### Table of Proportional Quantities (TPQ)

Instructions: Filling out this table will help you learn very important new ideas and review for the First Semester Physics Final Exam. As best you can, work alone, and from memory, and fill out all blank spaces using common sense and careful thinking. Follow the examples given. Guess symbols as necessary.

#### Examples for you to follow

<table>
<thead>
<tr>
<th>(col.0)</th>
<th>(col.1)</th>
<th>(col.2)</th>
<th>(col.3)</th>
<th>(col.4)</th>
<th>(col.5)</th>
<th>(col.6)</th>
<th>(col.7)</th>
<th>(col.8)</th>
</tr>
</thead>
</table>
| In the spaces below you should draw diagrams to illustrate the meaning of each respective proportion. (You may tape on extra paper as needed or write on back.) | Name of the newly Defined concept. (Please realize that the new defined concept of the proportion is necessarily a Constant !!!) | m = Shape of graph. This gives a general equation for proportion: \( y = mx \) \( \text{(units)} / \text{(units)} \) | \( \mu \) \( \text{vertical} \) \( \mu \) \( \text{horizontal} \) \( y = \mu x \) | \( m \) \( \text{y-axis} / \text{dx} \) \( \text{where} \ h = \text{hypotenuse} \) | \( y = m x \) | Line must be straight- and through \((0,0)\). Column four is always “left over right”.

#### Common proportions for first semester physics. Those should be easy to fill out

- \( \rho = \text{Density of a material} \)
  - \( \rho \text{ ( } \text{ Put Units) } \)
  - \( \rho \text{ mass } \text{length} \)
  - \( \rho \text{ distance } \text{ time} \)
  - \( \rho \text{ change vel. } \text{time} \)
  - \( \rho \text{ work } \text{time} \)
  - \( \rho \text{ Force } \text{stretch} \)
  - \( \rho \text{ Work Out} \text{ Work In} \)

#### Special Notes concerning what specific conditions must be true in the indicated proportion. Study examples given.

- \( \text{The rope or cable must be "Uni-form". i.e. Everywhere the same.} \)
- \( \text{What must be condition of car engine?} \)
- \( \text{Spring must...} \)
- \( \text{Work Out must...} \)
- \( \text{Work In} \)

#### Diagrams, Maps, and Building Plans: Rules for Space we live in.

- \( \text{B = Scale Factor for all scale diagrams. (Similar to concept of magnification).} \)
  - \( \text{In Model } B = \text{(in Model) } B \text{ (in Diagram)} \)
  - \( \text{In scale diagrams angles are same as world, but sides are all proportionally smaller.} \)
- \( \mu \text{ (Sides Small Rt. D)} \)
- \( \mu \text{ (Sides Large Rt. D)} \)
- \( \text{What is same? My Answer:} \)
  - \( \text{The space we live in every-where accurately follows Euclid's Plane Geometry and standard trigonometry !!!} \)
  - \( \text{This means no near-by Black Holes and no "curved space". Under these conditions the} \)

---

**Note:** Please keep in mind that some diagrams are shown improperly because of the limitations of web presentation software etc.
| Angle J | H | Definition of
<table>
<thead>
<tr>
<th>cosine of Angle J</th>
<th></th>
<th>Commutative Property of Vectors is experimentally true and independent of scale.</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>h</td>
<td>Definition of tangent of angle J = (\frac{\text{opposite}}{\text{adjacent}}) = grade of a road = so-called “gradient”.</td>
</tr>
</tbody>
</table>

**Geometry of Circles.**

Above have shown example diagrams. Here and below you are to show your own diagrams.

**(Sm. Circle)** µ **(Lg. Circle)**

**Definition of cosine of Angle J**

**Definition of tangent of angle J**

\[ \text{Definition of \( \tan J \)} = \frac{\text{rise}}{\text{run}} = \text{slope} = \text{grade of a road} = \text{so-called “gradient”}. \]

\[ \text{What is same?} \]

\[ \text{Circle moving particle} \]

\[ \omega = \text{Angular velocity. Here follow (by analogy) velocity above.} \]

\[ a = \text{Angular acceleration. Here follow (by analogy) with acceleration above.} \]

\[ s, v, a, J, v, a \text{ are variables.} \]

From geometry of a circle the definitions above relate linear to angular as follows: (ignore units)

\[ s = \text{arc distance} \]

\[ r = \text{radius} \]

\[ \text{What's constant?} \]

For small angles, \( J \theta \) follows from the definitions.

\[ \text{Gravity \\ \\ Astronomy} \]

\[ g = \text{Gravitational Field Strength} \]

A new way to look at an old equation.

\[ g = \frac{\text{gravitational force on any object mass at any position}}{m} \]

\[ \text{So } g = 9.8 \text{m/s}^2 = \text{“Gravitational Field Strength” at surface of earth and is less far from earth.} \]

Surface Tension

\[ \text{Surface Tension} \]

\[ \text{Surface Tension (a 2nd equivalent definition)} \]

\[ \text{May omit sketch, unless you have good idea.} \]

\[ \text{Think!!!} \]

\[ \text{The constant is a property of a material. See handbooks.} \]

\[ \text{Surface Tension} \]

\[ \text{Coefficient of Thermal Expansion of a Material.} \]

\[ \text{May omit sketch, unless you have good idea.} \]
Ditto above.

| \( \frac{DV}{
\frac{D 
\mu}{
D 
V 
\mu}} 
\frac{DT}{
\mu} 
V 
\mu} \) | \( \text{Coefficient of}
\text{Thermal}
\text{Expansion of a}
\text{Liquid}. \) |
|---|---|

Ditto above.

| \( \frac{DH}{
\frac{D 
\mu}{
D 
H 
\mu}} 
\frac{DT}{
\mu} 
\mu} \) | \( c_p = \) \( \text{Heat of combustion}
\text{or}
\text{other chemical reaction} \)
|---|---|

| \( \) | \( \text{Heat of mass}
\text{involved} \)
|---|---|

Force held by a rod of given area.

| \( \) | \( \text{Heat of fusion/melt} \)
|---|---|

| \( \) | \( \text{Heat of condense/vaporize} \)
|---|---|

| \( l = \text{Length of object being}
\text{stretched}; \ D \frac{l}{
\text{Length of object}} \) | \( \text{Force on}
\text{rod. omit sketch} \)
|---|---|

| \( D \] | \( \text{Applied or}
\text{holding ability} \)
|---|---|

| \( \frac{D 
\mu}{
A 
\mu} 
\mu} \) | \( \text{Elastic Modulus} \)
|---|---|

| \( \) | \( \text{E} = \) \( \text{(may ignore}
\text{units}) \)
|---|---|

| \( N_p = \) \( \text{Avogadro's}
\text{Number} \)
|---|---|

Atoms and Gases.

| \( P \) | \( \text{Ideal Gas Constant} \)
|---|---|

| \( k = \) \( \text{Boltzman's Constant} \)
|---|---|

| \( P = \) \( \text{percent} \times \) \( \# \) per 100
|---|---|

| \( S = \) \( \text{Entropy} \)
|---|---|

| \( E = \text{Energy (Flow) of light}
\text{or sound. (Joules/sq. meter/sec)} \)
|---|---|

| \( \) | \( \text{Put any other}
\text{proportions you can think of here.} \)
|---|---|

Summary

| \( \text{The proportionality constant is the}
\text{relationship between the two variables.}
\text{Example: Density is the constant relationship}
\text{between mass & volume in homogeneous}
\text{substance like steel. Density is an example of}
\text{an "intensive quantity", i.e. how much}
\text{"concentration".} \)
|---|---|

| \( \text{The two variables above are called}
\text{"extensive variables"} \)
|---|---|

| \( \text{Calculus is used to change the ratio}
\text{constant (above) to a variable, in}
\text{which case the defined concept is}
\text{now called an "intensive variable"} \)
|---|---|

6/20/19, 4:42 PM
The proportions listed on this table are only those where the constant ratio defines a new concept. There are many other proportions in physics where for a variety of practical reasons the constant ratio happens not to get a special name. Here are some examples:

| Work = \( F \cdot s \) OR Torque = \( F \cdot r \) OR KE = \( \frac{1}{2}mv^2 \) OR PE = mgh OR Velocity Wave = f \lambda |