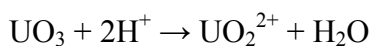


2014 CHEMISTRY ASOE ANSWERS

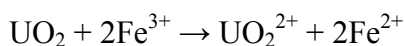
Question	Answer	Question	Answer	Question	Answer
1	E	6	B	11	D
2	D	7	A	12	D
3	A	8	B	13	B
4	B	9	E	14	A
5	E	10	D	15	C

Question 16

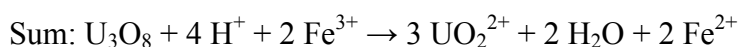
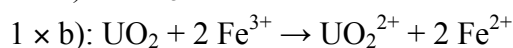
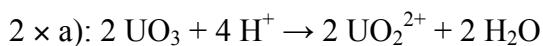
(a)



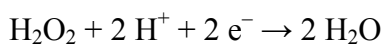
(b)



(c)



(d)



(e)

$$\text{Molar mass} = 238.0 + 2 \times 16.00 + 2 \times (14.01 + 3 \times 16) + 6 \times (2 \times 1.008 + 16.00) = 502.116 \text{ g mol}^{-1}$$

(f)

$$n(\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}) = \frac{0.500 \text{ g}}{502.116 \text{ g mol}^{-1}} = 9.958 \times 10^{-4} \text{ mol}$$

$$[\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}] = \frac{9.958 \times 10^{-4} \text{ mol}}{0.5 \text{ L}} = 1.992 \times 10^{-3} \text{ mol L}^{-1} (1.992 \text{ mM})$$

(g)

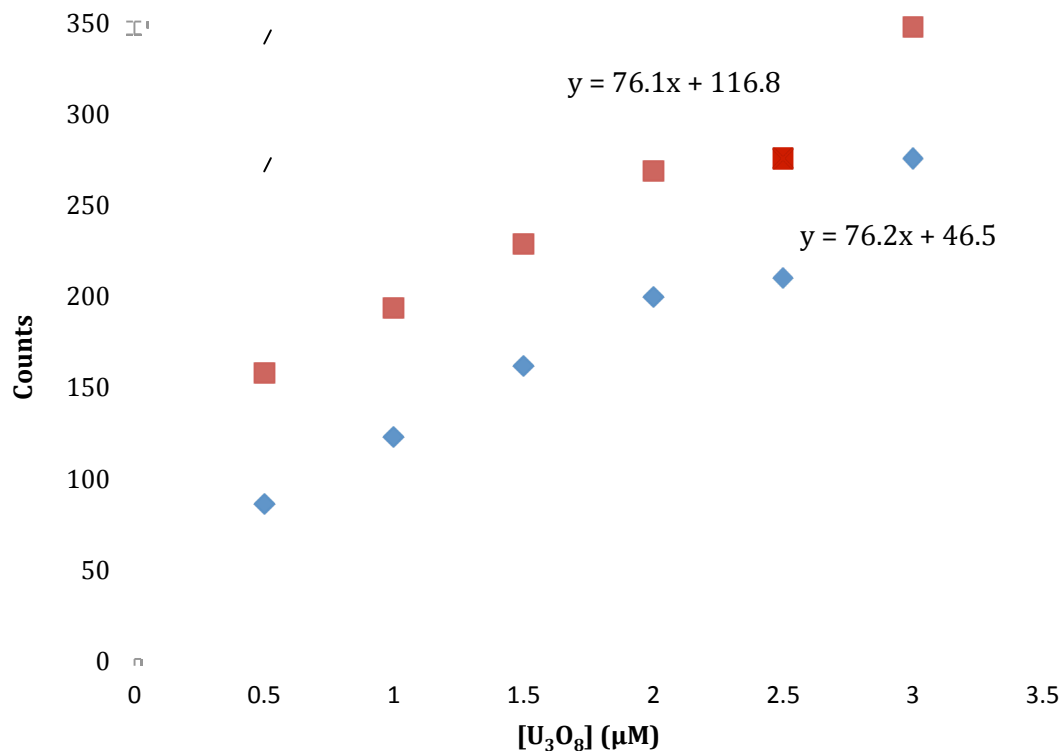
$$\text{From (c), } \text{U}_3\text{O}_8 \rightarrow 3\text{UO}_2^{2+} \text{ so } [\text{U}_3\text{O}_8] = \frac{1.992 \times 10^{-3} \text{ mol L}^{-1}}{3} = 6.639 \times 10^{-4} \text{ mol L}^{-1} (0.6639 \text{ mM})$$

(h)

$$n(\text{U}_3\text{O}_8) = 0.5000 \times 10^{-3} \text{ L} \times 6.639 \times 10^{-4} \text{ mol L}^{-1} = 3.319 \times 10^{-7} \text{ mol}$$

$$[\text{U}_3\text{O}_8] = \frac{3.319 \times 10^{-7} \text{ mol}}{0.1000 \text{ L}} = 3.319 \times 10^{-6} \text{ mol L}^{-1}$$

(i)(j)



(k)

Increase in fluorescence intensity = 70 counts

So increase in $[\text{U}_3\text{O}_8]$ in the spiked sample solutions from the ore = $0.92 \mu\text{M}$

So $[\text{U}_3\text{O}_8]$ in 1.00 mL original ore sample = $\frac{101.0}{1.00} \times 0.92 \mu\text{M} = 92 \mu\text{M}$

(l)

$$[\text{U}] = \frac{20080 \text{ counts}}{31.81 \text{ counts (mg kg}^{-1}\text{)}^{-1}} = 631.2 \text{ mg kg}^{-1}$$

(m)

$$\text{Th counts} = 5.824 \text{ counts (mg kg}^{-1}\text{)} \times 631.2 \text{ mg kg}^{-1} = 3676 \text{ counts}$$

(n)

1 mg Th kg⁻¹ gives 2.413 counts in the U-ROI (i.e. due to U).

So 1 mg Th kg⁻¹ contains $\frac{2.413 \text{ counts}}{31.81 \text{ counts (mg kg}^{-1})^{-1}} = 7.586 \times 10^{-2} \text{ mg U kg}^{-1}$

So ratio of [Th] / [U] = $\frac{1 \text{ mg kg}^{-1}}{7.586 \times 10^{-2} \text{ mg kg}^{-1}} = 13.18$

(o)

For the standard Th samples:

Th counts from Th and U = 10.48 counts (mg kg⁻¹)⁻¹

From part n), Th counts from U = $\frac{5.824 \text{ counts (mg kg}^{-1})^{-1}}{13.18} = 0.4417 \text{ counts (mg kg}^{-1})^{-1}$

∴ Th counts from Th = 10.48 – 0.4417 = 10.04 counts (mg kg⁻¹)⁻¹

For the ore sample:

Th counts from Th = (Th counts from Th and U) – (Th counts from U)

From part m), Th counts from U = 3676 counts.

∴ Th counts from Th = 4200 – 3676 = 524 counts

[Th] = $\frac{524 \text{ counts}}{10.04 \text{ counts (mg kg}^{-1})^{-1}} = 52.2 \text{ mg kg}^{-1}$

Question 17

(a) **B** - Ionisation Energy

(b) $(13.6 \times 1.602 \times 10^{-19}) \times 6.022 \times 10^{23} \times 1 \div 22.71 = \underline{57.8 \text{ kJ}}$

(c) $m(\text{sun}) = 2 \times 10^{33} \text{ g}$
 $m(\text{H}) \text{ approx} = 1.008 \div (6.022 \times 10^{23}) = 1.674 \times 10^{-24} \text{ g atom}^{-1}$
 $n(\text{H}) = 2 \times 10^{33} \div (1.674 \times 10^{-24}) = \underline{1.195 \times 10^{57} \text{ atoms}}$
 $V(\text{H}) = 1.195 \times 10^{57} \div (1000 \text{ atoms mL}^{-1}) = 1.195 \times 10^{54} \text{ mL}$
 $= \underline{1.195 \times 10^{48} \text{ m}^3}$
 $= (4/3)\pi r^3$
 So $r = 6.583 \times 10^{15} \text{ m}$
 And $\underline{d = 1.317 \times 10^{16} \text{ m}}$

(d) 0.7 Å, minimum of the potential energy curve

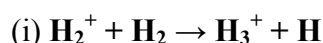
(e) + 4.8 V

(f) (i) **Electrons attract** positively charged nuclei
Nuclear repulsion is shielded by electrons. Or equivalently, electron-proton attractions overcome nuclear-nuclear repulsions

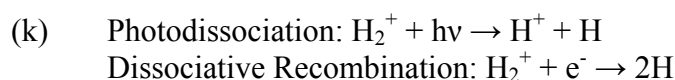
(ii) **Reduced electron density** between nuclei
Nuclear repulsion stronger due to decreased shielding

(g) He^{2+} : 2
 H_2^+ : 2
 TTF^{2+} : Approx 102

(h) H_3^+ and C^{4+}

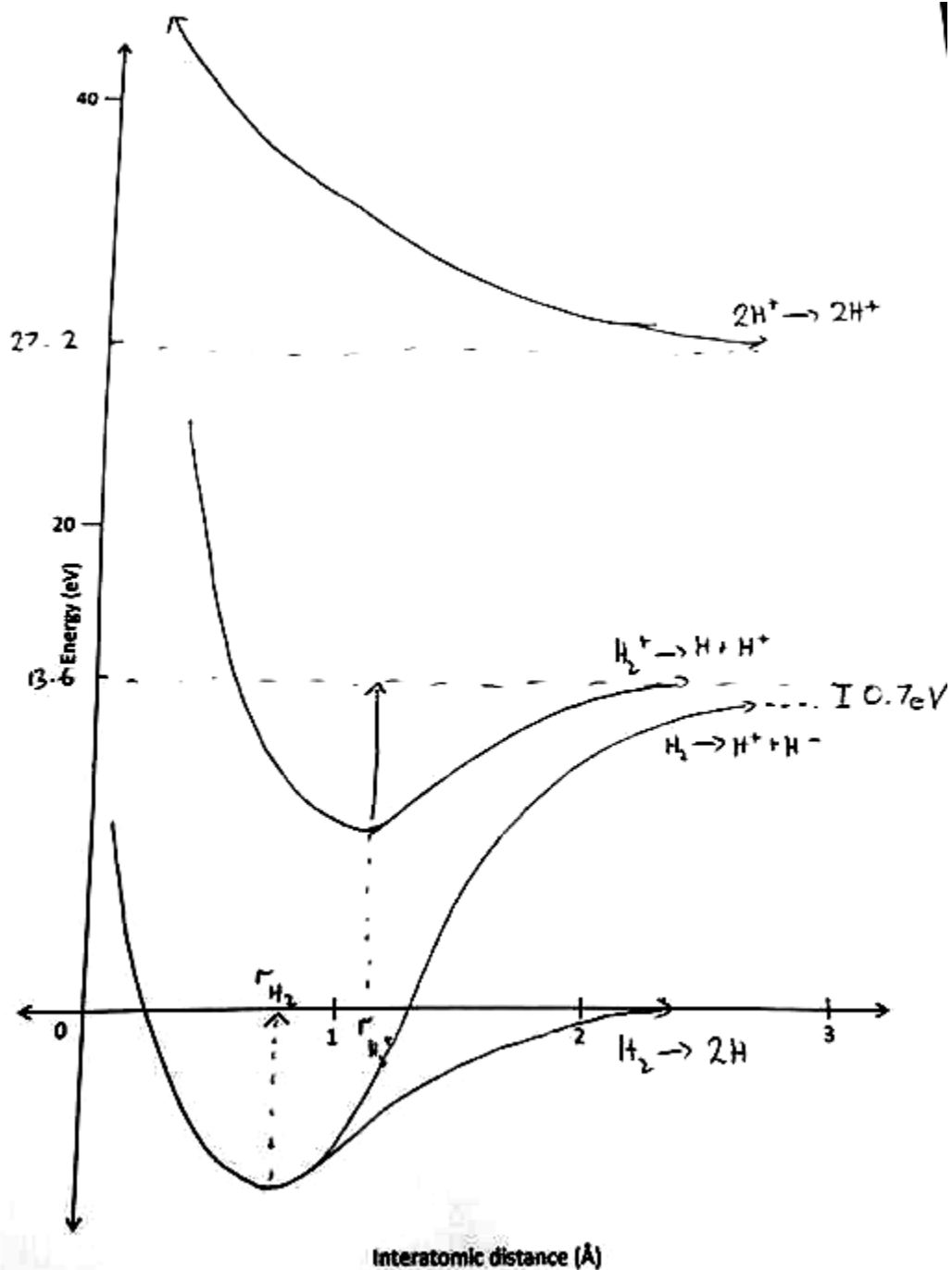


(j) Triangular and linear arrangement of 3 hydrogen atoms
 A general comment on "electron deficiency"



(l) 13.6 eV

(m) Longer bond length
 Decreased electron density decreases shielding and increases nuclear repulsion



- (n) Redrawing H_2 curve
- H_2^+ Curve: Greater equilibrium bond length than H_2
 Curve is higher than H_2 curve
 Curve goes to 13.6 eV at infinite distance
 Same shape as H_2 curve
- $2H^+$ Curve: Correct shape
 Goes to 27.2 eV at infinite distance
- (o) Correct shape extending from original H_2 curve
 Goes to $13.6 - 0.7 = 12.9$ eV at infinite distance

Question 18

(a)

eight

(b)

Yes. (Higher temperature will result in a shorter retention time)

(c)

20.30 min

(d)

2, 3, 1

(e)

D. Hexane is a non-polar solvent. The most polar compound would adhere strongly to the polar stationary phase and thus travel the least distance.

(f)

A, C, D, B

(g)

0.35

(h)

R_f values would be higher. Acetone is a more polar solvent, but still less polar than the stationary phase. The reduced difference in polarity between the two phases allows for more travelling by all compounds.

(i)

False. Same R_f value so very similar polarity. Not necessarily same compound.

(j)

When the mobile phase reaches the top edge of the plate, it continues to flow upwards due to evaporation and as a result, mixture components keep moving although the solvent front has stopped. This counteracts the earlier separation.

(k)

Larger molecules would elute first as they are heavier and therefore travel through the medium the fastest. They also have a shorter path to travel as they don't get caught in the pores.

(l)

Glutamic acid would elute last as the negatively charged carboxylates would interact favourably with the positive ions in the column.

(m)

The pH should be decreased as the amino acid would become protonated in the acidic pH and therefore detach from the positively charged column.

(n)

The chloride ions would attach to the positive column and replace the negative amino acid, hence pushing it off the column.