Name_____ P-G-S_____ Date_____

PHY.01 INTRO TO MOTION < 1 > 8/11/15 PM

Section I: Do You Know? Do You Know? Do You Know?

BASIC CONCEPT QUESTIONS

The Structure of Science / The Why-How Tree

I-SSWH1. If biological processes can be understood in terms of chemistry and chemical reactions can be understood in terms of physics, what can physics be understood in terms of?

I-SSWH 2. Every question of nature can ultimately be explained in terms of the principles of which branch of science?

The Rules of the Universe

I-ROTU1. As our understanding of nature grows, what happens to the list of The Rules of the Universe? (Does it get bigger/smaller? Explain!)

I-ROTU2. Suppose you broke a Rule of the Universe. Which of the following would most likely happen and why?

A. You'd be sent to the principle's office* B. You'd be arrested and taken to jail.
C. You'd spontaneously combust. D. You'd win the Nobel Prize in Physics.

IROTU3. As of today, about how many basic principles are needed to explain all known natural phenomena?

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Section I: Do You Know? Do You Know? Do You Know?

BASIC CONCEPT QUESTIONS

Scientific Notation

I-ScNo1. The number 512 can be written as 5.12×10^2 or

a. _____ x 10^1 b. _____ x 10^0 c. _____ x 10^3

I-ScNo2. The number 0.000 082 4 can be written as 82.4×10^{-6} or

a. _____ x 10^{-5} b. _____ x 10^{-7}

I-ScNo3. Which number is twice as big as 3×10^{20}?

A. 6×10^{20} B. 3×10^{40} C. 6×10^{40} D. 9×10^{60}

I-ScNo4. Which number is 3E+20 squared?

A. 9E+20 B. 3E+40 C. 9E+40 D. 3E+400 E. 9E+400

SI Prefixes

I-SIPr1. A certain computer hard drive has a capacity of 500,000,000,000 bytes.
a. Write its capacity using scientific notation.

b. Write its capacity using engineering notation.

c. Write its capacity using SI prefix notation.

I-SIPr2. A single drop of ink from a single nozzle on a certain inkjet printer has a volume of 2.0 pL (where L represents a liter).
a. Write its capacity using engineering notation.

b. If the print head has 2440 nozzles, how much ink can be sprayed if each nozzle shoots one drop? Express your answer in scientific notation *and* in SI prefix notation.

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Section I: Do You Know? Do You Know? Do You Know?

BASIC CONCEPT QUESTIONS

I-SIPr1. Suppose that SI prefixes could be applied to any set of items. What would the following items be called? (Ex: 10^6 bucks or 1,000,000 bucks is a megabuck.) Notice that the correct answer is not *megabucks* (plural), but rather *megabuck* (singular).

a. 10^6 phones

b. 0.000001 phone

c. 10^9 los

d. 1 trillion bulls

e. 10^{15} fajitas

f. 1E–12 boo

g. 10^{-18} boy

h. 0.001 vanilli

i. 1,000,000 deths

j. 10^{-6} nesia

k. 10^{18} lents

l. 1 quadrillion rabbits

m. 2000 mockingbirds

n. 10^{24} lay-hee-hoos

o. 10^{21} Joneses (hint: Katherine)

p. 1E+6 trons

q. Can you think of any "loony quantities" like these?

Orders of Magnitude

I-SIPr2. Of what order of magnitude (in meters) is the length of

a. a fly

b. a car

c. a pencil

d. the head of a pin

e. a football stadium

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Section I: Do You Know? Do You Know? Do You Know?

BASIC CONCEPT QUESTIONS

Speed

I-Spd1. Speed is the rate at which *what* happens?

I-Spd2. a. What is the difference between *instantaneous speed* and *average speed?*

b. Does the speedometer of a car read instantaneous speed or average speed?

I-Spd3. What is meant by saying, "motion is relative"? For everyday motion, what is motion relative to?

I-Spd4. What is the difference between *speed* and *velocity?*

I-Spd5. If the speedometer in a car reads a constant speed of 50 mph, you can say that the car has a constant speed but you can't say that it has a constant velocity. Why is this?

I-Spd6. Which two controls on a car enable a change in *speed?* Name another control that enables a change in *velocity* (without a change in speed).

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Section I: Do You Know? Do You Know? Do You Know?

BASIC CONCEPT QUESTIONS

Acceleration

I-Acc1. a. Acceleration is the rate at which *what* happens?

b. Rewrite your response to part a without using the word "velocity."

I-Acc2. What is the difference between *velocity* and *acceleration?* Answer this question carefully; it is one of the most important questions in the unit.

I-Acc3. a. Can acceleration occur when *speed* is constant?

b. Can acceleration occur when *velocity* is constant?

I-Acc4. Which has a greater acceleration when moving in a straight line—a car that increases its speed from 50 km/h to 60 km/h, or a bicycle that goes from zero to 10 km/h in the same time? Explain.

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Section I: Do You Know? Do You Know? Do You Know?

BASIC CONCEPT QUESTIONS

Freefall

I-FrFa1. Acceleration due to gravity is 9.8 m/s^2 downward. What is the acceleration of a ball thrown straight upward

a. just after it leaves the thrower's hand?

b. at the top of the flight?

c. just before it is caught by the thrower?

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Section II: Smooth Operations

EQUATION MANIPULATION EXERCISES

Space and Time

II-SpTi1. An ant walks along the edge of a meterstick. At 10:34:23, the ant crosses the 31.9 cm point. At 10:34:37, the ant passes the 73.5 cm point.
a. How far did the ant travel during this interval?

b. What was the duration of this interval?

c. How fast (on average) was the ant moving during this interval?

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Section II: Smooth Operations

EQUATION MANIPULATION EXERCISES

Speed

II-Spd1. Rewrite the equation for uniform motion ($v = \Delta x/\Delta t$)
a. solving for Δx

b. solving for Δt

II-Spd2. a. If $\Delta x = 132$ m and $\Delta t = 12$ s, determine v.

b. If $v = 13$ m/s and $\Delta t = 17$ s, determine Δx.

c. If $\Delta x = 144$ m and $v = 18$ m/s, determine Δt.

II-Spd3. James rolls his bowling ball more for speed than for accuracy.
a. If the ball rolls 19 m in 2.2 s, what was its speed?

b. Multiply by 9/4 to convert the speed from m/s to mph.

II-Spd4. A Galápagos Tortoise at the Darwin Research Station can travel at 0.11 m/s. How long does it take the tortoise to travel the 5.0 m from its favorite cooling pad to its feeding area?

II-Spd5. The US Space Shuttle (1981-2011) traveled at about 7600 m/s and orbits the Earth once every 90 minutes.
a, How far did the shuttle travel in each orbit?

b. Divide the result by 1600 to convert it from meters to miles.

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Section II: Smooth Operations

EQUATION MANIPULATION EXERCISES

Introduction to Acceleration

II-Acc1. Rewrite the equation $a = \Delta v/\Delta t$
a. solving for Δv

b. solving for Δt

II-Acc2. a. If $\Delta v = 64$ m/s and $\Delta t = 12$ s, what is a?

b. If $a = 17$ m/s^2, $\Delta t = 9.0$ s, what is Δv?

c. If $\Delta v = 66$ m/s and $a = 8.8$ m/s^2, what is Δt?

II-Acc3. A sports car goes from 0 to 26 m/s in 4.6 s. What is its acceleration?

II-Acc4. A rock falls with acceleration of 10 m/s^2. How fast is it traveling after falling for 3.2 s?

II-Acc5. A roller-coaster accelerates at 3.5 m/s^2 down the first hill. How long does it take for the roller-coaster to go from 10 m/s to 25 m/s?

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Section III: Mysteries of the Universe

GEDANKEN QUESTIONS

Uniform Motion

III-UM1. **Sam.†** Dr. Pisani exercises his dog Sam on a 15-minute walk by throwing a stick that Sam chases and retrieves. When Sam returns the stick, Dr. Pisani throws it again. To keep Sam running for the longest time as Dr. Pisani walks, should he throw the stick in front of him, behind him, to the side of him, or doesn't the direction make any difference? Explain your answer.

III-UM2. **Two Bikes and the Bee.†** Two bicycles are traveling toward each other. Each bicycle has a speed of 15 mph. When the bicycles are 30 miles apart, a bee flies from the front wheel of one bicycle toward the other at a uniform speed of 20 mph. When the bee reaches the front wheel of the other bicycle, it turns around (instantaneously) and flies back toward the first bicycle. This process continues until the bicycles meet and the bee is squashed. Determine the total mileage accumulated by the bee during this time. *(Hint: Finding the answer to this question can be very difficult or very easy, depending on your method.)*

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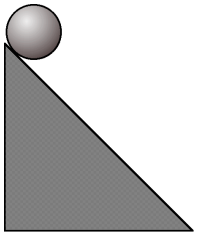
Section III: Mysteries of the Universe

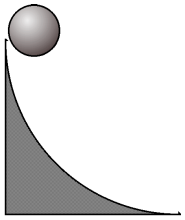
GEDANKEN QUESTIONS

Acceleration



III-Acc1. **Speed Ain't Acceleration 1.** Characterize the speed and acceleration of the ball as it rolls down the hill shown.
a. What can be said of the *speed* of the ball as it rolls down the hill?

b. What can be said of the *acceleration* of the ball as it rolls down the hill?



III-Acc2. **Speed Ain't Acceleration 2.**† Characterize the speed and acceleration of the ball as it rolls down the hill shown.
a. What can be said of the *speed* of the ball as it rolls down the hill?

b. What can be said of the *acceleration* of the ball as it rolls down the hill?

Sources: *Teaching Introductory Physics* by Arnold Arons, © John Wiley & Sons • *The Book of Phyz* by Dean Baird, © Dean Baird • *Physics* by Arthur Beiser, © Addison-Wesley • *Conceptual Physics: A High School Program* by Paul Hewitt, © Addison-Wesley • *Physics* by Douglas Giancoli, © Douglas Giancoli, Prentice-Hall • *Fundamentals of Physics* by Halliday and Resnick, © John Wiley & Sons • *College Physics* by Serway and Faughn, © Saunders College Publishing • *Physics* by Jerry Wilson, © D.C. Heath • † *Thinking Physics* by Lewis Epstein, © Insight Press • †† *The Flying Circus of Physics With Answers* by Jearl Walker, © John Wiley & Sons • ‡ *Physics in the Real World* by Keith Lockett, © Cambridge University Press

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