A. Introduction to Proportionality

Proportionality A regular mathematical relationship between two variables. Used very frequently in physics to understand formulas.
Direct Proportionality A linear proportionality relationship in which, if one variable increases, the other increases by the same proportion.
Inverse Proportionality If one variable increase, the other *decreases* by the same proportion.

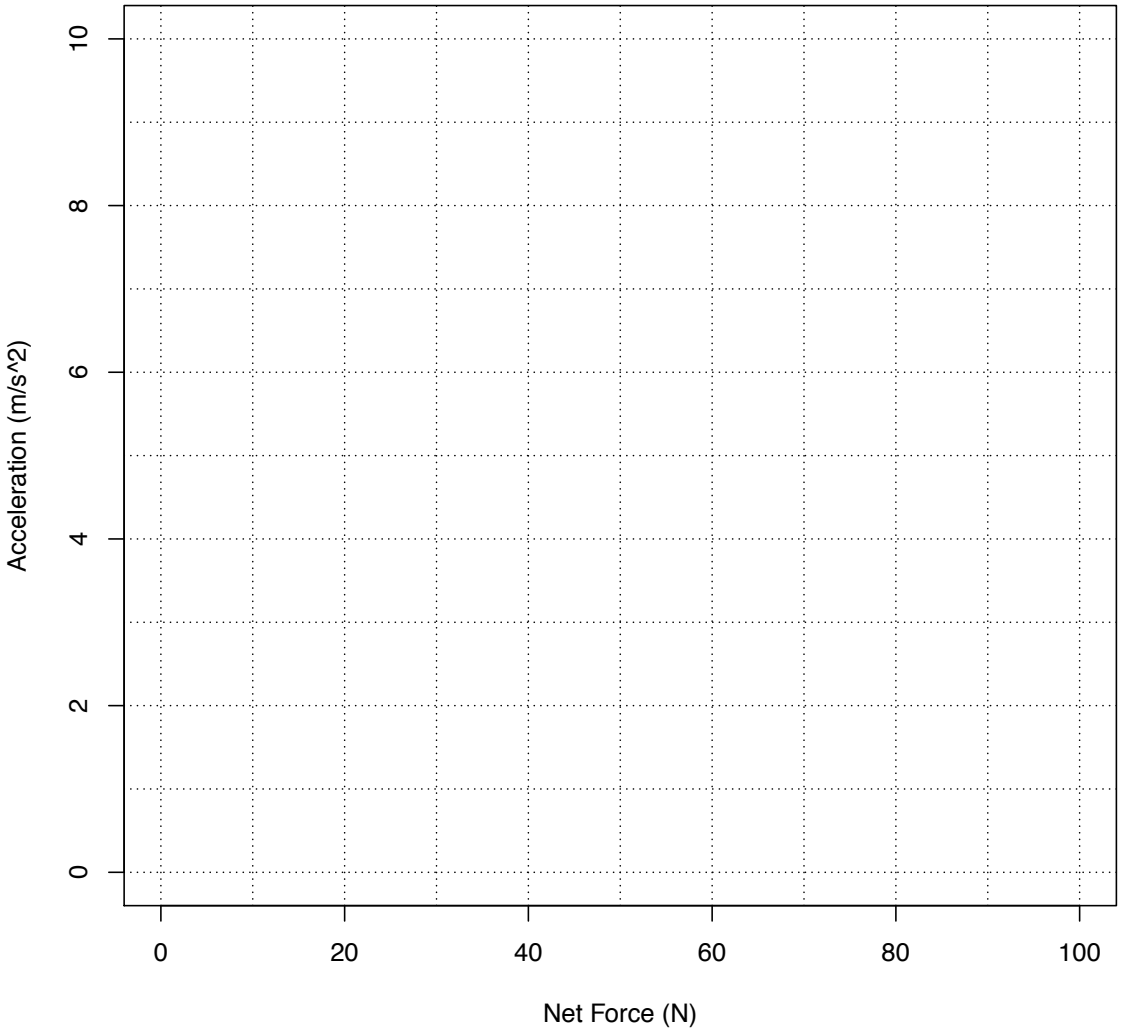
1. Use the following formula (Newton's Second Law) to fill out the following table.

$$\Sigma F = ma \tag{1}$$

Net Force (N)	**mass** (kg)	**Acceleration** (m/s^2)
10	10	
20	10	
30	10	
40	10	
50	10	
60	10	
70	10	
80	10	
90	10	
100	10	

2. Which two variables change? 3. Which variable remains constant?

4. Make a graph of Net Force and Acceleration from the table on the previous page. This graph represents a *Direct Proportion*.



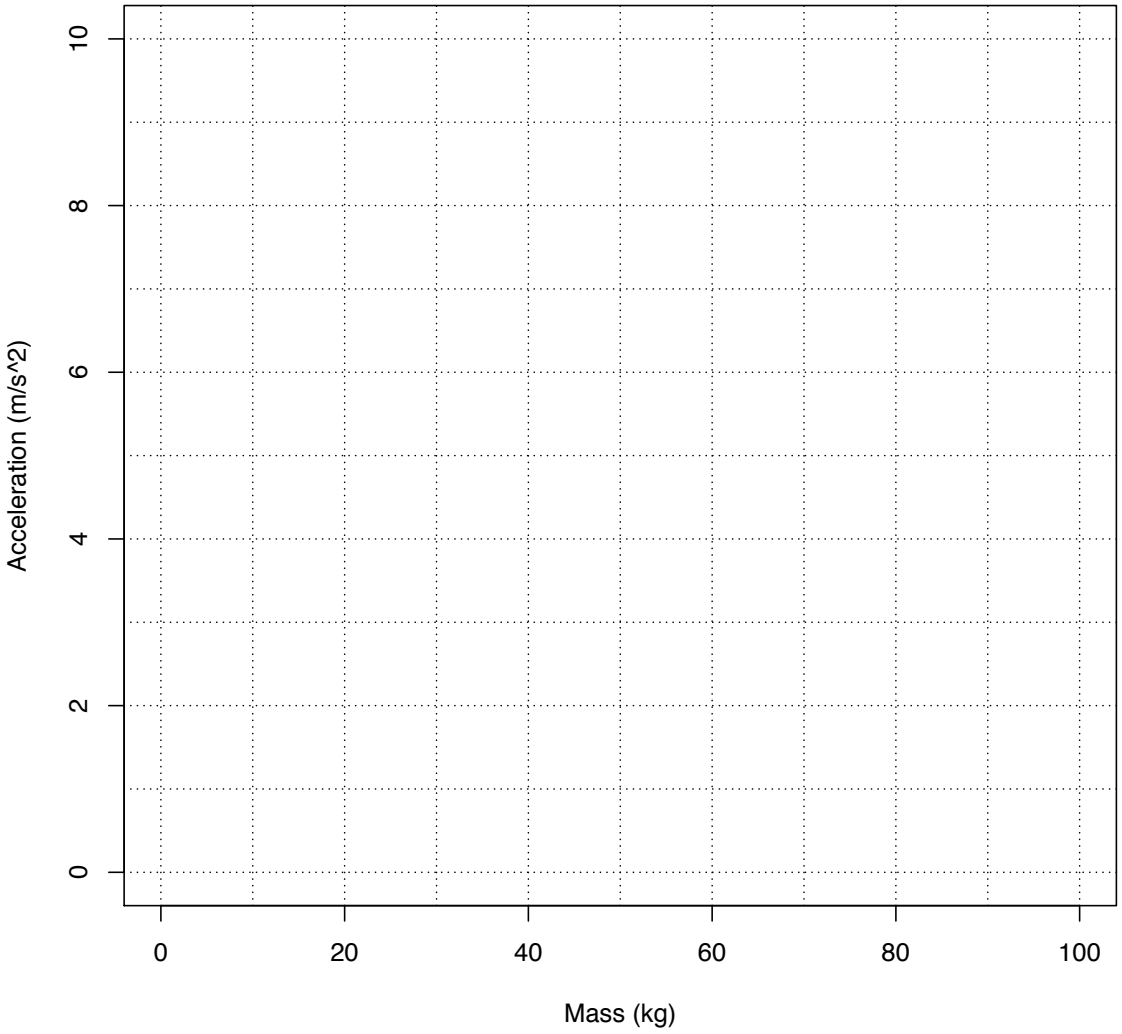
5. Use the equation (Newton's Second Law) to fill out the following table.

$$\Sigma F = ma \tag{2}$$

Net Force (N)	**mass** (kg)	**Acceleration** (m/s^2)
100	10	
100	20	
100	30	
100	40	
100	50	
100	60	
100	70	
100	80	
100	90	
100	100	

6. Which two variables change? 7. Which variable remains constant?

8. Create a graph of mass and acceleration from the previous page. This graph represents two quantities with an *Inverse Proportion*



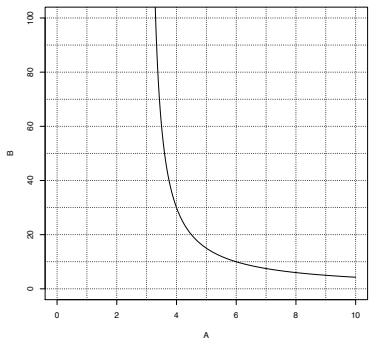
B. Analyzing Graphs for Proportionality

Graph for Direct Proportionality
The graph for a direct proportionality is a straight line with a positive, finite slope that goes *through the origin.*

Graph for Inverse Proportionality
The graph for inverse proportionality is called a *hyperbola.*
It is made by creating an *asymptote* on each of the two axes.
It never touches the axes.

For each graph, state whether is represents direct proportionality, inverse proportionality, or neither.

A



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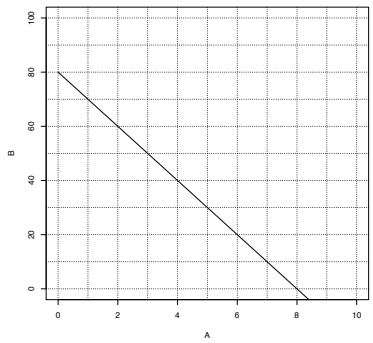

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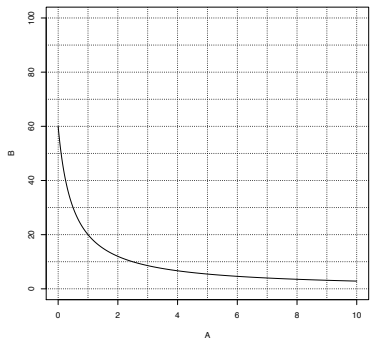

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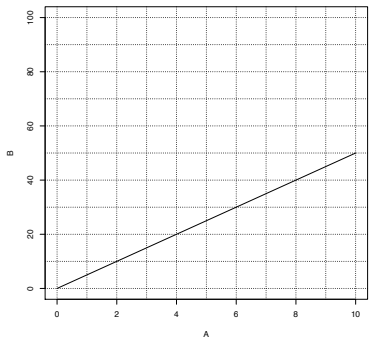

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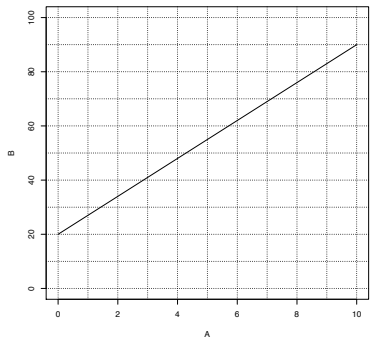

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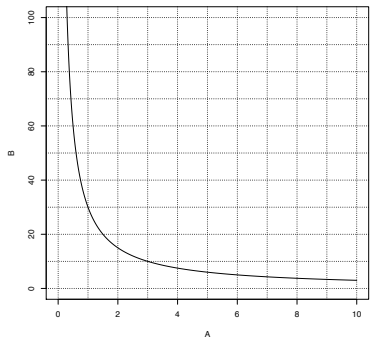

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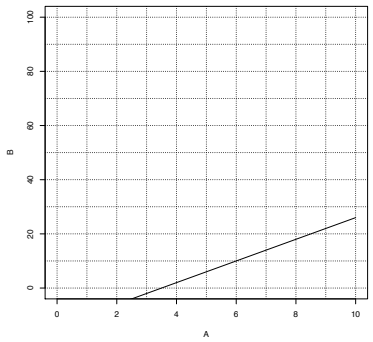

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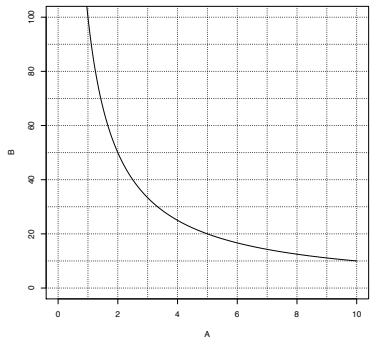

I

xxx

Answers

A – neither, it is not inverse proportionality because the vertical asymptote is located at $x = 4$, not $x = 0$.

B – direct proportionality

C – neither, for direct proportionality the line must go through the origin

D – neither

E – neither, once again, the line does not go through the origin

F – inverse proportionality (if, as the graph continues, it forms asymptote on the two axes)

G – neither, it cannot be inverse proportionality because the curve touches the y-axis

H – inverse proportionality)

Numerical and Equation Proportionality Name _____

Part C: Proportionality Mathematics

1. A and B are *directly proportional*.

If A is doubled, what happens to B?

If B is doubled, what happens to A?

2. A has a value of 40. B has a value of 30.
The value of A increase to 160.
What is the new value of B?

3. C and D are *directly proportional*
C has a value of 6 and D has a value of 0.01.
If C is decreased to 3, what is the new value of D?

4. E and F are inversely proportional.
When E has a value of 5, F has a value of 11.
When E is increased to 15, what is the new value of F?

5. G and H are inversely proportional.
When G has a value of one million, H has a value of 6.
When G is decreased to 500000, what is the new value of H?

6. I and J are directly proportional.
When I has a value of 4000, J has a value of 0.0002.
When I is increased to 16000, what is the new value of J?

7. K and L are inversely proportional.
When K has a value of 8×10^{-10}, L has a value of 4 million.
If the value of L is increased to 8 million, what is the new value of K?

8. M and N are directly proportional.
When M has a value of 3×10^{4}, N has a value of 6×10^{-8}.
When M is increased to 3×10^{6}, what is the new value of N?

Numerical and Equation Proportionality Name _____

Part D. How to tell proportionality from equations:

If A = B * constant Then A and B are *directly proportional*.	If A = constant / B or constant = A * B Than A and B are *inversely proportional*.

There always has to be at least one thing *constant* in order to make a proportionality relationship.

Important physics formulas

$\Sigma F = ma$	$p = mv$
$V = IR$	$F_g = mg$

Symbol	**Quantity**	**Symbol**	**Quantity**
ΣF	Net Force	V	Voltage
m	Mass	I	Current
a	Acceleration	R	Resistance
p	Momentum	F_g	Weight
v	Velocity	g	Free-fall acceleration, determined by the planet you are on

Numerical and Equation Proportionality Name _____

9. Fill out the following table describing the relationship between various variables. Note that one variable must be constant for the other two to be proportional.

Variable 1	**Variable 2**	**Constant Variable(s)**	**Relationship**
Net force	Acceleration	Mass	
Mass	Acceleration	Net force	
Velocity	Momentum	Mass	
Mass	Momentum	Velocity	
Mass	Weight	Planet you are on	
Voltage	Current	Resistance	
Resistance	Current	Voltage	

10. Write Ohm's Law (V=IR) as two statements about proportionality:

Numerical and Equation Proportionality Name _____

Answers:

1. If A is doubled, B is doubled; if B is doubled, A is doubled.
2. 120
3. 0.005
4. 33
5. 12
6. 0.0008
7. 4×10^{-10}
8. 6×10^{-5}

9.

Variable 1	**Variable 2**	**Constant Variable(s)**	**Relationship**
Net force	Acceleration	Mass	Direct
Mass	Acceleration	Net force	Inverse
Velocity	Momentum	Mass	Direct
Mass	Momentum	Velocity	Direct
Mass	Weight	Planet you are on	Direct
Voltage	Current	Resistance	Direct
Resistance	Current	Voltage	Inverse

1.
When resistance is constant, voltage and current are directly proportional.
When voltage is constant, resistance and current are inversely proportional.

(These two sentences, together, are mathematically identical to the formula V= IR.)