

## Chemistry Olympiad 2000 Mark Scheme

- Q1**
- i)  $2 \text{Cu}^{2+} + 4\text{I}^- \rightarrow 2 \text{CuI} + \text{I}_2$  (1)
- ii)  $2\text{S}_2\text{O}_3^{2-} + \text{I}_2 \rightarrow 2\text{I}^- + \text{S}_4\text{O}_6^{2-}$  (1)  
(Ignore state symbols)
- iii)  $2\text{H}^+ + \text{CO}_3^{2-} \rightarrow \text{H}_2\text{O} + \text{CO}_2$  (1)  
or  $\text{Na}_2\text{CO}_3 + 2\text{HNO}_3 \rightarrow 2\text{NaNO}_3 + \text{H}_2\text{O} + \text{CO}_2$
- iv) moles of  $\text{Cu}^{2+} = 0.0298$  (1)
- v) 67.5% (1)

**TOTAL 5 MARKS**

- Q2**
- i)  $2\text{NaN}_3$  to  $0.4 \text{KNO}_3$  (1)  
3.22 :1 (or 130 :40.4) by mass (1)
- ii) Either  $60 \text{dm}^3 \text{N}_2 = 2.5 \text{mol}$  (1)  
or use of  $PV = nRT$   
133g (1)  
or 130.5g
- iii) N-N-O both linear (1)  
N-N-N (1)
- iv) Cycle (1)  
 $?H_f (\text{NaN}_3) = + 361.7 \text{KJ mol}^{-1}$  (1)  
 $?H$  for reaction 1 = -723 KJ (1)

**TOTAL 9 MARKS**

- Q3**
- i) 340 moles (1)
- ii) 51 moles (1)
- iii) Black  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$  (1)
- Red  $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$  (1)
- Gold  $\text{H}_2\text{S} + 1\frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{SO}_2$  (1)
- iv) Black none or -8.5 (1)
- Red 153 (Any 2 =1)
- Gold 51 (Any 2 =1)
- v) Black  $-2 \times 10^4$  kJ (1)
- Red  $-8.2 \times 10^4$  kJ (Any 2 =1)
- Gold  $-3.5 \times 10^4$  kJ (Any 2 =1)

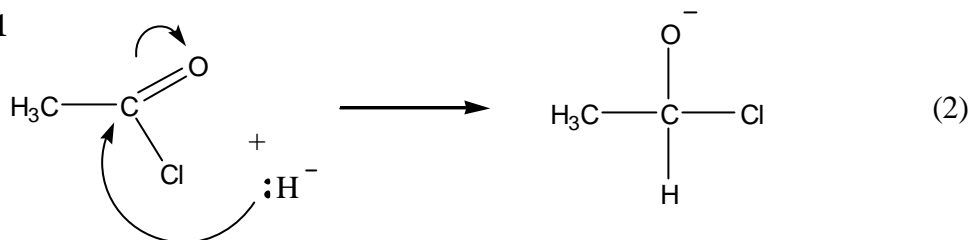
**TOTAL 9 MARKS**

- Q4**
- i) B (1)
- ii)  $\frac{28.50}{1000} \times 0.2 = 0.00570$  mole HCl (1)
- $100\text{cm}^3$  contained  $5 \times 0.00570 = 0.0285$  mole NaOH (1)
- $= 1.14\text{g}$  (1)
- $\frac{15.3}{1000} \times 0.200$  reacts with carbonate = 0.00306 mole (1)
- so moles of carbonate =  $\frac{1}{2} \times 0.00306 = 0.00153$  (1)
- $100\text{cm}^3$  solution contained 0.811g (1)

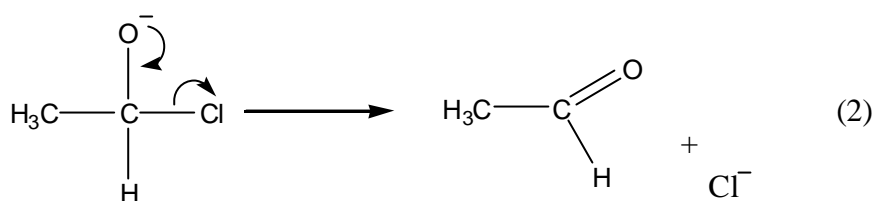
**TOTAL 7 MARKS**

**Q5**

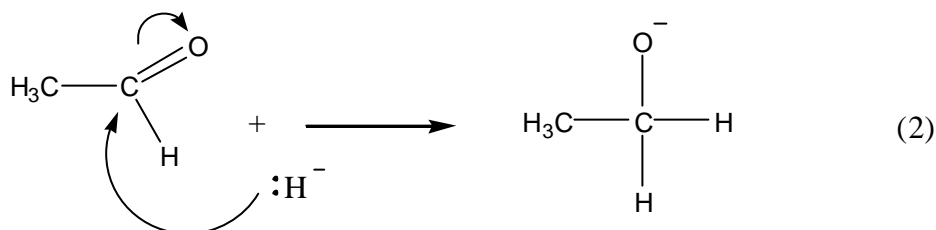
**Step 1**



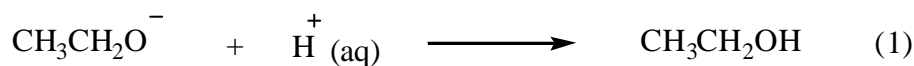
**Step 2**



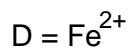
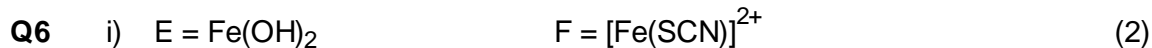
**Step 3**



**Step 4**

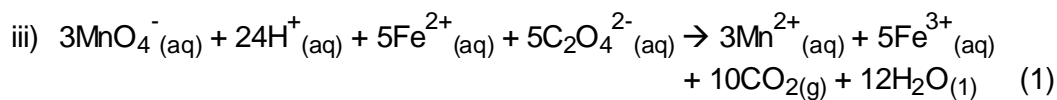
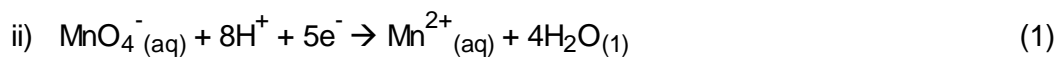


**TOTAL 7 MARKS**



All 3 = 2

(Any 2 = 1)



v)  $x = 2$  i.e. 2 mol  $\text{H}_2\text{O}$  in 1 mol of Q

(1)

vi)  $\text{FeC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$

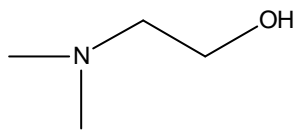
(no mark)

**TOTAL 8 MARKS**

Q7

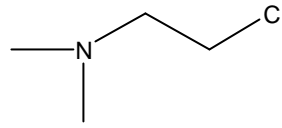
1 mark each

I =



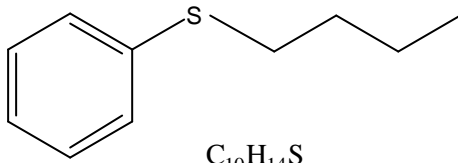
$C_4H_{11}NO$

G =



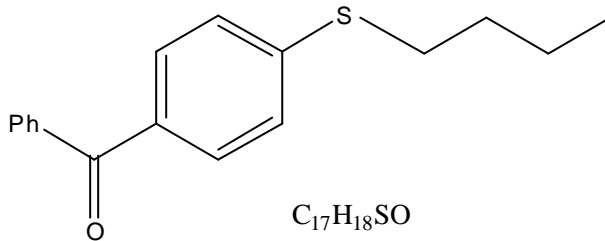
$C_4H_{10}NCl$

J =



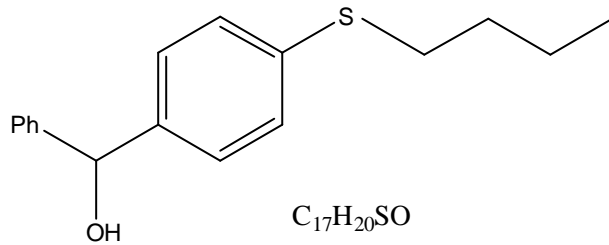
$C_{10}H_{14}S$

K =



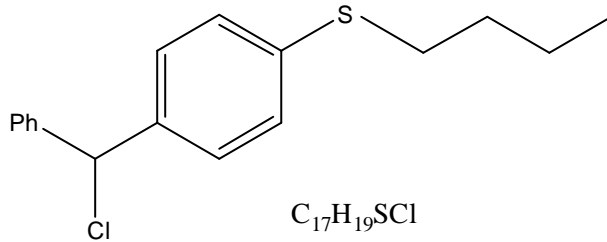
$C_{17}H_{18}SO$

L =

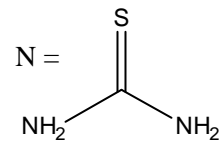


$C_{17}H_{20}SO$

M =



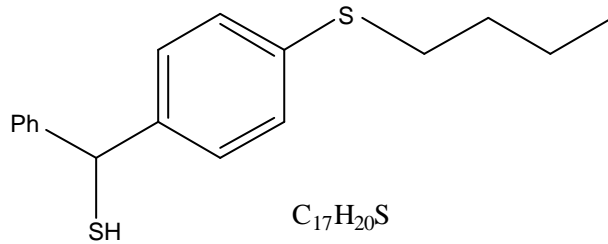
$C_{17}H_{19}SCl$



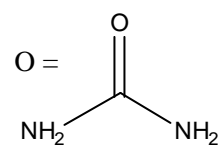
N =

$NH_2$   $NH_2$

H =

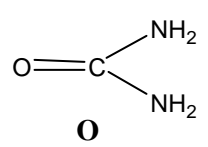
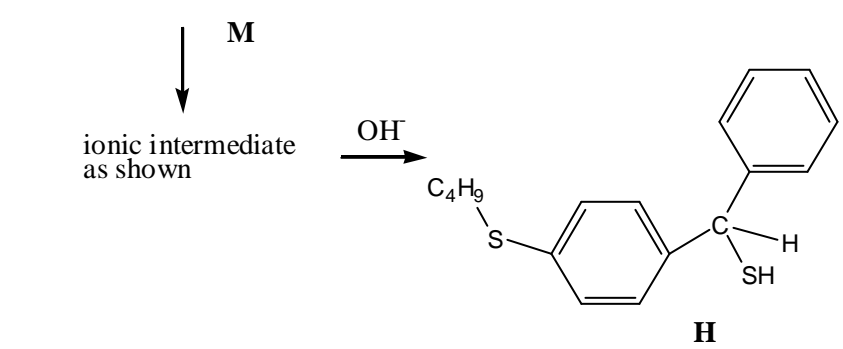
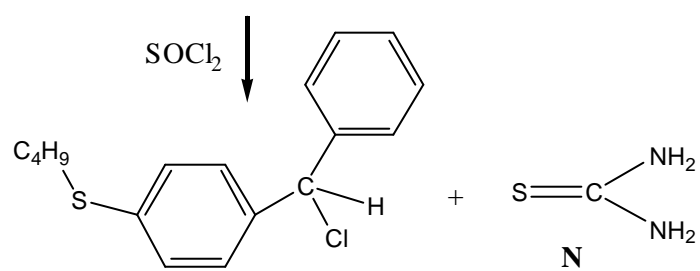
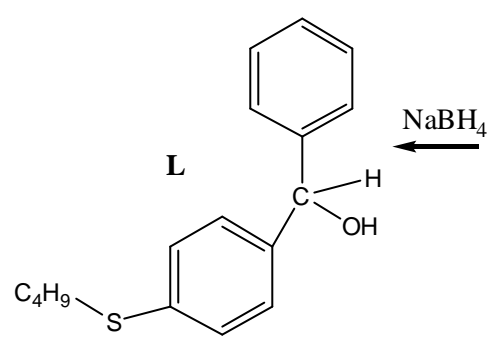
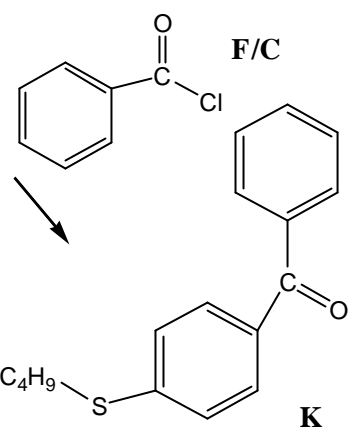
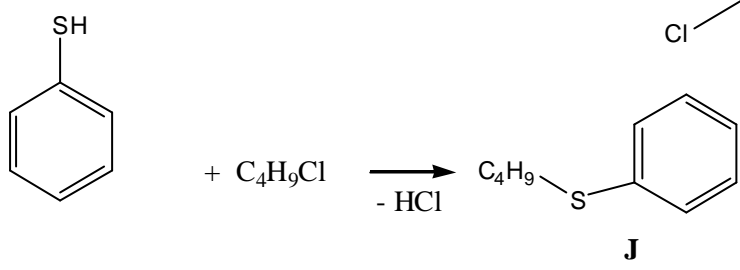
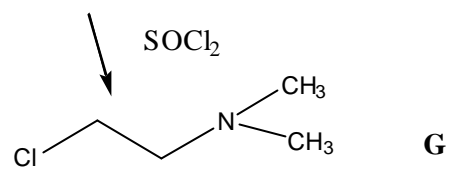
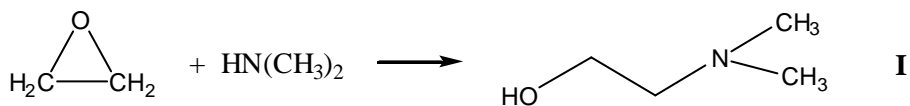


$C_{17}H_{20}S$



O =

$NH_2$   $NH_2$



TOTAL 9 MARKS

- Q8**
- i)  $\text{H}_3\text{AsO}_3 + \text{I}_3^- + \text{H}_2\text{O} \rightarrow \text{H}_3\text{AsO}_4 + 3\text{I}^- + 2\text{H}^+$  (1)
- ii) 1 (1)  
 constant  $\frac{1}{2}$  life (1)
- iii)  $\text{H}_3\text{AsO}_3$ , 1, (double concentration, double rate) (1)  
 $\text{H}^+$ , -1, (double concentration, halve rate) (1)  
 $\text{I}^-$ , -2, (1)  
 Reasons not needed
- iv) Rate =  $K [\text{H}_3\text{AsO}_3]^1 [\text{H}^+]^{-1} [\text{I}^-]^{-2}$  (1)  
 or ecf
- $K = 0.112$  (1)  
 Units  $\text{mol}^2 \text{dm}^{-6} \text{s}^{-1}$  (1)

**TOTAL 9 MARKS**

TOTAL FOR PAPER = 63 MARKS