GRADE 11 PHYSICS

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PRE-VISIT ACTIVITY

CW Physics, Science & Math Program Activities
A correlation with the Ontario Science Curriculum Physics, Grade 11, University Preparation

(B = Kinematics, C = Forces, D = Energy and Society)

ACTIVITIES	GRADE 11 specific expectations
Leviathan **Dragon Fire** **Mighty Canadian** **Minebuster** **Flight Deck** **Vortex** **Wild Beast** **Lab Exercises**	B2.1 use appropriate terminology related to kinematics, including, but not limited to: *time, distance, position, displacement, speed, velocity,* and *acceleration*
	B2.2 analyse and interpret postion-time, velocity-time and acceleration-time graphs of motion in one dimension
	B2.3 use a velocity-time graph for constant acceleration to derive the equation for average velocity and the equations for displacement, and solve simple problems in one dimension using these equations
	B2.4 conduct an inquiry into the uniform and non-uniform linear motion of an object
	B2.5 solve problems involving distance, position and displacement
	B2.6 plan and conduct an inquiry into the motion of objects in one dimension, using vector diagrams and uniform acceleration equations
	B2.7 solve problems involving uniform and non-uniform linear motion in one and two dimensions, using graphical analysis and algebraic equations
	C2.1 use appropriate terminology related to forces, including, but not limited to: *mass, time, speed, velocity, acceleration, friction, gravity, normal force,* and *free-body diagrams*
	C2.2 conduct an inquiry that applies Newton's laws to analyse, in qualitative and quantitative terms, the forces acting on an object, and use free-body diagrams to determine the net force and the acceleration of the object
	C2.3 conduct an inquiry into the relationship between the acceleration of an object and its net force and mass and analyse the resulting data
	C2.5 plan and conduct an inquiry to analyse the effect of forces acting on objects in one dimension, using vector diagrams, free-body diagrams, and Newton's laws
	C2.6 analyse and solve problems involving the relationship between the force of

gravity and acceleration for objects in free fall (AI)

C3.4 describe, in qualitative and quantitative terms, the relationships between mass, gravitational field strength and force of gravity

D2.1 use appropriate terminology related to energy transformations, including, but not limited to: *mechanical energy, gravitational potential energy, kinetic energy, work, power, fission, fusion, heat, heat capacity, temperature,* and *latent heat*

D2.2 solve problems relating to work, force, and displacement along the line of force

D2.3 use the law of conservation of energy to solve problems in simple situations involving work, gravitational potential energy, kinetic energy, and thermal energy and its transfer (heat)

D2.4 plan and conduct inquiries involving transformations between gravitational potential energy and kinetic energy (e.g., using a pendulum, a falling ball, an object rolling down a ramp)to test the law of conservation of energy

D2.5 solve problems involving the relationship between power, energy, and time

AMUSEMENT RIDE GRAPHING RUBRIC

CATEGORY	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
Knowledge and Understanding Describes different kinds of motion and the quantitative relationships among position and time	- demonstrates limited understanding of graphing techniques	- demonstrates some understanding of graphing techniques	- demonstrates considerable understanding of graphing techniques	- demonstrates thorough understanding of graphing techniques
Inquiry Applies the steps of a problem solving process to find average speed using a graph of position vs time	- applies the steps of a problem solving process with assistance	- applies the steps of a problem solving process with some assistance	- independently applies the steps of a problem solving process with considerable effectiveness	- independently applies the steps of a problem solving process with a high degree of effectiveness
Communication Communicates the results of the investigation	- uses scientific terminology and symbols with limited accuracy and effectiveness	- uses scientific terminology and symbols with some accuracy and effectiveness	- uses scientific terminology and symbols with accuracy and effectiveness	- uses scientific terminology and symbols with a high degree of accuracy and effectiveness
MakingConnections Applies knowledge about slope to approximate an amusement ride's speed	- applies concepts and simple procedures to partially solve problems and shows limited understanding of connections relating to familiar settings	- applies concepts and simple procedures tosolve problems and shows some understanding of connections relating to familiar settings	- applies concepts and procedures tosolve problems and shows considerableunderstanding of connections relating to familiar settings	- applies concepts andprocedures tosolve problems and shows thorough understanding of connections relating to familiar settings

CATEGORY	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
Knowledge and Understanding Demonstrates an understanding of the relationship between forces and the acceleration of an object in linear motion	- demonstrates limited understanding of relationships between forces and acceleration	- demonstrates some understanding of relationships between forces and acceleration	- demonstrates considerable understanding of relationships between forces and acceleration	- demonstrates thorough understanding of relationships between forces and acceleration
Inquiry Applies technical skills and procedures of a problem solving process	- design experiments involving energy transformations and the law of conservation of energy, with limited competence	- design experiments involving energy transformations and the law of conservation of energy, with moderate competence	- design experiments involving energy transformations and the law of conservation of energy, with competence	- design experiments involving energy transformations and the law of conservation of energy, with a high degree of competence
Communication Communicates the results of the investigation	- uses scientific terminology, symbols, and standard units (SI) with limited accuracy and effectiveness	- uses scientific terminology, symbols, and standard units (SI) with some accuracy and effectiveness	- uses scientific terminology, symbols, and standard units (SI) with accuracy and effectiveness	- uses scientific terminology, symbols, and standard units (SI) with a high degree of accuracy and effectiveness
MakingConnections Analyses the effect of a net force on the linear motion of an object in quantitative terms using calculations, free-body diagrams and written descriptions	- proposes courses of practical action in designing a roller coaster with limited clarity and precision	- proposes courses of practical action in designing a roller coaster with some clarity and precision	- proposes courses of practical action in designing a roller coaster with clarity and precision	- proposes courses of practical action in designing a roller coaster with a high degree of clarity and precision

BASIC MEASUREMENTS

To get ready for the trip to Canada's Wonderland for the Physics, Science and Math program, you should find answers to all of the questions below. On the day of the trip, take this sheet with you so you can use the numbers.

TIME

Number of seconds per minute   _____

Number of minutes per hour   _____

Number of seconds per hour   _____

YOUR BODY MEASUREMENTS

Height   _____ cm   _____ m

Arm span   _____ cm   _____ m

Length of shoe   _____ cm   _____ m

Hand Span   _____ cm   _____ m

PULSE AND BREATHING RATES

	Pulse Rate (beats per minutes)	Breathing Rate (breaths per minute)
Sitting		
Standing (before exercise)		
Standing (after exercise)		

MATH PRACTICE

1.   Discuss in class how to find each of the following numbers:
        a) pulse rate (per minute)
        b) breathing rate (per minute)
        c) the perimeter of a square, a rectangle, or other polygon
        d) the diameter of a circle
        e) the circumference of a circle
        f) multiplying two numbers with units

>   e.g.   6 paces x 40 cm/pace = 240 cm
>   5 hand spans x 18 cm/hand span = 90 cm
>   3 cars x 4 passengers/car = 12 passengers

        g) the average of two or more numbers

2.   Solve the following problems. Where possible, show how you calculated the answer.
        a) Julie measures 36 heart beats in 30 seconds. What is her pulse rate per minute?

        b) Soo-Jin breathes 26 times in two minutes. What is her breathing rate per minute?

        c) Terry measures 19 pulse beats in 15 seconds. What is his pulse beat per minute?

        d) Determine the perimeter of this page in centimetres.

e) Measurethe diameter of a dollar coin (loonie) in centimetres.

f) Measure your hand span in centimetres. Then use you hand span to estimate the length of a desk.

g) Use your hand span to estimate the diameter of a large circle, such as a bicycle wheel or a hula-hoop.

h) Use your hand span to estimate the circumference of the circle in g).

i) Measure your average pace in centimetres. Use your pace to find the length and width of your classroom.

j) How many desks are there in a room that has 5 rows of desks with 6 desks in a row?

k) Teepu's mass is 42kg and Angela's mass is 54 kg. Find the average of their masses.

DEFINITIONS

Acceleration The rate at which velocity increases. When a roller coaster train moves down a hill its velocity increases. That is, the train is accelerating.

Accelerometer (horizontal) A device used to measure horizontal acceleration as well as the height of objects.

Accelerometer (vertical) A device used to measure vertical acceleration.

Deceleration The rate at which velocity decreases. When a roller coaster train is moving up a hill its velocity decreases. That is, the train is decelerating.

Displacement A vector quantity which describes the difference between the initial and final position of an object.

Pier Part of a structure whose function is to resist compressive forces. The cylindrical piers on a metal roller coaster support the track by resisting compressive forces caused by the weight of the roller coaster train and its passengers.

Scalar A quantity that contains a magnitude and unit.

Speed The distance an object travels in a certain time interval.

Vector A quantity that contains a magnitude, unit and direction.

Velocity The displacement an object travels in a certain time interval.

VOCABULARY

Acceleration
Accelerometer (vertical or horizontal)
Displacement
Distance
Energy
Force
Friction
G-Force
Gravitational
Potential Energy
Gravity
Joule
Kilogram
Kinetic Energy

Law of Conservation of Energy
Mass
Metre
Newton
Newton's Three Laws of Motion
Power
Second
Speed
Track
Profile
Velocity
Watt
Weightlessness
Work

Applying science language to an amusement ride:

The force of **GRAVITY** between the roller coaster train in which you are riding and the earth pulls you down the roller coaster hills.

The greater the **WEIGHT** of the roller coaster train, the more strength the structure must have to support the tracks.

The addition of more passengers will increase a roller coaster's **MASS** and weight.

The supporting structure of a roller coaster is a series of connected parts called the **FRAME**.

The supporting structure of the wave pool in **Splash Works** is a one piece **SHELL**.

A **PIER** is the part of a structure whose function is to resist compressive forces. The cylindrical **PIERS** on a metal roller coaster support the track by resisting compressive forces caused by the weight of the roller coaster and its passengers.

On the wooden roller coasters the **TRUSS** is a structural element (whose function is to resist tension and compression forces) made up of a series of triangular frames.

The downward force, which is applied to the structure's support piers, is called **COMPRESSION**.

The outward force, which occurs when the roller coaster train is travelling around a curve, puts **TENSION** on the structure's support wires.

The **VELOCITY** of the roller coaster train increases as it rolls down a hill.

A roller coaster train **ACCELERATES** as it gains speed while rolling down a hill.

A roller coaster train **DECELERATES** as it loses speed while climbing up a hill.

A roller coaster train gains enough **MOMENTUM** falling down a hill to keep it going all the way to the top of the next hill.

A roller coaster has the most **POTENTIAL ENERGY** when it is at the highest peak of the ride. As the velocity increases going down a hill, a roller coaster train gains **KINETIC ENERGY**. **INERTIA** causes the passenger to lean forward when the roller coaster train stops at the end of the ride.

The rubbing between the roller coaster train's wheels and the track causes a **FRICTIONAL** force, which slows the roller coaster train down.

Roller coaster hills are shaped in a curve called a **PARABOLA** so that the passengers will feel almost **WEIGHTLESS** as the train goes over the hill.

The roller coaster track is tilted inward to allow the **CENTRIPETAL FORCE** to push the coaster train toward the centre of the curve.

PNEUMATIC devices, such as roller coaster brakes, are operated by air or gas pressure; using fluids to operate mechanical devices is called **HYDRAULICS**.

The **COMPRESSIBILITY** or **INCOMPRESSIBILITY** of a substance is determined by that substance's ability to be reduced in size due to pressure.

ERGONOMIC DESIGN refers to the way different aspects of the amusement ride are designed to be comfortable, adjustable to different sizes of people, and supportive to prevent injury.

SCIENCE LANGUAGE QUIZ

Select the correct word and complete each sentence:

PIER	**VECTOR**
SCALAR	**DISPLACEMENT**
SPEED	**VELOCITY**
ACCELERATION	**DECELERATION**
HORIZONTAL ACCELEROMETER	**VERTICAL ACCELEROMETER**

1. A decrease in speed is called _____.

2. A _____ quantity states a magnitude and unit.

3. The rate of change of displacement with time is called _____.

4. A device used to measure height as well as acceleration is called a
   _____.

5. The _____ of an object is found by determining the difference between the initial and final positions of that object.

6. The rate of change of velocity with time is called _____.

7. A _____ quantity states a magnitude, unit and direction.

8. The distance traveled in a certain time interval is called _____.

9. A device used to measure the acceleration of a falling object is called a
   _____.

10. A _____ is a part of the roller coaster's structure that counteracts compression forces.

Distance, Velocity and Acceleration

d = distance travelled (m)
v_i = initial velocity (m/s)
v_f = final velocity (m/s)
a = acceleration (m/s^2)
t = time (s)

For uniform acceleration:
$\Delta d = (v_f + v_i) \, t \, / \, 2$
$\Delta d = v_i \, t + \frac{1}{2} \, a \, t^2$
$v_f = v_i + a \, t$
$v_f^2 = v_i^2 + 2 \, a \, \Delta d$
$a = \Delta v \, / \Delta t$

For uniform motion:
$d = v \, t$

At the surface of the Earth:
$g = 9.8 \text{ m/s}^2$

Energy, Work, Power

h = height (m)
m = mass (kg)
F = force (N)

Gravitational Potential Energy
$PE = m \, g \, h$

Kinetic Energy
$KE = \frac{1}{2} \, m \, v^2$

Work
$W = F \, \Delta d$

Power
$P = W \, / \, t$

Force

$F_{net} = m \, a$
$F_f = \mu \, F_N$
$F_g = mg$

METHODS OF PERFORMING MEASUREMENTS

A) TIME

The times that are required to work out the problems can be measured using a digital watch with a stopwatch mode or a watch with a second hand. In order to achieve a more accurate result be sure to measure multiple occurrences and then average.
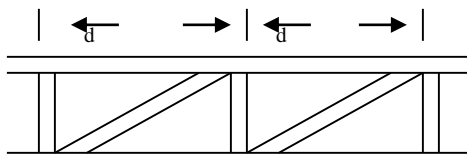
B) DISTANCE

Since you cannot interfere with the normal operation of the rides, you will not be able to directly measure heights, diameters, etc. All but a few of the distances can be measured remotely using one or another of the following methods. They will give you a reasonable estimate.

1. Pacing: Determine the length of your stride by walking at your normal rate over a measured distance. Divide the distance by the number of steps, giving you the average distance per step. Knowing this, you can pace off horizontal distances.

I walk at a rate of _____ paces per _____ ...or... My pace = _____ m

2. Ride Structure: Distance estimates can be made by noting regularities in the structure of the ride. For example, tracks may have regularly spaced cross-members as shown below. The distance d can be estimated, and by counting the number of cross members, distances along the track can be determined. This can be used for both vertical and horizontal distances.


C) HEIGHT

1. For measuring height by triangulation, a horizontal accelerometer can be used. Suppose the height h of a ride must be determined. First the distance L is estimated by pacing it off (or given at the park). Sight along the accelerometer to the top of the ride and read the angle, θ. Add in the height of your eye to get the total height
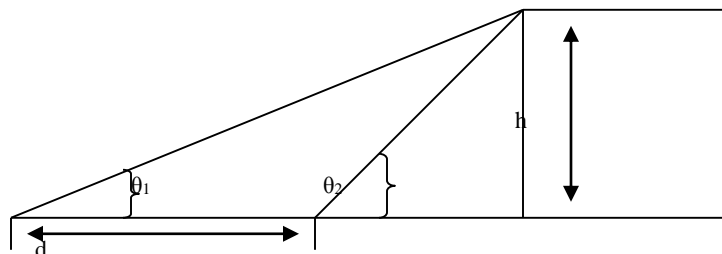
h = Total Height
$h = h_1 + h_2$
$h_1 = d \tan \theta$
h_2 = Height from ground to eye level
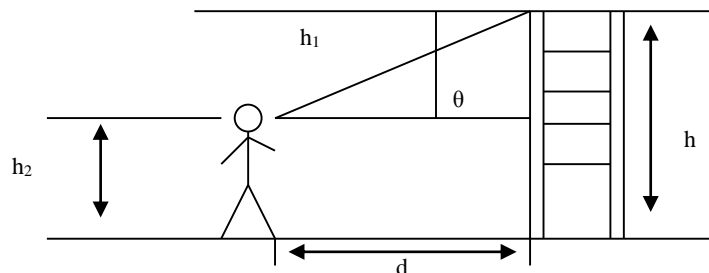
2. A similar triangulation can be carried out where you cannot measure the distance to the base of the ride. Use the law of sines as illustrated in the figure below. Measure the angles θ_1 and θ_2 with a protractor (actually, the horizontal accelerometer) at two different locations.

$$h = d\frac{\sin\theta_1 \sin\theta_2}{\sin(\theta_1 - \theta_2)}$$

D)   LATERAL OR LONGITUDINAL ACCELERATION

This instrument consists of a protractor, a weight and a string as illustrated in the sketches below:
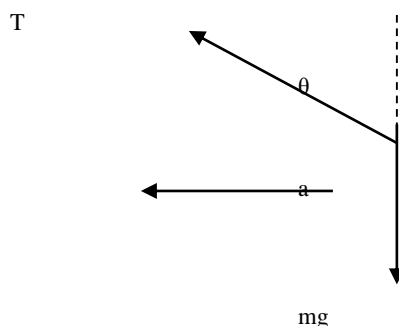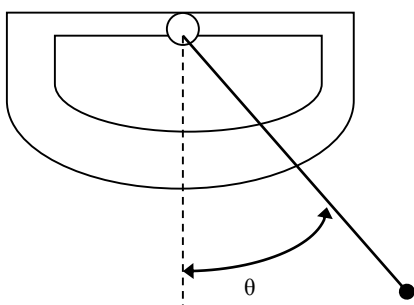
T = Tension on the string
m = Mass
g = 9.8m/s^2
a = Acceleration

where:
$$T\cos\theta = mg$$
$$T\sin\theta = ma$$
$$a = g\tan\theta$$

To measure lateral acceleration, hold the protractor in front of you so that the straightedge is horizontal and is perpendicular to the direction of travel.

To measure longitudinal acceleration, hold the protractor in such a way that the straightedge is horizontal and is parallel to the direction of travel

E)	**VERTICAL ACCELERATION**
The vertical accelerometer gives an acceleration reading parallel to its long dimension. It is normally calibrated to read in "g's". A reading of 1 g means an acceleration of 9.8m/s^2, the normal acceleration of gravity here on earth. Another way of stating this is to say that you are experiencing a force equivalent to your normal earth weight.
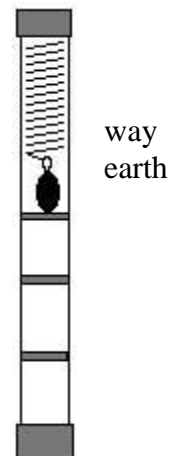
F)	**SPEED**

The average speed of an object is simply distance divided by time. For circular motion, it is the circumference divided by time, if the speed is in fact constant.

$$v_{avg} = \frac{\Delta d}{\Delta t} = \frac{2\pi R}{\Delta t}$$

To measure the instantaneous speed of a moving train, divide its length by the time it takes to pass a particular point on the track.

$$v_{inst} = \frac{\Delta d}{\Delta t} = \frac{\text{length of train}}{\text{time to pass a point}}$$

In a situation where friction is ignored and the assumption is made that total mechanical energy is conserved, speed can be calculated using energy considerations:

$$PE = KE$$
$$mgh = \frac{1}{2}mv^2$$
$$v^2 = 2gh$$

Consider a more complex situation:
$$PE_A + KE_A = PE_B + KE_B$$
$$mgh_A + \frac{1}{2}mv_A^2 = mgh_B + \frac{1}{2}mv_B^2$$

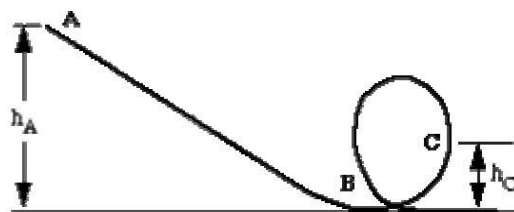**Figure I**

POSITION-TIME GRAPH LAB EXERCISE

EXERCISE A: POSITION-TIME GRAPH

Your trip to Wonderland will involve calculating velocities of different moving objects. Since it is difficult to measure these velocities directly, you should develop skills in determining velocity from a graph.

Objective   To find the velocity of a walking classmate using a position-time graph
Materials   Stopwatch, metre stick, masking tape and graph paper

Procedure and Analysis

1.   Copy the following table in your notebook:

POSITION (m)	TIME (s)
0	0
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

2.   In a group of three, use masking tape to mark out equal one - metre intervals on the floor in a space that is ten metres long.

3.   Have partner # 1 walk at a constant speed along your pre-set markers while partner #2 starts the stopwatch and partner #3 records the time intervals at which partner # 1 reaches each marker. (Note: a) record your times as the walker's body crosses each line, b) the stopwatch must continue to run during the experiment).

4.   Use the data collected to plot a position-time graph with position on the y-axis and time on the x-axis.

5.   Draw a line of best fit on your graph. Is the line linear or quadratic?

LINEAR ACCELERATION LAB EXERCISE

EXERCISE B: MEASURING LINEAR ACCELERATION

Your trip to Wonderland will involve calculating linear acceleration or deceleration of different moving objects. Since it is difficult to measure these values directly, you should develop skills in determining acceleration and deceleration in other ways.

Objective   To use a horizontal accelerometer to determine the acceleration of a mousetrap car undergoing uniform acceleration and to check the result using at least one other method

Materials   Horizontal accelerometer, mousetrap car, stopwatch, metre stick and masking tape

Procedure and Analysis

1.   Attach the horizontal accelerometer to the mousetrap car.

2.   Release the car. As the car accelerates forward, measure the angle that the string or beads on the accelerometer make with the vertical. (Note: be sure to measure the angle while the car is accelerating and not decelerating).

3.   Use the angle to calculate the linear acceleration. Apply the equation $a = g\,sin\theta$, where g $= 9.8$ m/s^2.

4.   Release the car a second time. Measure the distance the car travels until it reaches top speed. Measure the time required to reach this distance.

5.   Calculate the acceleration of the car using $\Delta d = v_1 t + \frac{1}{2}at^2$. Note, $v_1 = 0$.

Applications

1.   Compare the acceleration of the car obtained using both methods.

2.   Should the two values be the same? What might have caused a discrepancy in the two values?

3.   Which method was the most accurate? Why?

EXERCISE A: MEASURING LINEAR ACCELERATION

The name "horizontal accelerometer" implies that this instrument should be capable of measuring the rate of acceleration of something that is accelerating linearly forward. How would you hold the accelerometer to indicate your own acceleration as you start increasing your speed from an initial velocity of zero?Discuss this with other students and your teacher before you tackle the exercise here.

Objective   To use the horizontal accelerometer to determine the acceleration of a cart undergoing uniform acceleration, and to check the result using at least one other method
Materials   A horizontal accelerometer and a lab set-up similar to what you would have used to learn about Newton's second law of motion. (An air track with related apparatus provides another alternative.)

Procedure and Analysis

1. Attach the horizontal accelerometer to the cart, as illustrated in the diagram. As the cart accelerates forward, measure the angle that the cart string or bead makes with the vertical. Use the angle to calculate the linear acceleration. (Apply the equation $a = g \sin\theta$). Devise at least one other way to check your result.

2.Repeat Step 1 using a different mass suspended from the string so that a different acceleration occurs.
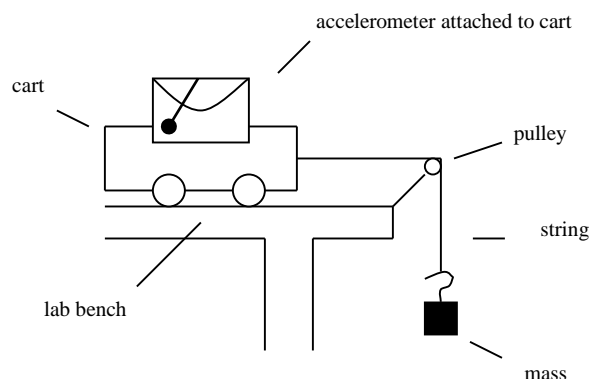
Applications

1. Domenic is viewing a horizontal accelerometer from the side while sitting on a ride at Wonderland. Suddenly the ride accelerates forward, and the maximum angle that Domenic observes on the accelerometer is 18°. What maximum acceleration did Domenic experience?

2.Using a horizontal accelerometer, Soo Jin discovers that the linear acceleration she experiences at the beginning of a certain ride is 0.36 g. What angle did she observe on her accelerometer during this acceleration?

Extensions

1. Describe how you would determine the maximum (negative) acceleration of a moving object that slows down rapidly, coming to a stop.If your teacher approves your method, try it.What suggestions would you make for improving the results?

2. Use your horizontal accelerometer in a subway car, a bus, or a car to determine the maximum positive and negative accelerations experienced under normal conditions.

(NOTE: If you do this in a car, be sure to exercise safety. Remember that photo radar is an excellent application of physics principles.)

EXERCISE B: ANALYZING FRICTION

When was the last time you thanked your physics teacher for being kind to you? You should do so every time she or he tells you to ignore friction in solving a mechanics problem. Ignoring friction makes a problem easier to solve, but it does not provide a realistic situation. Being able to analyze the effects of friction is a very important part of designing and safely operating many amusement park rides, including roller coasters.

Objective   To apply the law of conservation of energy to estimate the amount of friction experienced by a moving object
Materials   A track with at least one vertical loop, a ball, a metre stick or metric ruler, apparatus needed to determine the speed of a moving ball (e.g., a photogate timer connected to a computer)

Procedure and Analysis

1. Using the diagram below as a reference, you can use the following steps to determine what portion of the input energy goes to overcoming the friction acting on a moving ball.
   - With the ball at rest at the starting position (A), determine an expression for the ball's gravitational potential energy relative to the position (B) where you can measure its speed. Express the potential energy in terms of the ball's mass, m. (Can you tell why the mass of the ball does not have to be known to solve this problem?)
   - Devise a way to measure the speed with which the ball leaves the track at position B after having been released from rest at position A. (If you do not have a photogate timer available, try using your knowledge of projectile motion to solve this problem. All you would need is a metre stick and an understanding of equations.)
   - Use the ball's speed at B to calculate an expression for its kinetic energy in terms of the ball's mass, m.
   - Calculate what portion of the ball's initial maximum potential energy was used to overcome friction.

2. Predict what will happen if you release the ball from rest from position C, which is at the sameposition horizontally as position D, which is the inside top of the loop.
   - Verify your prediction experimentally.
   - Give reasons for what you observe.
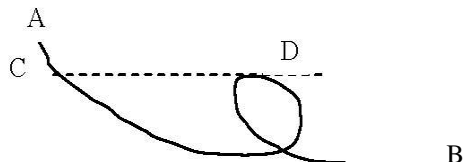
3. Can you or other members of your group think of other ways of determining the amount of friction on a moving steel ball? If so, try to carry out an investigation with your teacher's approval.

Application

Any roller coaster ride that resembles the looped track that was part of this exercise is called a "gravity ride". Why do you think this is so?

Extension

Using the same ball-and-track apparatus, devise and carry out your own experiment to solve some other problem(s).

GRAPHING EXERCISES

AMUSEMENT RIDE ACTIVITIES

DRAGON FIRE

DROP TOWER

VORTEX

MIGHTY CANADIAN MINEBUSTER

WILD BEAST

THE FLY

*On **Dragon Fire**, unrelenting speed and loops are just some of this coaster's tricks. This immense steelcoaster hurls riders through two 360-degree loops, a full corkscrewand a side-winding helix.*
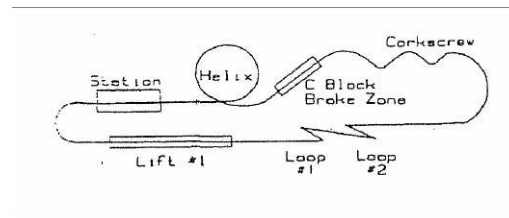
QUESTIONS

PART A: PROCEDURAL CALCULATIONS
(Time, Distance, Speed and Acceleration)

1. You have been asked by Canada's Wonderland park engineers to report on whether the coaster's lift motor is operating at the proper speed. In order to accomplish this task you will have to figure out the speed of the train as it moves up to the top of the first hill. Later, you will compare your data with standard operating data to determine if the motor is operating at optimal speed. In order to do this you will need to first platform the following steps:

a) **[B2.4]** Find the sign indicating a distance point to the first drop and record the value here.

b) **[B2.4]** Using a horizontal accelerometer and the "Methods of Performing Measurements" hand out provided, find the height *(h)* of the first hill.

c) **[B2.5]** Given that the slope of the first hill is 25°, calculate the distance from the bottom of the hill to the top. Use the formula $L = h / sin\ \theta$, where θ is the slope of the hill, h is the height of the first hill (calculated in part b above) and L is the distance from the bottom of the lift to the top. Record the length of the track below.

2. **[B2.6]** Using a stopwatch, measure the time for the train to travel from the bottom of the first hill where the train hooks onto the chain to the top of the hill before it falls.

QUESTIONS

3. **[B2.6]** Using the data collected in questions 1 and 2 find the speed of the train moving up the first hill.

4. **[B2.6]** Park safety engineers are interested in monitoring the acceleration of the ride to find out the top speed of the ride at the bottom of the first hill. The top speed is then used to determine the forces acting on the riders' bodies. In order to do this you will need to perform the following steps:

a)   Using a stopwatch, measure the time for the train to travel from the top of the first hill to the bottom (using the point of release from the chain as the starting point).

b)   Given that the distance from the top to the bottom of the first hill is 38.2m find the acceleration *(a)* of the train using
$d = v_1t + \frac{1}{2}at^2$. Note, your initial speed *(v₁)* at the top of the hill has been calculated in question #3.

c)   Using the calculated acceleration *(a),* initial speed *(v₁)* and time *(t)* find the final speed *(v₂)* of the train at the bottom of the first hill using the equation
$a = (v_2 - v_1) / t$.

QUESTIONS

5.   Roller coaster maintenance crews constantly monitor the trains' braking system to determine and record its deceleration capabilities. You have been hired as a junior assistant in order to ride the train and calculate its deceleration from the point where your car leaves the last curve of the ride until it comes to a complete stop before making its final journey into the loading platform. In order to do this you will need to perform the following steps:

a)   **[B2.5]** Using a stopwatch, measure the time for the train to travel from the end of the last curve to its stop before reaching the loading platform.

b)   **[B2.6]** Given that the speed of the train as it rounds the last curve is 2.8 m/s, find the deceleration of the train using $a = (v_2 - v_1) / t$. Note, $v_2 = 0$.

6.   **[B2.4]** List three uncertainties (possible errors) in your experimental measurements above (e.g., accurately stopping and starting the stopwatch).

QUESTIONS

PART B: GRAPHING DATA

7. **[B2.2] [B2.3]** In an independent study the following standard operating data was found and represents a train's position over time while climbing up the first hill of this ride. This data is routinely used to monitor the functioning of the roller coasters lift motor. Using the following data and the grid provided draw and label a position-time graph:

Position (m) (y-axis)	Time (s) (x-axis)
0	0
4	1.8
10	4.5
18	8.2
35	15.9
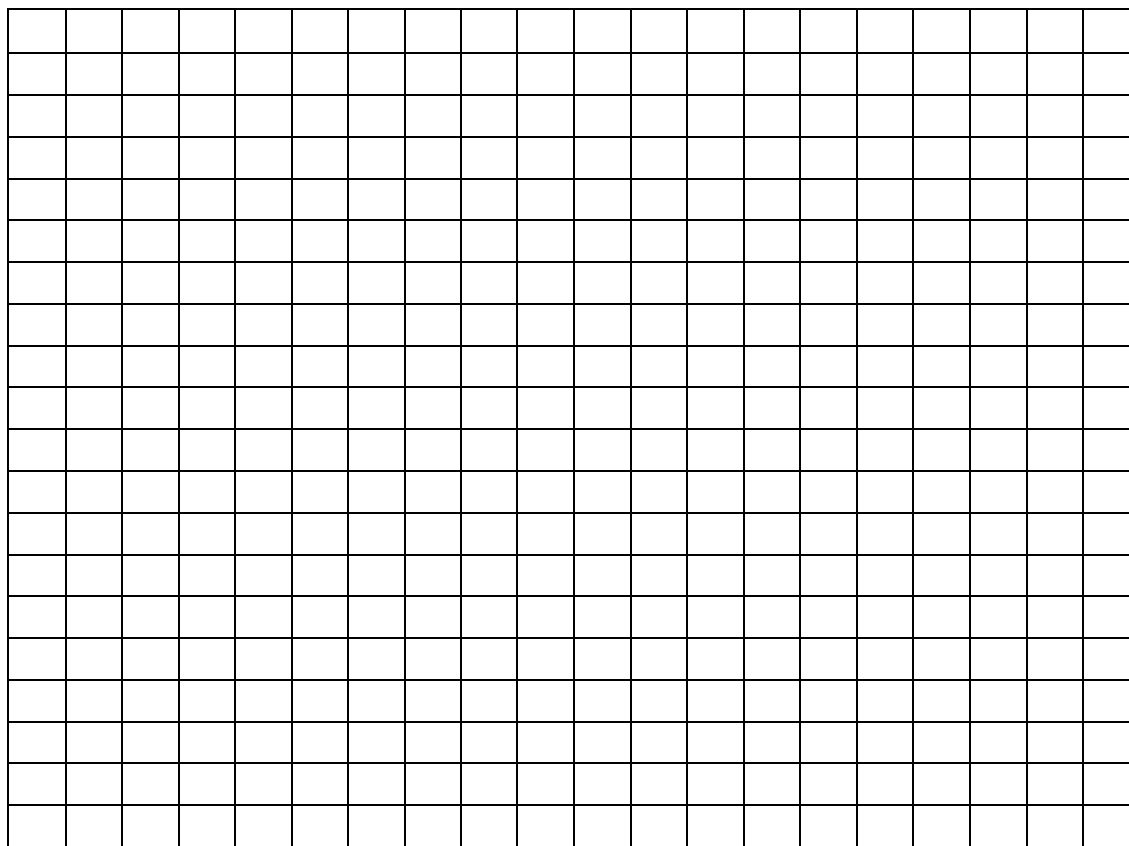
QUESTIONS

8.   **[B2.2]** Calculate the slope of your position-time graph in the space provided below.

9.   **[B2.2] [B2.3]** Does the slope of a position-time graph represent (circle one):
          a) acceleration   b) speed   c) displacement   d) time

QUESTIONS

PART C: REFLECTIONS

10.   **[B2.7]** Use your earlier calculation to compare the velocity of the train moving up the first hill with the speed found above in your graph. What are your findings? Is the lift motor operating at optimal speed? If there is a discrepancy discuss the reasons why?

11.   **[B2.1]** In a journal entry, use appropriate science vocabulary, SI (system international) units, numbers and formulas to reflect on the various methods that could be used by Wonderland park engineers to check the daily operation of amusement rides and monitor the rides' velocity and acceleration.

*On **Drop Tower**, riders sit on a high-speed transport lift that travels over 16 feet per second, 230 feet in the air. At the top of the tower, guests have but moments to take in the panoramic view of the Park before it registers that what goes up must come down. Free falling at more than 100 km/h, 23 stories flash by as the ground races up and catches riders in a silent, smooth stop.*
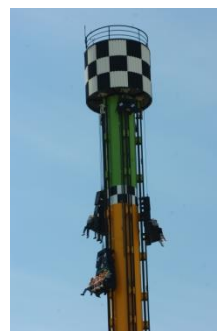
QUESTIONS

PART A: PROCEDURAL CALCULATIONS
(Time, Distance, Speed and Acceleration)

1. You have been asked by Canada's Wonderland park engineers to report on whether **Drop Tower**'s lift motor is operating at the proper speed. In order to accomplish this task you will have to figure out the speed of the ride as it moves up to the top of the stunt tower. Later, you will compare your data with standard operating data to determine if the motor is operating at optimal speed. In order to do this you will need to first perform the following steps:

a)   **[B2.1]** Find the sign indicating a distance point to **Drop Tower** and record the value here.

b)   **[B2.1]** Using a horizontal accelerometer and the "Methods of Performing Measurements" hand out provided, find the height *(h)* of the stunt tower.

QUESTIONS

2.   **[B2.5]** Using a stopwatch, measure the time for the passenger compartment to travel slowly from the bottom of the stunt tower to the top.

3.   **[B2.6]** Using the data collected in questions 1 and 2 find the speed of the passenger compartment moving up the tower.

4.   Film Studio is interested in determining whether **Drop Tower** would be an effective way to screen for future stunt actors and determine whether the individual can handle the effects of free fall. We need your help to determine if the acceleration of the ride matches that of an object falling freely due to gravity. This will help us to determine whether **Drop Tower** is a realistic test for these candidates. In order to do this you will need to follow the following steps:

a)   **[B2.5]** Using the horizontal accelerometer measure the free fall distance of the passenger compartment. This is the distance from the top of the tower to where it begins to brake.

QUESTIONS

b) **[B2.5]** Using a stopwatch, measure the time for the passenger compartment to travel from initial fall to initial braking.

c) **[B2.3]** Find the acceleration *(a)* of the passenger compartment using the equation $d = v_1 + \frac{1}{2}at^2$. *Note,* your initial velocity at the top of the tower is zero *($v_1 = 0$)*.

d) **[B2.6]** Compare the acceleration found in part (c) to that of the acceleration due to gravity (9.8 m/s^2). Which is greater?

e) Based on your findings do you think that **Drop Tower** would be a realistic test for these candidates? Why?

5. **[B2.4]** List three uncertainties (possible errors) in your experimental measurements above. (e.g., accurately stopping and starting the stopwatch)

PART B: GRAPHING DATA

6. **[B2.2] [B2.3]** In an independent study the following standard operating data was found and represents the passenger compartment's position over time while climbing to the top of the tower. This data is routinely used to monitor the functioning of **Drop Tower**'s lift motor. Using the following data and the grid provided draw and label a position time graph:

Position (m) (y-axis)	Time (s) (x-axis)
0	0
12.1	4.2
34.4	12.0
45.1	15.7
58.7	20.5
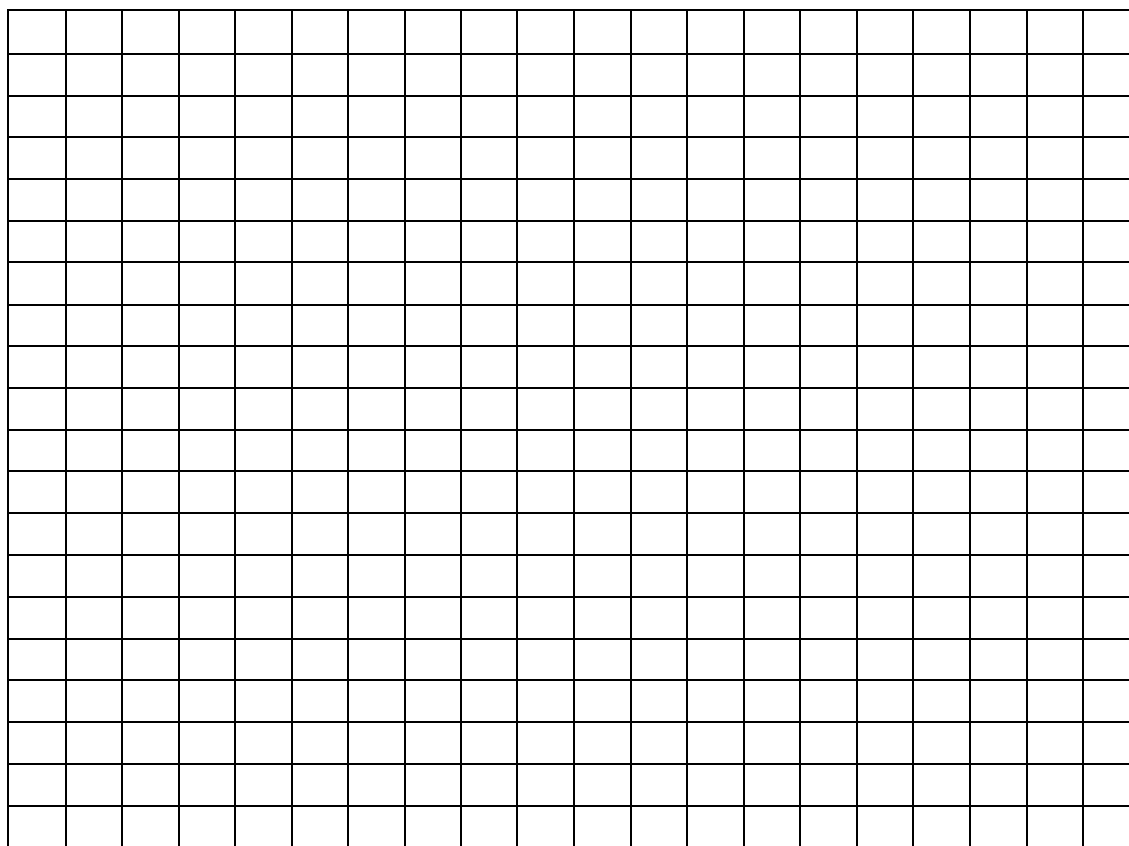
DROP TOWER - GRAPHING

QUESTIONS

7. **[B2.2]** Calculate the slope of your position-time graph in the space-provided below.

8. **[B2.3]** Does the slope of a position-time graph represent (circle one):
   a) acceleration b) speed c) displacement d) time

QUESTIONS

PART C: REFLECTIONS

9. **[B2.7]** Use your earlier calculation to compare the speed of the passenger compartment moving up the stunt tower with the speed found above in your graph. What are your findings? Is the lift motor operating at optimal speed? If there is a discrepancy discuss the reasons why?

10. **[B2.1]** In a journal entry, use appropriate science vocabulary, SI (system international) units, numbers and formulas to reflect on the various methods that could be used by Canada's Wonderland park engineers to check the daily operation of amusement rides and monitor the rides' velocity and acceleration.

*On **Vortex**, riders will enjoy the thrills of Canada's first suspended roller coaster. This steel coaster plunges over Wonder Mountain, reaching speeds of 90 km/h. **Vortex**'s invisible track drives riders trough unrelenting turns, swooping, diving, and plunging over a scenic waterscape.*

DATA

Mass of each empty car = 700 kg

Total length of track = 720 m

Radius of the turn at the bottom of the first track = 16.8 m

Length of lift track = 62.8 m

Change of elevation of first drop = 26.0 m

Lift chain sprocket has 22 teeth at 102.63 mm pitch

Gear box reduction ratio is 31:90:1

Rotational speed of sprocket = 1750 rpm

QUESTIONS

PART A: PROCEDURAL CALCULATIONS
(Time, Distance, Speed and Acceleration)

1. You have been asked by Canada's Wonderland park engineers to report on whether the coaster's lift motor is operating at the proper speed. In order to accomplish this task you will have to figure out the speed of the train as it moves up to the top of the first hill. Later, you will compare your data with standard operating data to determine if the motor is operating at optimal speed. In order to do this you will need to first perform the following steps:

   a) **[B2.1]** Find the sign indicating a distance point to the first drop and record the value here.

QUESTIONS

b) **[B2.4]** Using a horizontal accelerometer and the "Methods of Performing Measurements" hand out provided, find the height *(h)* of the first hill.

c) **[B2.5]** Given that the slope of the first hill is 250, calculate the distance from the bottom of the hill to the top. Use the formula $L = h\,/\,sin\theta$, where θ is the slope of the hill, h is the height of the first hill (calculated in part b above) and L is the distance from the bottom of the lift to the top. Record the length of the track below.

2. **[B2.6]** Using a stopwatch, measure the time for the train to travel from the bottom of the first hill where the train hooks onto the chain to the top of the hill before it falls.

QUESTIONS

3.   **[B2.6]** Using the data collected in questions 1 and 2, find the speed of the train moving up the first hill.

4.   **[B2.6]** Park safety engineers are interested in monitoring the acceleration of the ride to find out the top speed of the ride at the bottom of the first hill. The top speed is then used to determine the forces acting on the riders' bodies. In order to do this you will need to perform the following steps:

   a)   Using a stopwatch, measure the time for the train to travel from the top of the first hill to the bottom (using the point of descent down the hill as the starting point).

   b)   Given that the distance from the top to the bottom of the first hill is 30.7 m find the acceleration *(a)* of the train using
   $d = v_1t + \frac{1}{2}at^2$. Note - your initial speed *(v₁)* at the top of the hill has been calculated in question #3.

   c)   Using the calculated acceleration *(a)*, initial speed *(v₁)* and time *(t)* find the final speed *(v)* of the train at the bottom of the first hill using the equation $a = (v_2 - v_1) / t$.

QUESTIONS

5.   Roller coaster maintenance crews constantly monitor the trains' braking system to determine and record its deceleration capabilities. You have been hired as a junior assistant in order to ride the train and calculate deceleration. You will calculate the train's deceleration from the last pier before the horizontal stopping platform until the ride comes to a complete stop before making its final journey into the loading platform. In order to do this you will need to perform the following steps:

   a)   **[B2.5]** Using a stopwatch, measure the time for the train to travel from the last pier before the horizontal stopping platform to a complete stop before reaching the loading platform.

   b)   **[B2.6]** Given that the speed of the train as it enters the horizontal stopping platform is 6.1m/s, find the deceleration of the train using $a = (v_2 - v_1) / t$. Note, $v_2 = 0$.

6.   **[B2.6]** List three uncertainties (possible errors) in your experimental measurements above (e.g., accurately stopping and starting the stopwatch).

QUESTIONS

PART B: GRAPHING DATA

7.   **[B2.2] [B2.3]** In an independent study the following standard operating data was found and represents a train's position over time while climbing up the first hill of this ride. This data is routinely used to monitor the functioning of the roller coasters lift motor. Using the following data and the grid provided draw and label a position time graph:

Position (m) (y-axis)	Time (s) (x-axis)
0	0
9.3	8.2
17.1	15.1
33.4	29.6
45.5	40.3
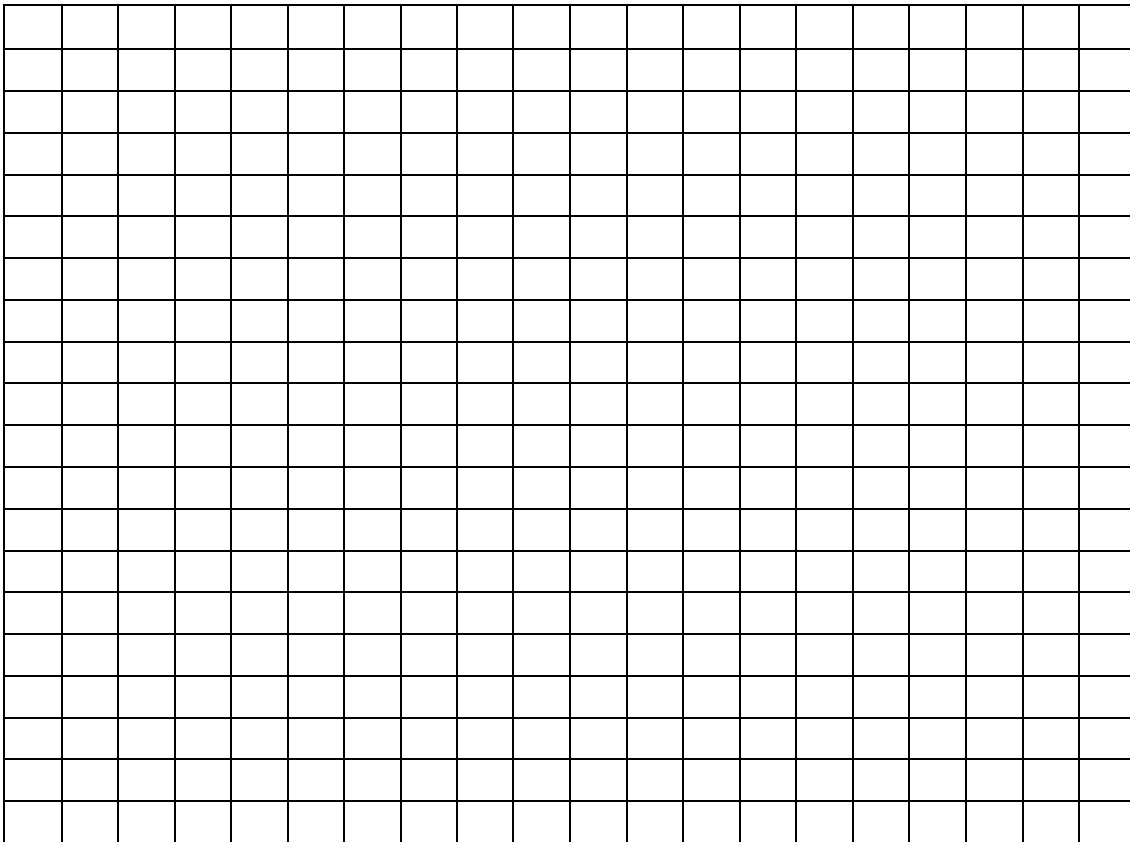
QUESTIONS

8.   **[B2.2]** Calculate the slope of your position-time graph in the space provided below.

9.   **[B2.2] [B2.3]**   Does the slope of a position-time graph represent (circle one):

a) acceleration b) speed c) displacement d) time

QUESTIONS

PART C: REFLECTIONS

10. **[B2.7]** Use your earlier calculation to compare the velocity of the train moving up the first hill with the speed found above in your graph. What are your findings? Is the lift motor operating at optimal speed? If there is a discrepancy discuss the reasons why?

11. **[B2.1]** In a journal entry, use appropriate science vocabulary, SI (system international) units, numbers and formulas to reflect on the various methods that could be used by Wonderland park engineers to check the daily operation of amusement rides and monitor the rides' velocity and acceleration.

*The **Mighty Canadian Minebuster** is the largest and longest wooden coaster in Canada. Its immense wooden track is full of side-winding turns, stomach lifting camel humps, and breath-taking drops. The **Minebuster** reaches astounding speeds of more than 90 km/h on its 4000 feet of serpentine designed track.*

DATA

Mass of each empty car $=$ 810 kg

Total length of track = 1085 m

Slope of the lift = 20°

Horizontal distance from bottom of lift to top $=$ 82 m

Change in elevation at first drop $=$ 31 m

QUESTIONS

PART A: PROCEDURAL CALCULATIONS
(Time, Distance, Speed and Acceleration)

1. You have been asked by Canada's Wonderland park engineers to report on whether the coaster's lift motor is operating at the proper speed. In order to accomplish this task you will have to figure out the speed of the train as it moves up to the top of the first hill. Later, you will compare your data with standard operating data to determine if the motor is operating at optimal speed. In order to do this you will need to first perform the following steps:

a) **[B2.4]** Find the sign indicating a distance point to the first drop and record the value here.

QUESTIONS

b) **[B2.4]** Using a horizontal accelerometer and the "Methods of Performing Measurements" hand out provided, find the height *(h)* of the first hill.

c) **[B2.5]** Given that the slope of the first hill is 20.30, calculate the distance from the bottom of the hill to the top. Use the formula $L = h / sin\theta$, where θis the slope of the hill, *h* is the height of the first hill (calculated in part b above) and *L* is the distance from the bottom of the lift to the top. Record the length of the track below.

2. **[B2.6]** Using a stopwatch, measure the time for the train to travel from the bottom of the first hill where the train hooks onto the chain to the top of the hill before it falls.

3. **[B2.6]** Using the data collected in questions 1 and 2 find the speed of the train moving up the first hill.

QUESTIONS

4. **[B2.6]** Park safety engineers are interested in monitoring the acceleration of the ride to find out the top speed of the ride at the bottom of the first hill. The top speed is then used to determine the forces acting on the riders' bodies. In order to do this you will need to perform the following steps:

    a) Using a stopwatch, measure the time for the train to travel from the top of the first hill to the bottom (using the point of initial free fall as the starting point).

    b) Given that the distance from the top to the bottom of the first hill is 37.9 m find the acceleration *(a)* of the train using
        $d = v_1t + \frac{1}{2}a^2$. Note, your initial speed *(v₁)* at the top of the hill has been calculated in question #3.

    c) Using the calculated acceleration *(a)*, initial speed *(v₁)* and time *(t)* find the final speed *(v)* of the train at the bottom of the first hill using the equation
        $a = (v_2\text{-}v_1) / t$.

QUESTIONS

5.   Roller coaster maintenance crews constantly monitor the trains' braking system to determine and record its deceleration capabilities. You have been hired as a junior assistant in order to ride the train and calculate its deceleration from the point where your car leaves the last curve of the ride until it comes to a complete stop before making its final journey into the loading platform. In order to do this you will need to perform the following steps:

a)   **[B2.5]** Using a stopwatch, measure the time for the train to travel from the end of the last curve to its stop before reaching the loading platform.

b)   **[B2.6]** Given that the speed of the train as it rounds the last curve is 4.8m/s, find the deceleration of the train using $a = (v_2 – v_1) / t$. Note, $v_2 = 0$.

6.   **[B2.4]** List three uncertainties (possible errors) in your experimental measurements above (e.g., accurately stopping and starting the stopwatch).

QUESTIONS

PART B: GRAPHING DATA

7.   **[B2.2] [B2.3]** In an independent study the following standard operating data was found and represents a train's position over time while climbing up the first hill of this ride. This data is routinely used to monitor the functioning of the roller coasters lift motor. Using the following data and the grid provided draw and label a position-time graph:

Position (m) (y-axis)	Time (s) (x-axis)
0	0
11.9	4.1
24.7	8.6
45.0	15.5
58.6	20.2

QUESTIONS

8. **[B2.2]** Calculate the slope of your position-time graph in the space provided below.

9. **[B2.2] [B2.3]** Does the slope of a position-time graph represent (circle one):

    a) acceleration   b) speed   c) displacement   d) time

QUESTIONS

PART C: REFLECTIONS

10. **[B2.7]** Use your earlier calculation to compare the velocity of the train moving up the first hill with the speed found above in your graph. What are your findings? Is the lift motor operating at optimal speed? If there is a discrepancy discuss the reasons why?

11. **[B2.1]** In a journal entry, use appropriate science vocabulary, SI (system international) units, numbers and formulas to reflect on the various methods that could be used by Wonderland park engineers to check the daily operation of amusement rides and monitor the rides' velocity and acceleration.

*On **Wild Beast**, get set to ride the banks and jump the humps on this massive serpentine designed wooden coaster. With more than 3000 feet of track, this wildcat coaster reaches maximum speeds through a never-ending stretch of camel humps and hairpin turns.*

DATA

Mass of each empty car $= 610$ kg

Total length of track $= 917$ m

Slope of the lift $= 20°$

Horizontal distance from bottom of lift to top $=$ 68.0 m

Change in elevation at first drop $= 23.25$ m

QUESTIONS

PART A: PROCEDURAL CALCULATIONS
(Time, Distance, Speed and Acceleration)

1. You have been asked by Canada's Wonderland park engineers to report on whether the coaster's lift motor is operating at the proper speed. In order to accomplish this task you will have to figure out the speed of the train as it moves up to the top of the first hill. Later, you will compare your data with standard operating data to determine if the motor is operating at optimal speed. In order to do this you will need to first perform the following steps:

    a) **[B2.1]** Find the sign indicating a distance point to the first drop and record the value here.

    b) **[B2.4]** Using a horizontal accelerometer and the "Methods of Performing Measurements" hand out provided, find the height *(h)* of the first hill.

QUESTIONS

c)   **[B2.6]** Given that the slope of the first hill is 20°, calculate the distance from the bottom of the hill to the top. Use the formula $L = h / sin\theta$, where θ is the slope of the hill, h is the height of the first hill (calculated in part b above) and L is the distance from the bottom of the lift to the top. Record the length of the track below.

2.   **[B2.6]** Using a stopwatch, measure the time for the train to travel from the bottom of the first hill where the train hooks onto the chain to the top of the hill before it falls.

3.   **[B2.6]** Using the data collected in questions 1 and 2 find the speed of the train moving up the first hill.

QUESTIONS

4. **[B2.6]** Park safety engineers are interested in monitoring the acceleration of the ride to find out the top speed of the ride at the bottom of the first hill. The top speed is then used to determine the forces acting on the riders' bodies. In order to do this you will need to perform the following steps:

   a) Using a stopwatch, measure the time for the train to travel from the top of the first hill to the bottom (using the point of release from the chain as the starting point).

   b) Given that the distance from the top to the bottom of the first hill is 34.9 m find the acceleration *(a)* of the train using $d = v_1 t + \frac{1}{2}at^2$. Note your initial speed *(v₁)* at the top of the hill has been calculated in question #3.

   c) Using the calculated acceleration *(a)*, initial speed *(v₁)* and time *(t)* find the final speed *(v₂)* of the train at the bottom of the first hill using the equation $a = (v_2 - v_1) / t$.

QUESTIONS

5. Roller coaster maintenance crews constantly monitor the trains' braking system to determine and record its deceleration capabilities. You have been hired as a junior assistant in order to ride the train and calculate its deceleration from the point where your car leaves the last curve of the ride until it comes to a complete stop before making its final journey into the loading platform. In order to do this you will need to perform the following steps:

a) **[B2.5]** Using a stopwatch, measure the time for the train to travel from the beginning of the horizontal stopping platform to a full stop before reaching the loading platform.

b) **[B2.6]** Given that the speed of the train as it enters the horizontal stopping platform is 6.3 m/s, find the deceleration of the train using $a = (v_2 - v_1)/t$. Note, $v_2 = 0$.

6. **[B2.6]** List three uncertainties (possible errors) in your experimental measurements above (e.g., accurately stopping and starting the stopwatch).

QUESTIONS

PART B: GRAPHING DATA

7. **[B2.2] [B2.3]** In an independent study the following standard operating data was found and represents a train's position over time while climbing up the first hill of this ride. This data is routinely used to monitor the functioning of the roller coasters lift motor. Using the following data and the grid provided draw and label a position-time graph:

Position (m) (y-axis)	Time (s) (x-axis)
0	0
18.8	6.1
38.3	12.4
55.6	18.3
69.8	22.6
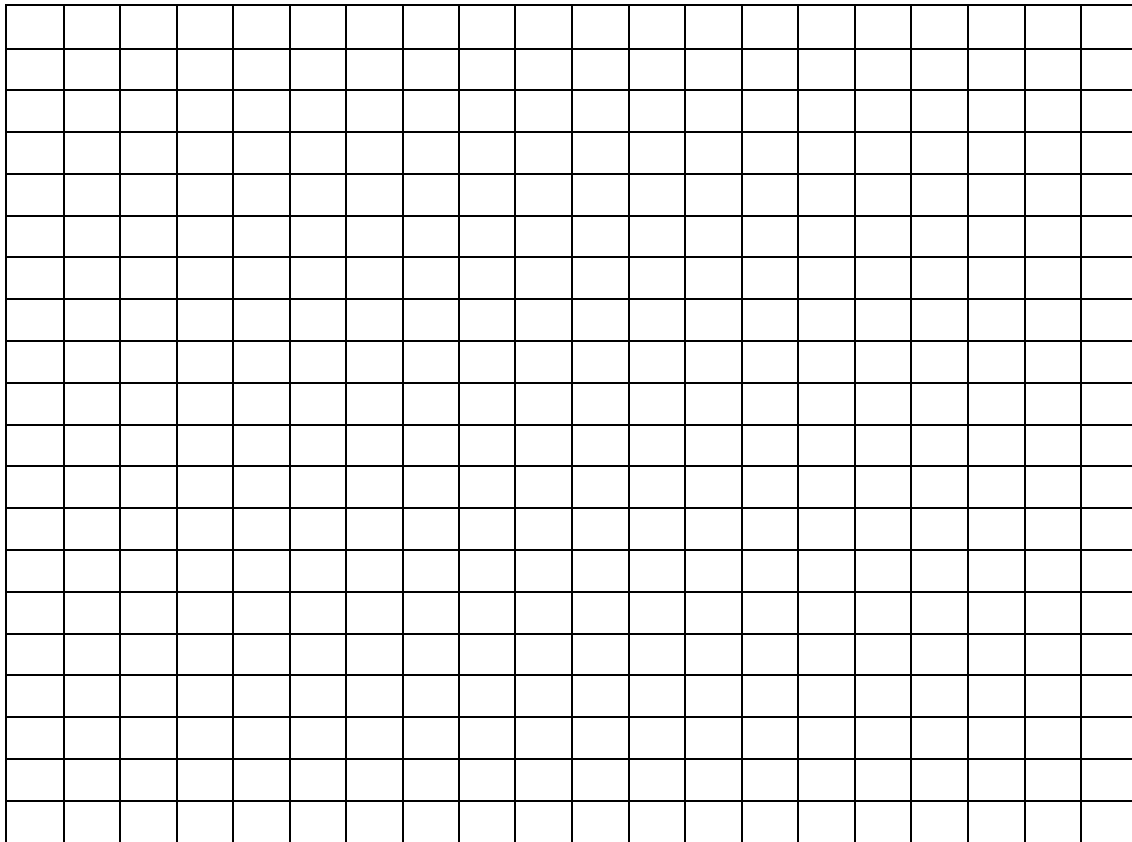
QUESTIONS

8.   **[B2.2] [B2.3]** Calculate the slope of your position-time graph in the space provided below.

9.   **[B2.2] [B2.3]** Does the slope of a position-time graph represent (circle one):

   a) acceleration   b) speed   c) displacement   d) time

QUESTIONS

PART C: REFLECTIONS

10.   **[B2.7]** Use your earlier calculation to compare the velocity of the train moving up the first hill with the speed found above in your graph. What are your findings? Is the lift motor operating at optimal speed? If there is a discrepancy discuss the reasons why?

11.   **[B2.1]** In a journal entry, use appropriate science vocabulary, SI (system international) units, numbers and formulas to reflect on the various methods that could be used by Canada's Wonderland park engineers to check the daily operation of amusement rides and monitor the rides' velocity and acceleration.

The Fly takes four thrill seekers at a time over an exhilarating 50-foot drop, through hairpin twists and turns and wild, breathtaking bumps. This coaster's unique design provides each rider with the feeling that they are riding in the front car while also allowing for some of the wildest side winding turns ever experienced in a coaster.

QUESTIONS

PART A: PROCEDURAL CALCULATIONS
(Time, Distance, Speed and Acceleration)

1. You have been asked by Canada's Wonderland park engineers to report on whether the coaster's lift motor is operating at the proper speed. In order to accomplish this task you will have to figure out the speed of the car as it moves up to the top of the first hill. Later, you will compare your data with standard operating data to determine if the motor is operating at optimal speed. In order to do this you will need to first perform the following steps:

    a) **[B2.4]** Find the sign indicating a distance point to the first drop and record the value here.

    b) **[B2.4]** Using a horizontal accelerometer and the "Methods of Performing Measurements" hand out provided, find the height *(h)* of the first hill.

QUESTIONS

c)   **[B2.5]** Given that the slope of the first hill is 26.5°, calculate the distance from the bottom of the hill to the top. Use the formula $L = h / sin\theta$, where θ is the slope of the hill, h is the height of the first hill (calculated in part b above) and L is the distance from the bottom of the lift to the top. Record the length of the track below.

2.   **[B2.6]** Using a stopwatch, measure the time for the car to travel from the bottom of the first hill where the car hooks onto the chain to the top of the hill before it falls.

3.   **[B2.6]** Using the data collected in questions 1 and 2, find the speed of the car moving up the first hill.

QUESTIONS

4.   **[B2.6]** Park safety engineers are interested in monitoring the acceleration of the ride to find out the top speed of the ride at the bottom of the first hill. The top speed is then used to determine the forces acting on the riders' bodies. In order to do this you will need to perform the following steps:

a)   Using a stopwatch, measure the time for the car to travel from the top of the first hill to the bottom (using the point of descent down the hill as the starting point).

b)   Given that the distance from the top to the bottom of the first hill is 17.7 m find the acceleration *(a)* of the car using
$d = v_1t + \frac{1}{2}at^2$. Note, your initial speed *(v₁)* at the top of the hill has been calculated in question #3.

c)   Using the calculated acceleration *(a)*, initial speed *(v₁)* and time *(t)* find the final speed *(v₂)* of the car at the bottom of the first hill using the equation $a = (v_2 - v_1) / t$.

QUESTIONS

5.   **[B2.6]** Roller coaster safety crews constantly monitor the cars' deceleration up ramps to ensure a smooth and safe ride. You have been hired as a junior assistant in order to ride the car and calculate its deceleration from the point where your car starts climbing the hill after the first drop to the top of that hill. In order to do this you will need to perform the following steps:

   a)   Using a stopwatch, measure the time for the car to travel from the bottom to the top of the hill after the first drop.

   b)   Given that the speed of the car as it reaches the top of the hill is 1.5 m/s, find the deceleration of the car using $a = (v_2 - v_1) / t$. Note, v_1 was found in question 4c.

6.   **[B2.4]** List three uncertainties (possible errors) in your experimental measurements above (e.g., accurately stopping and starting the stopwatch).

QUESTIONS

PART B: GRAPHING DATA

7. **[B2.2] [B2.3]** In an independent study the following standard operating data was found and represents a car's position over time while climbing up the first hill of this ride. This data is routinely used to monitor the functioning of the roller coasters lift motor. Using the following data and the grid provided draw and label a position-time graph:

Position (m) (y-axis)	Time (s) (x-axis)
0	0
8.6	3.9
14.9	6.7
21.6	9.7
28.5	12.8
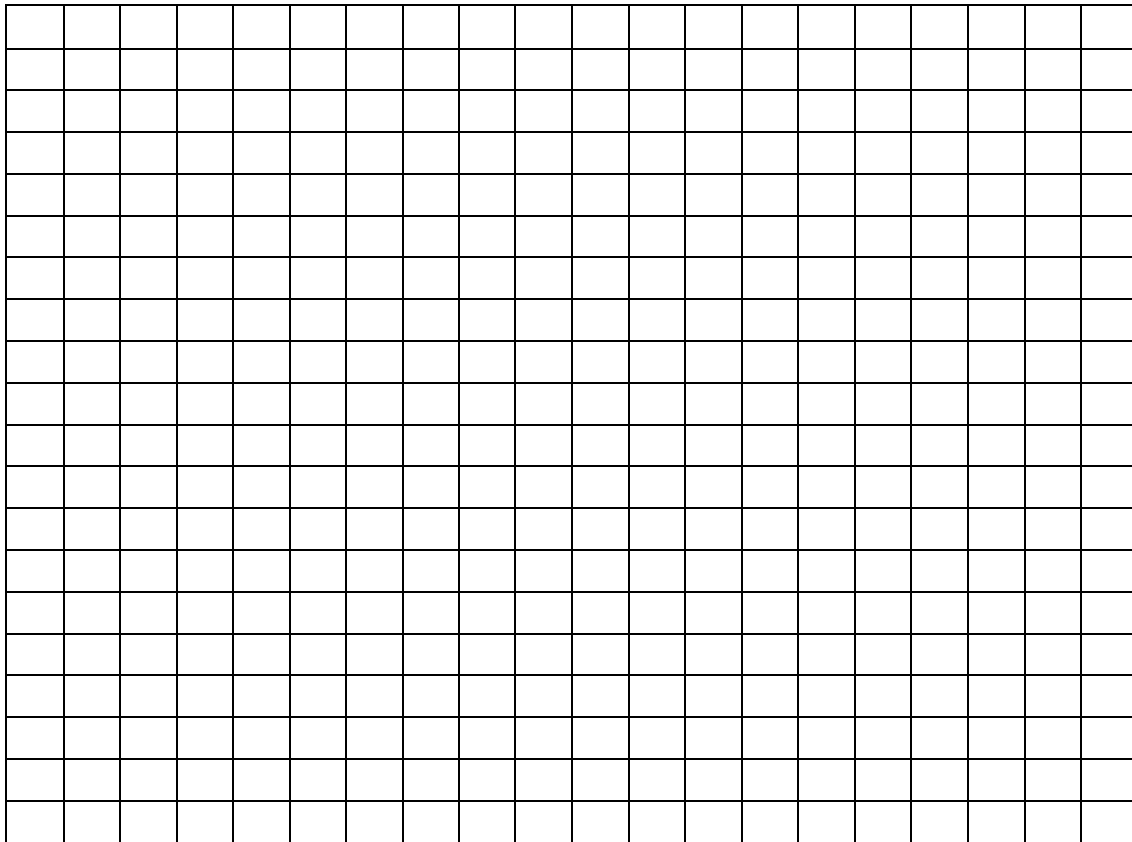
QUESTIONS

8.   **[B2.2]** Calculate the slope of your position-time graph in the space provided below.

9.   **[B2.2] [B2.3]** Does the slope of a position-time graph represent (circle one):

a) acceleration   b) speed   c) displacement   d) time

QUESTIONS

PART C: REFLECTIONS

10.   **[B2.7]** Use your earlier calculation to compare the velocity of the train moving up the first hill with the speed found above in your graph. What are your findings? Is the lift motor operating at optimal speed? If there is a discrepancy discuss the reasons why?

11.   **[B2.1]** In a journal entry, use appropriate science vocabulary, SI (system international) units, numbers and formulas to reflect on the various methods that could be used by Wonderland park engineers to check the daily operation of amusement rides and monitor the rides' velocity and acceleration.

GRADE 11

AMUSEMENT RIDE ACTIVITIES

LEVIATHAN

DRAGON FIRE

VORTEX

MIGHTY CANADIAN MINEBUSTER

WILD BEAST

FLIGHT DECK

AUTHENTIC PROBLEM

Your design and build firm has been asked to submit a proposal to Canada's Wonderland to create a new amusement ride for the park. In this exercise you will use your basic knowledge of Grade 11 Physics to collect data, make observations, measurements and calculations on your ride. You will later use this information and your own creative ideas to design a new amusement ride for the park. This proposal will be submitted to your teacher (an "official agent" of Canada's Wonderland). The commission will go to the design/build firm that demonstrates the best application of the basic physics principles outlined.

PART A: DATA COLLECTION

Time for one complete ride _____ s
Length of one car _____ m
Length of train _____ m

Using the vertical accelerometer find the location of the maximum and minimum g forces acting on you.

Maximum g force _____ g's   Location _____
Minimum g force _____ g's   Location _____

Find the sign indicating the distance to the base of the first hill _____ m

Use the horizontal accelerometer to find the angle of inclination of the first hill from this same point _____ degrees

Calculate the height of the first hill _____ m

Measure the time for the entire length of the train to pass a point on the top of the first hill _____ s

Measure the time for the entire length of the train to pass a point on the bottom of the first hill _____ s

Measure the time for the train to travel from the top of the first hill to the bottom of the first hill _____ s

PART B: EXPLORATION QUESTIONS

In order to complete your task, you will first need to collect some basic information, which you will later draw on in designing your amusement ride.

1.   In terms of forces, explain why Leviathan uses a long, shallow first incline. If the hill were steeper, what would need to be changed?

2.   **[D2.3]** Which hill on the ride was the highest? Why are there no other hills on the ride as high or higher?

3.   **[C2.6]** As you go down the first large hill you are obviously speeding up. Should the accelerometer reading during this section account for this acceleration? Explain!

4.   **[C2.3]**Where does the accelerometer give its highest reading? Explain why?

5.   **[C2.2]** Where on the ride were you lifted off your seat? At what point on the ride do you feel heaviest?Why would this happen?

6.   **[C2.2]** Did you feel lateral forces while on the ride? That is, were you thrown from side to side in the train car? Give an example of where you experienced this and explain what would cause this feeling?

7.   **[C2.1]** Identify three sources of friction in this ride.

8.   **[B2.1]** Would an empty roller coaster and a full roller coaster take the same amount of time for a single trip? Explain.

6.   **[C3.4]** Describe the sensations of weight at the following points. Use your vertical accelerometer and compare the readings with your sensations.

        a) climbing the first hill

        b) going down the first hill

        c) at the bottom of the first hill

        d) climbing the second hill

7.   **[D2.1]** Sketch a diagram of the roller coaster track layout and label the following:

        Maximum potential energy – PE_{max}
        Minimum potential energy – PE_{min}
        Maximum kinetic energy – KE_{max}
        Minimum kinetic energy – KE_{min}
        Weightless feeling – W
        Heavy feeling – H
        Maximum acceleration – a_{max}
        Where friction has greatest effect – F

PART C: PROCEDURAL CALCULATIONS

Before you begin the design process you will need to use the data that you have previously collected to perform calculations which you will later need to consider in designing your amusement ride.

Use this space for calculations

1. **[B2.1]** Find the speed of the train knowing its length and the time it takes to pass a certain point on top of the first hill: _____ m/s

2. **[B2.1]** Using the same procedure as question one above, find the speed of the train at the bottom of the first hill: _____ m/s

3. **[B2.1]** Calculate the acceleration of the train down the first hill: _____ m/s^2

4. **[D2.3]** Use conservation of energy to determine the speed of the train at the bottom of the first hill. (assume a frictionless track and no gravitational potential energy at the bottom of the first hill) _____ m/s

5. **[C2.1]** Account for any differences in your answers for questions 2 and 4.

6. **[D2.2]** Calculate how much work is done in getting the train filled with passengers to the top of the first hill? Assume the mass of the train is 4320 kg and the mass of each rider is the same as yours. _____ joules

7. **[D2.5]** How much power does the chain motor have to put out in order to lift the train (with passengers) to the top of the first hill? _____ watts

8. **[D2.4]**Use the law of conservation of energy to determine the speed of the car in the high speed curve. If the given speed is 122 km/h, how much energy has been lost as heat since the beginning of the ride?

PART D: ROLLER COASTER DESIGN REPORT PROPOSAL

[C2.1, C2.5, C3.4, D2.1, D2.3, D2.4]

Canada's Wonderland requires a design report proposal from your firm, which outlines the key components and justifications for your "winning" design. This report is the crucial make or break document that will determine whether your firm will win this contract. In your proposal you will need to include:

      1. A track profile detailing the hills and turns.

      2. A Free Body Diagram of the riders at the following four locations,
          a) climbing the first hill

          b) going down the first hill

          c) at the bottom of the first hill

          d) climbing the second hill

      3. A written report outlining considerations that need to be taken in order to build a roller coaster (e.g., speed, friction and g-forces).

4. Outline the key features of your ride and justify why your proposal should be the one to win the contract.

DRAGON FIRE - ENERGY

AUTHENTIC PROBLEM

Your design and build firm has been asked to submit a
proposal to Canada's Wonderland to create a new
amusement ride for the park. In this exercise you will use
your basic knowledge of Grade 11 Physics to collect data,
make observations, measurements and calculations on your
ride. You will later use this information and your own
creative ideas to design a new amusement ride for the park.
This proposal will be submitted to your teacher (an "official agent" of Canada's Wonderland).
The commission will go to the design/build firm that demonstrates the best application of the
basic physics principles outlined.

PART A: DATA COLLECTION

        Time for one complete ride: _____ s
        Length of one car: _____ m
        Length of train: _____ m

Using the vertical accelerometer find the location of the maximum and minimum g forces
acting on you.

        Maximum g force: _____ g's   Location: _____
        Minimum g force: _____ g's   Location: _____

Find the sign indicating the distance to the base of the first hill: _____ m

Use the horizontal accelerometer to find the angle of inclination of the first hill from this same
point: _____ degrees

Calculate the height of the first hill: _____ m

Measure the time for the entire length of the train to pass a point on the top of the first hill:
_____ s

Measure the time for the entire length of the train to pass a point on the bottom of the first hill:
_____ s

Measure the time for the train to travel from the top of the first hill to the bottom of the first hill:
_____ s

PART B: EXPLORATION QUESTIONS

In order to complete your task you will first need to collect some basic information, which you will later draw on in designing your amusement ride.

1.   **[D2.3]** Which hill on the ride was the highest? Why are there no other hills on the ride as high or higher?

2.   **[C2.2]** Where on the ride were you lifted off your seat? Why would this happen?

3.   **[C2.2]** Did you feel lateral forces while on the ride? That is, were you thrown from side to side in the train car? Give an example of where you experienced this and explain what would cause this feeling?

4.   **[C2.1]** Identify three sources of friction in this ride.

5.   **[B2.1]** Would an empty roller coaster and a full roller coaster take the same amount of time for a single trip? Explain.

6.   **[C3.4]** Describe the sensations of weight at the following points. Use your vertical accelerometer and compare the readings with your sensations.

   a) climbing the first hill

   b) going down the first hill

   c) at the bottom of the first hill

   d) climbing the second hill

7.   **[D2.1]** Sketch a diagram of the roller coaster track layout and label the following:
   Maximum potential energy – PE_{max}
   Minimum potential energy – PE_{min}
   Maximum kinetic energy – KE_{max}
   Minimum kinetic energy – KE_{min}
   Weightless feeling – W
   Heavy feeling – H

PART C: PROCEDURAL CALCULATIONS

Before you begin the design process you will need to use the data that you have previously collected to perform calculations which you will later need to consider in designing your amusement ride.

Use this space for calculations

1.**[B2.1]** Find the speed of the train knowing its length and the time it takes to pass a certain point on top of the first hill: _____ m/s

2.**[B2.1]** Using the same procedure as question 1 above, find the speed of the train at the bottom of the first hill: _____ m/s

3.**[B2.1]** Calculate the acceleration of the train down the first hill: _____ m/s^2

4.**[D2.3]** Use conservation of energy to determine the speed of the train at the bottom of the first hill. (assume a frictionless track and no gravitational potential energy at the bottom of the first hill) _____ m/s

5.**[C2.1]** Account for any differences in your answers for questions 2 and 4.

6.**[D2.2]** Calculate how much work is done in getting the train filled with passengers to the top of the first hill? Assume the mass of the train is 3972 kg and the mass of each rider is the same as yours. _____ joules

7. **[D2.5]** How much power does the chain motor have to put out in order to lift the train (with passengers) to the top of the first hill? _____ watts

PART D: ROLLER COASTER DESIGN REPORT PROPOSAL

[C2.1, C3.4, C2.5, D2.1, D2.3, D2.4]

Canada's Wonderland requires a design report proposal from your firm, which outlines the key components and justifications for your "winning" design. This report is the crucial make or break document that will determine whether your firm will win this contract. In your proposal you will need to include:

1. A track profile detailing the hills and turns.

2. A Free Body Diagram of the riders at the following four locations,

   a) climbing the first hill

   b) going down the first hill

   c) at the bottom of the first hill

   d) climbing the second hill

3. A written report outlining considerations that need to be taken in order to build a roller coaster (e.g., speed, friction and g-forces).

4. Outline the key features of your ride and justify why your proposal should be the one to win the contract.

AUTHENTIC PROBLEM

Your design and build firm has been asked to submit a proposal to Canada's Wonderland to create a new amusement ride for the park. In this exercise you will use your basic knowledge of Grade 11 Physics to collect data, make observations, measurements and calculations on your ride. You will later use this information and your own creative ideas to design a new amusement ride for the park. This proposal will be submitted to your teacher (an "official agent" of Canada's Wonderland). The commission will go to the design/build firm that demonstrates the best application of the basic physics principles outlined.

PART A: DATA COLLECTION

       Time for one complete ride: _____ s
       Length of one car: _____ m
       Length of train: _____ m

Using the vertical accelerometer find the location of the maximum and minimum g forces acting on you.

       Maximum g force: _____ g's   Location: _____
       Minimum g force: _____ g's   Location: _____

Find the sign indicating the distance to the base of the first hill: _____ m

Use the horizontal accelerometer to find the angle of inclination of the first hill from this same point: _____ degrees

Calculate the height of the first hill: _____ m

Measure the time for the entire length of the train to pass a point on the top of the first hill: _____ s

Measure the time for the entire length of the train to pass a point on the bottom of the first hill: _____ s

Measure the time for the train to travel from the top of the first hill to the bottom of the first hill: _____ s

PART B: EXPLORATION QUESTIONS

In order to complete your task you will first need to collect some basic information, which you will later draw on in designing your amusement ride.

1.   **[D2.3]** Which hill on the ride was the highest? Why are there no other hills on the ride as high or higher?

2.   **[C2.2]** Where on the ride were you lifted off your seat? Why would this happen?

3.   **[C2.2]** Did you feel lateral forces while on the ride? That is, were you thrown from side to side in the train car? Give an example of where you experienced this and explain what would cause this feeling?

4.   **[C2.1]** Identify three sources of friction in this ride.

5.   **[B2.1]** Would an empty roller coaster and a full roller coaster take the same amount of time for a single trip? Explain.

6.   **[C3.4]** Describe the sensations of weight at the following points. Use your vertical accelerometer and compare the readings with your sensations.

    a)   climbing the first hill

    b)   going down the first hill

    c)   at the bottom of the first hill

    d)   climbing the second hill

7.   **[D2.1]** Sketch a diagram of the roller coaster track layout and label the following:

        Maximum potential energy – PE_{max}
        Minimum potential energy – PE_{min}
        Maximum kinetic energy – KE_{max}
        Minimum kinetic energy – KE_{min}
        Weightless feeling – W
        Heavy feeling – H

PART C: PROCEDURAL CALCULATIONS

Before you begin the design process you will need to use the data that you have previously collected to perform calculations which you will later need to consider in designing your amusement ride.

Use this space for calculations

1. **[B2.1]** Find the speed of the train knowing its length and the time it takes to pass a certain point on top of the first hill: _____ m/s

2.**[B2.1]** Using the same procedure as question one above, find the speed of the train at the bottom of the first hill: _____ m/s

3.**[B2.1]** Calculate the acceleration of the train down the first hill: _____ m/s^2

4.**[D2.3]** Use conservation of energy to determine the speed of the train at the bottom of the first hill. (Assume a frictionless track and no gravitational potential energy at the bottom of the first hill) _____ m/s

5.**[C2.1]** Account for any differences in your answers for questions 2 and 4.

6.**[D2.2]** Calculate how much work is done in getting the train filled with passengers to the top of the first hill? Assume the mass of the train is 4200 kg and the mass of each rider is the same as yours. _____ joules

7.**[D2.5]** How much power does the chain motor have to put out in order to lift the train (with passengers) to the top of the first hill? _____ watts

PART D: ROLLER COASTER DESIGN REPORT PROPOSAL

[C2.1, C3.4, C2.5, D2.1, D2.3, D2.4]

Canada's Wonderland requires a design report proposal from your firm, which outlines the key components and justifications for your "winning" design. This report is the crucial make or break document that will determine whether your firm will win this contract. In your proposal you will need to include:

1.   A track profile detailing the hills and turns.

2.   A Free Body Diagram of the riders at the following four locations,

   a) climbing the first hill

   b) going down the first hill

   c) at the bottom of the first hill

   d) climbing the second hill

3.   A written report outlining considerations that need to be taken in order to build a roller coaster (e.g., speed, friction and g-forces).

4.   Outline the key features of your ride and justify why your proposal should be the one to win the contract.

AUTHENTIC PROBLEM

Your design and build firm has been asked to submit a
proposal to Canada's Wonderland to create a new amusement
ride for the park. In this exercise you will use your basic
knowledge of Grade 11 Physics to collect data, make
observations, measurements and calculations on your ride.
You will later use this information and your own creative ideas
to design a new amusement ride for the park. This proposal will be submitted to your teacher (an
"official agent" of Canada's Wonderland). The commission will go to the design/build firm that
demonstrates the best application of the basic physics principles outlined.

PART A: DATA COLLECTION

      Time for one complete ride: _____ s
      Length of one car: _____ m
      Length of train: _____ m

Using the vertical accelerometer find the location of the maximum and minimum g forces acting
on you.

      Maximum g force: _____ g's   Location: _____
      Minimum g force: _____ g's   Location: _____

Find the sign indicating the distance to the base of the first hill: _____ m

Use the horizontal accelerometer to find the angle of inclination of the first hill from this same
point: _____ degrees

Calculate the height of the first hill: _____ m

Measure the time for the entire length of the train to pass a point on the top of the first hill:
_____ s

Measure the time for the entire length of the train to pass a point on the bottom of the first hill:
_____ s

Measure the time for the train to travel from the top of the first hill to the bottom of the first hill:
_____ s

PART B: EXPLORATION QUESTIONS

In order to complete your task you will first need to collect some basic information, which you will later draw on in designing your amusement ride.

1.   **[D2.3]** Which hill on the ride was the highest? Why are there no other hills on the ride as high or higher?

2.   **[C2.2]** Where on the ride were you lifted off your seat? Why would this happen?

3.   **[C2.2]** Did you feel lateral forces while on the ride? That is, were you thrown from side to side in the train car? Give an example of where you experienced this and explain what would cause this feeling?

4.   **[C2.1]** Identify three sources of friction in this ride.

5.   **[B2.1]** Would an empty roller coaster and a full roller coaster take the same amount of time for a single trip? Explain.

6.   **[C3.4]** Describe the sensations of weight at the following points. Use your vertical accelerometer and compare the readings with your sensations.

   a)   climbing the first hill

   b)   going down the first hill

   c)   at the bottom of the first hill

   d)   climbing the second hill

7.   **[D2.1]** Sketch a diagram of the roller coaster track layout and label the following:
         Maximum potential energy – PE_{max}
         Minimum potential energy – PE_{min}
         Maximum kinetic energy – KE_{max}
         Minimum kinetic energy – KE_{min}
         Weightless feeling – W
         Heavy feeling – H

PART C: PROCEDURAL CALCULATIONS

Before you begin the design process you will need to use the data that you have previously collected to perform calculations which you will later need to consider in designing your amusement ride.

Use this space for calculations

1. **B2.1]** Find the speed of the train knowing its length and the time it takes to pass a certain point on top of the first hill: _____ m/s

2. **[B2.1]** Using the same procedure as question one above, find the speed of the train at the bottom of the first hill: _____ m/s

3. **[B2.1]** Calculate the acceleration of the train down the first hill: _____ m/s^2

4. **[D2.3]** Use conservation of energy to determine the speed of the train at the bottom of the first hill. (assume a frictionless track and no gravitational potential energy at the bottom of the first hill) _____ m/s

5. **[C2.1]** Account for any differences in your answers for questions 2 and 4.

6. **[D2.2]** Calculate how much work is done in getting the train filled with passengers to the top of the first hill? Assume the mass of the train is 2500 kg and the mass of each rider is the same as yours. _____ joules

7. **[D2.5]** How much power does the chain motor have to put out in order to lift the train (with passengers) to the top of the first hill? _____ watts

PART D: ROLLER COASTER DESIGN REPORT PROPOSAL

[C2.1, C3.4, C2.5, D2.1, D2.3, D2.4]

Canada's Wonderland requires a design report proposal from your firm, which outlines the key components and justifications for your "winning" design. This report is the crucial make or break document that will determine whether your firm will win this contract. In your proposal you will need to include:

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2.   A Free Body Diagram of the riders at the following four locations,
            a) climbing the first hill
            b) going down the first hill
            c) at the bottom of the first hill
            d) climbing the second hill

3. A written report outlining considerations that need to be taken in order to build a roller coaster (e.g., speed, friction and g-forces).

4.   Outline the key features of your ride and justify why your proposal should be the one to win the contract.

AUTHENTIC PROBLEM

Your design and build firm has been asked to submit a proposal to
Canada's Wonderland to create a new amusement ride for the
park. In this exercise you will use your basic knowledge of
Grade 11 Physics to collect data, make observations, measurements
and calculations on your ride. You will later use this information and your own creative ideas to
design a new amusement ride for the park. This proposal will be submitted to your teacher (an
"official agent" of Canada's Wonderland). The commission will go to the design/build firm that
demonstrates the best application of the basic physics principles outlined.

PART A: DATA COLLECTION

       Time for one complete ride: _____ s
       Length of one car: _____ m
       Length of train: _____ m

Using the vertical accelerometer find the location of the maximum and minimum g forces acting
on you.
       Maximum g force: _____ g's   Location: _____
       Minimum g force: _____ g's   Location: _____

Find the sign indicating the distance to the base of the first hill: _____ m

Use the horizontal accelerometer to find the angle of inclination of the first hill from this same
point: _____ degrees

Calculate the height of the first hill: _____ m

Measure the time for the entire length of the train to pass a point on the top of the first hill:
_____ s

Measure the time for the entire length of the train to pass a point on the bottom of the first hill:
_____ s

Measure the time for the train to travel from the top of the first hill to the bottom of the first hill:
_____ s

PART B: EXPLORATION QUESTIONS

In order to complete your task you will first need to collect some basic information, which you will later draw on in designing your amusement ride.

1.   **[D2.3]** Which hill on the ride was the highest? Why are there no other hills on the ride as high or higher?

2.   **[C2.2]** Where on the ride were you lifted off your seat? Why would this happen?

3.   **[C2.2]** Did you feel lateral forces while on the ride? That is, were you thrown from side to side in the train car? Give an example of where you experienced this and explain what would cause this feeling?

4.   **[C2.1]** Identify three sources of friction in this ride.

5.   **[B2.1]** Would an empty roller coaster and a full roller coaster take the same amount of time for a single trip? Explain.

6.   **[C3.4]** Describe the sensations of weight at the following points. Use your vertical accelerometer and compare the readings with your sensations.

    a)   climbing the first hill

    b)   going down the first hill

    c)   at the bottom of the first hill

    d)   climbing the second hill

7.   **[D2.1]** Sketch a diagram of the roller coaster track layout and label the following:
        Maximum potential energy – PE_{max}
        Minimum potential energy – PE_{min}
        Maximum kinetic energy – KE_{max}
        Minimum kinetic energy – KE_{min}
        Weightless feeling – W
        Heavy feeling – H

PART C: PROCEDURAL CALCULATIONS

Before you begin the design process you will need to use the data that you have previously collected to perform calculations which you will later need to consider in designing your amusement ride.

Use this space for calculations

1.**[B2.1]** Find the speed of the train knowing its length and the time it takes to pass a certain point on top of the first hill: _____ m/s

2. **[B2.1]** Using the same procedure as question one above, find the speed of the train at the bottom of the first hill: _____ m/s

3.**[B2.1]** Calculate the acceleration of the train down the first hill: _____ m/s^2

4.**[D2.3]** Use conservation of energy to determine the speed of the train at the bottom of the first hill. (assume a frictionless track and no gravitational potential energy at the bottom of the first hill) _____ m/s

5.**[C2.1]** Account for any differences in your answers for questions 2 and 4.

6.**[D2.2]** Calculate how much work is done in getting the train filled with passengers to the top of the first hill? Assume the mass of the train is 3660 kg and the mass of each rider is the same as yours. _____ joules

7.**[D2.5]** How much power does the chain motor have to put out in order to lift the train (with passengers) to the top of the first hill? _____ watts

PART D: ROLLER COASTER DESIGN REPORT PROPOSAL

[C2.1, C3.4, C2.5, D2.1, D2.3, D2.4]

Canada's Wonderland requires a design report proposal from your firm, which outlines the key components and justifications for your "winning" design. This report is the crucial make or break document that will determine whether your firm will win this contract. In your proposal you will need to include:

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        a) climbing the first hill

        b) going down the first hill

        c) at the bottom of the first hill

        d) climbing the second hill

3.   A written report outlining considerations that need to be taken in order to build a roller coaster (e.g., speed, friction and g-forces).

4.   Outline the key features of your ride and justify why your proposal should be the one to win the contract.

AUTHENTIC PROBLEM

Your design and build firm has been asked to submit a proposal to
Canada's Wonderland to create a new amusement ride for the Park.
In this exercise you will use your basic knowledge of Grade 11
Physics to collect data, make observations, measurements and
calculations on your ride. You will later use this information and your own creative ideas to
design a new amusement ride for the park. This proposal will be submitted to your teacher (an
"official agent" of Canada's Wonderland). The commission will go to the design/build firm that
demonstrates the best application of the basic physics principles outlined.

PART A: DATA COLLECTION

      Time for one complete ride: _____ s
      Length of one car: _____ m
      Length of train: _____ m

Using the vertical accelerometer find the location of the maximum and minimum g forces acting
on you.

      Maximum g force: _____ g's   Location: _____
      Minimum g force: _____ g's   Location: _____

Find the sign indicating the distance to the base of the first hill: _____ m

Use the horizontal accelerometer to find the angle of inclination of the first hill from this same
point: _____ degrees

Calculate the height of the first hill: _____ m

Measure the time for the entire length of the train to pass a point on the top of the first hill:
_____ s

Measure the time for the entire length of the train to pass a point on the bottom of the first hill:
_____ s

Measure the time for the train to travel from the top of the first hill to the bottom of the first hill:
_____ s

PART B: EXPLORATION QUESTIONS

In order to complete your task you will first need to collect some basic information, which you will later draw on in designing your amusement ride.

1.   **[D2.3]** Which hill on the ride was the highest? Why are there no other hills on the ride as high or higher?

2.   **[D2.2]** Where on the ride were you lifted off your seat? Why would this happen?

3.   **[C2.2]** Did you feel lateral forces while on the ride? That is, were you thrown from side to side in the train car? Give an example of where you experienced this and explain what would cause this feeling?

4.   **[C2.2]** Identify three sources of friction in this ride.

5.   **[B2.1]** Would an empty roller coaster and a full roller coaster take the same amount of time for a single trip? Explain.

6.   **[C3.4]** Describe the sensations of weight at the following points. Use your vertical accelerometer and compare the readings with your sensations.

  a)   climbing the first hill

  b)   going down the first hill

  c)   at the bottom of the first hill

  d)   climbing the second hill

7.   **[D2.1]** Sketch a diagram of the roller coaster track layout and label the following:
Maximum potential energy – PE_{max}

      Minimum potential energy – PE_{min}
      Maximum kinetic energy – KE_{max}
      Minimum kinetic energy – KE_{min}
      Weightless feeling – W
      Heavy feeling – H

PART C: PROCEDURAL CALCULATIONS

Before you begin the design process you will need to use the data that you have previously collected to perform calculations which you will later need to consider in designing your amusement ride.

Use this space for calculations

1. **[B2.1]** Find the speed of the train knowing its length and the time it takes to pass a certain point on top of the first hill: _____ m/s

2. **[B2.1]** Using the same procedure as question one above, find the speed of the train at the bottom of the first hill: _____ m/s

3. **[B2.1]** Calculate the acceleration of the train down the first hill: _____ m/s^2

4. **[D2.3]** Use conservation of energy to determine the speed of the train at the bottom of the first hill. (assume a frictionless track and no gravitational potential energy at the bottom of the first hill) _____ m/s

5. **[C2.1]** Account for any differences in your answers for questions 2 and 4.

6. **[D2.2]** Calculate how much work is done in getting the train filled with passengers to the top of the first hill? Assume the mass of the train is 4100 kg and the mass of each rider is the same as yours. _____ joules

7. **[D2.5]** How much power does the chain motor have to put out in order to lift the train (with passengers) to the top of the first hill? _____ watts

PART D: ROLLER COASTER DESIGN REPORT PROPOSAL

[C2.1, C3.4, C2.5, D2.1, D2.3, D2.4]

Canada's Wonderland requires a design report proposal from your firm, which outlines the key components and justifications for your "winning" design. This report is the crucial make or break document that will determine whether your firm will win this contract. In your proposal you will need to include:

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   b)   going down the first hill
   c)   at the bottom of the first hill
   d)   climbing the second hill

3.   A written report outlining considerations that needs to be taken in order to build a roller coaster (e.g., speed, friction and g-forces).

4.   Outline the key features of your ride and justify why your proposal should be the one to win the contract.

GRADE 11

OTHER ACTIVITIES

RIDE SAFETY EXERCISE

EXPLORING THEME PARK CAREERS

JOB SEARCH

RIDE SAFETY EXERCISE

Canada's Wonderland provides for the safety of their guests in many ways. Security personnel walk the grounds, making sure Park rules are followed by all guests and Park staff. Park ride operators are well informed about the rides and are always watching to be sure that the ride is operating properly and safely. Rules are posted at each ride and are to be obeyed for a safe and enjoyable ride.

Select two different types of rides and answer the following questions on the table.

QUESTIONS	FIRST RIDE	SECOND RIDE
1. What is the name of the ride?		
2. What type of ride is it? (Is it a wooden roller coaster, loop-the-loop rollercoaster, circular ride, etc?)		
3. Do you have to be a certain height to ride the ride? If so, how is this height measured?		
4. What safety checks does the ride operator make prior to starting the ride?		
5. How does the ride operator start and stop the ride?		
6. Does the ride have a lap bar or safety belt that holds you firmly in the seat? If so, what form of safety belt is used and how does if work?		
7. Are there specific rules or restrictions posted at the ride? If so, what are they?		
8. What other safety features or operation checks do you see on the ride?		
GENERAL QUESTIONS		
9. Why is there a height rule for some rides and not others?		
10. Which rides are more likely to have safety belts or lap bars?		

EXPLORING THEME PARK CAREERS

Just like the real world, a theme or amusement park offers many career opportunities. In fact, an amusement park is a microcosm, a community regarded as a miniature world.

Your job here is to identify at least one Park career/job for each occupational cluster listed below. After you identify the career/job, you will need to complete the chart by listing a few basic skill requirements and the education necessary to be successful in that particular job.

Good luck on your job search!

Occupational Cluster & Identified Job	Job Description	Necessary Education
1. Agri-business/ Natural Resources		
2. Manufacturing		
3. Business/ Office		
4. Health		
5. Public Service		
6. Environment		
7. Communications/ Media		
8. Hospitality/ Recreation		
9. Marketing/ Distribution		
10. Personal Services		
11. Marine Science		
12. Construction		
13. Transportation		
14. Consumer/ Homemaking		
15. Fine Arts/ Humanities		

To build an amusement park like Canada's Wonderland, to keep it going and to keep it growing, involves many people with different educational backgrounds doing lots of different things.

Take a break or use some of the time you might be waiting in line to do a little thinking about what jobs must be filled to successfully operate Canada's Wonderland. Divide your jobs into two categories: jobs easily observed and those that must take place behind the scenes. You may discover a job you might like to have in the future!

a)Jobs easily observed:

1 _____ 2 _____ 3 _____

4 _____ 5 _____ 6 _____

7 _____ 8 _____ 9 _____

10 _____ 11 _____ 12 _____

b)Jobs behind the scenes:

1 _____ 2 _____ 3 _____

4 _____ 5 _____ 6 _____

7 _____ 8 _____ 9 _____

10 _____ 11 _____ 12 _____

c)Select one of the jobs that you identified that might be of interest to you in the future.

1. What job did you select? _____

2. Write a job description for your job _____
_____
_____
_____
_____

3. What education is necessary for your job?_____

4. What do you expect is the annual salary of your job? $_____