Name: _____ DISC: _____ Score: _____ / 20

Instructions:

- Do your own work.
- Answer the questions below in the space provided.
- Make sure you show all your work and any equations that you use.
- Please place a box around your answers.
- Remember to give the correct units with all numerical answers

Q1	Q2	Q3	Q4
5	5	5	5

PHYSICAL QUANTITY	SYMBOL	UNITS
Mass	$M\ (or\ m)$	kg
Radius	r	m
Time	t	s
Weight	W	$kg\ m/s^2$

1. The weight of an object due to the Earth's gravity is expressed: $W = \frac{GMm}{r^2}$, where G is known as the *Universal Gravitational Constant (or just Gravitational Constant).* Using the information in the table above, find the units on G. **(Week 1 Discussion 1-2)**

Answer: 5 pts

This is a problem of dimensional analysis:

First, write out the expression $W = \frac{GMm}{r^2}$ as $[W] = \frac{[G][M][m]}{[r^2]}$, which denotes that we are going to work with the units of each of these quantities. Now substitute the appropriate units:

$[W] = \frac{[G][M][m]}{[r^2]}$ becomes $kg\frac{m}{s^2} = \frac{[G](kg)(kg)}{m^2} = \frac{[G](kg^2)}{m^2}$. Now perform the algebra to find $[G]$:

$$kg\frac{m}{s^2} = \frac{[G](kg^2)}{m^2}$$

$$\frac{kg}{kg^2}\frac{m(m^2)}{s^2} = [G]$$

$$\frac{m^3}{kg\ s^2} = [G]$$

The most common errors I found were:

1) **Incorrect cancellation of terms: -2 pts (this is after all the point of the exercise)**
2) **Incorrect powers of units: -1 pt (they're given in the table)**

There were a lot of miscellaneous errors as well, but these were the two most common I found in my group.

2. You are on a hike through the woods. The table below describes the path you took.

STEP	DIRECTION	DISTANCE
1	West	$3\ km$
2	North	$2\ km$
3	30^o south-of-east	$4\ km$

Set up a coordinate system, with $(0\ km, 0\ km)$ your starting point (let the $+x$-axis be East and the $+y$-axis be North). **(Week 2 Discussion 2-2)**

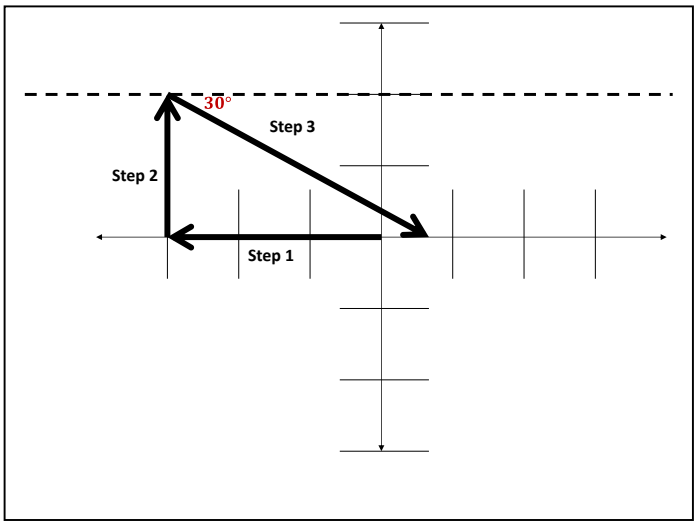
Diagram: 2 pts

Coordinates: 2 pts.

Distance: 1 pt.

i. Draw your path through the woods in the space below.
ii. What are the coordinates of your final location? $\mathbf{(0.46\ km, 0\ km)}$
iii. How far from the starting point $(0\ km, 0\ km)$ do you finish? $\mathbf{0.46\ km\ East}$

To solve this problem we first need a coordinate system. Then we can plot our vectors on that coordinate system:



Components:

1: $\mathbf{(-3\ km, 0\ km)}$
2: $\mathbf{(0\ km, 2\ km)}$
3: $\mathbf{(4\ km \times \cos 30°, -4\ km \times \sin 30°) = (3.46\ km, -2\ km)}$

Final vector: Components

$\mathbf{v_{final} = (-3\ km + 3.46\ km, 2\ km - 2\ km)}$
$\mathbf{v_{final} = (0.46\ km, 0\ km)}$

The most common errors I found in my group were:

1) **Incorrect diagram:**
   a. **-2 pts if the diagram was completely incorrect**
   b. **-1 pt for the incorrect step 3 vector (very common)**
   c. **-1 pt for a diagram that begins and ends at the origin**
2) **Incorrect trig function/angle: -1 pt.**
3) **Failure to add steps 1 and 2 to step 3: -1 pt.**

3. You have a bag which contains 2 types of coins: dimes ($\$0.10$) and nickels ($\$0.05$).
   The bag: **(Week 1 Discussion 1-3)**
   i. Contains 10 coins.
   ii. Has a otal value: $0.95.
   How many dimes and nickels are in the bag?

Dimes:	Nickels:
9	**1**

Dimes: 1 pt.
Nickels: 1 pt.
Algebra: 3 pt.

This is a problem of two equations in two unknowns:
Let n be the number of nickels and d be the number of dimes.

$$n + d = 10 \quad \text{multiply through by 5}$$
$$\$0.05\,n + \$0.10\,d = \$0.90 \quad \text{multiply through by 100}$$

$$\begin{array}{rl} & 5n + 5d = 50 \\ (-) & 5n + 10d = 95 \\ \hline & -5d = -45 \end{array}$$

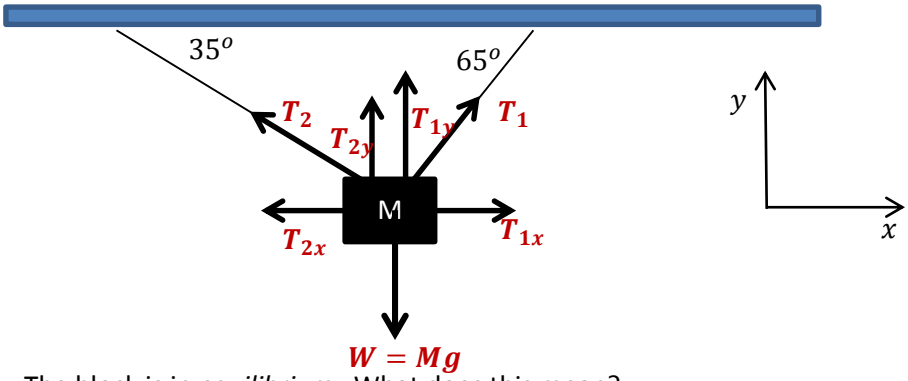
$d = 9$, after dividing both sides by 5.

Now use the equation:
$n + d = 10$ and substitute for d--$n = 10 - 9 = 1$.

Overall this problem went very well in my group. The most common error I found was:

1) **Miscellaneous arithmetic errors: -1 pt per occurrence—propagate a single occurrence**

4. A block hangs from the ceiling as shown in the diagram: **(Lecture 2)**



a. The block is in *equilibrium*. What does this mean?

If the block is in equilibrium, it experiences no net acceleration.

Definition: 2 pts.

b. On the diagram above, draw all of the forces vectors *and* their components. Remember to label all of your vectors.

Vectors: 3 pts.

This problem went reasonably well in my group. The most common errors I found were:

1) **Incorrect definition of equilibrium: -2 pts.**
2) **Failure to draw and label correct components: -1 pt per occurrence.**
3) **Miscellaneous errors.**