Names:

School:

2003 UTAH SCIENCE OLYMPIAD - PHYSICS LAB

CONSTANT LINEAR ACCELERATED MOTION - PAGE 1

In this part of the Physics Lab competition, you will use a stopwatch, a protractor and a meter stick to measure the motion of a toy car and a brass cylinder as they roll down a ramp. You can change the angle of the ramp by moving the bolt and wing-nut at the top end of the ramp. Only put the bolt through the round holes that have a black circle around them. Read the entire lab before beginning.

Useful equation: $x - x_o = v_o t + 1/2\ at^2$

- -

1. Determine the acceleration of the toy car down the ramp for three values of the ramp angle, using the round holes with the black circles around them. Carefully explain how you measured the car’s acceleration below. Show all of your calculations on the blank paper provided, and write your results in the table on the next page.

2. Determine the acceleration of the brass cylinder down the ramp for the same three values of the ramp angle. Show all of your calculations on the blank paper provided, and write your results in the table on the next page.

Continued on next page

Names:

School:

2003 UTAH SCIENCE OLYMPIAD - PHYSICS LAB

CONSTANT LINEAR ACCELERATED MOTION - PAGE 2

3. For each ramp angle, which had the greater acceleration - the toy car or the brass cylinder? Why? Give your best explanation, in words, for the difference between the acceleration of the toy car and the brass cylinder.

- -

Table of Results

Ramp position	Ramp angle (degrees)	Acceleration of car (m/s^2)	Acceleration of cylinder (m/s^2)
1			
2			
3			

Names:

School:

2003 UTAH SCIENCE OLYMPIAD - PHYSICS LAB

SIMPLE MEASUREMENTS - PAGE 1

For this part of the Physics Lab competition you will use a refrigerator storage jar filled with marbles. Carefully remove the top of the jar and verify that all of the marbles lie below the top rim of the jar. (You may have to shake the jar so the marbles settle and become more closely packed.) All of the questions below refer to the jar without its top; do not include the removable top in any of your calculations.

Express all of your answers in the proper SI units.

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1. Dump the marbles into the plastic tray and count the number of marbles. Write your value here:

number of marbles = _____

2. Measure the volume of the jar as accurately as you can. (The volume includes all of the space inside the jar up to the rim of the jar.) Carefully explain below your calculation procedure and describe what each measurement is. Write your value here, including the proper SI units:

volume of jar = _____

Continued on next page

Names:

School:

2003 UTAH SCIENCE OLYMPIAD - PHYSICS LAB

SIMPLE MEASUREMENTS - PAGE 2

3. Calculate the volumetric number density of the marbles in the jar. Show your calculation below, and write your answer here, including the proper SI units:

number density = _____

4. Suppose one drop of paint can cover one square centimeter of area. As accurately as you can, estimate how many drops of paint will it take to paint all of the jar's surface, both inside and outside. Carefully explain your calculation procedure and describe what each measurement is. Write your value here:

number of paint drops = _____

Continued on next page

Names:

School:

2003 UTAH SCIENCE OLYMPIAD - PHYSICS LAB

SIMPLE MEASUREMENTS - PAGE 3

5. When all of the marbles are in the jar, what percentage of the jar's volume is occupied by the marbles? Carefully explain your calculation procedure and describe what each measurement is. Write your value here:

percentage occupied = _____ percent

TIE BREAKER

Suppose you melt down all of the marbles and recast them into the form of a single solid sphere. If the density of the material does not change, calculate the radius of the sphere. Carefully explain your calculation procedure and write your answer here, including the proper SI units:

radius of sphere = _____