Instructions: This test is divided into two parts. Part A is entitled short answer questions where you are to pick the best word, phrase or choice of answers which best answers or, in some cases, defines the statement. Part B is entitled longer answer questions. Make your answer clear and concise. If you need more room turn over the test paper and continue on the back, but please write "over" on the test. For problems, it is the procedure that will be checked, not only the answer so please try to make it clear. Be sure to include all units in answering problems (such as we've done in class). Point weighing is indicated in parentheses. Use the rule for precision and sig. figs. for underlined lab data. So for this, the first test of the summer energy course, Good Luck!

A. Short Answer Questions

1. (8) Choose from the following physical quantities which we have discussed -- length, area, volume, time, mass, force, speed, acceleration, work -- to answer the following:

   a) A measure of a push or a pull is called a ____.
   
   b) "Weight" is a ____.
   
   c) A measure of how much an object speeds up is ____.
   
   d) A measure of how fast an object is moving is ____.
   
   e) A measure of the amount of surface is ____.
   
   f) A measure of the quantity of matter contained by an object is ____.
   
   g) A force multiplied by the distance through which that force acts defines ____.
   
   h) A measure of the amount of space is ____.

2. (12) Choose from the list of physical quantities listed in question 1 to identify the quantities listed below taken from various problems. Note: Some quantities may be used more than once.

   a) 4.56 ft²
   b) 2.1 m/sec²
   c) 9.73 ft/sec/sec
   d) 8.22 m/sec
   e) 9 ft lb
   f) 8.3 cubic m
   g) 8.7 kg
   h) 9.2 m

3. (3) Write the following in scientific notation.

   a) .000593 kg
   b) 93,000,000 kg
   c) .059 kg

4. (3) Write the following in ordinary notation.

   a) 5.2 x 10⁵ m
   b) 5.2 x 10⁻⁵ m
   c) 5.0 x 10¹ m
5. (2) A box measuring 2.0 m by 3.0 m by 0.50 m contains \(? \) m\(^3\) or \(? \) cm\(^3\).

\[
\text{Volume} = (200 \text{ cm}) \times (300 \text{ cm}) \times (50 \text{ cm}) = 3,000,000 \text{ cm}^3
\]

6. (1) The prefix "kilo" such as in kilojoules (kJ) means \(?\).

7. (1) One \(\mu\)g (or one microgram) equals \(?\) gram.

8. (2) If 12.0 gallons of water flow through a faucet every six hours, how many gallons will flow through the faucet in 24 hours?

\[
12 \times 4 = 48 \text{ gal}
\]

9. (2) Suppose that consumption of a resource by humankind has grown exponentially at the rate of 7% per year. The consumption of that resource in one decade (10 years) is approximately equal to the total of all previous consumption in the entire history of humankind. (true, false)

10. (2) If the doubling time of bacteria in a bottle were 3 min and the bottle was completely full at 12 noon, at what time would the bottle be \(\frac{1}{2}\) full?

\[
12 \text{ Noon FULL} \quad \text{11:54 \frac{1}{4}} \text{ PM}
\]

11. (2) If the distance from Hamline University to downtown Minneapolis is 7.0 mi, find the time required to make the drive if you average 42 mi/h.

\[
\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{7.0 \text{ mi}}{42 \text{ mi/h}} = 0.167 \text{ h} = 10.0 \text{ min}
\]

12. (1) The dollar sum of all goods and services that is produced by a nation in one year is called the \(?\). Cross Domestic Product GDP

13. (2) The current atmosphere of our earth consists of \(?\%\) of \(?\) and \(?\%\) of \(?\).

Choose from oxygen, water vapor, carbon dioxide, nitrogen, argon, methane.

14. (2) A wall measures 60.0 in by 12.0 ft. The area of the wall is \(?\) ft\(^2\) or it is also \(?\) in\(^2\).

\[
\text{Area} = (60.0 \text{ in}) \times (1 \text{ ft/in}) = 8640 \text{ in}^2
\]

15. (2) If a car travels 80 ft in 4.0 s, how far will it travel in 12 s?

\[
\text{Distance} = \frac{\text{Speed} \times \text{Time}}{\text{Time}} = \frac{(20 \text{ km/h}) \times (1 \text{ mi/km})}{1 \text{ hr}} = 12.5 \text{ mi}
\]

16. (1) If 1.6 km = 1 mile, a distance of 20 km equals \(?\) mi.

17. (2) A person exerts a force of 17 lb in pushing a box a distance of 5.0 ft. The work done by the 17 lb force is \(?\). (Include units with your answer.)

\[
\text{Work} = \text{Force} \times \text{Distance} = (17 \text{ lb}) \times (5.0 \text{ ft}) = 85 \text{ ft-lb}
\]

18. (1) Ten square meters equals \(?\) square centimeters.

\[
100 \text{ cm}^2 = (1 \text{ m})^2 (100 \text{ cm/m})^2 = 100,000 \text{ cm}^2
\]

19. (1) If an object is moving at a constant speed (with no increase or decrease in that speed), then the acceleration of that object is \(?\).

\[
\text{Acceleration} = \text{Change in velocity} / \text{Time} = 0 / \text{time} = 0 \text{ m/s}^2
\]

20. (2) Suppose that Country X is experiencing inflation of 70% per year. Find the cost of a loaf of bread in that country three years from now if it cost \$5 today. (Note: Treat the unit of currency of Country X as "\$".)

\[
\text{Future Value} = \text{Present Value} \times (1 + \text{Rate})^\text{Time} = 5 \times (1 + 0.70)^3 = 20 \text{ \$}
\]

21. (1) The time that it takes for a finite resource to become depleted when acted upon by exponential growth is called the \(?\).

22. (1) The part of the atmosphere in which we live is called the \(?\). Choose from Stratosphere, Troposphere, Mesosphere.
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B. Longer Answer Questions

1. (4) A car travels a distance of 100 m in 5 s.
   (a) Find the average speed of the car:
   \[ v = \frac{d}{t} = \frac{100 \text{ m}}{5 \text{ s}} = 20 \text{ m/s} \]
   (b) Find the distance traveled:
   (i) After 1 s: 20 m
   (ii) After 2 s: 40 m
   (iii) After 4 s: 80 m

2. (4) A dragster speeds up from rest to 100 ft/s in 5 s.
   (a) What is the acceleration of the car? (Be sure to include units!)
   \[ a = \frac{\text{change in speed}}{\text{time}} = \frac{100 \text{ ft/s}}{5 \text{ s}} = 20 \text{ ft/s}^2 \]
   (b) Find the speed of the car
   (i) After 1 s: \( v = 20 \text{ ft/s} \)
   (ii) After 2 s: \( v = 40 \text{ ft/s} \)
   (iii) After 4 s: \( v = 80 \text{ ft/s} \)

3. (4) Current world population is about 7 billion people. Thirty years ago, the world growth rate was about 1.9%. Today, the world growth rate is about 1.1%. For each of the two growth rates, calculate how long it would take for the world population to become 28 billion people.

   \[
   \begin{align*}
   \text{For 1.9\%:} & \quad DT = \frac{70}{1.9} = 37 \text{ years} \quad \text{Now 7B} \quad 37\text{yrs} 14\text{B} \quad 74\text{yrs} 28\text{B} \\
   \text{For 1.1\%:} & \quad DT = \frac{70}{1.1} = 64 \text{ years} \quad \text{Now 7B} \quad 64\text{yrs} 14\text{B} \quad 128\text{yrs} 28\text{B}
   \end{align*}
   \]

4. (4) Define exponential growth and give three examples of exponential growth.
   Exponential growth occurs whenever a sample grows at a fixed rate per year and that growth is added to the original sample. Therefore, providing even more growth. Examples:
   - Money in savings account \( 2\% \text{/yr} \)
   - Inflation \( 2\% \text{/yr} \)
   - World population growth \( 720 \text{ people} / \text{yr} \) (initially 7B)

5. (3) A force of 5 N acting on a box moves the box a distance of 400 cm. What work is done in joules? (Caution: Be careful regarding units.)
   \[ \text{Work} = \text{Force} \times \text{Distance} = (5 \text{ N})(4 \text{ m}) = 20 \text{ Nm} = 20 \text{ J} \]
6. (4) Use two of the three methods discussed in class to determine the number of cubic inches in one cubic yard. (Hint: 1 yd = 3 ft and 1 ft = 12 in)

- **Visualization**: 36 in$^3$ along front edge. 
  Top layer contains ($36 \text{ in}^3$)(36 in) = 1296 in$^3$ 
  Volume = ($\frac{1296 \text{ in}^3}{\text{yd}^3}$)(36 in) = $46,656 \text{ in}^3$ 

- **Unspaced Volume**: Box Vol = (36 in)(36 in)(36 in) = 46,656 in$^3$ 

- **Cubed Both Sides**: Start 36 in = 1 yd 
  Cube 46,656 in$^3$ = 1 yd$^3$

7. (6) Convert 30 km/hr to in/s.

$$60 \text{ km} = \left( \frac{60 \text{ km}}{1 \text{ hr}} \right) \left( \frac{1 \text{ in}}{1 \text{ km}} \right) \left( \frac{2.54 \text{ cm}}{1 \text{ in}} \right) \left( \frac{1 \text{ ft}}{12 \text{ in}} \right) \left( \frac{1 \text{ hr}}{60 \text{ min}} \right) \left( \frac{1 \text{ min}}{60 \text{ s}} \right) = \frac{55}{5} \text{ ft/s}$$

- OR

$$60 \text{ km} = \left( \frac{60 \text{ km}}{1 \text{ km}} \right) \left( \frac{1000 \text{ m}}{1 \text{ km}} \right) \left( \frac{1 \text{ in}}{1 \text{ m}} \right) \left( \frac{1 \text{ ft}}{2.54 \text{ cm}} \right) \left( \frac{1 \text{ ft}}{12 \text{ in}} \right) \left( \frac{1 \text{ min}}{60 \text{ s}} \right) = \frac{55}{5} \text{ ft/s}$$

8. (5) Fill in the diagram used by Bartlett. What is it and discuss its significance. (Be sure to include in your discussion the percent rate of growth and the doubling time.)

The diagram illustrates the use of WORLD OIL by using area. World oil prior to 1973 increased at 7%/year. This gives a doubling time of $\frac{70}{7} = 10$ years. Hence every 10 years, the amount of world oil usage would have doubled. If we would have "run out" by the turn of the century.
9. Define and briefly discuss the following from the viewpoint of the text:

(4) Gross Domestic Product (GDP). In your discussion be sure to mention which countries enjoy a large GDP per capita with a minimal expenditure of energy per capita. Also include “standard of living” in your discussion.

Gross Domestic Product (GDP) is the dollar sum of all goods and services used by a country each year. If you divide the GDP by the population, you have a measure of the standard of living (GDP per capita) for that country. Those countries with a large GDP per capita with a minimal energy per capita are Switzerland & Japan (about 1/2 the energy per capita of that of the U.S.) Australia is also a close third place according to our text.

(2) “Climate” as compared to “weather”. “Climate” is more of an earthwide description of average conditions such as temperature, humidity, etc. While “weather” is a local, hour-by-hour description.

(2) Geothermal is energy obtained from below the surface of our earth (about 50°F, two or three feet below and then warmer as you go deeper!). The earth is still in the process of cooling from its original formation.

(2) Albedo (from our discussion of the earth’s energy flows) is the amount of energy from our sun that is immediately reflected back into space (from white snow, ice, tops of clouds, etc.). This fraction of energy reflected is currently 30%.

(2) Greenhouse gases includes water vapor (H₂O) that has always been present plus carbon dioxide (CO₂) & other gases that are currently increasing! These gases serve as a kind of “blanket” that keep our earth warmer that if they were absent.

Please Record My “Secret Number” (any number from one to four digits that only you and my computer will know) as ________