

You need some values that can be found in the back cover of your textbook.

Homework 1.10

Name: SOLUTIONS

- After completing this assignment, go to www.physicsbydiscovery.com to check your work.
- Follow this guidance from the syllabus: *You may consult solutions I have posted for help, and are expected to use the solutions to check your work. Write a * at the point in your work where you look at the solutions for help (every time). Then close the solutions or move to another room to continue your work. No writing of any kind is allowed while the solutions are visible to you.*
- The work on this assignment should be correct by the time you arrive at class. Specific phrasing may vary in justifications. If you have questions, write them on a post-it note and find me before class.

1. Go through your binder and check that everything is in order, and that it is complete and correct. Verify that you have made necessary corrections on quizzes.

2. Find Daily Quiz 2. Cover your answers and try it again.

3. Find Daily Quiz 4. Cover your answer to the second question and try it again.

4. Carol completes three experiments to find relationships between R, P, F, and T.

- In Experiment #1, she holds F and T constant and finds that $R = C_1 P^2$
- In Experiment #2, she holds P and T constant and finds that $R = \frac{C_2}{\sqrt{F}}$
- In Experiment #3, she holds P and F constant and finds that $R = \frac{C_3}{T}$

What would be the single mathematical model that relates R, P, F, and T?

$$R = C \left(\frac{P^2}{(\sqrt{F})(T)} \right)$$

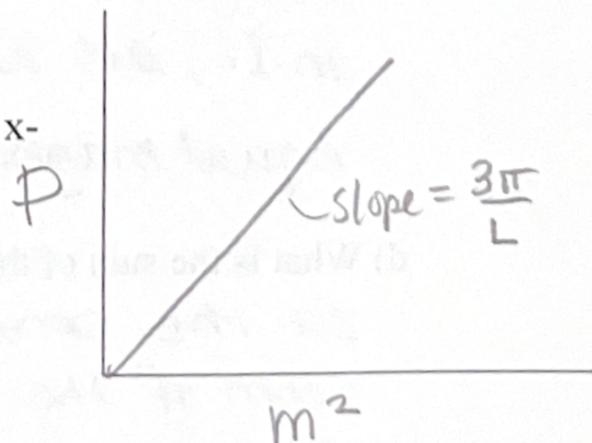
5. In the mathematical model $P = 3\pi \frac{m^2}{L}$, L is a constant.

a) Write this mathematical model in the form of a direct proportion. Put a box around the constants, circle and label "y" and circle and label "x".

$$\textcircled{P} = \boxed{\frac{3\pi}{L}} \textcircled{m^2}$$

y = c x

b) Decide how you could graph this function so the graph would have a linear pattern. Sketch the shape of the resulting graph. Label the y-axis, x-axis, and the slope in terms of the given constants and variables.



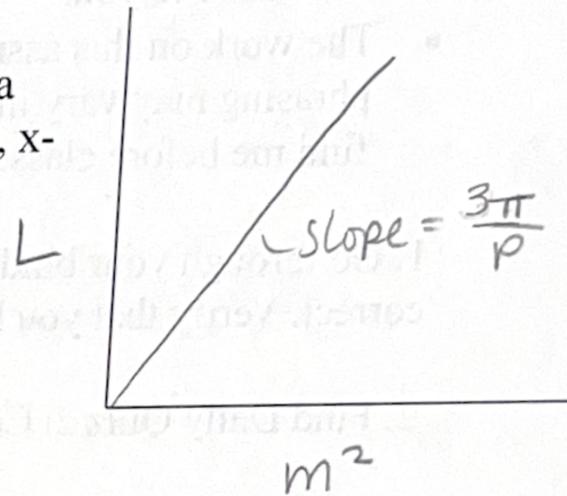
6. Now suppose that m is constant in the mathematical model $P = 3\pi \frac{m^2}{L}$, and P and L are the variables.

a) Write this mathematical model in the form of a direct proportion. Put a box around the constants, circle and label "y" and circle and label "x".

$$L = \frac{3\pi}{P} m^2$$

$y = c x$

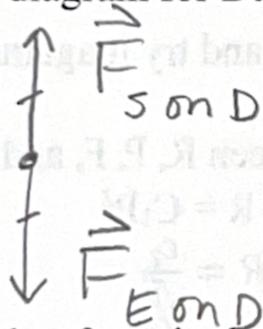
b) Decide how you could graph this function so the graph would have a linear pattern. Sketch the shape of the resulting graph. Label the y-axis, x-axis, and the slope in terms of the given constants and variables.



7. David (mass 55 kg) is standing on the sidewalk, at rest.

a) Draw a force diagram for David, labeling each force.

S = sidewalk
E = Earth
D = David



b) What is the other force in the force pair that includes the force exerted by Earth on David? Justify your answer with a fact.

A pair of forces results from each interaction, with one force on each object: $F_{A \text{ on } B}$ and $F_{B \text{ on } A}$. In this situation, the $F_{E \text{ on } D}$ is from the interaction of David and Earth, so the other force in the pair is $F_{D \text{ on } E}$.

c) How do the two forces in (b) compare? Justify your answer with a fact.

The two forces in a force pair always have equal magnitudes and opposite directions. Since the two forces in (b) are a force pair ($F_{E \text{ on } D}$ and $F_{D \text{ on } E}$), they have equal magnitudes and opposite directions.

d) What is the sum of the forces on David? Justify your answer with a fact.

If the center of mass of a system is at rest, the sum of the forces by the environment on the system is zero. Since David's center of mass is at rest, the sum of the forces on him is 0.

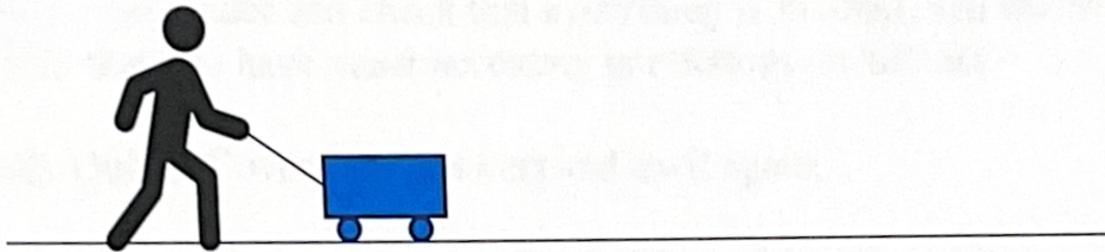
e) Calculate the force of Earth on David due to the gravitational interaction. Justify your answer with a fact.

When two objects interact gravitationally, they both experience the same force of attraction given by $F_{1on2} = F_{2on1} = G \frac{m_1 m_2}{r^2}$. In this situation,

$$F_{EonD} = (6.67 \times 10^{-11} \frac{N \cdot m^2}{kg^2}) \frac{(55 kg)(5.98 \times 10^{24} kg)}{(6.37 \times 10^6 m)^2}$$

= 541 N, toward Earth ← You need magnitude & direction!

8. A heavy lawnmower is at rest on a level lawn. Jack pushes downward on the mower in the same direction as the handle. The lawnmower remains at rest. Please use additional paper so your diagrams can be large.



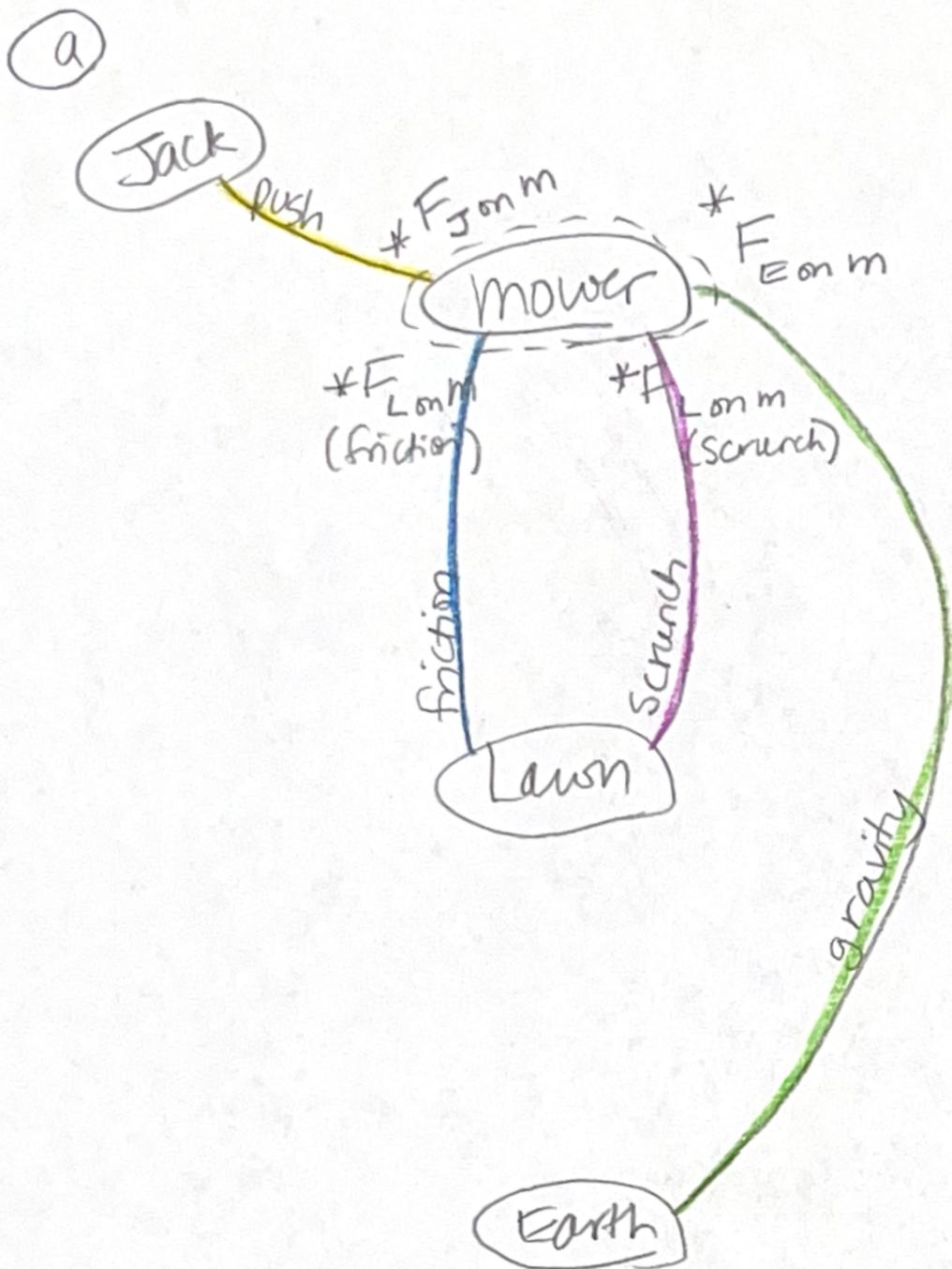
a) Draw a large interaction diagram for the crate that uses a different color for each interaction

- Label each interaction with its type
- Put a dashed boundary around system
- Label the external forces on the system and mark each with a *. You do not need to label any other forces on the interaction diagram.

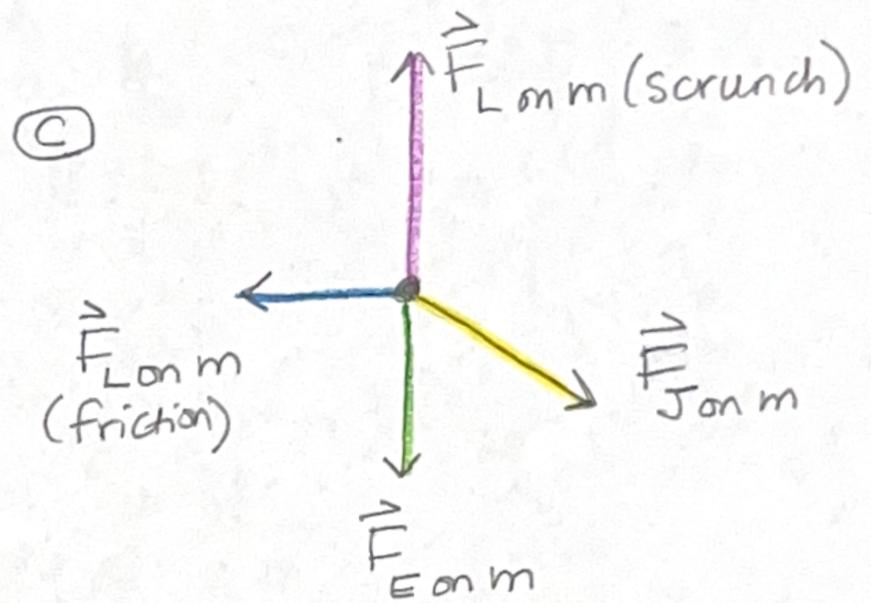
b) Identify your system and object model in words

c) Draw a force diagram for the system, using colors that match your interaction diagram, making the force vectors qualitatively correct as much as is possible.

d) Sketch a vector addition diagram that shows the sum of the forces and is consistent with your answer to (f). Label each vector on the diagram.



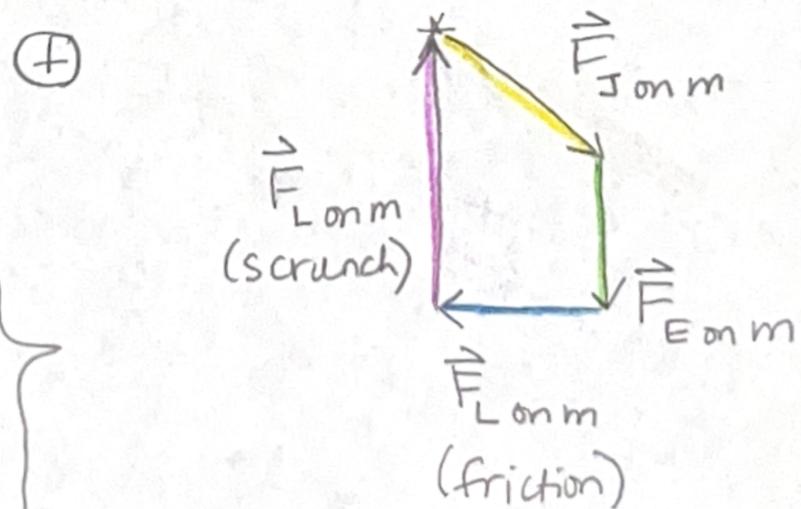
b) System: mower
object model: point particle



d) $\Sigma \vec{F}_{\text{on } m} = \vec{F}_{J \text{ on } m} + \vec{F}_{E \text{ on } m} + \vec{F}_{L \text{ on } m} \text{ (friction)} +$

e) $\Sigma \vec{F} = 0$ because it is at rest.

$\vec{F}_{L \text{ on } m}$ (scrunch)



Colors are not necessary on the vector addition diagram.

I ended at the same place I began to show that the sum of the forces is 0.