

## Olympic Drug Scandal (UV-VIS): Student Resource

One of the pills from the Olympic competitors was found to be illegal in sport; however, it is not illegal in small doses. You have been asked by the Olympic committee to determine if the amount of drug in the competitor's urine sample is above the legal limit.

### Method:

Using a concentration curve, which compares concentration of the drug to the UV absorbance, must be made. A stock solution of known concentration will be provided. Make up the following solutions of different concentrations to create a set of standards.

1. Prepare a blank, by filling a cuvette with deionised water.
2. Test a sample of the stock solution on the machine, using the wavescan function (3), to find the wavelength of maximum absorbance ( $\lambda_{\max}$ ).
  - Run a full spectrum, from 200-900 nm, on a sample of the stock solution.
  - Look for the highest peak and record the value for  $\lambda_{\max}$  on the worksheet provided.
3. Prepare Standards for UV/Vis Analysis
  - Using volumetric pipettes, measure out 1, 2, 3, 4 and 5 mL concentrations of the stock solution into each of 5 test tubes, following the Table 1, provided in this script.
  - Using volumetric pipettes, add deionised water to the test tubes to make each sample 5mL, following Table 1.
4. Measure the absorbance of each solution of known concentration and the unknown "urine sample", using the single wavelength function (1). Record the values on the worksheet provided.

### Analysis of the data:

1. Plot the concentration vs. absorbance on a sheet of graph paper or using an excel spreadsheet. Use this calibration graph to determine the concentration of the unknown sample.
2. Compare the concentration from the unknown that you determined by the graph with the data points in the worksheet table. Does this answer make sense? Can you estimate where the answer should be by using the table?
3. Using the concentration determined and the value, can you determine if the competitor has too much of the drug in his system?
  - Ephedrine is prohibited when its concentration in urine is greater than 10 micrograms per millilitre (10 ppm)<sup>1</sup>.  $\lambda_{\max}$  for ephedrine is 206nm<sup>2</sup>.

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<sup>1</sup> World Anti-Doping Agency. "2012 Prohibited List". [http://www.wada-ama.org/Documents/World\\_Anti-doping\\_Program/WADP-Prohibited-list/2012/WADA\\_Prohibited\\_List\\_2012\\_EN.pdf](http://www.wada-ama.org/Documents/World_Anti-doping_Program/WADP-Prohibited-list/2012/WADA_Prohibited_List_2012_EN.pdf), accessed 30 April 2012.

<sup>2</sup> Hellriegel, C., H. Händel, M. Wedig, S. Steinhauer, F. Sörgel, K. Albert, U. Hozgrabe. *Journal of Chromatography A*, **914**, (2001), 315-324.

- Pseudoephedrine is prohibited when its concentration in urine is greater than 150 micrograms per millilitre (150 ppm)<sup>3</sup>.  $\lambda_{\max}$  for pseudoephedrine is 206nm<sup>4</sup>.
- Caffeine was prohibited when its concentration in urine was above 12 micrograms per millilitre (12 ppm). This is approximately equivalent to 8 cups of coffee, drunk in one sitting. In 2004, the World Anti-Doping Agency (WADA) took caffeine off the list of performance enhancing drugs.  $\lambda_{\max}$  for caffeine is 273nm<sup>5</sup>.

4. What would you recommend to the British Olympic Association about this competitor?

Concentration	Amount of Stock (mL)	Amount of H <sub>2</sub> O (mL)
100ppm	1.00	4.00
200ppm	2.00	3.00
300ppm	3.00	2.00
400ppm	4.00	1.00
500ppm	5.00	0.00

Table 1: mL of stock solution and water needed to create appropriate standard dilutions for concentration curve.

<sup>3</sup> World Anti-Doping Agency. "2012 Prohibited List". [http://www.wada-ama.org/Documents/World\\_Anti-doping\\_Program/WADP-Prohibited-list/2012/WADA\\_Prohibited\\_List\\_2012\\_EN.pdf](http://www.wada-ama.org/Documents/World_Anti-doping_Program/WADP-Prohibited-list/2012/WADA_Prohibited_List_2012_EN.pdf), accessed 30 April 2012.

<sup>4</sup> Hellriegel, C., H. Händel, M. Wedig, S. Steinhauer, F. Sörgel, K. Albert, U. Hozgrabe. *Journal of Chromatography A*, **914**, (2001), 315-324.

<sup>5</sup> MacMichael, S. "WADA president to urge re-banning of caffeine". *Road.cc*, 11 Aug 2010. <http://road.cc/content/news/21341-wada-president-urge-reconsideration-lifting-caffeine-ban>, Accessed 30 April 2012.

## Student Worksheet – UV/Vis:

$\lambda_{\text{max}} = \text{_____ nm}$

Concentration (ppm)	Absorbance (A)
0.0 (blank, deionised water)	
100 ppm	
200 ppm	
300 ppm	
400 ppm	
500 ppm	
Unknown	



This activity was undertaken as a part of the National HE STEM Programme, via the South West Spoke. For more information on South West Spoke projects, please see [www.hestem-sw.org.uk](http://www.hestem-sw.org.uk). For more information on the overall national programme, please see [www.hestem.ac.uk](http://www.hestem.ac.uk).



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