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THE UNIVERSITY OF BRITISH COLUMBIA

Faculty of Science

UBC DEPARTMENT OF

PHYSICS ASTRONOMY

Défi Scientifique Michael Smith Science Challenge

Wednesday, February 24th 2021

This challenge will be a one-hour, timed contest to be started and completed between 06:00-20:00 Pacific Standard Time

Instructions

1. Be certain that you understand all of the instructions. If not, ask your teacher. **Make sure you have received your school's unique Teacher ID from your teacher.**
2. Do not ask your teacher or any other person for any help with the content of the contest.
3. This contest is open-book. You are allowed to use the internet or books, but you may not seek assistance from anyone in person or online.
4. You may use any kind of calculator.
5. You will receive **7.5 minutes** to complete each question, and you will not be able to return to the same question once you have proceeded to the next page.
6. When the timer is up, **you will automatically proceed to the next page**. Your submissions for the previous question will be automatically saved.
7. This exam consists of 8 questions. All questions are multiple choice.
8. Enter your official name and other information clearly. Only those who do so can be counted as official contestants.
9. Once you proceed to the next page, you will have **60 minutes** to finish the contest.
10. Please do not exit or reload this page before you finish the exam. Your progress will **not** be saved unless you proceed to the final page and see the "*Your response has been recorded*." message.
11. We will be monitoring our email mschall@phas.ubc.ca from 6 am to 8 pm PST on February 24th. Please contact us by email if you require any assistance on the day of the challenge.

Scoring

There are no penalties for incorrect answers. The questions are not of equal difficulty. We are challenging the strongest science students in Canada; it is possible that the highest overall score will be less than 80%. This is meant to be tough!

Submission

To ensure that your response is submitted, be sure to keep the tab open until you see the End of Exam message on this page.

Contest Named in Honour of UBC Professor Michael Smith (1932-2000)

Nobel Prize 1993, awarded for work on site-directed mutagenesis, the progenitor of gene therapies.

Contest Committee

Chris Waltham, Theresa Liao, Yuka Ma, and Nikita Bernier (translator)

The challenge will start when you proceed to the next page. Once you proceed to the next page, you will have 60 minutes to finish the contest.
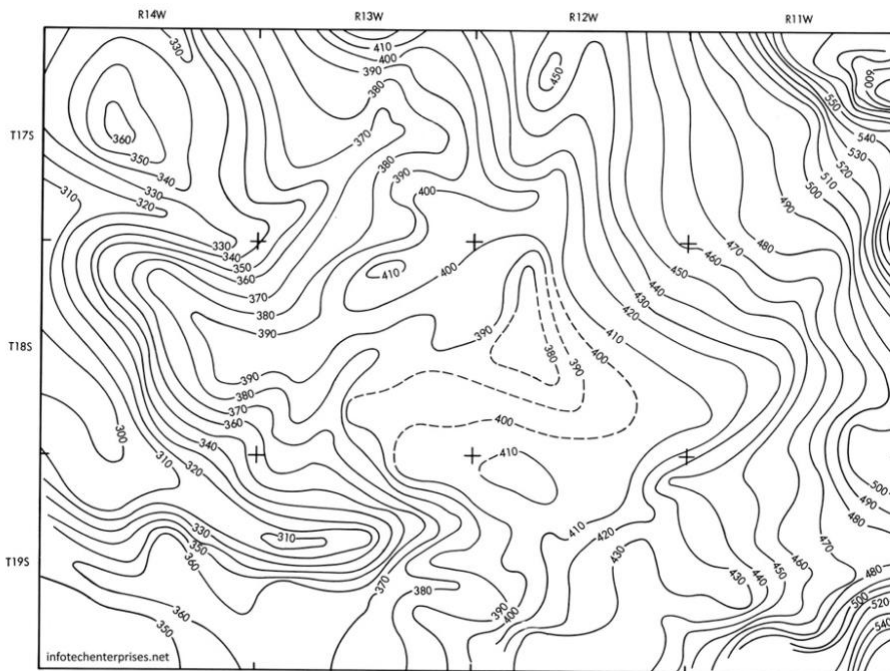
Contour Map (Ver. A)

The chart shown below is a contour map.

A stream that flows from a spring originates at the red X. Place a dot where the stream leaves the map.
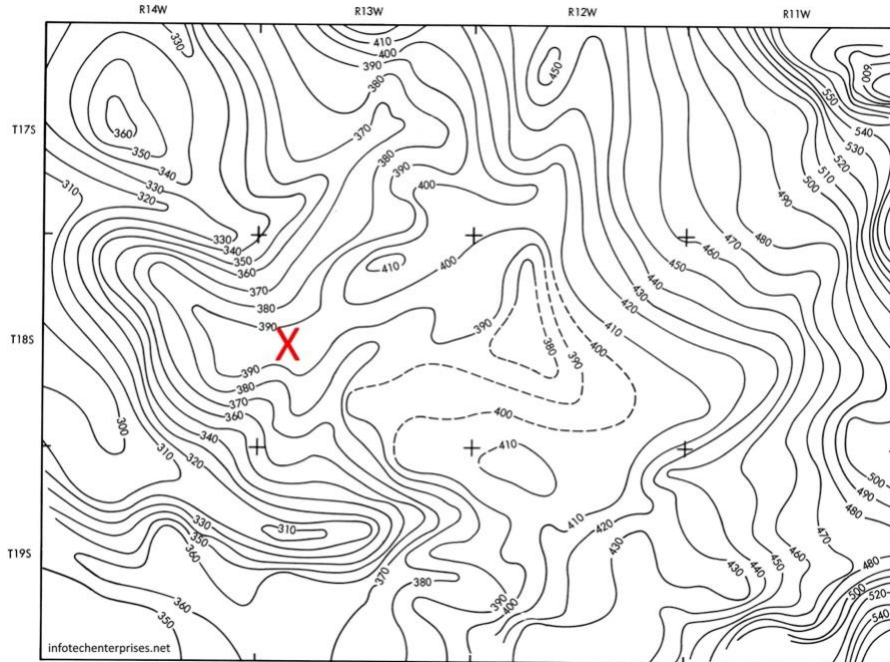
Place two dots on the map where a lake might form. Order does not matter.

Note: Each student was shown one of four versions of the first map, each with a different spring location.
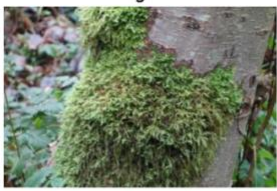
Plant Classification (Ver. A)

For the following question, you may access the following given links to aid in your research to find the correct answer.

Land plants are divided into four groups: (please right click and open these links in a new tab)

A) Bryophyte

B) Pteridophyte

C) Gymnospermae

D) Angiospermae

Drag and drop the following into their correct groups.

Items

Bryophyte	Pteridophyte

Gymnospermae	Angiospermae

Not plants

Note: Each student was shown one of four similar versions of this question, each with a different set of plant pictures.

Gold-Slice

Assume that you have an infinitely sharp knife and the ability to manipulate and observe matter all the way down to the atomic scale. Start cutting a solid in half. After the first cut, you take one of the two resulting pieces and cut it in half, and continue repeating this process until you can no longer do it because you are down to a single atom. Approximately how many times could you cut a mass of *700 g* of pure gold in half? **Round down to the closest integer if your result is not a whole number.**

- ○ 75
- ○ 76
- ○ 77
- ○ 78
- ○ 79
- ○ 80
- ○ 81
- ○ 82
- ○ 83
- ○ 84
- ○ 85

Note: Each student received a randomized mass of the pure gold given in this question.

COVID

Consider the COVID infection rates for health regions A, B, C.

Health region A has a population of *848450*, and *880* infections per day, averaged over the last week.

Health region B has a population of *2049310*, and *4345* infections in the last week.

Health region C has *700* infections per 100,000 people in the last week.

Drag and drop the following health regions by the size of their COVID problem:

Items

Health region A

Health region B

Health region C

Worst COVID Problem (one answer only)

Least Bad COVID Problem (one answer only)

Note: Each student received randomized population numbers and infection rates for each health region.

Antilock Braking Systems (ABS) cause a sharply braking vehicle to leave rubber skid marks on the road at a rate of **18 times per second**. In the case of an accident, police can use the spacing of these marks to determine the vehicle's speed prior to the crash.

The same information can be obtained from an iPhone video, by measuring the distance the car travels between frames, taken at **24 frames per second.**

Consider three cases involving cars A, B, C below.

Car A: Speed is *82* km/h, speed limit is 60 km/h

Car B: ABS spacing is *118* cm, speed limit is 60 km/h

Car C: iPhone frame spacing is *84* cm, speed limit is 60 km/h

Rank how much each car was violating the speed limit by dragging and dropping the cars into their corresponding group.
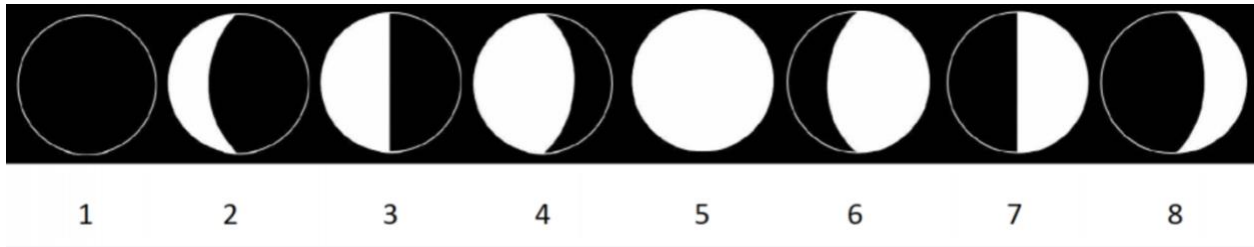
Items

Car A

Car B

Car C

Violating the speed limit the most (one answer only)

Violating the speed limit the least (one answer only)

Note: Each student received randomized values (speed, ABS spacing, frame spacing) for each car.

Moon

You are standing somewhere in Canada and the Moon appears like one of the images (1-8) below:

How would the Moon appear to someone standing in Argentina at the same time?

Given moon in Canada is 3, moon in Argentina: ⌄

Given moon in Canada is 1, moon in Argentina: ⌄

Note: Each student was given randomized numbers for how the Moon appears in Canada. Answer options were a dropdown list of integers 1-8.

Marathon

You are training for a marathon and need a lot of energy. On the other hand, you are trying to reduce the salt in your diet. You have three brands of bread A, B, C to choose from.

Brand A: *12* g carbohydrate and *100* mg salt per slice (25 g)

Brand B: *249* g carbohydrate and *1206* mg salt per loaf (20 slices)

Brand C: *46* g carbohydrate and *341* mg salt per 100 g

Rank the brands from better to worse for your requirements by dragging and dropping the brands into their corresponding group.

Items
Brand A

Brand B

Brand C

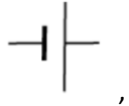**Best brand (one answer only)**

Worst brand (one answer only)

Note: Each student received randomized grams of carbohydrates and milligrams of salt for each brand.

Circuit

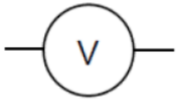In the incomplete circuit below you will see

A battery:

,

and a resistor:
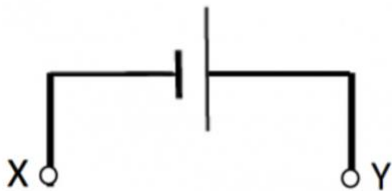

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Where would you place a voltmeter:

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An ammeter:

And length of wire:

in order to measure the power coming from the battery and absorbed in the resistor?

Voltmeter:

- ◯ WX
- ◯ XY
- ◯ YZ
- ◯ WZ

Ammeter:

- ◯ WX
- ◯ XY
- ◯ YZ
- ◯ WZ

Wire:

- ◯ WX
- ◯ XY
- ◯ YZ
- ◯ WZ