



Michael Smith National Science Challenge 2011

Thursday, March 10th, 2011

9-10 Pacific, 10-11 Mountain, 11-12 Central, 12-1 Eastern, 1-2 Atlantic, 1:30-2:30 Newfoundland

PLEASE PRINT DOUBLE-SIDED (BLACK AND WHITE OK)

Instructions

1. Do not open this examination booklet until you are told to do so.
2. Be certain that you understand all of the instructions. If you are unsure about something, ask your supervisor.
3. This examination is closed-book. No notes of any kind (printed or electronic) are allowed.
4. You may use a calculator (may be a graphing calculator) and a ruler.
5. Write your answers in this exam booklet and hand it back to your teacher at the end.
6. This exam booklet consists of 6 questions on 10 pages; including this page of instructions and a data sheet. Check to make sure you have all the pages.
7. Print your name and other information clearly. Only those who do so can be counted as official contestants.
8. When your teacher instructs you to begin, you will have **60 minutes** to finish the examination.

Scoring

Full marks will be given to a student who demonstrates clear understanding of the science required by the question.

Partial marks will be given for partial understanding. There are no penalties for incorrect answers. The questions are not of equal difficulty. Remember we are challenging the best science students in Canada; it is possible that even the best papers may not achieve an overall score of 80%. This is meant to be tough!

Teachers

Please mail* the following **2 items** to Michael Smith Challenge, Department of Physics & Astronomy, 6224 Agricultural Road, UBC, Vancouver, BC, V6T 1Z1 before the end of **Friday, March 11th, 2011**:

1. Students' exam booklets
2. A cheque payable to University of British Columbia, for \$5.00 per script returned (if paying by cheque) **OR** a printed receipt of your payment (if paid by credit card).

* Canada Post regular mail; express/couriers *not* necessary.

Contest Named in Honour of Dr. Michael Smith (1932-2000)

UBC's 1993 Nobel Prize Winner

Examination Committee

Andrzej Kotlicki and Chris Waltham, UBC Department of Physics and Astronomy
Edson Sanchez, UBC Physics and Astronomy Outreach

Translator

Edson Sanchez, UBC Physics and Astronomy Outreach

"It is a small problem merely, but a problem that will agitate the little grey cells most adequately."
- Hercule Poirot

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INFORMATION TABLE

Speed of sound at 3° C	333.3 m/s
Speed of light	3×10^8 m/s
Density of water	1 g/cm ³
1 tonne (metric ton)	1000 kg

ATOMIC MASSES

H	1
C	12
O	16

NAME (PRINT): _____

SCHOOL: _____

GRADE: _____ PROVINCE: _____

DATE: _____

START TIME: _____

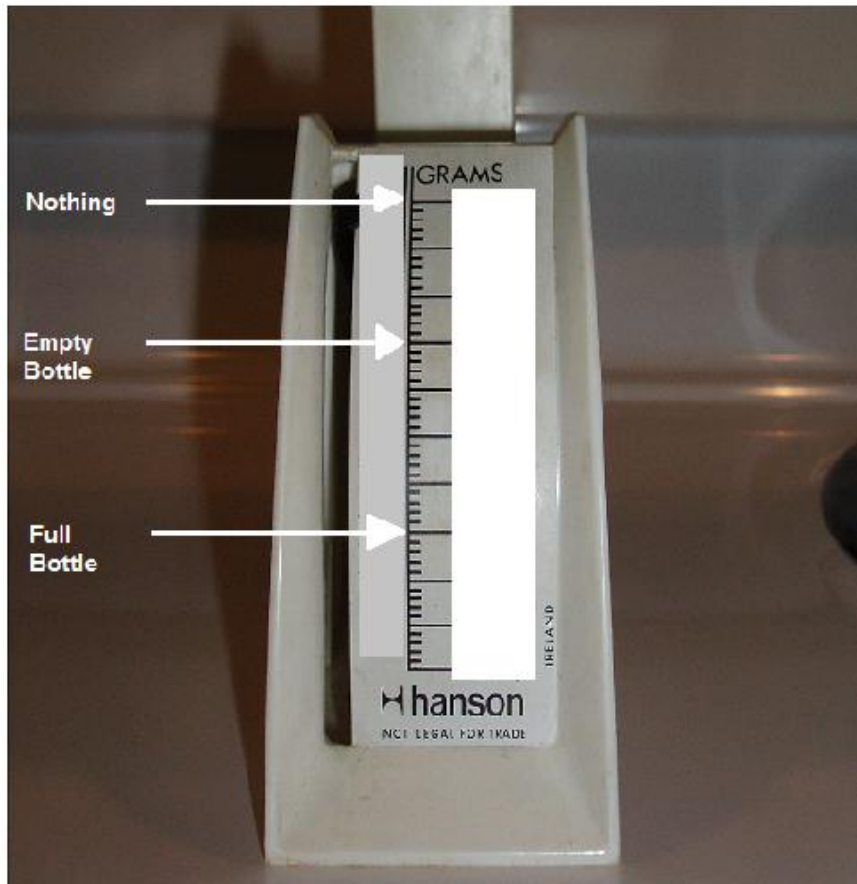
FINISH TIME: _____

Questions

1. (10 marks)

A kitchen scale has lost its numbers. You want to put them back, but all you have is a 1 litre milk bottle of unknown mass. You place the empty bottle on the scale, and then place it on again full of water. **Mark the numbers on the scale.**

To receive any marks, you need to show your working.



2. (10 marks)

In North America, wind farms kill approximately 200 000 birds per year. By way of comparison, estimate as best you can how many birds are killed by cats each year in North America. Hint: If you do not have an outside cat of your own, you may wish to consider that one of the authors of this contest has a family of five people and two cats, one of which kills about 10 birds per year.

To receive any marks, you need to show your working.

3. (10 marks)

The composition of wood is 49% carbon, 6% hydrogen and 44% oxygen, by weight.

- a)** We can write the approximate chemical (empirical) formula for wood as $C_xH_yO_z$.
Give values for x, y, z.

To receive any marks, you need to show your working.

- b)** What mass of atmospheric CO_2 goes into making a tonne of wood?

To receive any marks, you need to show your working.

4. (10 marks)

Unfortunately, a significant number of animals are currently at risk of extinction. For example, the number of tigers living in the wild has decreased dramatically during the last century. Tigers have become an endangered species primarily because of habitat destruction and hunting. The following data table shows how many tigers remained in the wild during a given year. If there is no human intervention to increase the number of tigers living in the wild, estimate when wild tigers will become extinct.

Year	Number of tigers left in the wild
1900	100 000
1950	50000
1970	40000
1980	30000
1990	20000
2000	10000
2010	5000

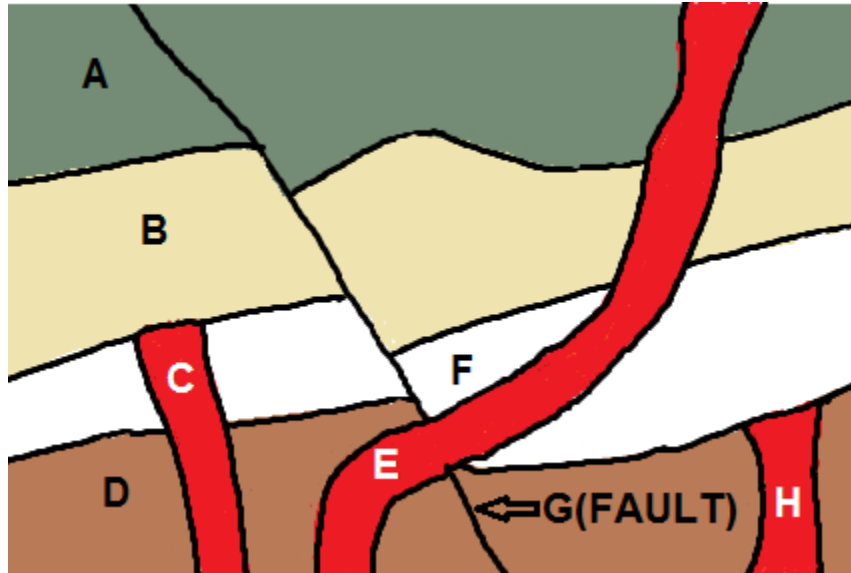
To receive any marks, you need to show your working. You may use the graph paper on the following page.

A table structure consisting of 13 columns and 7 rows. Each row is defined by a pair of horizontal lines, creating a series of horizontal channels. The vertical lines are evenly spaced across the width of the table.

A standard grid table with 13 columns and 13 rows. The grid is composed of thin, light gray lines forming a uniform square pattern. The table is empty of any text or data.

5. (15 marks)

The face of a cliff shows the following geological structure. It contains a fault, layers of sedimentary rock and igneous dikes.



a) Identify all the layers of sedimentary rock.

b) Which of the igneous dikes is the oldest?

c) Arrange the letters corresponding to each part of the geological structure in order, from oldest to youngest:

_____ Oldest

_____ Youngest

6. (15 marks)

a) You see a flash of lightning and 8 seconds later you hear the start of a thunderclap. How far away was the strike?

b) You are standing close to a small storm travelling from the west. The weather forecast had accurately predicted that it would be travelling at 20 km/h. You see that three lightning strikes are produced, each one at a different location. You hear the thunder and see the light created by the strikes at the following times:

LIGHTNING STRIKE	LIGHT	THUNDER
1	09:51:00	09:51:15
2	10:00:00	10:00:12
3	10:09:00	10:09:15

Mark on the map the track of the storm.

To receive any marks, you need to show your reasoning.

