

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. So for this, the first test of the summer energy course, Good Luck!

A. Short Answer Questions

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

- force a) A "push" or a "pull" is a ?.
area b) A measure of the amount of surface (2D) is ?.
energy c) A measure of the *capacity* to do work is called ?.
speed d) How fast an object is moving is ?.
mass e) The quantity of matter contained by an object is ?.
force f) Weight is a ?.

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.

- | | | |
|--|--------------------------------------|----------------------------|
| <u>speed</u> a) 4.59 m/s | <u>mass</u> e) 9 kg | <u>force</u> l) 7.4 pounds |
| <u>force</u> b) 2.1 N | <u>work or energy</u> f) 8.3 joules | <u>length</u> j) 1.35 m |
| <u>area</u> c) 9.73 m ² | <u>acceleration</u> g) 8.7 ft/s/s | <u>length</u> k) 7.32 mi |
| <u>acceleration</u> d) 8.22 m/s ² | <u>volume</u> h) 9.2 ft ³ | <u>time</u> i) 3.21 min |

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

- 5.93×10^7 m a) 59,300,000 m
 6.5×10 N b) 65 N
 5.903×10^{-7} kg c) .0000005903 kg

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

- .00522 m a) 5.22×10^{-3} m
52,200 m b) 5.22×10^4 m
5.05 c) 5.05×10^0 m

$DT = \frac{70}{P} = \frac{70}{7} = 10 \text{ years}$

10 years
5. (2) What is the doubling time in years if oil consumption increases at a mere 7% per year?

exponential approximation time
6. (1) The time that it takes for a finite resource to be completely depleted when being used at a constant rate of growth is called ?

10^{-3} or $\frac{1}{1000} \text{ s}$
7. (2) The prefix "milli" as applied to milliseconds (ms) means ?

$\frac{6 \text{ m}}{1 \text{ s}}$
8. (2) An object travels 60 m in 10 s. Its average speed is ?. $v = \frac{d}{t} = \frac{60 \text{ m}}{10 \text{ s}} = 6 \frac{\text{m}}{\text{s}}$

30
52,000
9. (2) A box measuring 2.0 ft by 3.0 ft by 5.0 ft contains ? ft^3 or equivalently, it would contain ? in^3 .
 $24 \text{ in} \times 36 \text{ in} \times 60 \text{ in}$

$\frac{6 \text{ m/s}}{1 \text{ s}} = 6 \frac{\text{m}}{\text{s}^2}$
10. (2) An object speeds up from rest to 24 m/s in 4.0 s. Its acceleration is ?. $acc = \frac{24 \text{ m/s} - 0}{4 \text{ s}} = 6 \frac{\text{m}}{\text{s}^2}$

42
420,000
11. (2) A wall measures 6.0 m by 7.0 m. The area of the wall is ? m^2 or it is also ? cm^2 .
 $6.00 \text{ m} \times 7.00 \text{ m} = 42.0 \text{ m}^2$
 $420,000 \text{ cm}^2$

180 ft
12. (2) If a car travels 60 ft in 4.0 s, how far will it travel in 12 s?

32 km
13. (2) If 1.6 km = 1.00 mile, a distance of 20 miles is equal to ? km.

$20 \text{ mi} = \left(\frac{20 \text{ mi}}{1 \text{ mi}}\right) \left(\frac{1.6 \text{ km}}{1 \text{ mi}}\right) = 32 \text{ km}$

True
14. (2) With the rate of consumption of a resource growing at the rate of 14% per year, the consumption in one-half decade (5 years) very nearly equals (or equals) the total of all previous consumption (True, False). $DT = \frac{70}{P} = \frac{70}{14} = 5 \text{ years}$

(f) 100 years
15. (2) President Carter in the year 1977 suggested that the United States increase the use of its domestic coal supply by 5% per year. Even if one uses the highest estimate of reserves of coal in the United States, the entire supply of coal would be used up in about (a) 10,000 years (b) 5,000 years (c) 3,000 years (d) 1000 years (e) 500 years (f) 100 years (g) 50 years

11:51
16. (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 1/8 full?
FULL 12 NOON
 $\frac{1}{2}$ " 11:57
 $\frac{1}{4}$ " 11:54
 $\frac{1}{8}$ " 11:51

(e) Canada
17. (2) The US today imports from 62% to nearly 70% of its oil. The country that supplies the most oil to the US is (a) Saudi Arabia (b) Iraq (c) Iran (d) Mexico (e) Canada (f) Venezuela (g) Nigeria

0
18. (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 ?

\$\$\$80
21. (2) Suppose that Country X is experiencing inflation of 70% per year. Find the cost of a loaf of bread in that country four years from now if it cost \$\$\$5 today. (Note: Treat the unit of currency of Country X as \$\$\$.)
 $DT = \frac{70}{P} = \frac{70}{70} = 1 \text{ year}$

Today	\$\$\$5
1 yr	\$\$\$10
2 yrs	20
3 yrs	40
4 yrs	80

B. Longer Answer Questions

1. (4) A car travels a distance of 100 ft in 5 sec.

(a) Find the average speed of the car:
 $v = \frac{d}{t} = \frac{100 \text{ ft}}{5 \text{ s}} = 20 \frac{\text{ft}}{\text{s}}$

(b) Find the distance traveled:

- (i) After 1 sec: 20 ft
- (ii) After 2 sec: 40 ft
- (iii) After 4 sec: 80 ft

2. (4) List and briefly define four of the eight forms of energy discussed yesterday.

- ① Kinetic Energy $KE = \frac{1}{2}mv^2$ is the energy of motion
- ② Gravitational Potential Energy $GPE = \text{weight} \times \text{height}$ is the energy of elevation
- ③ Heat Energy is capability of doing work from the flow of heat thru a temp. differ.
- ④ Chemical Energy is energy released in combustion (atomic rearrangement).
- ⑤ Electrical Energy is energy due to separation of positive & negative charge
- ⑥ Nuclear Energy (or mass energy) is energy released from nucleus of atom ($E=mc^2$)
- ⑦ Electromagnetic (Solar) energy " " carried by waves at speed of light
- ⑧ Sound Energy is the capability of sound waves to exert a force thru a distance

3 (4) Current world population growth is 6.8 billion people. Thirty years ago, the world growth rate was about 1.9%. Today, the world growth rate is about 1.2%. For each of the two growth rates, calculate how many years it would take for the world population to quadruple—namely, to become 27.2 billion people.

For 1.9%

$$DT = \frac{70}{1.9} = 38.6 \text{ yrs}$$

TODAY 6.8B people
~~38~~ yrs 13.6B "

74 yrs 27.2B "

For 1.2%

$$DT = \frac{70}{1.2} = 58.3 \text{ yrs}$$

TODAY 6.8B people
 58 yrs 13.6B "

116 yrs 27.2B "

2 Doubling Times!

4. (4) Define exponential growth and give three examples of exponential growth.

Exponential Growth occurs when a sample grows at a fixed percent each year (actually "continuous" growth) and that growth is added on to the original sample thereby producing even more growth.

Examples: World oil usage prior to 1973 (at 7%/yr).

Money in a savings account

Population growth (at 1.2%/yr)

Disease epidemics, Bacteria growth in a fertile environment, Inflation, ...

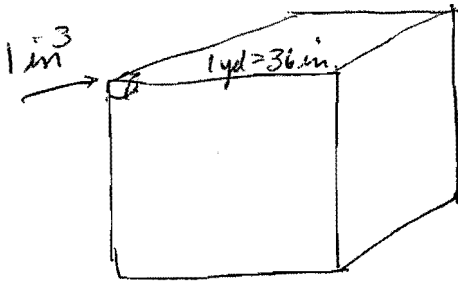
5. (4) Discuss Bartlett's example of the mathematician, the king and the grains of wheat on the chessboard, and list two major points that Bartlett was attempting to make

① Exponential growth leads to very large amounts very quickly. (after 63 doublings, the # of grains of wheat exceed world yearly harvest)

② The number of grains of wheat req'd for the next square is approximately equal to the SUM of grains of wheat on all previous squares.

Payment: 1 grain of wheat for 1st square, double to get 2 grains 2nd square, double to get 4 grains 3rd square, double to get 8 grains 4th " ,
 " " " 16 " 5th " , on up to 64th square!

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)



① Visualization: There are 36 in^3 along front edge
There are $36 \text{ rows} \times \frac{36 \text{ in}^3}{\text{row}} = 1296 \text{ in}^3$ for top layer

There are 36 layers
Volume = $\frac{1296 \text{ in}^3}{\text{layer}} \times 36 \text{ layers} = 46656 \text{ in}^3$

② Volume = $(36 \text{ in})(36 \text{ in})(36 \text{ in}) = 46656 \text{ in}^3$

③ Cube both sides $1 \text{ yd} = 36 \text{ in}$
 $1 \text{ yd}^3 = 46656 \text{ in}^3$

7. (6) Convert 95 km/hr to in/s.

NOTE: 5280 ft = 1 mile
2.54 cm = 1 in
12 in = 1 ft
1.6 km = 1 mile
60 s = 1 min
60 min = 1 H
↑ 2 Sig. Figs (USING "1" RULE)

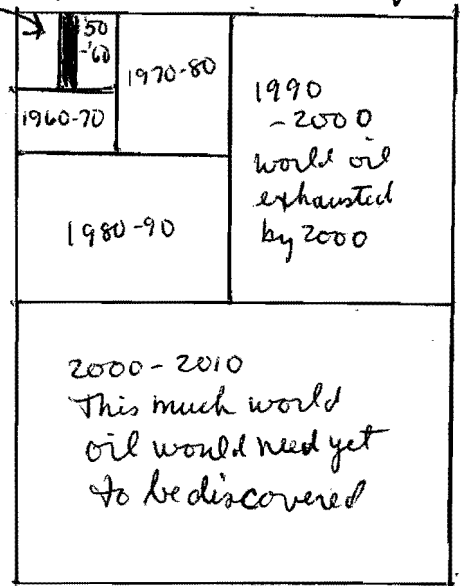
$$95 \frac{\text{km}}{\text{H}} = \left(\frac{95 \text{ km}}{1 \text{ H}} \right) \left(\frac{1 \text{ mi}}{1.6 \text{ km}} \right) \left(\frac{5280 \text{ ft}}{1 \text{ mi}} \right) \left(\frac{12 \text{ in}}{1 \text{ ft}} \right) \left(\frac{1 \text{ H}}{60 \text{ min}} \right) \left(\frac{1 \text{ min}}{60 \text{ s}} \right) = 1045 \frac{\text{in}}{\text{s}}$$

OR $95 \frac{\text{km}}{\text{H}} = \left(\frac{95 \text{ km}}{1 \text{ H}} \right) \left(\frac{1000 \text{ m}}{1 \text{ km}} \right) \left(\frac{100 \text{ cm}}{1 \text{ m}} \right) \left(\frac{1 \text{ in}}{2.54 \text{ cm}} \right) \left(\frac{1 \text{ H}}{60 \text{ min}} \right) \left(\frac{1 \text{ min}}{60 \text{ s}} \right) = 1039 \frac{\text{in}}{\text{s}} = 1040 \frac{\text{in}}{\text{s}}$

↑ 2 Sig. Figs (ALSO USING "1" RULE)

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

The amount of oil consumed by the world prior to 1950



The diagram illustrates the amount of world oil consumption growing at the pre-1973 rate of 7% per year. Here the Doubling Time is

$$DT = \frac{70}{P} = \frac{70}{7} = 10 \text{ years}$$

The amount of oil consumed is represented by the area of each rectangle.

9. Define and discuss the following from the viewpoint of the text

- (3) Gross Domestic Product (GDP). In your discussion be sure to mention which countries enjoy the greatest GDP per capita with a minimal expenditure of energy per capita.

The Gross Domestic Product (GDP) is the dollar sum of all goods & services that are produced by a country. If you divide GDP by the population of the country (to get GDP per capita) you get a number that is representative of a "standard of living". The countries which enjoy the greatest GDP per capita with a minimum of energy per capita are Japan & Norway. (The big energy "hogs" are the US & Canada.)

- (3) Energy consumption of the United States. Be sure to mention the contribution of various sources of energy (coal, natural gas, oil, nuclear, and renewables).

The energy consumption of the U.S. today is mainly OIL (~40%). Both coal and natural gas contribute approximately equally at about 23% for coal and 23% for natural gas. Nuclear power contributes about 8% of all of US energy consumption and renewables about 6% (mainly due to hydropower).

"HISTORICAL ANSWER" (also discussed in class): In the 1850s, energy consumption was mainly wood! But then coal became the major source in 1900. In 1950, oil slightly edged out coal & natural gas. In 2000, oil is our major source.

- (2) Geothermal - is an energy resource whereby ^{heat} energy is obtained by tapping the heat from the earth below its surface. Regions of the world where the earth's crust is thin (high earthquake areas such as California, Italy, New Zealand, etc) are viable

- (2) Hydroelectric - is the use of dams to increase the ^{water} ^{electricity} elevation of water & hence increase the gravitational potential energy. This energy can then be channeled thru pipes to the bottom of the dam & produce electricity via a turbine & electrical generator.

- (2) Renewable energy - are forms of energy such as solar power, hydropower, geothermal, biomass, wind, etc all of which can be renewed over time.

Severe
#1