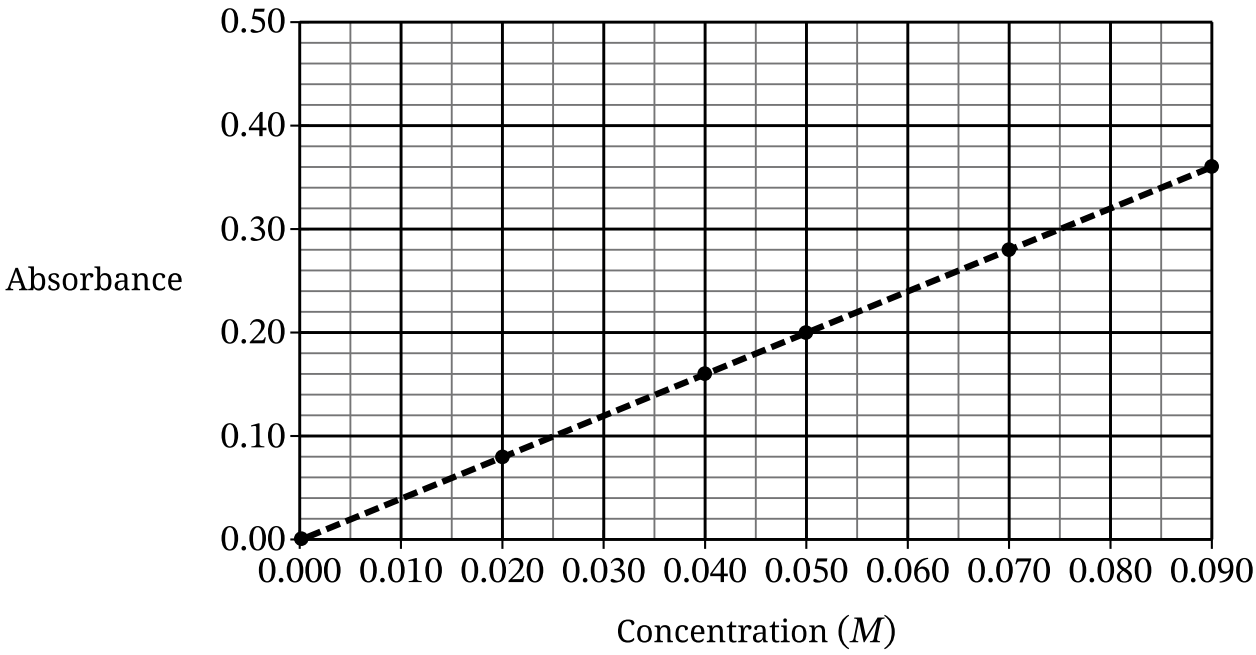
Question 6: Version J

6. A student performs a spectrophotometry experiment with $V^{2+}(aq)$ solutions and produces the calibration curve shown in Figure 1 by measuring the absorbance of several solutions of known concentration.

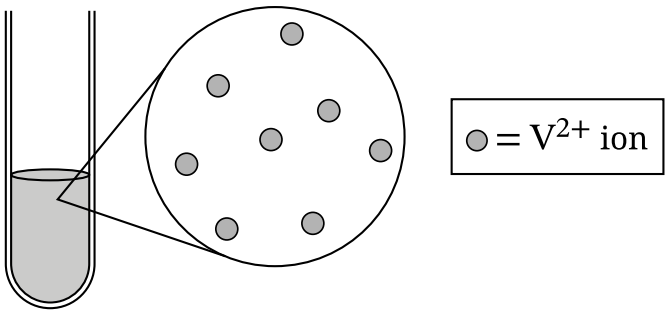
Figure 1



Part A

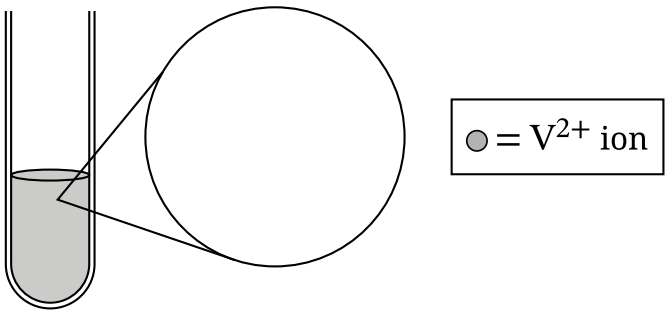
The student measures an absorbance of 0.32 for a $V^{2+}(aq)$ solution. The concentration of V^{2+} ions in the solution is represented by the particle diagram in the circle in Figure 2. In the circle in Figure 3, **draw** the correct number of V^{2+} ions to represent the concentration of a solution with an absorbance of 0.08. (Water molecules have been omitted for clarity. Assume that each particle diagram represents the same volume.)

Figure 2



Absorbance = 0.32

Figure 3



Absorbance = 0.08

Part B

The student measures the absorbance of a different $V^{2+}(aq)$ solution with an unknown molarity, but the absorbance is higher than 0.36 (the upper limit of the graph). The student then transfers 3.00 mL of this $V^{2+}(aq)$ solution to a 25.0 mL volumetric flask, dilutes to the mark on the flask with distilled water, and measures the absorbance of the diluted solution.

i. The absorbance of the diluted solution is 0.22. **Determine** the molarity of $V^{2+}(aq)$ in the diluted solution.

ii. **Determine** the molarity of $V^{2+}(aq)$ in the original, undiluted solution. Show the work that leads to your answer.

Part C

The concentration of $V^{2+}(aq)$ calculated in part B (ii) is lower than the actual concentration of the undiluted solution. The student claims that the calculated concentration is too low because during the dilution step, the final level of the solution was higher than the mark on the volumetric flask. Do you agree or disagree? **Justify** your answer.