| CO4: | Name: Rajat Kumar<br>Batch: C5-3 Roll No.: 54<br>Date: |
|---|---|

# Experiment No. 9

**Title: Determination of Unknown concentration of Metal ion using spectrophotometer**

**Aim:** To record and interpret the UV-VIS spectrum of Chromium in $K_2Cr_2O_7$ and determine the concentration of unknown sample.

**Instrument:** Cary 60 UV-VIS Double beam spectrophotometer.

**Requirements:** Quartz cells with path length 1cm were used.

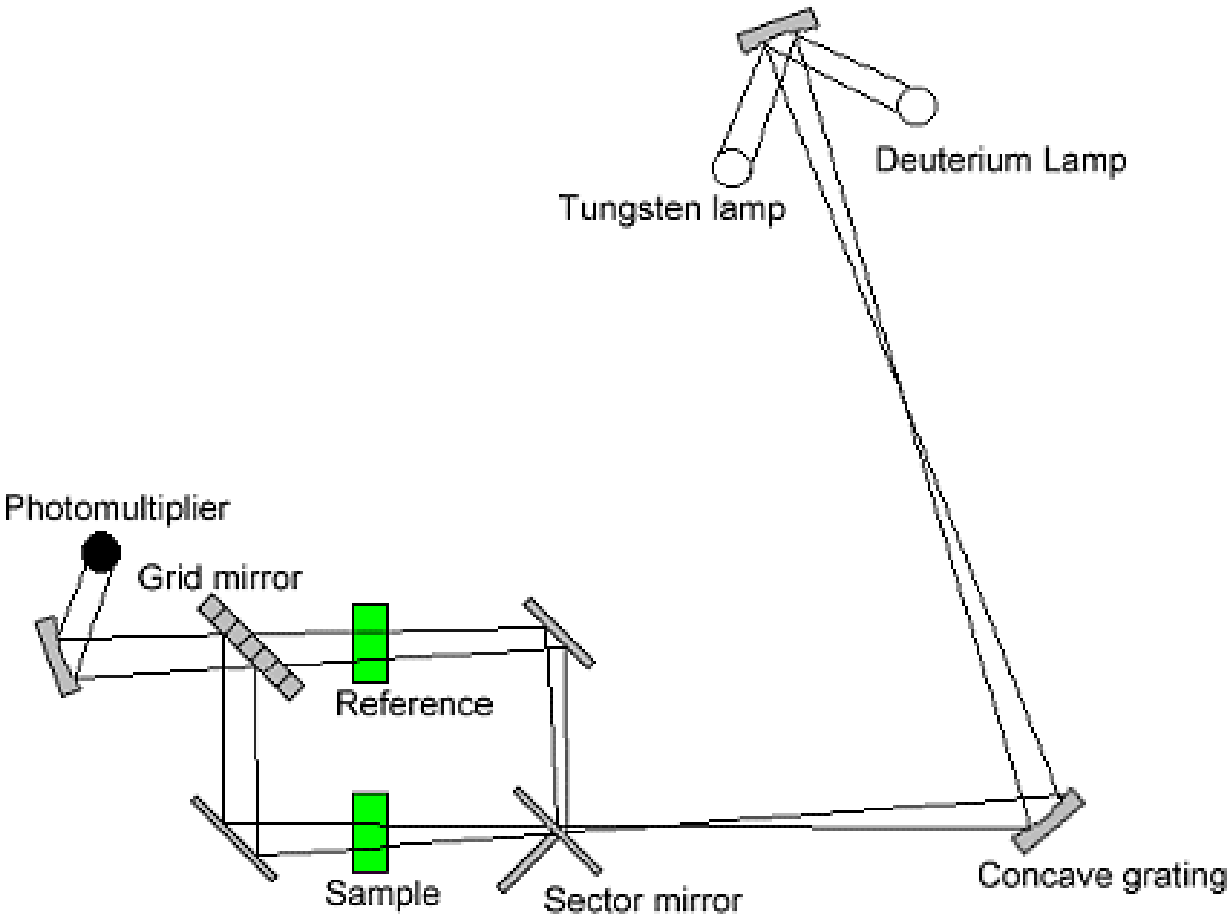
**Principle:** The method utilises a double-beam spectrophotometer which records only the absorption differences between the blank and test solutions to give the spectrum of the chemical being tested.

**Procedure: Sample preparation –**
Prepare the solutions of chromium with concentration 5ppm, 10ppm, 15ppm, 20ppm, 25ppm in 100mL standard measuring Flask. Solvent used for dilution was water.

***Blank solutions* –**
A blank must be prepared which contains the solvent and all chemical species other than the test chemical. Water is used as blank.

**Procedure:** Rinse the cells to be employed with the blank solution (water) and then filled with the same. The instrument was set to scan at a rate 0.5nm/ scan for the wavelength. Resolution range 200-800nm and the spectrum of the blank is recorded. The sample cell is rinsed and filled with the test solution and the scanning repeated, preferably on the same spectrum chart, to display the baseline. The test was carried out at 25°C. Plot the **graph** of absorbance v/s concentration. Record the absorbance of unknown sample solution and determine its concentration using graph.

## Diagram:



## Observation:

**Reagent: Hexaaquacobalt(II) ion** (or) **[Co(H2O)6]2+**

**For Peak: ($\lambda_{max}$ = 510 nm)**

**Path length = 1 cm**

| Sample No. | Concentration (in ppm) | Concentration (in moles/lit) | Absorbance (A) | ε |
|---|---|---|---|---|
| 1 | **166.93** | **0.001** | **0.1012** | **101.2** |
| 2 | **333.86** | **0.002** | **0.2024** | **101.2** |
| 3 | **500.79** | **0.003** | **0.3036** | **101.2** |
| 4 | **667.72** | **0.004** | **0.4048** | **101.2** |
| 5 | **834.65** | **0.005** | **0.5060** | **101.2** |
| 6 | **1001.58** | **0.006** | **0.6072** | **101.2** |
| Unknown | **2420.48** | **0.0145** | **1.4674** | **101.2** |

**Average ε = 101.2**

## Calculations:

Molar Mass of Hexaaquacobalt(II) ion (or) [Co(H2O)6]2+
= 58.93 + (18 × 6) = 58.93 + 108 = **166.93 g/mol**

The molar absorption coefficient ε was calculated for all absorbance maxima of the test substance. The formula for this calculation is –

$$\varepsilon = \frac{A}{c_i \times d}$$

Where; A = Absorbance of sample,
$c_i$ = concentration of sample,
d = cell path length

**For Sample 1,**
ε = 0.1012 / 0.001×1 = **101.2**

**For Sample 2,**
ε = 0.2024 / 0.002×1 = **101.2**

**For Sample 3,**
ε = 0.3036 / 0.003×1 = **101.2**

**For Sample 4,**
ε = 0.4048 / 0.004×1 = **101.2**

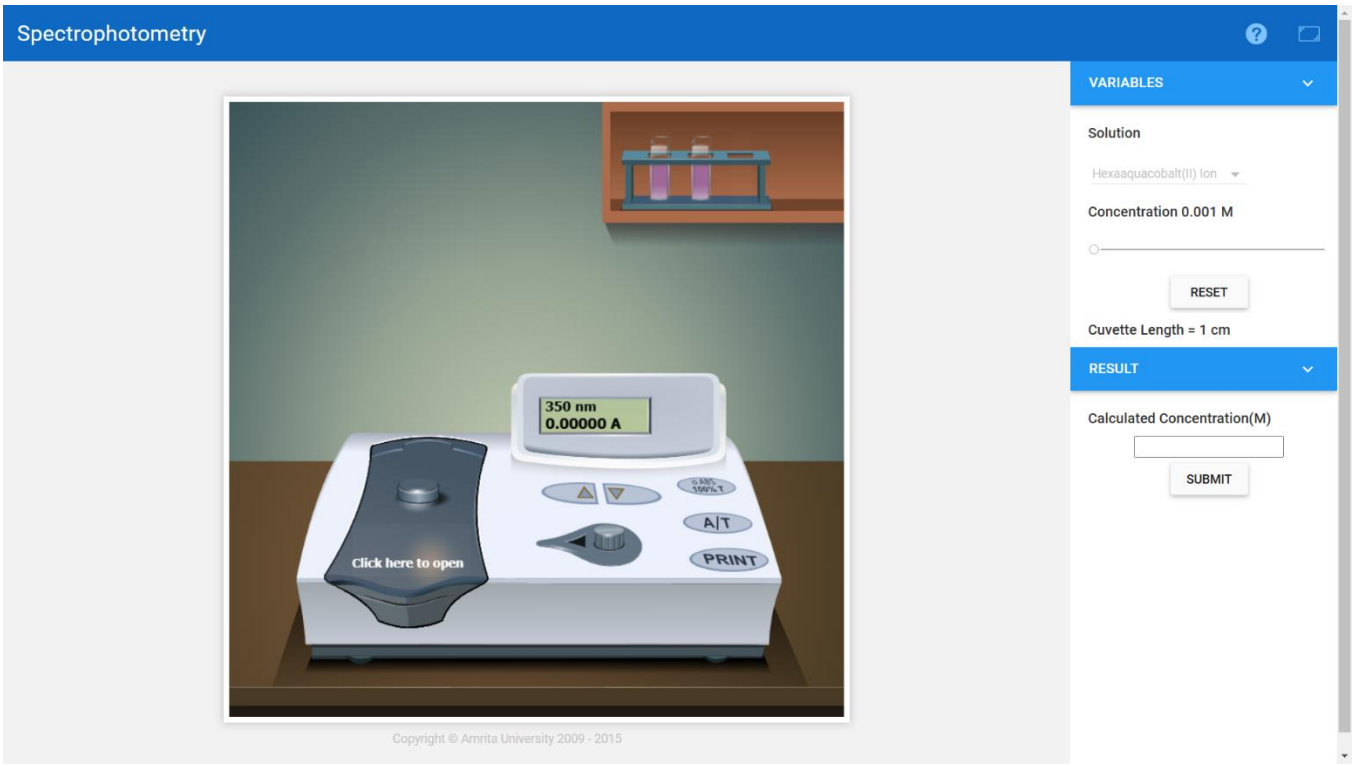
**For Sample 5,**
ε = 0.5060 / 0.005×1 = **101.2**

**For Sample 6,**
ε = 0.6072 / 0.006×1 = **101.2**

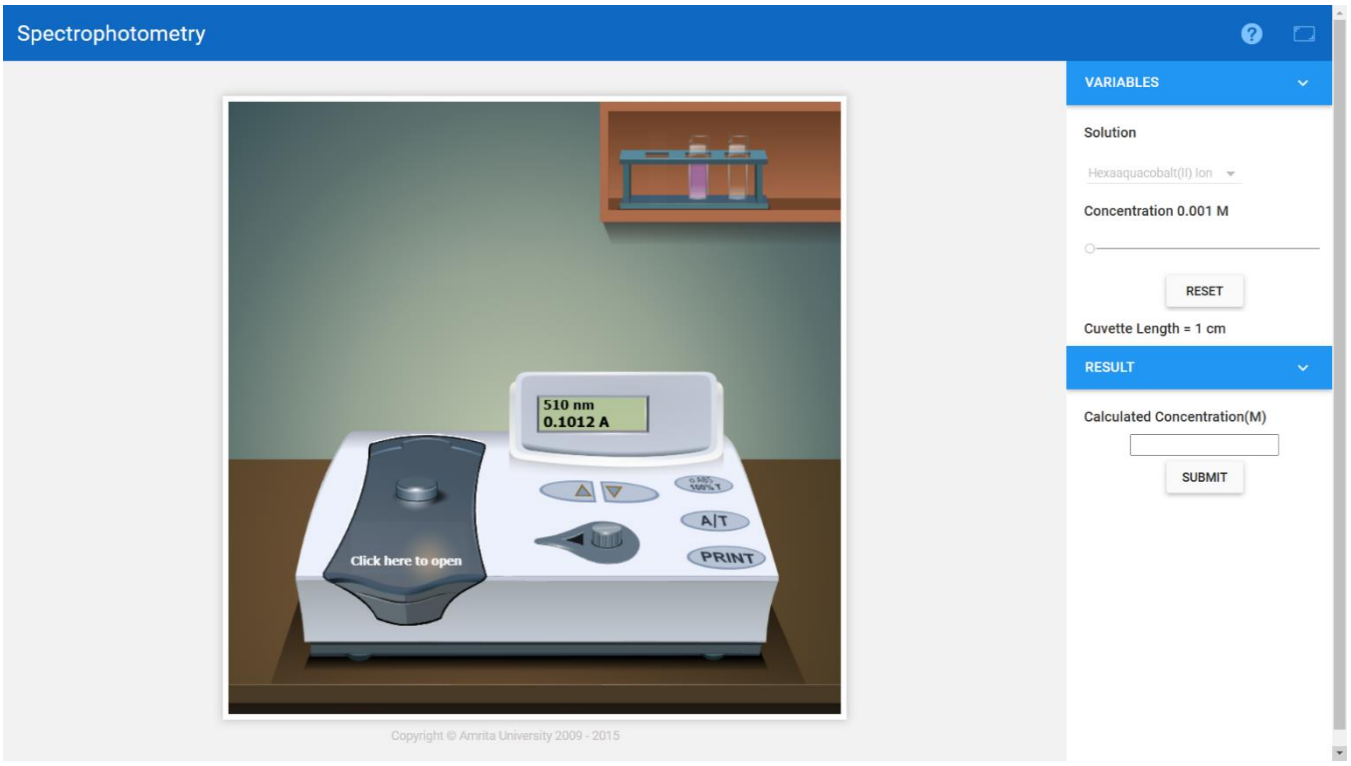
**For Unknown Sample, Calculating Concentration**
**c** = 1.4674 / 101.2×1 = **0.0145 M**

**ScreenShots –**

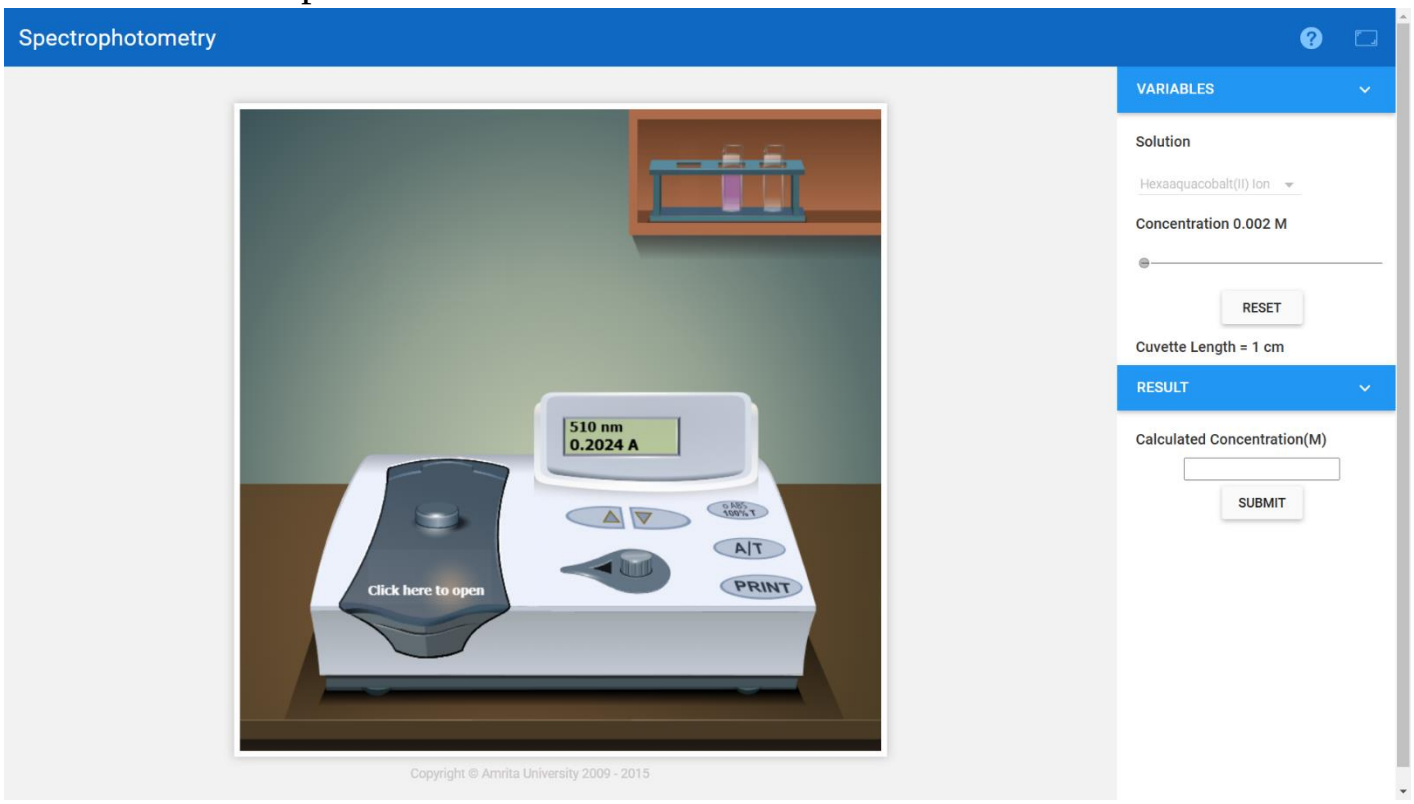
1. *Blank solutions –*



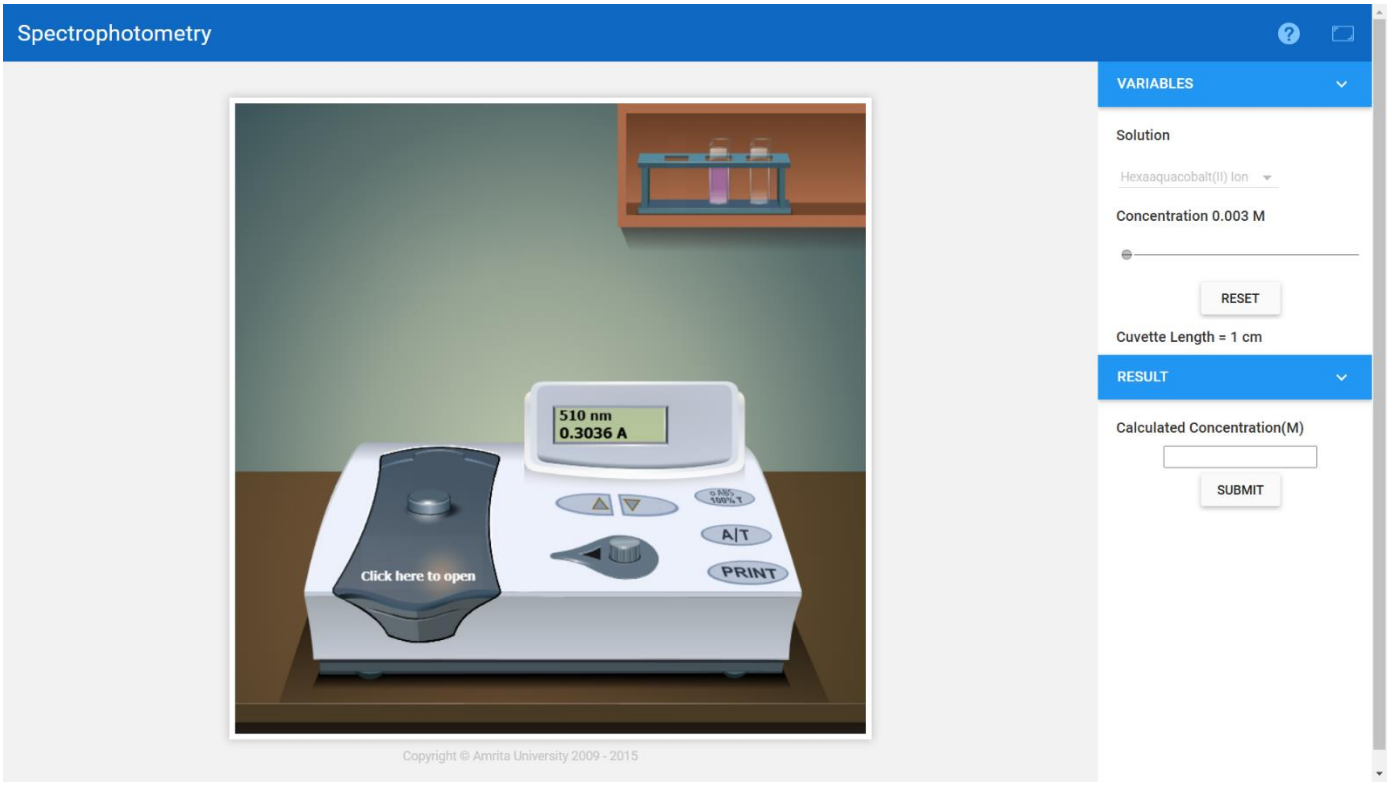

2. Sample No. 1 –



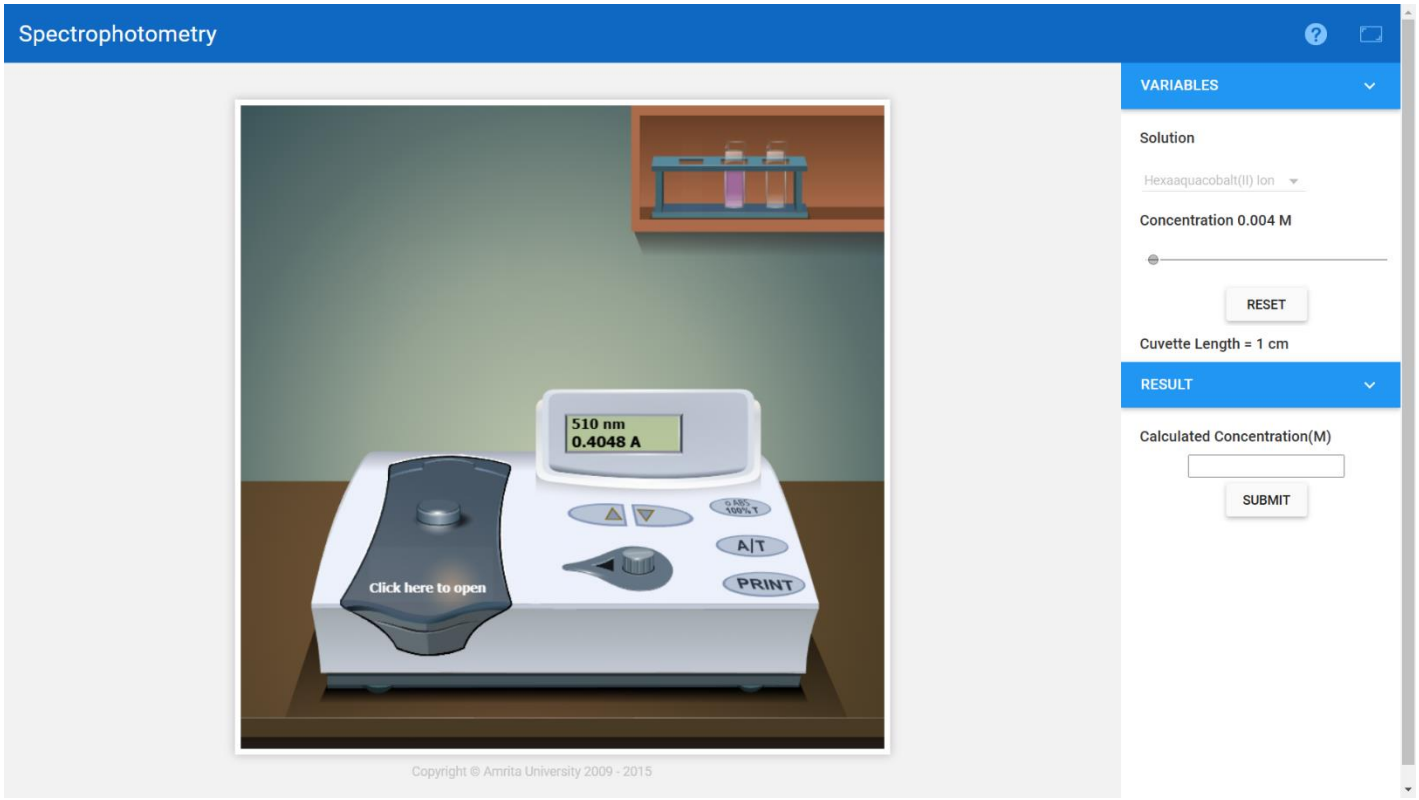
3. Sample No. 2 –



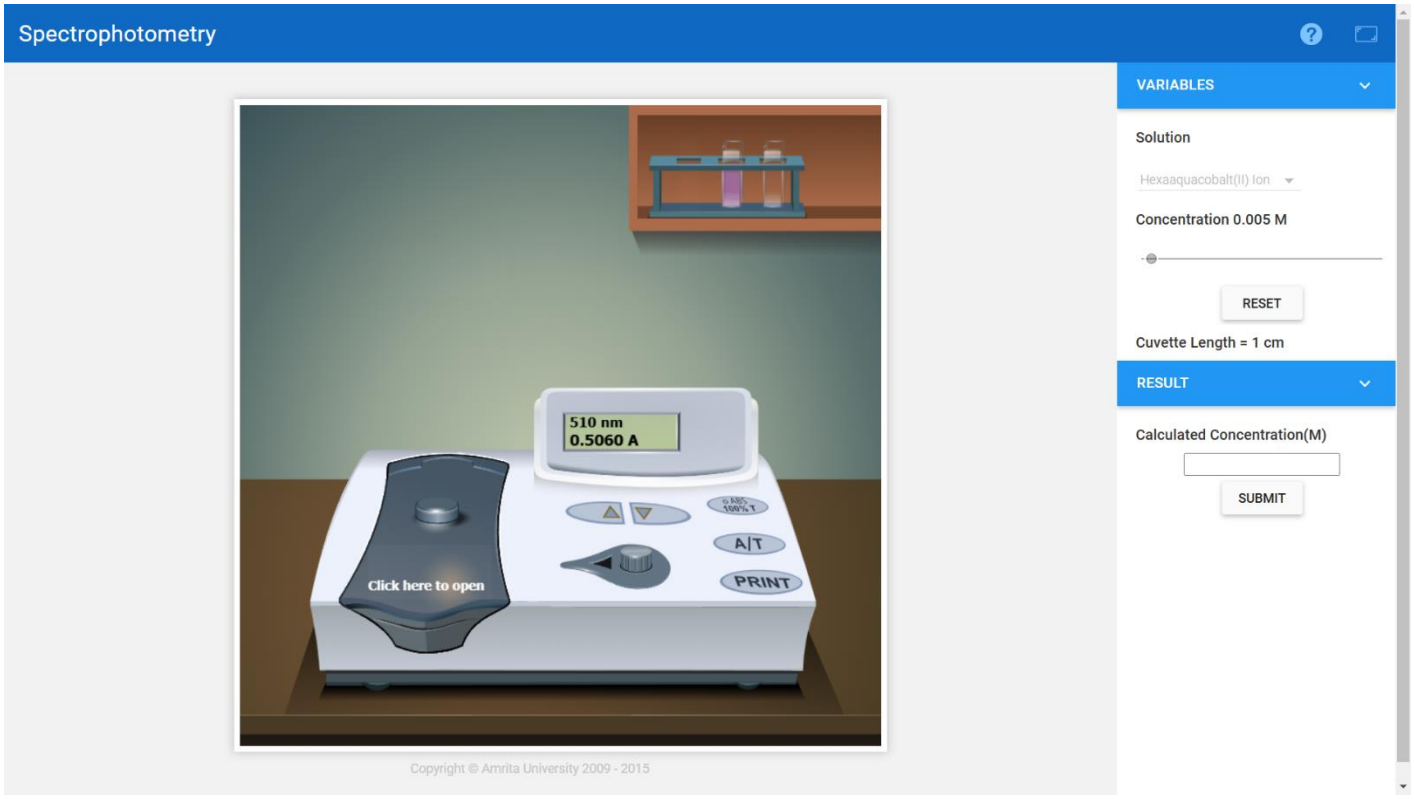

4. Sample No. 3 –



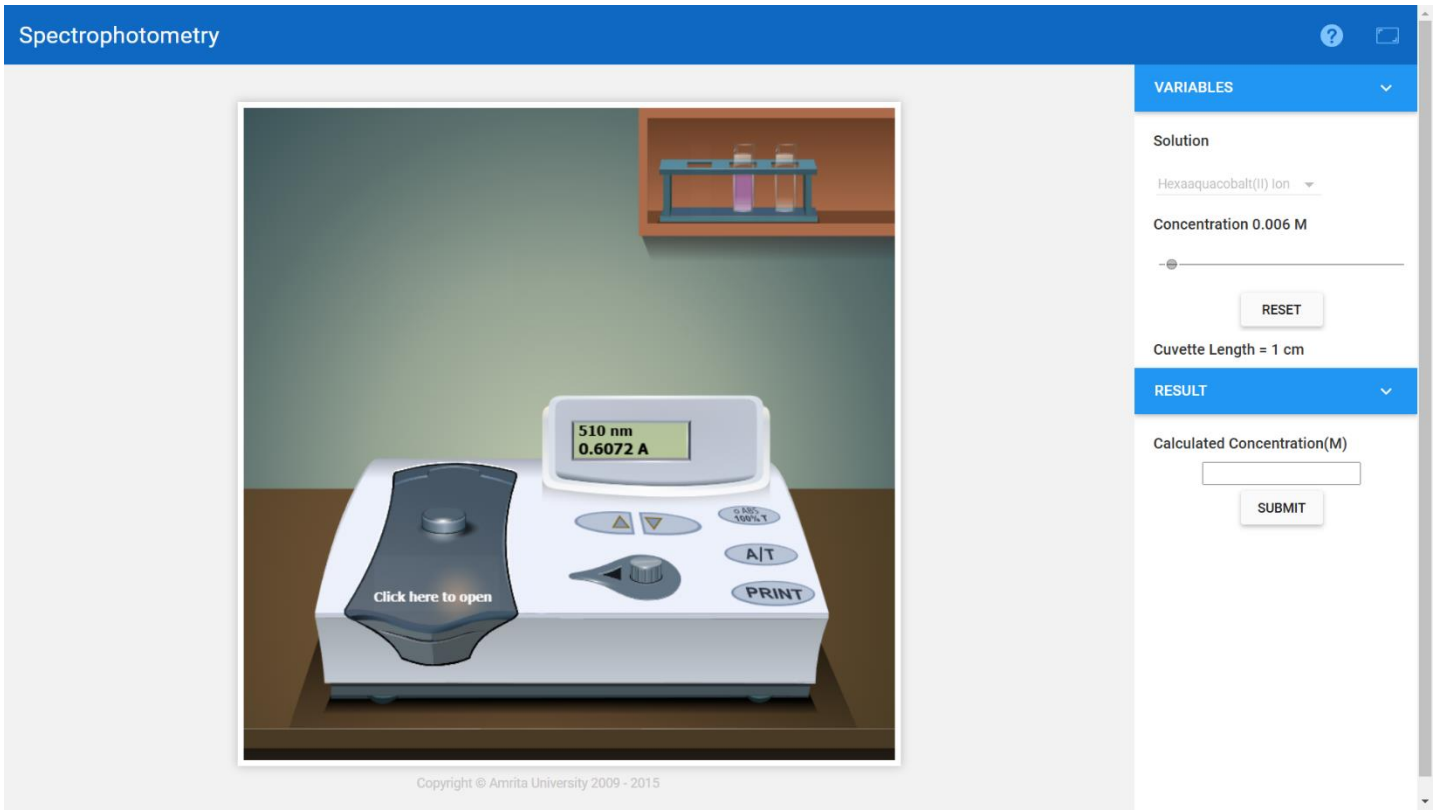
5. Sample No. 4 –



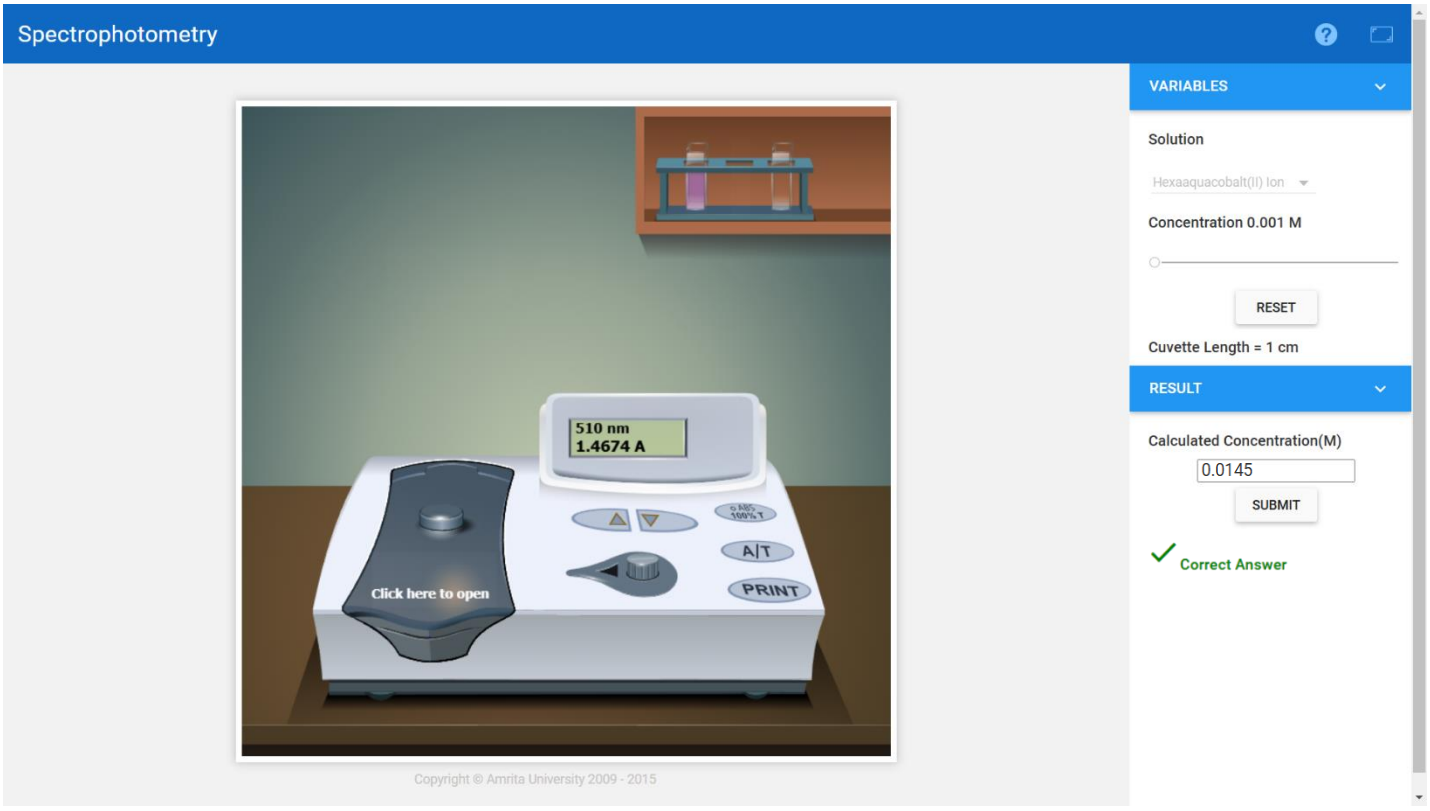

6. Sample No. 5 –



7. Sample No. 6 –




8. Unknown Sample –



## Result:

1. **Concentration of unknown (from graph) = 0.0145 mol/L**
2. **Concentration of unknown (by calculation) = 0.0145 mol/L**
3. **Slope of graph** = (0.6072-0.5060)/(0.006-0.005) **= 101.2**