

## Preparation of Solutions

Solutions A and B (for 1 L)

In 1000mL water, dissolve the following:

10g glucose

10g sodium hydroxide

10mL 1% methylene blue (Dissolve 0.1g methylene blue powder in 10mL ethyl alcohol.)

Flask A: half-filled (or half-empty depending on your point of view) and stoppered

Flask B: filled to top with NO air space below the stopper.

CAUTIONS: Sodium hydroxide is very caustic. Avoid contact with skin and eyes. Flush with water if contact is made.

## Solving a Problem with the Scientific Method

### **PART A.**

1. Do you think both flasks contain the same liquid? \_\_\_\_\_
2. Explain why you think that way. \_\_\_\_\_  
\_\_\_\_\_
3. Is your answer to question 1 based on experimentation or guessing? \_\_\_\_\_  
\_\_\_\_\_
4. Would scientists guess at answers to questions or would they experiment first? \_\_\_\_\_  
\_\_\_\_\_
5. Are both flasks exactly alike in amounts of liquid? \_\_\_\_\_
6. What gas may be in the upper half of flask A that is not in flask B? \_\_\_\_\_  
\_\_\_\_\_
7. Is there any direct evidence for your answer to question 5? \_\_\_\_\_  
\_\_\_\_\_

### **PART B.**

#### *Experiment 1*

8. After shaking the flasks, do you think they contain different liquids? \_\_\_\_\_
9. Is it possible that the liquids in both flasks are the same and that the space above the liquid in flask A is responsible for any change that might have occurred? Why do you think so?  
\_\_\_\_\_  
\_\_\_\_\_

*Experiment 2*

10. Do both flasks now appear to contain the same liquid? \_\_\_\_\_

\_\_\_\_\_

11. What may have been added to flask B that was not present before? \_\_\_\_\_

\_\_\_\_\_

*Experiment 3*

12. After one shake, are the two liquids generally 'behaving' in a similar way? That is, is the time needed for flasks A and B to return to their original condition about the same?

\_\_\_\_\_

\_\_\_\_\_

13. After two or three shakes, are flasks A and B generally 'behaving' in a way similar to each other?

\_\_\_\_\_

\_\_\_\_\_

14. Refer to data Table .

a) Does flask A show an increase or decrease in time needed to return to its original condition as the number of shakes increases from one to three? \_\_\_\_\_

\_\_\_\_\_

b) Does flask B show a similar change? \_\_\_\_\_

15. Refer to data Table .

Do three trials give better evidence that flask A is 'behaving' in a way similar to flask B after shaking each flask? \_\_\_\_\_

\_\_\_\_\_

a) once? \_\_\_\_\_

b) twice? \_\_\_\_\_

c) three times? \_\_\_\_\_

16. Do three trials give better evidence that an increase in time is needed for the liquid to return to its original condition as the number of shakes increases from one to three

- a) for flask A? \_\_\_\_\_
- b) for flask B? \_\_\_\_\_

17. Explain why scientists perform a number of trials in an experiment instead of basing the conclusions on only one trial. \_\_\_\_\_

---

---

*Experiment 4*

18. Does the removal of the stoppers cause any differences in the manner in which the liquids 'behave'? \_\_\_\_\_

19. What may have entered the flasks while they were open? \_\_\_\_\_

---

**PART C – Interpretations**

20. Think carefully about what you have observed and answer each of the following questions.

a) On the basis of your first observations, could you decide if both flasks contain the same liquid? \_\_\_\_\_

b) After performing Experiment 1, could you decide if both flasks contain the same liquid? \_\_\_\_\_

c) Did you ever suspect that flasks A and B both contained the same liquid? \_\_\_\_\_

d) Do Experiments 3 and 4 support the conclusion that the liquids are the same? \_\_\_\_\_

e) Beside the liquid itself, what seems to be needed for the change to occur in the liquid? \_\_\_\_\_

f) Which experiments support your answer to question 'e'? \_\_\_\_\_

---

**PART D.**

Write a hypothesis that attempts to explain the following:

- a) why the liquid in flask B did not change when the flask was filled completely with the liquid.
- b) why the liquid in flask B changed when the flask was only half filled.
- c) why it is important that shaking occur in both flasks A and B.
- d) why the liquids in flasks A and B would take longer to change back to their original color with more shaking.

Table 1- First Observations

Similarities	Differences

Table 2- Results of Experiment 1

Similarities	Differences

Table 3- Results from Experiment 2

Similarities	Differences

Table 4- Results of Experiment 3

Time in seconds to return to original condition			
	1 shake	2 shakes	3 shakes
Flask A			
Flask B			

Table 5- Three trials of Experiment 3

Time in seconds to return to original condition									
Trial	1 shake			2 shakes			3 shakes		
	1	2	3	1	2	3	1	2	3
Flask A									
Flask B									

Table 6- Results of Experiment 4

Similarities	Differences