volume of solution A used

$$\frac{25.0 + 25.0 + 25.0}{3} \sqrt{\frac{1}{2}} = 25.0\text{cm}^3 \sqrt{\frac{1}{2}}$$

(b) (i) Moles of HCl used =  $0.1 \times \frac{25}{1000}$   
 $= 0.0025 \text{ mol } \sqrt{\frac{1}{2}}$

Moles ratio of acid :  $\text{B}_2\text{X} \cdot 10\text{H}_2\text{O} = 2 : 1 \sqrt{\frac{1}{2}}$

$\therefore$  Moles of  $\text{B}_2\text{X} \cdot 10\text{H}_2\text{O}$  used =  $\frac{1}{2} \times 0.0025 \sqrt{\frac{1}{2}}$   
 $= 0.00125 \text{ mol } \sqrt{\frac{1}{2}}$

(ii)  $25\text{cm}^3$  of  $\text{B}_2\text{X} \cdot 10\text{H}_2\text{O}$  contains  $0.00125 \text{ mol}$   
 $1000\text{cm}^3$  of  $\text{B}_2\text{X} \cdot 10\text{H}_2\text{O}$  contains  $\frac{1000}{25} \times 0.00125 \sqrt{1}$   
 $= 0.05\text{M} \sqrt{1}$

Penalise  $\frac{1}{2}$  m for missing or wrong units

*This paper consists of 4 printed pages*

(iii)  $0.05 \text{ mol}$  of  $\text{B}_2\text{X} \cdot 10\text{H}_2\text{O}$  weighs  $19.1\text{g} \sqrt{\frac{1}{2}}$

$1 \text{ mol}$  of  $\text{B}_2\text{X} \cdot 10\text{H}_2\text{O}$  weighs  $\frac{1}{0.05} \times 19.1 \sqrt{\frac{1}{2}}$

**Turn Over**

$$= 382\text{g}$$

$$\text{R.F.M of } B_2X.10H_2O = 382 \checkmark 1$$

Penalise ½ m if units are used

$$(iv) \quad B_2X.10H_2O = 382 \checkmark \frac{1}{2}$$

$$2B + 156 + 180 = 382 \checkmark \frac{1}{2}$$

$$2B = 382 - 336$$

$$2B = 46 \checkmark \frac{1}{2}$$

$$B = 23 \checkmark \frac{1}{2}$$

2. (a) TABLE II

Final temperature ( $^{\circ}\text{C}$ )	
Initial temperature ( $^{\circ}\text{C}$ )	

Complete table  $\checkmark \frac{1}{2}$

Trend and accuracy  $\checkmark \frac{1}{2}$

$$(ii) \quad \Delta T_1 = \text{Final temperature} - \text{initial temperature} = \text{-ve value}$$

$$(b) \quad (i) \quad \Delta H = MC\Delta T$$

$$= \frac{30 \times 4.2 \times \Delta T_1}{1000}$$

$$= \text{+ve value in kJ}$$

Penalize ½ m for missing or wrongly written units

$$(ii) \quad 1 \text{ mol of } H_2C_2O_4.2H_2O = 126\text{g} \checkmark \frac{1}{2}$$

$$\therefore 2\text{g of } H_2C_2O_4.2H_2O = \frac{2 \checkmark \frac{1}{2}}{126} \times 1 \checkmark \frac{1}{2}$$

$$= 0.015873 \text{ mol} \checkmark \frac{1}{2}$$

(iii) 0.015873 mol of acid absorbs kJ in (b) (i) above

$$1 \text{ mol of acid absorbs } 1 \text{ x kJ in b(i)}$$

$$0.015873 \checkmark \frac{1}{2}$$

$$= \text{+ve value in } \text{kJmol}^{-1} \checkmark \frac{1}{2}$$

Penalize the ½ m for answer if units are missing or wrongly written.

2.

**TABLE III**

(c) (i)

Temperature of solution D, $T_1$ ( $^{\circ}\text{C}$ )	
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Temperature of solution E, T <sub>2</sub> (°C)	
Initial temperature T <sub>1</sub> + T <sub>2</sub> (°C)	
2	
Final temperature of mixture (°C)	

Complete table = 1 mark

Trend and accuracy = 1 mark

(ii)  $\Delta T_2 = \text{Final temperature} - \text{initial temperature} = +\text{ve value } ^\circ\text{C} \checkmark 1$

(d) (i) 
$$= \frac{\Delta H = MC\Delta T}{1000} \checkmark 1$$
  

$$= \frac{60 \times 4.2 \times \Delta T_2}{1000}$$
  

$$= -\text{ve value of kJ}$$

Penalize ½ mark if units are missing or wrongly written.

(ii) Moles of oxalic acid in solution D used

$$= \frac{30 \times 0.5}{1000} \checkmark 1/2$$

$$= 0.015 \text{ mol } \checkmark 1/2$$

(iii)  $\Delta H_2$  (Heat of reaction of one mole of oxalic acid with sodium hydroxide )

$$= \frac{1 \checkmark 1/2 \times \text{volume} - \text{d(i) above}}{0.015}$$

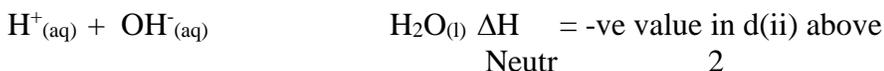
$$= -\text{ve value of kJ. } \checkmark 1/2$$

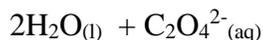
(iv) Oxalic acid H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>·2H<sub>2</sub>O is dibasic

Thus:



Hence





$$\Delta H_3 = \Delta H_1 + \Delta H_2 \quad \checkmark 1$$

$$= \text{-ve value in kJ} \quad \checkmark 1$$

Penalize ½ mark if units are missing or wrongly written.

3.	(a)	OBSERVATIONS	INFERENCEs
	-	Colourless gas evolved with pungent chocking smell $\checkmark \frac{1}{2}$	- Gas evolved in basic $\checkmark \frac{1}{2}$
	-	Gas turns red litmus paper blue $\checkmark \frac{1}{2}$	- $\text{NH}_3$ gas evolved $\checkmark \frac{1}{2}$
	-	Blue litmus paper remains blue $\checkmark \frac{1}{2}$ ( 1 ½ marks )	( 1 mark )
	(b)		
	-	Burns with a golden yellow flame. $\checkmark 1$	$\text{Na}^+$ ions present $\checkmark 1$
		( 1 mark )	( 1 mark )
	(c)		
		Purple acidified $\checkmark \text{KMnO}_4$ decolorised	$\text{SO}_3^{2-}$ ions present $\checkmark \frac{1}{2}$ / presence of a reducing agent $\checkmark 1$
		Rej. Colour disappears	
		Colourless solution formed ( 1 mark )	( 1 ½ marks )
	(d)		
		White precipitate formed $\checkmark \frac{1}{2}$ which dissolves in dilute HCl acid. $\checkmark \frac{1}{2}$	$\text{SO}_3^{2-}$ ions present $\checkmark 1$
		( 1 mark )	( 1 mark )