Waterloo Region District School Board
FOREST HEIGHTS COLLEGIATE INSTITUTE

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**Grade 11 Physics – SPH3U**
**Course Overview**

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**Course Type:** Science - Physics
**Teacher:** Ohrling
**Textbook:** Nelson Physics 11

**Grade Level: 11**
**Department:** Science
**Website:** http://mrohrling.yolasite.com/

### Course Description:

This course develops students' understanding of the basic concepts of physics. Students will explore kinematics, with an emphasis on linear motion; different kinds of forces; energy transformations; the properties of mechanical waves and sound; and electricity and magnetism. They will enhance their scientific investigation skills as they test laws of physics. In addition, they will analyse the interrelationships between physics and technology, and consider the impact of technological applications of physics on society and the environment.
**Prerequisite:** Science, Grade 10, Academic

## UNITS OF STUDY or BIG IDEAS

***Kinematics***
- Motion involves a change in the position of an object over time.
- Motion can be described using mathematical relationships.
- Many technologies that apply concepts related to kinematics have societal and environmental implications.

***Forces***
- Forces can change the motion of an object.
- Applications of Newton's laws of motion have led to technological developments that affect society and the environment.

***Energy and Society***
- Energy can be transformed from one type to another.
- Energy transformation systems often involve thermal energy losses and are never 100% efficient.
- Although technological applications that involve energy transformations can affect society and the environment in positive ways, they can also have negative effects, and therefore must be used responsibly.

***Waves and Sound***
- Mechanical waves have specific characteristics and predictable properties.
- Sound is a mechanical wave.
- Mechanical waves can affect structures, society, and the environment in positive and negative ways.

***Electricity and Magnetism***
- Relationships between electricity and magnetism are predictable.
- Electricity and magnetism have many technological applications.
- Technological applications that involve electromagnetism and energy transformations can affect society and the environment in positive and negative ways

## Overall Expectations:

**Kinematics**
B1. Analyse technologies that apply concepts related to kinematics, and assess the technologies' social and environmental impact;
B2. Investigate, in qualitative and quantitative terms, uniform and non-uniform linear motion, and solve related problems;
B3. Demonstrate an understanding of uniform and non-uniform linear motion, in one and two dimensions.

**Forces**
C1. Analyse and propose improvements to technologies that apply concepts related to dynamics and Newton's laws, and assess the technologies' social and environmental impact;
C2. Investigate, in qualitative and quantitative terms, net force, acceleration, and mass, and solve related problems;

C3. Demonstrate an understanding of the relationship between changes in velocity and unbalanced forces in one dimension

**Energy and Society**

D1. Analyse technologies that apply principles of and concepts related to energy transformations, and assess the technologies' social and environmental impact;
D2. Investigate energy transformations and the law of conservation of energy, and solve related problems;
D3. Demonstrate an understanding of work, efficiency, power, gravitational potential energy, kinetic energy, nuclear energy, and thermal energy and its transfer (heat).

**Waves and Sound**

E1. Analyse how mechanical waves and sound affect technology, structures, society, and the environment, and assess ways of reducing their negative effects;
E2. Investigate, in qualitative and quantitative terms, the properties of mechanical waves and sound, and solve related problems;
E3. Demonstrate an understanding of the properties of mechanical waves and sound and of the principles underlying their production, transmission, interaction, and reception.

**Electricity and Magnetism**

F1. Analyse the social, economic, and environmental impact of electrical energy production and technologies related to electromagnetism, and propose ways to improve the sustainability of electrical energy production;
F2. Investigate, in qualitative and quantitative terms, magnetic fields and electric circuits, and solve related problems;
F3. Demonstrate an understanding of the properties of magnetic fields, the principles of current and electron flow, and the operation of selected technologies that use these properties and principles to produce and transmit electrical energy.

**ASSESSMENT AND EVALUATION:**

A variety of assessment tasks will be used to evaluate student progress.

- **Late and Missed Assignments** – To achieve success in this course, all essential course components must be demonstrated. Incomplete work is **NOT** an option.
- **Cheating and Plagiarism** – It is important for students to do their own best work. If a student is suspected of cheating or plagiarizing, the teacher in consultation with administration, will determine the next steps and/or consequences.
- **Learning Skills and Work Habits** – The areas of Responsibility, Organization, Independent Work, Collaboration, Initiative, and Self-regulation are important and will be assessed and reflected on the provincial report card.
- **Attendance**– Attendance and punctuality in classes are important parts of learning and an expectation of student behaviour. Lates are to be avoided to benefit from full instructional time and not disrupt other's learning time. When a student is absent, a parent/guardian must call the school's attendance line on the date of absence, or provide a note explaining the absence for the student to submit the following day. Students are responsible for missed work during their absence.

**Course Evaluation:**

| | | |
|---|---|---|
| Final Evaluation 30% | Kinematics 15% | Forces 15% |
| Energy and Society 10% | Waves and Sound 15% | Electricity and Magnetism 15% |

By signing this course outline, I acknowledge that I have read and understood the expectations and requirements for successful completion of this course.

_____ _____
Student's Name Date

_____ _____ _____
Parent/Guardian Name Signature Date

# SPH3U – Physics, Grade 11
## University Preparation

**Course Website: http://mrohrling.yolasite.com/sph3u.php**

**An Inquiry-Based Course**
Welcome to the wonderful world of physics! SPH3U is an introduction to the world of physics and a prerequisite for the grade 12 course, SPH4U. This course is designed according to the principles of Physics Education Research which clearly demonstrate the power of learning through inquiry in a collaborative group format. Major Canadian and American universities (U of T, McGill, McMaster, MIT, Harvard, Stanford and more) are transforming their introductory physics courses by reducing or eliminating traditional lectures and replacing them with engaging activities that have a deep conceptual and practical focus.

**Homework**
The majority of the class time will be spent doing activities and discussing physics with your colleagues. At home you will be responsible for solving problems using our solution format. You should expect about 30 minutes of physics homework per day on average. Homework problems will be randomly submitted for assessment. Optional textbook readings, online lessons and resources are listed in the syllabus for each lesson.

**Assessment and Evaluation**
Due to the central role of group work in this course, the work you do in class will account for an important portion of your mark. Daily work will be randomly handed-in and assessed. To help ensure that individual students are pulling their weight in groups, there will be regular quizzes and tests. There is a final exam that covers the entire course material and a major project that will be announced halfway through the course.

**Mark Breakdown**
The basic mark breakdown for the course is 70% term work and 30% final examination.

**Attendance and Punctuality**
Students who are absent or late for class without a valid reason will not be eligible to submit any missed work or write any missed quizzes. Students who are absent are responsible for determining what was missed and making sure that they are caught up *before* the following class.

**Missed Tests**
If you miss a test you **must**:

- Let me know in advance if it is due to a pre-arranged reason (i.e. appointment for surgery)
- Call in to the school so your name goes on the daily "Absent List" in the main office.
- Contact me immediately after setting foot in the school upon your return.
- Provide a doctor's note if the reason is illness.
- Do not discuss the test by any means with your colleagues.
- Be prepared to write the test immediately, at my discretion.

Failure to do any of these will result in a zero for the test.

**Please Read This Document!**
Please sign below signifying that you have read this course description.

_____ _____

Signature of parent, or student if 18 and over Print name

# Gr. 11 Physics Introduction

This chart contains a complete list of the lessons and homework for Gr. 11 Physics. Please complete all the worksheets and problems listed under "Homework" before the next class. A set of optional online resources, lessons and videos is also listed under "Homework" and can easily be accessed through the links on the Syllabus found on the course webpage (http://mrohrling.yolasite.com/sph3u.php). You may want to bookmark or download the syllabus for frequent use.

The textbook readings are divided up into small parts (often a single paragraph) and don't follow the order in the text very closely. Be sure to read carefully all the assigned sections to supplement our work in class. You may take notes from the sections, but this is not necessary since most of the content is in your handbook.

Some of the video lessons listed are from the website "Khan Academy", www.khanacademy.org which has many math and physics lessons. Another excellent source of online lessons comes from the physics teachers at Earl Haig S. S. http://www.physicseh.com/. **One warning**: Sometimes the notation used in the online lessons is different from what we use in class. Please be sure to use our notation. The Physics Classroom (http://www.physicsclassroom.com) is another excellent website, but does include more advanced material as well.

| | Lesson | Topics | Homework |
|---|---|---|---|
| 1 | Welcome to Physics Course<br>Introduction<br>Group Work | Group roles, effective group work | Log on to course website.<br>Homework sheet: *How Groups Work*<br>Video: Dysfunctional Group<br>Video: Functional Group |
| 2 | Measurement | Significant figures, scientific notation | Homework sheet: *Measurement and Numbers*<br>Read: pg. 566, "*Significant Digits*"<br>Read: pg. 565, "*Scientific Notation*"<br>Video: Accuracy vs. Precision<br>Lesson: Scientific Notation |
| 3 | Review your Understanding | Math you should be able to do | Handbook*: Review your Understanding* |
| 4 | How to Answer a Question | Evaluation in Gr. 11 physics | Video: The Big Bang |

# SPH3U: How Groups Work

Recorder: _____
Manager: _____
Speaker: _____
0 1 2 3 4 5

Each group needs a whiteboard, marker and cloth. Assign each group member one role: **Manager, Recorder, or Speaker.** If there are four people in a group, two will act as the speaker. Working well in a group is a bit like acting in a play, we all have roles to perform!

Manager*: Ask the group members to read the following instructions for this activity.*

The majority of our work in Gr. 11 physics will take place in groups. Take a few moments to think about our experiences of working in groups. Think about your experiences in other courses and your experience so far in Gr. 11 physics. We will discuss these experiences, but please don't mention anyone's name!

Manager*: Ask the group to complete the next two questions individually, without any discussion. When you see that everyone has finished, have the group move on.*

Complete the following two questions individually.

1. In your experience, what are some of the enjoyable characteristics of working in groups?

2. In your experience, what are some of the less-enjoyable characteristics of working in groups?

Work together now. On your whiteboard compile a list of the group's responses to each question.

Manager*: Organize the discussion and ask for ideas from each group member.*
Recorder*: Neatly **summarize** the ideas on the whiteboard, write large enough so other groups could read it if you were to hold it up.*
Speaker*: Be prepared to speak to the class about your points when your group is called upon – if any points are unclear, ask your group questions.*

Continue the following questions as a group.

Manager: *Read out the next question and ask the group for their ideas. Kindly ask everyone for their input.*
Recorder: M*ake sure what you write down on your own sheet accurately represents the group's ideas – your teacher will be checking your copy. Ask the other members for clarification if you're not sure you have it right.*
Speaker: *Be prepared to speak on behalf of the group. If any ideas are not clear, ask the others for an explanation or ask specific questions. Make sure the group explanations would receive a mark of "5" – are they thorough and complete?*

We have all experienced difficulties working in groups. Sometimes, the challenge comes from within – for whatever reason you, as an individual, are unable to contribute effectively to the group. Other times, another group member may make the proper functioning of the group difficult.

3. (a) Think about the reasons why a group might *not* function at its best. Make a list of the reasons in the chart below – be specific. However, do **not** mention the names of any individuals. This is **not** a critique of your current group or any others you have been in.
   (b) Describe what specific actions could be taken to help the group work better in each case you listed above. Indicate which group member (R, M, S) would be best to carry out the action, or if it is an action for everyone (E).

| Reason Groups Might Not Work Well | Actions |
|---|---|
| 1. | |
| 2. | |
| 3. | |
| 4. | |

**Check your results with your teacher.**

Manager: *When the group decides it had finished question 3, call the teacher over. Keep an eye on the clock since we want to complete the whole activity in this period.*
Recorder: *The teacher will ask you to write up one example on the whiteboard for a class discussion. Have the others check this.*
Speaker: *Be prepared to speak on behalf of your group when called upon. Make sure the action is clear and precise.*

Manager: *Lead the group through the next question.*

4. Begin by working individually on the next question. In the chart below, list the responsibilities of your role in the group. When everyone is complete, share and discuss the results. Finally, complete the rest of the chart.

| Manager | Recorder | Speaker |
|---|---|---|
| | | |

## SPH3U: Homework – How Groups Work Name:

On the course website are two videos which chronicle the exploits of a dysfunction physics group and a well-functioning physics group. Begin by viewing the video of the dysfunctional group.

### A: Dysfunctional Group

1. **Observe.** Watch the video and note in the chart below any actions or behaviours of Sam, Robert or Mike that contribute to the poor functioning of the group.

| **Sam** | **Robert** | **Mike** |
|---|---|---|
| | | |

2. **Reflect**. The video is something of an exaggeration, but it does help us to think about our own behaviours. Which individual(s) do you think you share the most habits with? (Of course you won't be as extreme as these guys, but maybe you have a tendency to do some of the same things? Be honest!) Explain.

3. **Reason.** Imagine you were a well-function member of this group. Describe some actions you would have taken to help the group work better (i.e. to help smooth over some of the problems you mentioned above).

### B: The Well-Functioning Group

1. **Observe.** Watch the video of the well-functioning group. Record in the chart below the positive behaviors of Sam, Robert and Mike which help the group to function well.

| **Sam** | **Robert** | **Mike** |
|---|---|---|
| | | |

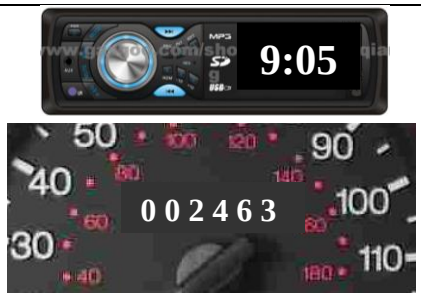
2. **Reflect.** Which of the behaviours that you mentioned in the previous question do you think you share with Sam, Robert or Mike? Explain.

3. **Reflect.** Which of the behaviours that you noted in question B#1 would you like to encourage more of in yourself? How can you do this?

# SPH3U: Measurement and Numbers Homework Name:

## A: The Physics Road Trip

You decide to take a trip to hear a lecture by one of your favourite physicists. When you begin driving, you glance at the clock in your car and also look at the odometer. As you pull in to the physics department parking lot, you look at the clock and the odometer a second time.





1. What is the readability of the clock and the odometer?

2. How much time did the trip take in **minutes**?

3. We would like to change this time interval into **seconds**. **Explain** how to do this.

4. Change the time interval into seconds. Show your math work. Use our guidelines to write the result. (Not a final result yet!)

5. What distance in kilometers did you travel?

6. We would like to change this distance into metres. **Explain** how to do this.

7. Change the distance into metres. Show your math work. Use our guidelines to write the result. (Not a final result yet!)

8. Calculate your average speed (average speed = distance traveled / time interval) during this trip twice – first, to get an answer with units of kilometers per minute, and again to get an answer with units of metres per second. Show your math work. Use our guidelines to record your **final** results.

| **kilometers per minute** | **metres per second** |
|---|---|
| | |

# SPH3U: The Art of Measurement and Numbers

Recorder: _____
Manager: _____
Speaker: _____
0 1 2 3 4 5

Measurements are the backbone of all science. Any scientific ideas, no matter how slick, are only as good as the measurements that have confirmed them. Without careful measurements, science is mostly guess work and hunches – suspicions and rumours.

## A: The Meter Stick

Our most basic scientific tool is the meter stick. But, do you know how to use it? For this investigation you will need one meter stick

1. Examine the markings on the meter stick. What is the size of the smallest interval marked on it?

2. Three students use the meter stick to measure the height of a desk and each reports their results: 95 cm, 94.8 cm, and 94.83 cm respectively. Which result illustrates the best use of this measuring device? Explain.

The term *significant digits* describes which digits in a number or measurement are physically meaningful or reliable. The *readability* of a measuring device is the smallest interval you can distinguish from the device. The readability gives a rough guide for deciding on the last significant digit in a measurement.

3. How many significant digits are in the measurement you chose in question A#2? What is the meter stick's readability?

4. Measure the height of your desk and record the measurement with an appropriate number of significant digits.

5. Two students each measure the length of the same running shoe. One student records a result of "281" and the other student records the result "27.9". How can two measurements of the same thing be so different … or are they? Explain by describing what critical element is missing from each measurement.

6. Two students make a measurement using a metre stick. One student measures the thickness of a text book to be 5.1 cm (biology!) The other student measures the length of a pencil to be 18.4 cm. Which measurement is more *precise*? Offer an explanation and mention what you think the word *precision* means.

## B: The Stopwatch

Now we will examine another common measuring device. You will need a stop watch. A student drops a pencil from a 1.00 m height. Another student times the fall. The stopwatch readout looks like this after the timing: 0:00.45

1. Write this reading as a number in decimal notation (not scientific notation) with units of seconds (s).

2. What is the readability of the stopwatch according to its display (i.e. to the nearest …)?

3. Drop the pencil five times from a 1 m starting height. Measure the time to drop and record the times below.

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |

4. There is a good chance that all five of your measurements above are different. Explain why they are different.

5. Since your five values are different, is it possible to find a "best value" for the time for the pencil to drop? Explain how and find this value.

**Guidelines for Writing Numbers**

(A) If you know how the result was measured:

- Use the readability to determine the last significant digit.

(B) If the result was part of a calculation, or you don't know how it was measured:

- When recording final results, use the number of significant digits that you read or were given. These digits are determined by how it would be written in scientific notation. For example when limited to 3 significant digits, if your calculator reads: 1 056 428, you write: 1 060 000 m or $1.06 \times 10^{6}$ m. Calculator: 0.01075, you write: 0.0108 s or $1.08 \times 10^{-2}$ s, Calculator: 1.00135 kg, you write: 1 kg or 1.00 kg
- Use scientific notation only when it is convenient (for really small or really big numbers)
- When we are given or use a quantity like 5 km, we will assume it has 3 significant digits. (5.00)
- For middle steps in calculations, keep one or two extra *guard digits* to help reduce the amount of rounding error.

These are very rough guidelines. In grade 12 we will improve on these and in university you will learn the real rules!

6. Rewrite your best value for the time for the pencil to drop using our guidelines for significant digits.

7. A group of students has been timing a motorized cart that travels at a steady speed. They used the same five measurements to find an average value and the calculator reads: 1.4632954. Isaac records his result using two significant digits. Emmy records her result using three significant digits. Albert records his result using one extra guard digit.
   (a) Write down their results.

   Isaac's time: Emmy's time: Albert's time:

   (b) The cart traveled a distance of 1.65 m during each trial. Use each person's time value to calculate the speed of the cart. (speed = distance / time interval). Record **each final result** using our significant digit guidelines.

   Isaac's speed: Emmy's speed: Albert's speed:

   (c) Whose technique was preferable? Explain.

## Review Your Understanding

1. Name three ways in which information is communicated among scientists.
2. The concept of universality illustrates one of the differences between science and art. What is this difference?
3. Why is it necessary to have an international system of units?
4. Why is it necessary to define units of measurement carefully?
5. What is the difference between a base unit and a derived unit? Give an example of each.
6. What are the SI units for the following: **a)** area; **b)** volume; **c)** force; **d)** pressure; **e)** work; and **f)** energy?
7. What SI unit would you use to express the following measurements: **a)** the diameter of a lead pencil; **b)** the temperature in your classroom; **c)** the time required for you to say the word *cheese*; **d)** your waist measurement; **e)** the area of your classroom; **f)** the distance from the earth to the sun?
8. Complete the following table:

| | | | |
|---|---|---|---|
| **a)** 3.15 m = | cm | **b)** 955 g = | kg |
| **c)** 1630 mL = | L | **d)** 20.0 Mg = | mg |
| **e)** 178 mm = | cm | **f)** 15.5 mg = | g |
| **g)** 1620 km = | Mm | **h)** 144 kg = | mg |
| **i)** 0.0117 mm = | cm | **j)** 126 $mm^3$ = | $cm^3$ |

9. Make any necessary corrections to the following, using the convention of style for writing measurements with SI units:
**a)** 25 gs; **b)** 10 grams/$cm^3$; **c)** 25,000 L; **d)** fifteen milligrams; **e)** 65 km.; **f)** 80 mg per millilitre.
10. Why is it useful to be able to express numbers in scientific notation?
11. Express the following numbers in scientific notation:
**a)** 1 003 000 000 000
**b)** 0.000 000 000 000 399 8
**c)** 52.23
**d)** 0.2038
**e)** 12 452
12. Convert the following numbers to decimal notation:
**a)** $1.776 \times 10^{7}$; **b)** $2.552 \times 10^{-9}$; **c)** $1.168 \times 10^{3}$; **d)** $4.44 \times 10^{-1}$; **e)** $1.399 \times 10^{0}$.
13. Express the results of the following operations in scientific notation:
**a)** $1.39 \times 10^{-2} + 3.11 \times 10^{-4}$
**b)** $1.17 \times 10^{4} - 3.57 \times 10^{2}$
**c)** $1.34 \times 10^{24} - 2.22 \times 10^{2}$
**d)** $2.15 \times 10^{5} + 1.56 \times 10^{3}$
14. Express the results of the following operations in scientific notation:
**a)** $(1.81 \times 10^{-3}) \times (1.06 \times 10^{20})$
**b)** $(5.77 \times 10^{-4})/(1.71 \times 10^{-11})$
**c)** $(4.44 \times 10^{-3}) \times (2.252 \times 10^{2})$
**d)** $(7.99 \times 10^{-3})/(1.33 \times 10^{6})$
15. Explain why it is important to use the correct number of significant digits in expressing a measurement.
16. Are all experimental measurements uncertain? Explain.
17. How many significant digits are in each of the following measurements?
**a)** 133.31 g; **b)** 0.02 g; **c)** 24.6 $cm^3$; **d)** 109.9457 mL; **e)** 29 marbles.
18. Identify the significant digits in each of the following:
**a)** 6.29 mL; **b)** 0.0990 g; **c)** 42 000 J (which is $4.2 \times 10^{4}$ J);
**d)** $1.81 \times 10^{-6}$ km; **e)** $1.772 \times 10^{10}$ Pa.
19. **a)** Which of the following three measurements contains the most significant digits: 1057 g, 13 g, or 0.479 g?
**b)** Which of the measurements in part **a)** of this question is the least precise?
**c)** Find the sum of the three measurements.

20. How many significant digits are there in the answers to the following problems?
   a) $24.4\ g + 12.692\ g + 14.79\ g$
   b) $2.229\ g - 0.5710\ g$
   c) $10.6\ N \times 6.9\ m$
   d) $(9.93 \times 10^{23}\ s)(6.9 \times 10^{-2}\ A)$
   e) $73\ mL - 36.9\ mL$

21. An opened bag of sugar has a mass of $746 \pm 3$ g.
   a) What is the smallest mass this bag of sugar could have?
   b) What is the largest mass this bag of sugar could have?

22. A person had a mass of $100 \pm 1$ kg at the start of a diet and $98 \pm 1$ kg after the first week of the diet.
   a) What is the least amount of mass that could have been lost?
   b) What is the greatest amount of mass that could have been lost?

23. Round off each of the following numbers to two significant digits:
   a) 36.4; b) 729; c) 0.145; d) 8.357; e) 0.001 07; f) $6.022 \times 10^{23}$.

24. Round off each of the numbers in the preceding question to one significant digit.

25. Solve each of the following problems by using dimensional analysis:
   a) What distance is covered in 4.25 h by a car travelling at 95 km/h?
   b) How much does it cost to register a car with a mass of 1800 kg if the registration fee is \$2.50/100 kg?
   c) How many grams of alcohol are present in 5.00 L of blood from a person with an alcohol level of 102 mg of alcohol per 100 mL of blood?

26. What was the cost of gasoline for a drive from Banff to Edmonton (428 km) if the car required 10.2 L/100 km and the cost of gasoline was \$0.45/L?

27. A recipe using hamburger serves eight people. The recipe calls for 2.0 kg of hamburger. However, you wish to prepare a meal that will serve three people. Use dimensional analysis to determine how many kilograms of hamburger you will need.

28. How many rail cars, each 15.0 m long, are in a freight train which requires 2.00 min to pass a station while the train is travelling at 60.0 km/h?

## Apply Your Understanding

1. The league was a unit of distance which varied in length at different periods of time and in different places. In English-speaking countries, it was usually estimated at 4.8 km. However, Jules Verne was probably thinking of a nautical league (5.6 km) when he wrote *Twenty Thousand Leagues Under the Sea*. Compare the radius of the earth (6.4 Mm) with twenty thousand nautical leagues.

2. It has been estimated that a gram of seawater contains 4.0 pg of gold. The oceans of the earth have a total mass of $1.60 \times 10^6$ Eg. How many grams of gold are present in the oceans?

3. A 9.76 g sample of table sugar is placed in a 25.00 mL flask. The flask is completely filled with benzene, and the sugar and benzene have a total mass of 26.31 g. The sugar does not dissolve in the benzene. If the density of benzene is 0.879 g/mL, what is the density of sugar?

4. The density of ethanol is 0.789 g/mL. The mass of ethanol required to fill a flask is 15.78 g. If this same flask can be filled with 18.34 g of olive oil, what is the density of olive oil?

5. If 4.18 J of energy are required to cause the temperature of one gram of water to increase by one degree Celsius, how many grams of water can be warmed from 15.6°C to 35.9°C by 14.5 kJ?

6. The concentration of pollutants is often expressed in "parts per million" or "ppm." The SI equivalent is "milligrams per kilogram." If one drop of a liquid pollutant has a mass of 50 mg, how many litres of water (density = 1.00 g/mL) are required to dilute the pollutant to a concentration of 1 ppm?

# SPH3U: How to Answer a Question?

Recorder: _____
Manager: _____
Speaker: _____
0 1 2 3 4 5

A major focus of Gr. 11 physics is the careful explanation of our observations and ideas. Every word question you encounter should be carefully explained using complete sentences and correct English. Even if the question doesn't actually say "explain", you must still justify your answers and outline your reasoning.

High quality responses to any physics question must be **correct**, **clear**, **concise** and **complete**. We will routinely use these terms and the notation explained below for the evaluation of your daily written work.

| Criteria | Description | Notation |
|---|---|---|
| Correct | The physics is correctly stated. Conclusions follow logically from the stated evidence and refer to key definitions or laws. Technical details are all present and correct. | Incorrect sections are underlined and given an "__X__". Correct ideas are checked " √ " |
| Clear | The explanation is precisely stated with a good choice of physics vocabulary. The explanation is straight forward with no awkward or unclear phrases. Spelling and grammar are correct. | Unclear sections are underlined with a wiggly line and ~~~~ given a "?" A poor word choice is indicated by a wiggly line. Spelling errors are cirlced. |
| Concise | There are no extraneous or distracting statements which may or may not be correct. | Phrases that are not relevant are crossed out. ~~Like this~~. |
| Complete | No important parts of the explanation are missing. The evidence supporting the conclusion is mentioned along with the relevant definitions or laws. | Where an explanation is missing or incomplete we will write ". . ." or "and …" or "more …" or give a clear hint at what is missing: "force?" |

## A: Mark Up These Responses!

Mark up the four student responses below to question A#6 from yesterday's activity. Use the criteria in the chart above.

**Response 1: The second measurement is more precise. It has three significant digits and the first one only has two. Precision is the number of signfinicant digits, so the more significant digits a measurement has, the more precise it is.**

**Response 2: The measurements have the same precise since they are measured to the nearest to the millimeter, which is the smallest unit on the metre stick. The smallest unit is what precision is because the smaller the unit the more precise things are. The book measurement was the same precision as pencil mesurement.**

**Response 3: Precision means how careful the measurement is done and there were no mistakes. Both measurements were careful to the one millimeter so they are equally good.**

**Response 4: Precision describes the smallest unit of measurement or interval that you can distinguish from the measurement device, so it is much like the readability. Both objects were measured in the same way with the same device and must have the same precision, which in this case happens to be to the nearest millimeter. The number of significant digits in each measurement (two and three) is not the same thing as precision.**

**Response 5: They have the same precision.**

## B: Evaluation

Your daily work in physics will be marked based on the four criteria for high quality responses. An overall mark will be assigned on a scale of 0 to 5 depending on how your responses meet the four criteria according to the rubric below.

| 0-2 | 3 | 4 | 5 |
|---|---|---|---|
| Responses are missing, fundamentally incorrect, or challenging to understand. A "yes or no" answer is given. | Response is basically correct, but contains problems or omissions. | Response is correct, but minor details could be improved or clarified. | Response is thoughtful, clear and complete. If another physics teacher saw it they would say, "Wow! A grade 11 student wrote this?" |

For each response on the previous page, use the rubric above to assign it a mark. Provide a specific and brief rationale for each.

**Response 1**

| 0-2 | 3 | 4 | 5 |
|---|---|---|---|
| Responses are missing, fundamentally incorrect, or challenging to understand. A "yes or no" answer is given. | Response is basically correct, but contains problems or omissions. | Response is correct, but minor details could be improved or clarified. | Response is thoughtful, clear and complete. If another physics teacher saw it they would say, "Wow! A grade 11 student wrote this?" |

0 1 2 3 4 5 because _____

**Response 2**

| 0-2 | 3 | 4 | 5 |
|---|---|---|---|
| Responses are missing, fundamentally incorrect, or challenging to understand. A "yes or no" answer is given. | Response is basically correct, but contains problems or omissions. | Response is correct, but minor details could be improved or clarified. | Response is thoughtful, clear and complete. If another physics teacher saw it they would say, "Wow! A grade 11 student wrote this?" |

0 1 2 3 4 5 because _____

**Response 3**

| 0-2 | 3 | 4 | 5 |
|---|---|---|---|
| Responses are missing, fundamentally incorrect, or challenging to understand. A "yes or no" answer is given. | Response is basically correct, but contains problems or omissions. | Response is correct, but minor details could be improved or clarified. | Response is thoughtful, clear and complete. If another physics teacher saw it they would say, "Wow! A grade 11 student wrote this?" |

0 1 2 3 4 5 because _____

**Response 4**

| 0-2 | 3 | 4 | 5 |
|---|---|---|---|
| Responses are missing, fundamentally incorrect, or challenging to understand. A "yes or no" answer is given. | Response is basically correct, but contains problems or omissions. | Response is correct, but minor details could be improved or clarified. | Response is thoughtful, clear and complete. If another physics teacher saw it they would say, "Wow! A grade 11 student wrote this?" |

0 1 2 3 4 5 because _____

**Response 5**

| 0-2 | 3 | 4 | 5 |
|---|---|---|---|
| Responses are missing, fundamentally incorrect, or challenging to understand. A "yes or no" answer is given. | Response is basically correct, but contains problems or omissions. | Response is correct, but minor details could be improved or clarified. | Response is thoughtful, clear and complete. If another physics teacher saw it they would say, "Wow! A grade 11 student wrote this?" |

0 1 2 3 4 5 because _____