

A

Dear Dr. Rupert:

I tested each of your subjects and found that subject B had kidney stones subject D might get kidney stones because his level is high and the other 2 subjects have less calcium so they are good but subject B & D should watch.
 subject A had 10.96 g/L of calcium.
 subject B had 39.92 g/L of calcium.
 subject C had 10.98 g/L of calcium.
 subject D had 32.36 g/L of calcium.
 so these are your results.

Medical lab tech

B

Procedure:

- ① obtain 4 urine samples
- ② add 30 ml Na₂SO₄ to each 25 ml urine sample
- ③ Filter solution through filter paper
- ④ Weigh filtrate when dry

	Weight of Filtrate	g/mol Ca	g/L calcium
SAMPLE A	0.15 g	0.04 g	1.6
B	2.64 g	0.77 g	30.8
C	0.14 g	0.04 g	1.6
D	2.0 g	0.58 g	23.2

Flame test:

- ① mix $\frac{1}{4}$ test tube of each urine sample with $\frac{3}{4}$ of Na₂CO₃
- ② filter the mixture and flame test the leftover liquid
- ③ record observations

	Results
SAMPLE A	orange
B	orange
C	orange
D	orange.

LOW LEVEL 1

C

Calculations - for g/L

SAMPLE

$$A \quad \frac{136.14}{40.08} = \frac{0.15}{x} \quad x = \frac{40.08 \times 0.15}{136.14} = 0.04 \text{ g/L}$$

$$B \quad \frac{136.14}{40.08} = \frac{2.64}{x} \quad x = \frac{40.08 \times 2.64}{136.14} = 0.77 \text{ g/L}$$

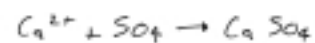
$$C \quad \frac{136.14}{40.08} = \frac{0.14}{x} \quad x = \frac{40.08 \times 0.14}{136.14} = 0.04 \text{ g/L}$$

$$D \quad \frac{136.14}{40.08} = \frac{2.0}{x} \quad x = \frac{40.08 \times 2.0}{136.14} = 0.58$$

D

Calculations - kidney stones

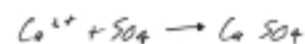
SAMPLE (A)



$$\frac{\text{CaSO}_4}{\text{Ca}^{2+}} \quad \frac{136.14}{40.08} = \frac{.90}{x}$$

$$\text{Ca}^{2+} = \frac{.264}{0.025} = \boxed{10.6} \quad x = .264$$

(B)



$$\frac{\text{CaSO}_4}{\text{Ca}^{2+}} \quad \frac{136.14}{40.08} = \frac{3.39}{x}$$

$$\text{Ca}^{2+} = \frac{.998}{0.025} = \boxed{39.92} \quad x = .998$$

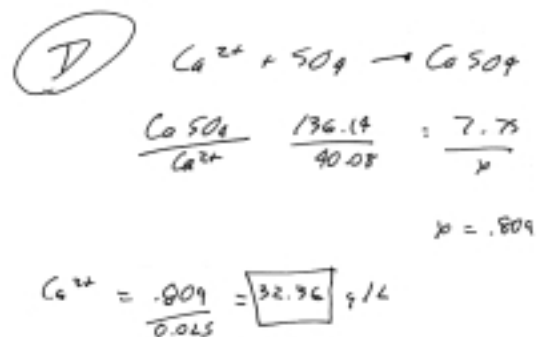
(C)



$$\frac{\text{CaSO}_4}{\text{Ca}^{2+}} \quad \frac{136.14}{40.08} = \frac{.90}{x}$$

$$\text{Ca}^{2+} = \frac{.262}{0.025} = \boxed{10.48} \quad x = 10.48$$

E



Teacher's Notes

Knowledge/Understanding

- The student describes the procedures with very limited accuracy. The student realizes that sodium sulfate is the appropriate reagent to precipitate calcium ions in the quantitative test. However, the details of the quantitative procedure are sketchy (e.g., there is no indication of how the solution volumes are measured; there is no instruction to determine the mass of each filter paper before filtering the product mixture). The step that reads "weigh filtrate when dry" confuses the filtrate with the precipitate. There is no procedure for the qualitative precipitation test. The flame test procedure includes no details of how a flame test is performed. The student does not include a list of materials needed for the tests.
- The student calculates ion concentrations with limited accuracy. In the calculations headed "Calculations - for g/L", the student appears aware that he or she is calculating the mass of calcium in each precipitate. However, three of the calculated values are expressed in "g/L", and the fourth calculated value has no units. The stoichiometric ratio is implicit in the calculations, but the student makes no mention of it. The significance of the calculations headed "Calculations - kidney stones" is unclear because they include quantities of unexplained origin and with no units (i.e., ".90" for sample A; "3.39" for sample B, and so on). The values in the second column of data in the first table show the mass of calcium in each 25 mL urine sample. The student appropriately multiplies these values by 40 to obtain the values in the final column, i.e., the mass of calcium per litre of each sample, but he or she does not show or explain this calculation method.

Inquiry

- The student creates chemical equations with limited competence. The only equation included is a net ionic equation that represents the precipitation of calcium sulfate. In this equation, the chemical formula for calcium sulfate is correct. The atoms are balanced in the equation. However, the charges are not balanced, because the charge on the sulfate ion is missing. No states are shown.

LOW LEVEL 1

- The student analyses the test results with very limited effectiveness. The only analysis appears in the summary for the doctor, where the student shows some awareness that calcium is involved in kidney stone formation (e.g., “the other 2 subjects have less calcium so they are good”). The student offers no justification for his or her conclusions (e.g., “subject B had kidney stones”) and provides no analysis of qualitative observations.

Communication

- The student displays laboratory results in a table format with very limited effectiveness. The first column of quantitative data in the first table includes the mass of each precipitate, expressed appropriately in grams. However, the measured masses used to determine each mass are not recorded, and the column has the inappropriate heading “weight of Filtrate”. The next column is headed incorrectly as “g/mL of Ca”, when the values in this column show the calculated mass of calcium in each 25 mL urine sample. The final column in this table has the unclear heading “g/L calcium”. The second table shows the colour observed in the flame tests, but no other qualitative observations are tabulated. In both tables, some of the lines needed to separate the cells are missing.
- The student communicates the procedures and results with limited clarity. The report begins appropriately with the summary for the doctor, but the report is not well organized overall (e.g., some tabulated data precede the calculations used to determine them). The report includes no useful sub-heads (e.g., “Procedure” does not indicate the quantitative analysis procedure; “Calculations - for g/L” precedes the calculation of the mass of calcium in each sample). The student uses little scientific terminology and shows some confusion over meanings (e.g., using “weight” instead of mass). He or she writes the formula of calcium sulfate correctly in some places but incorrectly as “CaSO⁴” in others, and writes other formulas incorrectly (i.e., “NaCO₃”, “NaSO₄”).

Making Connections

- The student summarizes the urinalysis testing with limited effectiveness. He or she writes a summary addressed to the doctor and includes the calculated concentration values. However, the calculated value of “10.6” for “subject A” becomes 10.96 g/L in the summary. The student makes the vague recommendation that “subject B, D should watch it”. The summary does not include any qualitative results.

Comments

This work is representative of a low level-1 performance. The student demonstrates a limited degree of achievement of the expectations in the Making Connections category of knowledge and skills. The student also demonstrates a limited degree of achievement with respect to one criterion in the Knowledge/Understanding category, one criterion in the Inquiry category, and one criterion in the Communication category. However, with respect to one criterion in each of the Knowledge/Understanding, Inquiry, and Communication categories, the student demonstrates a very limited degree of achievement.

Next Steps

In order to improve his or her performance, the student needs to:

- include all procedures in sufficient detail to permit replication;
- include a materials list that is completely consistent with the procedures;
- show more detailed calculations that reflect the experimental data and that explicitly make use of a stoichiometric ratio;
- write balanced ionic equations that include the states of all reactants and products;
- analyse the results for all patients and justify the conclusions;
- record all qualitative observations and mass measurements in tables that are easy to interpret and free of errors;
- edit and proofread the report to eliminate errors in the use of terminology, units, and chemical formulas, and to improve organization and clarity;
- write a more detailed summary that accurately reflects all the experimental results.