Waterloo Region District School Board
FOREST HEIGHTS COLLEGIATE INSTITUTE

Grade 12 Physics – SPH4C
Course Overview

Course Type: Science - Physics
Teacher: Ohrling
Textbook: Nelson Physics 12 (College Prep)
Grade Level: 12
Department: Science
Website: http://mrohrling.yolasite.com/

Course Description:

This course develops students' understanding of the basic concepts of physics. Students will explore these concepts with respect to motion; mechanical, electrical, electromagnetic, energy transformation, hydraulic, and pneumatic systems; and the operation of commonly used tools and machines. They will develop their scientific investigation skills as they test laws of physics and solve both assigned problems and those emerging from their investigations. Students will also consider the impact of technological applications of physics on society and the environment.
Prerequisite: Science, Grade 10, Academic or Applied

UNITS OF STUDY or BIG IDEAS

Motion and Its Applications
- All motion involves a change in the position of an object over time.
- Motion can be described using mathematical relationships.
- Many technologies that utilize the principles of motion have societal and environmental implications.

Mechanical Systems
- Mechanical systems use force to do work.
- The operation of mechanical systems can be described using mathematical relationships.
- Friction is a force that influences the design, use, and effectiveness of mechanical systems.
- Mechanical systems can be used to address social and environmental challenges.

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

Energy Transformations
- Energy can be transformed from one type to another.
- Systems that involve energy transformations 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.

Hydraulic and Pneumatic Systems
- Fluids under pressure can be used to do work.
- Fluids under pressure have predictable properties and many technological applications.
- The uses of hydraulic and pneumatic systems can have social and economic consequences.

Overall Expectations:

Motion and its Applications

B1. analyse selected technologies that are used to move objects or track their motion, and evaluate their impact on society and the environment, including their contribution to scientific knowledge;
B2. investigate, in qualitative and quantitative terms, the linear uniform and non-uniform motion of objects, and solve related problems;
B3. demonstrate an understanding of different kinds of motion and the relationships between speed, acceleration, displacement, and distance.

Mechanical Systems

C1. analyse common mechanical systems that use friction and applied forces, and evaluate their effectiveness in meeting social or environmental challenges;
C2. investigate forces, torque, work, coefficients of friction, simple machines, and mechanical advantage, and interpret related data;
C3. demonstrate an understanding of concepts related to forces and mechanical advantage in relation to mechanical systems.

Electricity and Magnetism

D1. analyse the development of selected electrical and electromagnetic technologies, and evaluate their impact on society and the environment;
D2. investigate real and simulated mixed direct current circuits and the nature of magnetism and electromagnetism, and analyse related data;
D3. demonstrate an understanding of the basic principles of electricity and magnetism.

Energy Transformations

E1. evaluate the impact on society and the environment of energy-transformation technologies, and propose ways to improve the sustainability of one such technology;
E2. investigate energy transformations and the law of conservation of energy, and solve related problems;
E3. demonstrate an understanding of diverse forms of energy, energy transformations, and efficiency.

Hydraulic and Pneumatic Systems

F1. analyse the development of technological applications related to hydraulic and pneumatic systems, and assess some of the social and environmental effects of these systems;
F2. investigate fluid statics, fluid dynamics, and simple hydraulic and pneumatic systems;
F3. demonstrate an understanding of the scientific principles related to fluid statics, fluid dynamics, and hydraulic and pneumatic systems..

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%	Motion 15%	Forces 15%
Mechanical Systems 10%	Electricity and Magnetism 15%	
Energy Transformations 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

SPH4C – Physics, Grade 12

College Preparation

Forest Heights Collegiate Institute

Teacher: Mr. Ohrling

Course Website: http://mrohrling.yolasite.com

This document and all other course documents are available on the course website above.

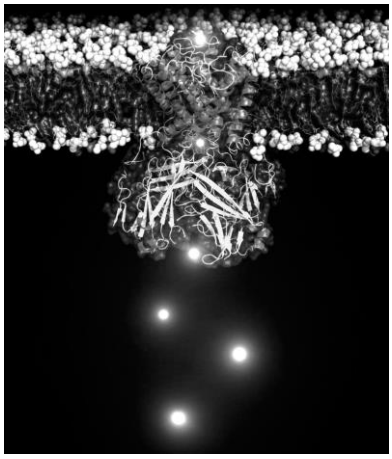
An Inquiry-Based Course

Welcome to the wonderful world of physics! This course is designed according to the principles of Physics Education Research (see http://www.compadre.org/PER/) 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.

MIT: http://www.nytimes.com/2009/01/13/us/13physics.html
U of T: http://www.upscale.utoronto.ca/Practicals/Overview/Overview.html
Harvard: http://youtu.be/WwslBPj8GgI

Text reading, Note-Taking and Homework

In Grade 12 physics, students will spend the majority of class time doing activities and discussing physics. To accommodate this, students are required to do textbook readings. In class, we will briefly clarify and amplify the text before returning to the activities and discussions. In addition to the readings, you will also have problems to solve as part of your homework. On average you will have about 15 minutes of homework each day. Your homework will be randomly checked for completion. Online lessons and resources are listed for each lesson.



Potassium Channel - It's All Physics

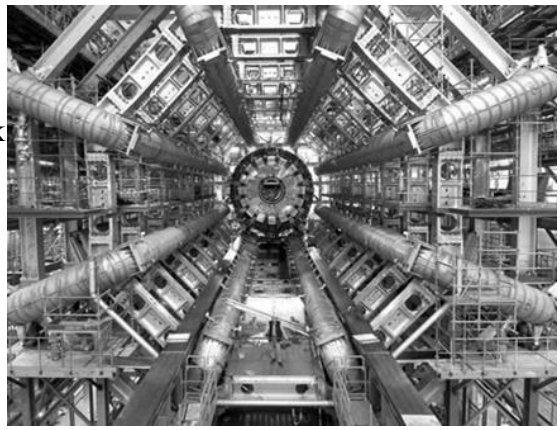
Assessment and Evaluation

Due to the central role of group work in this course, the work you do in groups will account for an important portion of your mark. Daily group work will be randomly handed-in and marked. To help ensure that individual students are pulling their weight in groups, there will be regular quizzes based directly on group work.

The content from your group work and home study will, of course, also appear on tests. There will be regular tests that survey each unit of our physics course. There is a final exam that covers the course's entire material and a few small projects that will be announced throughout the course.

Mark Breakdown

The categories of *Knowledge and Understanding*, *Thinking*, *Communication*, and *Application* are a component of most of the evaluation tools used in this course – however some focus on certain categories more than others. The basic mark breakdown for the course is 70% term work and 30% final examination.



Large Hadron Collider

Attendance and Punctuality

Most of your work takes place in groups and by being either absent or late you handicap yourself and your group. Students are responsible for determining what was missed and making sure that they are caught up *before* the following class – exchange phone numbers and consult your group members as your first step. Any evaluations of group work a student is absent for will be awarded a zero unless a valid reason with appropriate documentation is presented when the student returns to school.

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 your teacher 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 your teacher's discretion.

Failure to do any of these will result in a zero for that evaluation.

Please Read This!

Please sign below signifying that you have read this course introduction.

_____

Signature of parent, or student if 18 and over

_____

Parent e-mail for regular updates

_____

Print name

Gr. 12C Physics Syllabus

This chart contains a complete list of the lessons and homework for Gr. 12C Physics. Please complete all the readings 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.). 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.

Introduction

	Lesson	Topics	Materials	Homework
1	Welcome to Physics	Group roles, effective group work	Powerpoint: *Gr. 12 Introduction* Powerpoint: *Gr. 12 Group Work* White boards	Log on to course website. Homework sheet: *How Groups Work* Video: Dysfunctional Group Video: Functional Group
2	Measurement	Significant figures, scientific notation	Meter sticks, stopwatches	Homework sheet: *Physics and Numbers* Read: pg. 546, "*Significant Digits*" Read: pg. 547, "*Scientific Notation*" Lesson: Scientific Notation Video: How is Long is a Piece of String
3	Review your Understanding	Math you should be able to do		Handbook*: Review your Understanding*
4	How to Answer a Question	Evaluation in Gr. 12 physics	White boards – compare homework answers	Video: The Big Bang

SPH4C: 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. 12C 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. 12C 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. 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.

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

4. 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).

Check your results with your teacher.

Manager: *When the group decides it had finished question 4, 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.*

5. 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

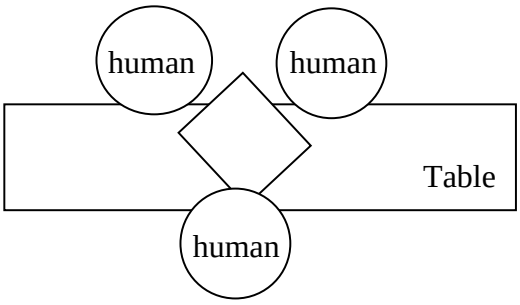
SPH4C: Group Work

The Idea
Group work is the main teaching format of the Gr. 12C physics course. Think of your group as your learning team - the people who will help you learn physics. Group membership will change every major unit, depending on the flow of the units in the course, and will always have a heterogeneous composition of students (all ability levels). Every student is expected to take-up a specific role within the group and to carry out the responsibilities listed below. Members of every group will evaluate one another on their performance in their respective roles. Roles within a group must change for each new task or activity.

Group Roles

Actions	What it sounds like
Manager • Make sure everyone has read the initial instructions before starting. • Direct the sequence of steps. • Keep your group "on-track." • Make sure everyone in your group participates. • Watch the time spent on each step.	*"Has everyone had a chance to read this before we continue?"* *"Let's come back to this later if we have time."* *"We need to move on to the next step."* *"Ralph, what do you think about this idea?"*
Recorder • Act as a scribe for your group. • Check for understanding of all members. • Make sure all members of your group agree on the explanations in the group write-up • Make sure names are on group products.	*"Do we all understand this diagram?"* *"Explain why you think that."* *"Are we in agreement on this?"*
Speaker • Speak on behalf of your group when called upon in class discussions • Ensure group ideas and responses are carefully explained. • Check - Would the group explanations receive a mark of "5"?	*"What other possibilities are there?"* *"Let's try to look at this another way."* *"Let's try to flesh this out."* *"I'm having trouble understanding this. Can we try another way to explain it?"*

Seating
When working in groups, please sit at the tables as illustrated to the right. This helps ensure that all members are able to interact easily with one another. When sitting three in one row, usually one person at the side is left out. I will constantly harass you to do this.



Whiteboards
One of the best ways to share work and ideas is using a whiteboard and your group's common workspace. This is much easier than all huddling around one sheet of paper. Please use these regularly!

SPH4C: 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

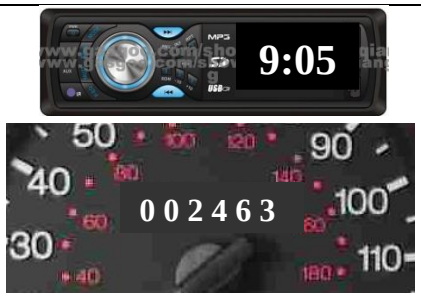
2. **Reflect.** Which of the behaviours that you mentioned in the previous question do you think you share with Sam, Robert or Mike? Explain.

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?

SPH4C: 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. How much time did the trip take in **minutes**?

2. We would like to change this time interval into **seconds**. Explain how to do this conversion and then show the math.

3. Think carefully about your result in seconds - how many of the digits do you think are reliable or significant? Remember that the measurement device only measures to the nearest minute. Rewrite your answer if necessary.

4. What distance, in kilometers, did you travel?

5. We would like to change this distance into metres. Explain how to do this conversion, then show the math.

6. Think carefully about your distance in metres – explain how many significant figures your result should have. Rewrite your answer if necessary.

7. Calculate your average speed (average speed = distance traveled / time interval) during this trip twice – first, to get an answer in kilometers per hour and second, to get an answer in metres per second.

kilometers per hour	**metres per second**

General Guideline for Significant Figures: When performing calculations, write the intermediate results with one extra significant figure and the final answer with no more significant figures than the piece of data with the least. This is a handy but very approximate rule of thumb. In university you will learn a mathematical system for determining the error in your calculated results which will replace this handy rule.

8. Explain how many significant figures each final answer should have.

SPH4C: The Art of Measurement

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

The 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 95.03 cm respectively. Considering the intervals marked on the meter stick, which result illustrates the best use of this measuring device? Explain.

The term *significant figures* describes which digits in a number or measurement are physically meaningful or reliable.

3. How many significant figures are in the measurement you chose in question A#2?

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

5. Two students each measure the length of a running shoe. One student records a result of "271". The other student measures the same shoe and 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 the 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 18.44 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 one 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 standard notation with units of seconds (s).

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

3. Perform the measurement four times, record the times below and calculate an average time.

				Avg:

4. How many significant figures are reasonable to use when writing down the calculated average? Explain.

General Guideline for Significant Figures: When performing calculations, write the intermediate results with one extra significant figure and the final answer with no more significant figures than the piece of data with the least. This is a handy but very approximate rule of thumb. In university you will learn a mathematical system for determining the error in your calculated results which will replace this handy rule.

In traditional notation, there can be some ambiguity about the number of significant figures a measurement has. Use scientific notation for clarity (clearly specifying the number of significant figures) or for convenience (very large or small numbers). Never write down all the digits your calculator computes – they are not always significant!

5. The whole class times how long it takes one student to run from the class, down to the FHCI vending machine and back, simply by observing the classroom clock. The computed average of the class measurements is 78.6176548 s. Explain how to write this calculator result in an appropriate way.

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) 1.776×10^7; **b)** 2.552×10^{-9}; **c)** 1.168×10^3; **d)** 4.44×10^{-1}; **e)** 1.399×10^0.
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 4.2×10^4 J); **d)** 1.81×10^{-6} km; **e)** 1.772×10^{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 × 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 ± 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 ± 1 kg at the start of a diet and 98 ± 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) 6.022×10^{23}.

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

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?

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?

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.

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

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.

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 1.60×10^6 Eg. How many grams of gold are present in the oceans?

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?

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?

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?

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?

SPH4C: How to Answer a Question?

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

A major focus of Gr. 12C 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.

A: Evaluation of Daily Work in Physics

Each day one or two groups at random will be selected to submit their work. Please staple each group member's copy together with the **recorder's** copy on the top. The recorder's copy will be marked in detail – please refer to it for feedback. The manager's and speakers copy will be marked briefly with only a small amount of feedback. The work by each member of a well-functioning group should be of comparable quality and will usually receive the same grade. When there is an obvious difference in quality, different marks will be assigned. Very high quality work is expected in physics. The final mark will usually be the **lowest** of the three categories described in the rubric below.

Language

0-2 Numerous errors to the point of distraction. Largely unintelligible. Fragmented.
3 Understandable, but messy or fragmented. Many spelling or grammatical errors.
4 Neat with complete sentences. Few spelling mistakes or errors in grammar. Clearly worded or phrased.
5 Essentially free of errors in language. Neat writing. Exceptionally clear phrasing. Persuasive, university-level writing. The question is clearly answered.

Mathematics

0-2 Numerous errors or omissions.
3 Most work is correct. Units or important steps are routinely missing.
4 Work is correct. Units and steps are shown. Only minor errors or omissions.
5 Work is correct and would be easily understood by a non-physics student. Units are shown. Algebraic steps are carefully shown or process is explained. Essentially no errors.

Physics

0-2 Clear difficulties with key physics ideas.
3 Main physics ideas are correct, but important details may not be. Explanations are brief and possibly incomplete or incorrect.
4 Main physics ideas are correct. Explanations are complete and clear. Difficulties with minor details.
5 Physics ideas are correct and thoroughly explained. Explanations **explicitly refer to observations or physical laws** and principles. Ideas are explained using multiple representations. Insight and higher-level thinking is demonstrated.

B: Evaluate These Responses!

Evaluate the four student responses below to question A#6 from yesterday's activity.

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

0 1 2 3 4 5 because _____

Response 2: *The measurements are equally precise since they are both accurate to one millimeter, which is the smallest unit indicated on the metre stick. The smallest unit is what precision refers to.*

0 1 2 3 4 5 because _____

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.*

0 1 2 3 4 5 because _____

Response 4: *Precision describes the smallest unit of measurement or interval that the measurement device can distinguish. 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 figures of the measurements (two and three) is not the same things as precision.*

0 1 2 3 4 5 because _____