Qualitative study of glucose

**Aim:** To determine the concentration of an unknown solution.

**Background:** There are many ways to measure blood glucose level. In this colour-based reaction, a standard curve will be produced using solutions of known glucose concentration; this will subsequently be used to estimate the glucose concentration in unknown solutions.

***The assay***

Glucose is a monosaccharide reducing sugar. In this reaction, the glucose readily donates electrons to permanganate (MnO4-), causing it to change colour from purple/pink to a reduced, colourless solution of manganese ions (Mn2+).

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As a result of this reaction, the glucose is oxidised. The time taken for the loss of colour from a standardised solution of permanganate is directly related to the concentration of glucose present in solution.

***Precautions***

* Accurate recording of time
* Avoid contamination by using clean syringes/beakers for each glucose concentration.

Step 1 – Preparing a linear dilution series of glucose

*Materials*

|  |  |  |
| --- | --- | --- |
| Glucose powder | Balance and weigh boat | 100 cm3 measuring cylinder |
| spatula | Magnetic flea and stirrer | 250 cm3 beaker |
| Distilled water | 5x 100 cm3 beakers | Range of measuring cylinders or glass pipettes/pump |

*Method*

1. To a beaker, add 20 g glucose and 50 cm3 distilled water. Use the magnetic flea and stirrer to fully dissolve the glucose.
2. Transfer the contents to the measuring cylinder and top up to 100 cm3 with distilled water.
3. A linear dilution series of glucose solutions (50cm3 of 2%, 4%, 6%, 8% and 10% glucose) must be prepared. Use the table below to prepare these, based on the formula C1V1=C2V2. In each case, the volume must be topped up to 50 cm3 with distilled water.

|  |  |  |  |
| --- | --- | --- | --- |
| **C1 (%)** | **V1 (cm3)** | **C2 (%)** | **V2 (cm3)** |
| 20 | 25 | 10 | 50 |
| 20 | 20 | 8 | 50 |
| 20 | 15 | 6 | 50 |
| 20 | 10 | 4 | 50 |
| 20 | 5 | 2 | 50 |

*C1 = stock concentration to use, i.e. for all dilutions, the 20% glucose stock will be used.*

*V1 = the volume of the 20% glucose solution to add to a beaker.*

*C2 = concentration of the new glucose solution.*

*C2 = volume of the new glucose solution required.*

*Example (3rd line in the table):*

To prepare 50 cm3 8% glucose solution, 20cm3 of the 20% glucose stock solution must be added to a beaker. This must be topped up to 50cm3 using distilled water.

Step 2 – The glucose standard curve assay

*Materials*

|  |  |
| --- | --- |
| Eye protection | Glucose solutions (2%, 4%, 6%, 8%, 10%) |
| Stopwatch | 3 solutions of unknown glucose concentration (A, B, C) – must be between 2-10% |
| Stirring rod | Universal of 1 mol/L Sulfuric acid |
| 6x boiling tubes and rack | Universal of 0.4 g/L Potassium permanganate |
| 3 syringes (2ml, 5ml, 10ml) | Marker pen |

*Method*

1. Using a marker pen, label each syringe with the solution it will be used for: “G” (for glucose), “PP” (for potassium permanganate) and “S” (for sulfuric acid).
2. To each boiling tube, use the “G” syringe to add 10cm3 glucose (of the appropriate concentration). Start with the weakest (2%) glucose solution.
3. To each boiling tube, use the “S” syringe to add 5cm3 sulfuric acid.
4. **To the 2% boiling tube**, use the “PP” syringe to add 2cm3 potassium permanganate. Use the stirring rod to mix the contents and immediately start the stopwatch. Rinse the stirring rod with water.
5. Record the time required for the pink colour to disappear.
6. Repeat these steps for the other glucose solutions of known concentration (see table below).
7. Repeat the full experiment a further two times and calculate average values.

***Standard Curve Data***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Glucose concentration (%)** | **Time for potassium permanganate to decolourise (s)** | | | |
| **1** | **2** | **3** | **Average** |
| 2 |  |  |  |  |
| 4 |  |  |  |  |
| 6 |  |  |  |  |
| 8 |  |  |  |  |
| 10 |  |  |  |  |

1. Repeat for the solutions of unknown concentration (A, B and C). Perform in triplicate.
2. Plot the standard curve for the glucose solutions of known concentration and use this to estimate the concentration of the unknown solutions.

***Data for “unknown” solutions***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Solution** | **Time for potassium permanganate to decolourise (s)** | | | |
| **1** | **2** | **3** | **Average** |
| A |  |  |  |  |
| B |  |  |  |  |
| C |  |  |  |  |

**See attached graph paper to graph standard curve**

***Determination of glucose concentration***

|  |  |
| --- | --- |
| **Solution** | **Glucose concentration (%)** |
| A |  |
| B |  |
| C |  |