Phyz Question and Problem Set

1.01 PRELIMINARIES

9/2/09 PM

NOTE: Do not record your answers on this packet. Record answers on your own paper in accordance with Question and Problem Set Expectations. Use pencil. Reading instructions* carefully *and following them* closely *will serve you well throughout Physics and in Life!

Do You Know? Do You Know? Do You Know?

BASIC CONCEPT QUESTIONS

INSTRUCTIONS: The following questions require written responses. Answers may include diagrams and/or references to equations. Respond in complete sentences and include a statement of the question in your response. Leave at least one blank line between your answers.

The Structure of Science / The Why-How Tree

1. 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?

2. Is a preposition an acceptable word to end a sentence in?

3. Every question of nature can ultimately be explained in terms of the principles of which branch of science?

4. If the ultimate answer to any question of nature lies in physics, why do people study chemistry, biology, earth science, astronomy, etc.?

The Rules of the Universe

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

6. Can one Rule of the Universe be stated in two or more ways? Explain.

7. 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.

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

Scientific Notation

9. The number 512 can be written as 5.12×10^2 or
a. _?_ $\times 10^1$ b. _?_ $\times 10^0$ c. _?_ $\times 10^3$

10. The number 0.000 082 4 can be written as 82.4×10^{-6} or
a. _?_ $\times 10^{-5}$ b. _?_ $\times 10^{-7}$

11. 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}

12. Which number is 3E+20 squared?
A. 9E+20 B. 3E+40 C. 9E+40 D. 3E+400 E. 9E+400

SI Prefixes

13. 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.

14. 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.

15. 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

16. 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

Units of Measure / Physical Quantities

17. There are seven SI Base units. List the five we will use in physics by naming the *unit*, its *abbreviation*, and the *physical quantity* it specifies.

18. Explain the difference between a *physical quantity* and a *unit of measure*. Include examples of each.

19. When an equation is written to describe a physical relation, it is written with letters, such as $E = mc^2$. Do the letters in such an equation represent units or physical quantities?

20. What is the difference between SI *base* units and SI *derived* units? Which are there more of?

Ratios & Proportionalities

21. What is the meaning of 329/26? Do not use words like "goes into" in your answer.

22. a. Building A has a height of L_A, building B has a height L_B. What is the meaning of L_B/L_A?
b. What is the meaning (not the name or the value) of the number obtained by dividing the circumference of a circle by its diameter?

23. A car travels 240 miles using 10 gallons of gasoline.
a. What is the meaning of 240/10 in this context?
b. What is the meaning of 10/240 in this context?

24. If 2177/13 represents the number of points Marc scored on *Trogdor* in each minute of play,
a. what is the number of points Marc scored on *Trogdor* in 13 minutes?
b. what is the number of minutes it took Marc to score 2177 points on *Trogdor*?

25. If 257/4 represents the number of miles a car travels in an hour,
a. what is the meaning of 257 in this context? (Be specific.)
b. what is the meaning of 4 in this context? (Be specific.)

Significant Figures

26. Identify the quantity in **bold** in each case as either a "measurement" or a "counting number."
a. A shopper finds that a group of 3 bananas weighs **1.34 pounds.**
b. A shopper finds that group of **3 bananas** weighs 1.34 pounds.
c. A staircase has **24 steps** and connects ground level to the first floor, 18 feet above the ground.
d. A staircase has 24 steps and connects ground level to the first floor, **18 feet** above the ground.
e. Coconuts are **0.83 dollars per pound.**

Smooth Operations

EQUATION MANIPULATION EXERCISES

INSTRUCTIONS: Solve the following exercises by writing out the appropriate equation, rearranging it and/or substituting given values into it as indicated. Diagrams may be helpful but are not required unless otherwise specified. Draw a box around your final answer. You may write solutions "two-across" on your paper (but no more than two across).

Algebra Review

27. Consider the relation $a = bc$.
a. If $b = 2$ and $c = 3$, what is a?
b. If $b = 2$ m and $c = 3$ m, what is a?
c. If $b = 2$ m/s and $c = 3$ s, what is a?
d. Rewrite the relation solving for b.
e. If $a = 12$ and $c = 4$, what is b?
f. If $a = 12$ m and $c = 4$ m, what is b?
g. If $a = 12$ m/s and $c = 4$ s, what is b?

28. Consider the relation $a = b + c$.
a. If $b = 2$ and $c = 3$, what is a?
b. If $b = 2$ m and $c = 3$ m, what is a?
c. If $b = 2$ m/s and $c = 3$ s, what is a?
d. Rewrite the relation solving for b.
e. If $a = 12$ and $c = 4$, what is b?
f. If $a = 12$ m and $c = 4$ m, what is b?
g. If $a = 12$ m/s and $c = 4$ s, what is b?

29. Consider the relation $a = b^2c$.
a. If $b = 3$ and $c = 4$, what is a?
b. If $b = 3$ m and $c = 4$ m, what is a?
c. If $b = 3$ s and $c = 4$ m/s^2, what is a?
d. Rewrite the relation solving for b.
e. If $a = 27$ and $c = 3$, what is b?
f. If $a = 27$ m and $c = 3$ m, what is b?
g. If $a = 27$ m/s and $c = 3$ s, what is b?

30. Consider the relation $a = \sqrt{(bc)}$.
a. If $b = 4$ and $c = 9$, what is a?
b. If $b = 4$ m and $c = 9$ m, what is a?
c. If $b = 4$ m/s^2 and $c = 9$ m, what is a?
d. Rewrite the relation solving for b.
e. If $a = 4$ and $c = 2$, what is b?
f. If $a = 4$ m and $c = 2$ m, what is b?
g. If $a = 4$ m/s and $c = 2$ s, what is b?

Significant Figures

31. Calculate answers to the following questions using the correct number of significant figures.
a. A shopper finds that a group of 3 bananas weighs 1.34 pounds. What is the average weight of a banana?
b. A staircase has 20 steps and connects ground level to the first floor, 216.38 inches above the ground. What is the height of each step in the staircase?

**Get it: "principle" as in a law or rule of the universe, instead of Principal as in Mr. Ginter! Is that hilarious or what? I'm dyin'-- "principle's office" instead of "Principal's office" ... Oh, forget it.*

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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