

**2. This question is about atmospheric chemistry**

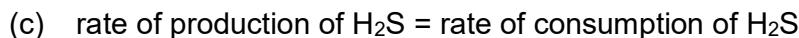


1

*Dots marking radicals are not required.*



1



$$7.65 \times 10^5 \text{ molecules cm}^{-3} \text{ s}^{-1} = k \times [\text{OH}] \times [\text{H}_2\text{S}]$$

$$7.65 \times 10^5 \text{ molecules cm}^{-3} \text{ s}^{-1} = 4.7 \times 10^{-12} \text{ cm}^3 \text{ s}^{-1} \times 1.1 \times 10^6 \text{ cm}^{-3} \times [\text{H}_2\text{S}]$$

$$[\text{H}_2\text{S}] = 1.48 \times 10^{11} \text{ molecules cm}^{-3}$$

2

$$[\text{H}_2\text{S}] = 1.5 \times 10^{11} \text{ molecules cm}^{-3}$$

*Please note that "molecules" can be omitted from the units. Correct answer with units scores full marks. One mark can be awarded if the following statement or equivalent is written:  $7.65 \times 10^5 \text{ molecules cm}^{-3} \text{ s}^{-1} = k \times [\text{OH}] \times [\text{H}_2\text{S}]$*

(d)  $[\text{H}_2\text{S}] = 1.48 \times 10^{11} \text{ cm}^{-3}$

$$[\text{H}_2\text{S}] = 1.48 \times 10^{17} \text{ m}^{-3}$$

$$[\text{H}_2\text{S}] = 2.46 \times 10^{-7} \text{ mol m}^{-3}$$

$$[\text{H}_2\text{S}] = 8.38 \times 10^{-6} \text{ g m}^{-3}$$

$$[\text{H}_2\text{S}] = 8.38 \text{ } \mu\text{g m}^{-3}$$

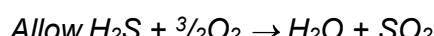
$$[\text{H}_2\text{S}] = 8.4 \text{ } \mu\text{g m}^{-3} \text{ (2 s.f.)}$$

1

*Correct answers scores mark. Intermediate steps in calculation not required.*

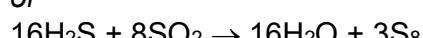


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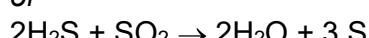


1

*or*



*or*



(f) Accept 3.7, 3.8 or 3.9 years 1  
One mark for correct reading of graph.

If said 3.7 years then  $1.168 \times 10^8$  s 1

If said 3.8 years then  $1.199 \times 10^8$  s

If said 3.9 years then  $1.231 \times 10^8$  s

One mark for correct value in seconds. Conversion calculation not required. Allow ECF from their answer in years for the value in seconds.

1 year = 365.25 days/year  $\times$  24 hours/day  $\times$  60 minutes/hour  $\times$  60 seconds/minute

1 year =  $3.156 \times 10^7$  s. Therefore their value in seconds should be the value in years multiplied by  $3.156 \times 10^7$

(g)  $[\text{OH}] = \ln 2 / (k_{2\text{nd}} \times t_{1/2})$   
 $[\text{OH}] = 0.693 / (1.0 \times 10^{-14} \times t_{1/2})$   
 $[\text{OH}] = 6.93 \times 10^{13} / t_{1/2}$

If they found  $t_{1/2} = 3.7$  years, then  
 $[\text{OH}] = 5.93 \times 10^5$  molecules  $\text{cm}^{-3}$

2

If they found  $t_{1/2} = 3.8$  years, then  
 $[\text{OH}] = 5.78 \times 10^5$  molecules  $\text{cm}^{-3}$

If they found  $t_{1/2} = 3.9$  years, then  
 $[\text{OH}] = 5.63 \times 10^5$  molecules  $\text{cm}^{-3}$

Correct answer with units scores full marks. Please note that "molecules" can be omitted from the units. One mark may be awarded for obtaining the expression:

$$[\text{OH}] = 6.93 \times 10^{13} / t_{1/2}$$

Allow ECF from their answer to part (f) using the above formula.

Question Total 11