

Section A (Multiple Choice)

Question #	Answer	Question #	Answer	Question #	Answer
Q1	D	Q6	D	Q11	C
Q2	D	Q7	A	Q12	B
Q3	A	Q8	E	Q13	E
Q4	B	Q9	E	Q14	B
Q5	B	Q10	A	Q15	A

Question 16

a. What is the oxidation state of chromium in the following species?

i)	Cr_2O_3	III
ii)	CrO_4^{2-}	VI
iii)	$\text{Cr}_2\text{O}_7^{2-}$	VI
iv)	FeCr_2O_4	III

b. Write the full balanced equations for the reduction of chromite using carbon and ferrosilicon.



c.

i) Write the half equation for the oxidation of chromite in base.



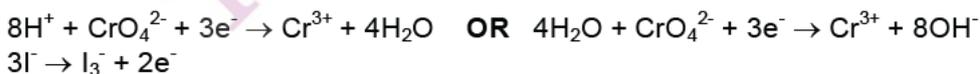
ii) Write the reduction half-equation.



iii) Write the balanced full-equation.

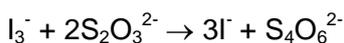
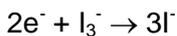


d. Write the half-equations and the full balanced equation for the reaction of chromate with iodide.



e. How many triiodide ions are generated for each chromate ion that is reduced?

f. Write two balanced ionic half equations and a full redox equation for the reaction between triiodide ions and thiosulfate ions.



g. What was the concentration of the stock sodium chromate solution?

$$n(S_2O_3^{2-}) = 23.10 \times 10^{-3} \times 0.100$$

$$= 2.31 \times 10^{-3} \text{ mol}$$

$$n(I_3^-) = 2.31 \times 10^{-3} \times 1/2$$

$$= 1.155 \times 10^{-3} \text{ mol}$$

$$n(\text{Cr}) = 1.155 \times 10^{-3} \times 2/3$$

$$= 0.77 \times 10^{-3} \text{ mol}$$

$$[\text{Cr}]_{\text{STOCK}} = 0.77 \times 10^{-3} / 25.00 \times 10^{-3}$$

$$= 0.0308 \text{ M}$$

h.

i) What percentage of the ore is actually chromite?

$$n(\text{FeCr}_2\text{O}_4) = \frac{1}{2} \times 0.0308$$

$$= 0.0154 \text{ mol}$$

$$m(\text{FeCr}_2\text{O}_4) = 0.0154 \times (55.85 + 2 \times 52.00 + 4 \times 16.00)$$

$$= 3.447 \text{ g}$$

$$\%(\text{FeCr}_2\text{O}_4) = 3.447 / 5$$

$$= 68.9 \%$$

ii) What percentage of the ore is chromium?

(Assume chromite is the only source of chromium in the ore.)

$$m(\text{Cr}) = 0.0308 \times 52.00$$

$$= 1.60 \text{ g}$$

$$\%(\text{Cr}) = 1.60 / 5$$

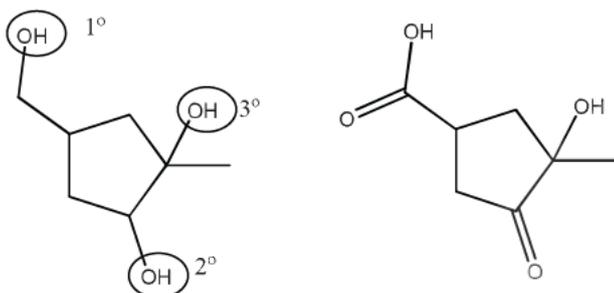
$$= 32.0 \%$$

Question 17

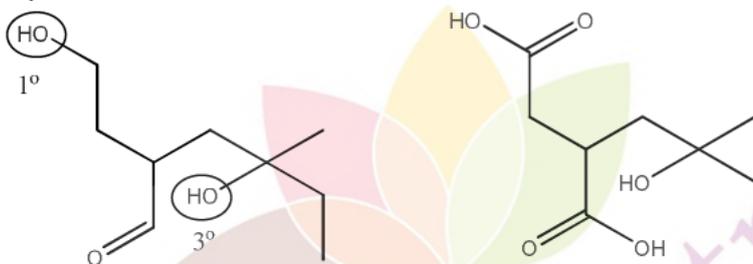
- (a) $2 \times 1.008 + 16.00 = 18.0$ (to 1 decimal place)
- (b) $89.1 + 105.1 \cdot 18.0 = 176.2$
- (c) Ser-Ala or Gly-Thr or Thr-Gly + appropriate structure
- (d) $89.1 + 105.1 + 89.1 \cdot 2 \cdot 18.0 = 247.3$
- (e) $89.1 + 75.1 + 165.2 + 133.1 \cdot 3 \cdot 18.0 = 408.5$
- (f) $b_1 = 89.1 \cdot 17.0 = 72.1$
 $b_2 = 72.1 + 105.1 \cdot 18.0 = 159.2$
- (g) $b_1 + 17.0 = 89.1 \rightarrow \text{AA1} = \text{Ala}$
 $b_2 \cdot b_1 + 18.0 = 121.1 \rightarrow \text{AA2} = \text{Cys}$
 $b_3 \cdot b_2 + 18.0 = 75.1 \rightarrow \text{AA3} = \text{Gly}$
 So AA1 = Ala, AA2 = Cys, AA3 = Gly
- (h) $y_1 = 89.1 + 1 = 90.1$
 $y_2 = 90.1 + 105.1 \cdot 18 = 177.2$
- (i) $y_1 \cdot 1 = 181.2 \rightarrow \text{AA3} = \text{Tyr}$
 $y_2 \cdot y_1 + 18.0 = 115.1 \rightarrow \text{AA2} = \text{Pro}$
 $y_3 \cdot y_2 + 18.0 = 131.2 \rightarrow \text{AA1} = \text{Met}$
 So AA1 = Met, AA2 = Pro, AA3 = Tyr
- (j) $b_1 + 17.0 = 149.2 \rightarrow \text{AA1} = \text{Met}$
 $b_2 \cdot b_1 + 18.0 = 165.2 \rightarrow \text{AA2} = \text{Phe}$
 $b_5 \cdot b_4 + 18.0 = 155.2 \rightarrow \text{AA5} = \text{His}$
 $y_1 \cdot 1 = 131.2 \rightarrow \text{AA6} = \text{Ile or Leu}$
 $y_2 = y_1 + 155.2 \cdot 18.0 = 269.4$
 $y_3 \cdot y_2 + 18.0 = 115.1 \rightarrow \text{AA4} = \text{Pro}$
 $b_3 = b_4 \cdot 115.1 + 18.0 = 380.5$
 $b_3 \cdot b_2 + 18.0 = 119.1 \rightarrow \text{AA3} = \text{Thr}$
 So AA1 = Met, AA2 = Phe, AA3 = Thr, AA4 = Pro, AA5 = His, AA6 = Ile or Leu

Question 18

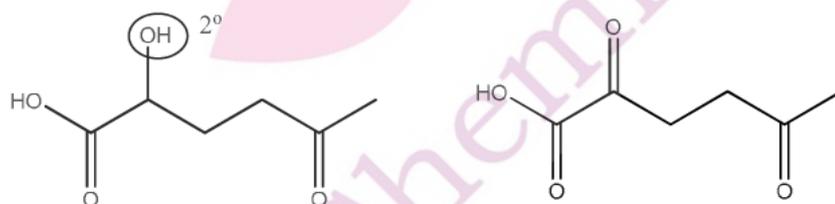
a) i) 3 Marks



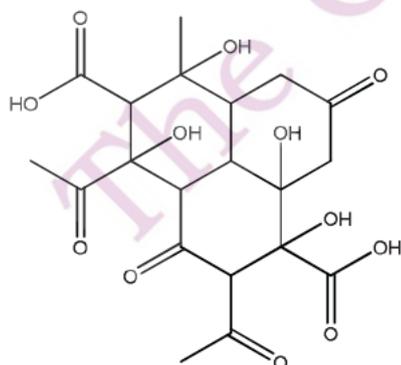
ii) 2 Marks



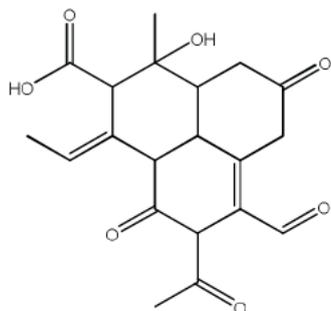
iii) 1 Mark



b) 4.5 Marks



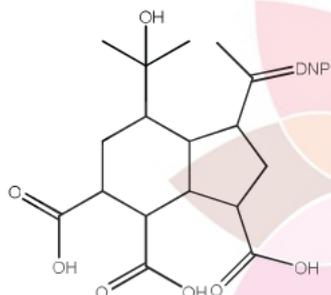
c) 1.5 Marks



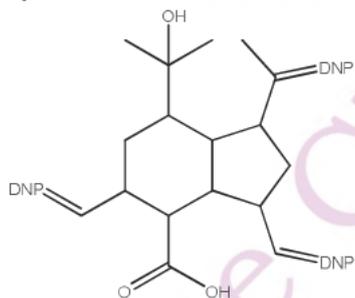
d) 1 Marks

The iodine was oxidising the alcohols to ketones/aldehydes, but since there was no methyl alcohol or methyl ketones in the structure, iodoform could not form.

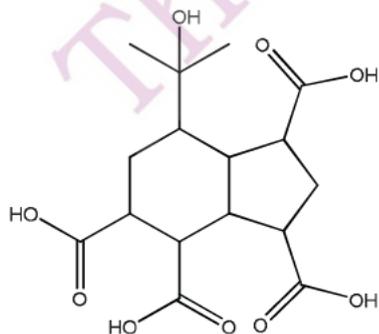
e) i) 2 Marks



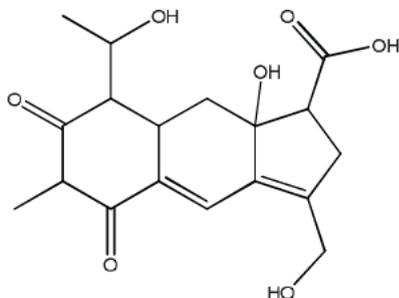
ii) 3 Marks



iii) 2 Marks



f) 3 Marks



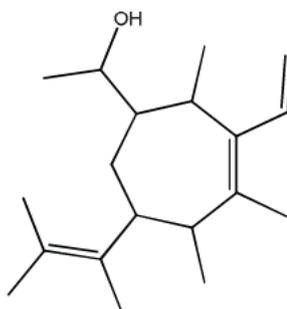
Note: Not the only correct structure, other solutions are possible

g) 4 Marks

- Positive test for Tollens' Reagent means presence of aldehyde functional group, hence not structure 1
- Positive test for PCC means presence of primary or secondary alcohol, hence not structures 3 or 4
- Positive test for DNP means presence of aldehyde or ketone functional group, hence not structure 1
- Decolourisation in the Iodoform test means the presence of alcohol or aldehyde functional group, but no methyl alcohol or methyl ketone, hence not structures 1, 3 or 5
- Negative test of Blue litmus means that the structure does not include a carboxylic acid functional group, hence not 3
- Acidified KMnO_4 reacts with all structures
- Compound E = 2

h) 4 Marks

- DNP must be before PCC or any ketone/aldehyde formed by due to PCC will all react with DNP
- PCC must be before KMnO_4 and I_2/NaOH or no reaction would be observed
- The order of KMnO_4 and I_2/NaOH does not matter.



Note: Not the only correct structure, other solutions are possible

Reagent 1 = DNP

Reagent 2 = PCC

Reagent 3 = I_2/NaOH Reagent 4 = KMnO_4

Reagent 1 = DNP

Reagent 2 = PCC

Reagent 3 = KMnO_4 Reagent 4 = I_2/NaOH

OR