SINGAPORE PHYSICS OLYMPIAD 2022

Practical Test   15 NOVEMBER 2022

Welcome to the experiment section of the Singapore Physics Olympiad 2022. You are given **two hours** for the experiment. Write your answers/data in this question paper. ANSWER ALL QUESTIONS.

Name: _____

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Investigation of the mystery cubes

The following Figure 1(a) shows a picture of 2 cubes fabricated by 3D printing. In fact for both Cube (A) and Cube (B), there is a cubic cavity right in the center of the cube as illustrated by Figure 1 (b). The design and dimensions of the cubes are the same. The cubic cavity in Cube (A) is filled with normal air. The cubic cavity in Cube (B) is completely filled with water.
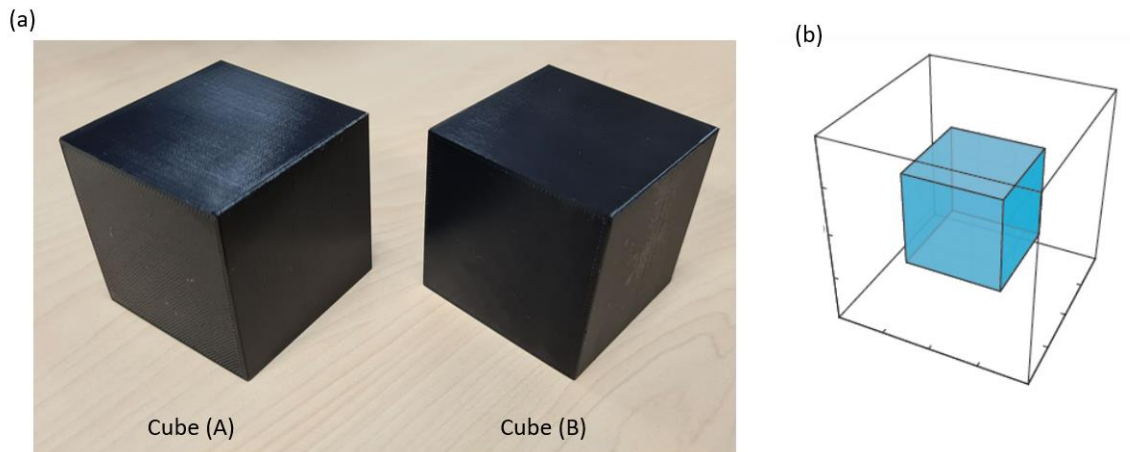

Figure 1: (a) 3D-printed cubes and (b) Cubic cavity inside the cube.

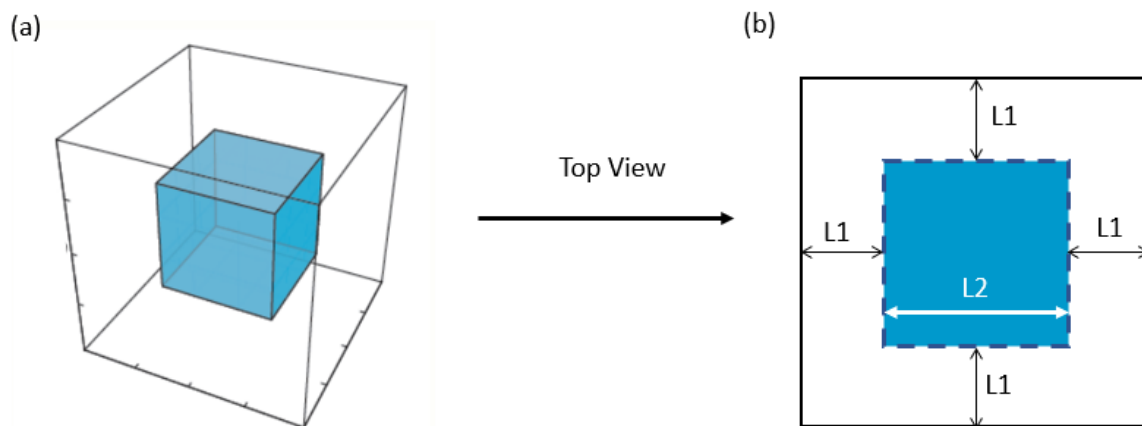In Figure 2, we label important dimensions of the cube and the cavity within.

Figure 2: Labelling of the important dimensions of the cube and its cavity.

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Let's find out more about the cubes

Design and carry out an experiment or a series of experiments to determine/estimate the following parameters:

(a) Mass of Cube (A).

(b) Mass of Cube (B).

(c) The length L1 as labelled in Figure 2.

(d) The length L2 as labelled in Figure 2.

(e) Density of the 3D printed material.

Note that you may assume

(i)   mass of air trapped inside Cube (A) is negligible.

(ii)   density of water is 1.0 g/cm^3.

(iii)   Acceleration due to gravity g = 9.8 m/s^2.

Note that you are not allowed to break the cubes. And you are only allowed to use the items provided and as shown in the picture below. All experiments must be carried out on your bench table and within your cubicle. You can of course use your calculator.

Hint: you may or may not need to make use of all the items provided. Some items are meant to distract you.
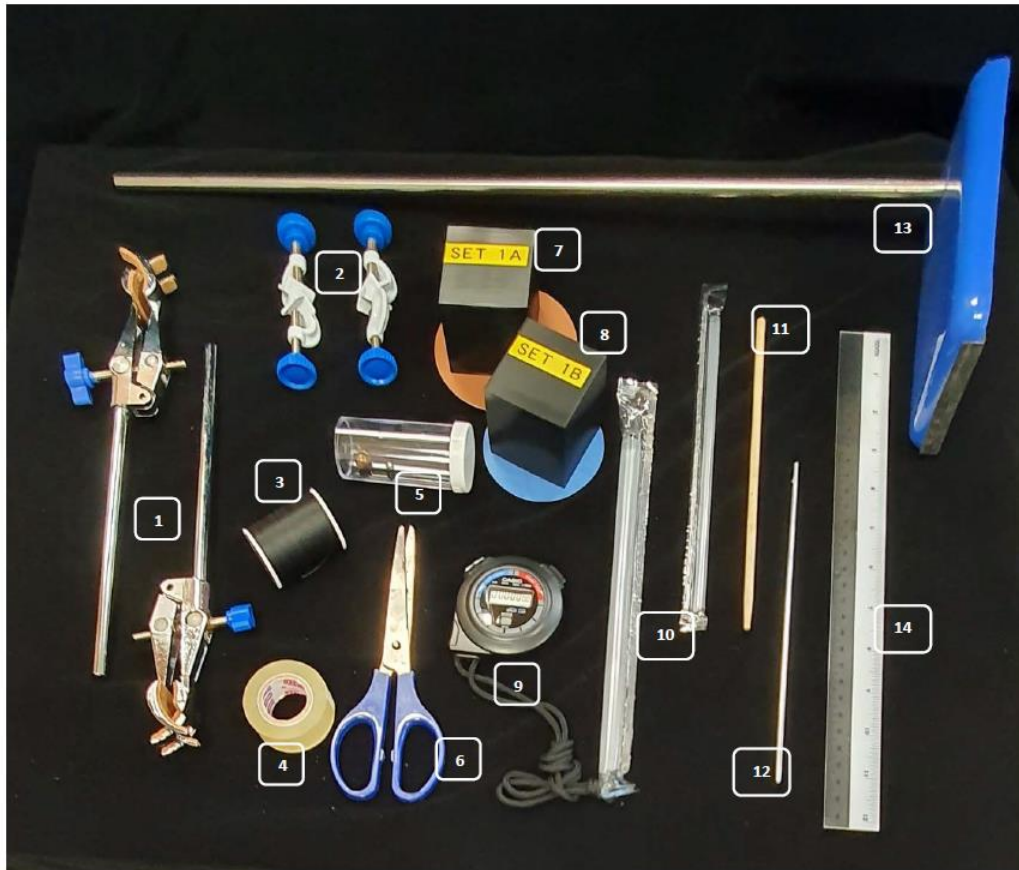
1) Clamps x2
2) Stand head clamps holder x2
3) Thread
4) Clear tape
5) Ball bearings x2
6) Scissor
7) Control (Set 1A). Cube with empty cavity
8) Cube with water (Set 1B)
9) Stop watch
10) Straws x2
11) Wooden stick
12) Aluminium rod

13) Retort Stand

14) Ruler

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Section (A)

Describe the experiment(s) you have designed here.
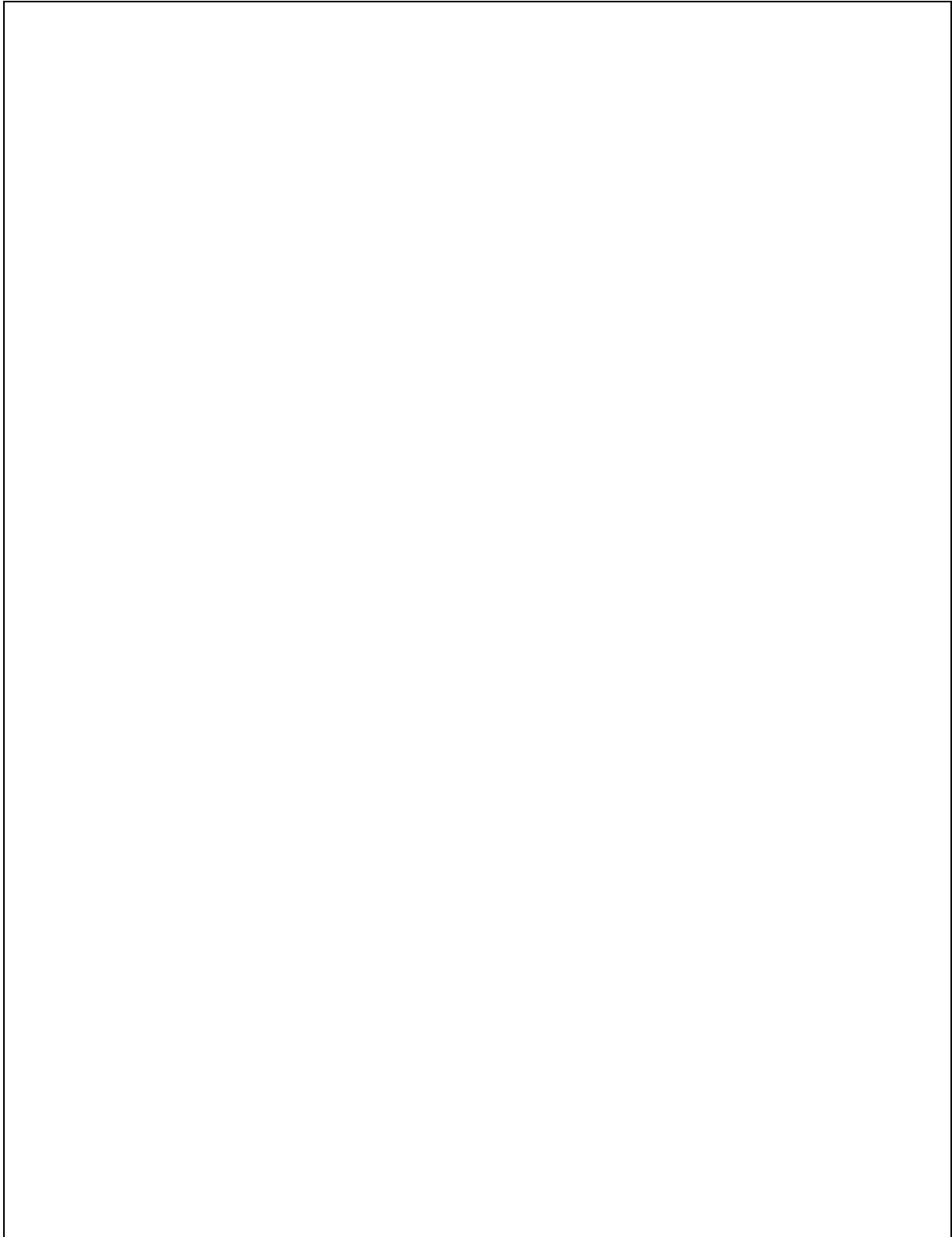
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Section (B)

In the box below, draw a sketch (or sketches if you have designed a series of experiments) with carefully labelled apparatus to illustrate your experimental design.

Note that marks will be given for your sketches (with good labelling of the apparatus).

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Section (C) Carry out the experiment(s) you have designed and proceed to determine the mass of Cube (A), mass of Cube (B), L1 and L2.

You can provide tabulation of your results, plotting of graphs (if applicable) and detail calculation here. (if more space is required, you can use the blank pages provided at the back of this answer booklet).

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Section (C) (Continue from previous page.)

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Section (D) Summary of the results.

Fill in the following table after you have completed your experiment(s).

	Result	Estimated Error in the result
Mass of Cube (A).		
Mass of Cube (B)		
The length L1 as labelled in Figure 2.		
The length L2 as labelled in Figure 2.		
Density of the 3D-printed material.		

Section (E) Discuss the sources of error in your experiment(s).

Name: Junior College/School:

Extra space in case it is required.

Name: Junior College/School:

Extra space in case it is required.

Name: Junior College/School: