Unit 3. 18 / 20 **PHOSPHORUS CONTENT IN LAWN FOOD** Name:_____

DATE: _____ **EXTENDED EXPERIMENT INVESTIGATION-4** Partner's Name:_____

CONDITION: This experiment will require approximately lesson.

THEORY: Phosphorus reacts with Ammonium Molybdate to form a blue compound called Phosphomolybdate after approximately 10 minutes. Phosphomolybdate can be reduced with ascorbic acid causing the blue colour to fade. The concentration of Phosphorus can be determined by its blue colour using Colorimetry. ✓

PURPOSE: To find the concentration of phosphorus using colorimetry (1 mark)

SKILLS IN CONDUCTING EXPERIMENT (Observed by Teacher) (3 marks)

EQUIPMENT: lawn food solution (6.3 % P), 0.1 M Ammonium Molybdate, Colorimeter, test tubes, de-ionised water, standard phosphorus solution containing 10.0 mg/L Phosphorus.

RISK MANAGEMENT: Use the MSDS & ERA sheets to discuss the dangers, precautions & disposal of chemicals. (2 marks) ✓

Ammonium Molybdate disposal down sink
dangers - harmful if swallowed may cause irritation
precaution - need goggles, labcoat, gloves, rinse if in eye, remove clothing and wash soap and water if on skin

PROCEDURE: Record the trade name and the Phosphorus content of the fertiliser induce vomiting if swallowed drink plenty of water / milk

1. *Weigh out 0.301 g of finely ground fertiliser into a 100 mL beaker.* **The first 3 steps have been done by the Lab Tech!**
2. *Add about 20 mL of boiling hot water and dissolve as much of the fertiliser as possible. Then transfer this to a 250 mL volumetric flask. Add de-ionised water accurately to the mark on the flask and shake the contents well.*
3. *Use a measuring cylinder to accurately transfer 25 mL of this solution to another 250 mL volumetric flask and again fill the flask to the mark and shake the contents.* ***This represents a 1:10 dilution of the original sample.***
   *Discard the original dissolved sample from the first volumetric flask (**not** the 1:10 diluted solution).*
4. Label 5 test tubes (near the top of the tube): **10.0 mg/L, 7.5 mg/L, 5.0 mg/L, 2.5 mg/L, 0 mg/L** (this is de-ionised water).
5. Place about 20 mL of the 1:10 diluted solution into another test tube and label this: **Unknown**.
6. Use a 10 mL measuring cylinder to add standard Phosphate ([P]) solution and de-ionised water according to the following table:

Standard [P]	**10.0 mg/L**	**7.5 mg/L**	**5.0 mg/L**	**2.5 mg/L**	**0 mg/L**
Volumes of 10 mg/L [P] and H_2O to use	20 mL std [P]	15 mL std [P] 5 mL H_2O	10 mL std [P] 10 mL H_2O	5 mL std [P] 15 mL H_2O	20 mL H_2O

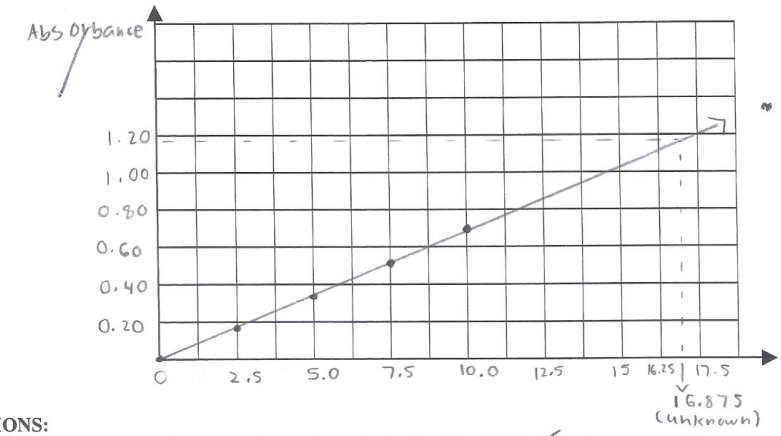
7. Get your teacher to add about 2 mL of Ammonium Molybdate reagent to each test tube. Then you add a few crystals of ascorbic acid to each of the 6 test tubes. Stir each test tube to dissolve the crystals. Then place all 6 test tubes in a 600 mL beaker containing 200 mL of boiling water. Warm the 6 test tubes for 5 minutes and then remove all 6 test tubes at the same time (so all of the test tubes are heated for the same time and have sufficient time for the blue colour to appear).
8. Turn on the colorimeter (red button), set the Filter to **YEL** & check for a red light next to Absorbance and **not** Transmittance, otherwise press the Unit (blue) button. ¾ fill a cuvette (cell) with the **0 mg/L** solution and wipe the outside of the cuvette with a tissue. Check the reading for the **0 mg/L** (de-ionised water) is 0, otherwise press the Unit (blue) button for 2 seconds.
9. Discard the liquid from the cuvette, rinse it twice with the **2.5 mg/L** solution and then fill it ¾ with the **2.5 mg/L** solution. Measure its absorbance. Repeat this step with the other standard Phosphate solutions and then with the **Unknown** sample, rinsing the cuvette twice with the solution about to be measured.
   *If any of the results are "unusual" re-test the **0 mg/L** standard and re-calibrate the colourimeter to 0 and repeat.*
10. Sketch a graph of the Absorbance vs [P] and plot the **Unknown** sample's absorbance and determine its concentration.

RESULTS: (2 marks)

1. % P in Fertiliser stated by manufacturer = 3.5% ✓ 10.6% as PO_4^{3-}
2. Mass of fertiliser = ~~0.301 g~~ 0.601g ✓
3. Complete the following table relating to the Concentration and Absorbance of the standard solutions & sample: ✓

Concentration	**0 mg/L**	**2.5 mg/L**	**5.0 mg/L**	**7.5 mg/L**	**10.0 mg/L**	**Unknown**
Absorbance	0.0	0.18	0.34	0.52	0.69	1.19

4. Complete the following graph of the Concentration and Absorbance of the standard solutions and the sample. **(3 marks)**
Show a line of best fit for the standard solutions so it can be used to determine the concentration of the **Unknown**:



QUESTIONS:

1. a). Provide the concentration of Phosphorus (in mg/L) in the diluted (20 mL) unknown sample. **(1 mark)**

[Phosphorus] $_{20ml\ diluted}$ = 16.875 mg/L Use 2sig figs

b). Determine the concentration of Phosphorus (in mg/mL) in the **original** sample before being diluted 1:10. **(1 mark)**

[Phosphorus] original = 16.875 x 10 ← ratio

= 168.75 mg/L

168.75 mg ÷1000 / L ÷100 = x mg / mL dilution factor by 10

0.16875 mg / 1 mL = 1.68×10^{-4} g/mL

2. a). Determine the mass of Phosphorus present in the original 250 mL flask containing all of the sample. **(1 mark)**

168.75 mg / 1 = x mg / 250 mL x4

168.75 mg = 4x mg

m = 168.75 x 250 / 4

= 42 mg.

1.68×10^{-4} g / mL x250 = x g / 250 mL

x = 42.188 mg = 0.04227 g

0.0422 g/mL

b). Determine the % by mass of Phosphorus in the fertiliser. **(1 mark)**

% mass of Phosphorus = 0.0422 / 0.601 x 100

= 7.02 %

3. Compare the result to that stated on the bottle and provide an explanation for any difference: **(2 marks)**

The result calculated is very high compared to the percentage stated (3.5%) by the manufacturer. There might have been errors in this prac but compare to 10.6% example test tubes not clean, adding ~~different amounts of~~ ascorbic acid, cuvettes not rinsed properly. The colour of the sample was darker than 10.0 mg/L so I am expecting a result that is high.

4. Why is a yellow filter used in a Colorimeter (or a UV Spectrometer) when testing blue solutions? **(1 mark)**

The yellow filter is used in the colorimeter because we have chosen a complementary colour close to blue. Blue is being reflected and yellow would be the best colour to measure absorbance (yellow absorbs best)

5. A student places some 2.5 mg/L solution in the curvette previously containing 10 mg/L without washing out the curvette and leaving it to dry. Explain how this error would affect the 2.5 mg/L solution's absorbance reading. **0/(1 mark)**

This would affect the cuvette because the cuvette would have a new concentration that would not produce the right absorbance that should be in range to others. It would be too high due to contamination from 10 mg/L

6. In another class, the Calibration Graphs produced by all of the students show an absorbance of 0.10 for a standard solution containing 0.00 % Phosphorus (de-ionised water). Provide an explanation for this occurrence. **(1 mark)**

There is probably a contamination that has occurred. At 0.00% there should be a 0 reading. Either there was contaminants from other solutions previously in the cuvettes or solution.