

Day 3: Dynamics pt. 2 - Homework

Physics + AP Physics 1 Virtual Camp

Saratoga High School Physics Club

Multiple-Choice Questions

1. A mass is hanging on a rope from the ceiling of an elevator, with a spring scale on the rope. At t_1 , the elevator is accelerating upward and the scale has a reading of W_1 , and at t_2 the elevator is accelerating downward and has a reading of W_2 . At rest and on earth, the mass has a weight of W . Compare the reading of the scale with W at t_1 and t_2 .

- a. $W_1 > W, W_2 > W$
- b. $W_1 < W, W_2 < W$
- c. $W_1 < W, W_2 > W$
- d. $W_1 > W, W_2 < W$

2. Sisyphus got tired of rolling that boulder up the hill, so he constructed an elevator to bring it up instead. Sisyphus put a scale down in the elevator and put the boulder on top of the scale. As the elevator neared the top floor, Zeus uses his magic to try and manipulate the elevator. The combined forces of Zeus and the elevator mechanism resulted in an upward acceleration of 3.5 m/s^2 . At this instant, the scale read 3000 N. What was the mass of the boulder?

- a. 150 kg
- b. 225 kg
- c. 300 kg
- d. 370 kg

3. Perry the Penguin™ (mass 25 kg) sits on a sled (mass 40 kg) that rests on a frictionless skating rink. Doctor Floof uses a “force gun” to push the sled with 15 N of force. To Doctor Floof’s

dismay, Perry the Penguin™ just acquired a new gadget, the “friction-ator”. This gadget allows Perry the Penguin™ to vary the coefficient of static friction between him and the sled. What is the minimum coefficient of static friction that this gadget needs to produce to ensure Perry the Penguin™ stays on board?

- a. 0.012
- b. 0.024
- c. 0.048
- d. 0.096

Use the following scenario to solve problems 4-6.

A pickup truck carrying a shipment of “borrowed goods” is in a high stakes police chase, and in the action, had its rear tailgate ripped off. This prompts the driver to begin accelerating at 15 m/s^2 . Thankfully, the crate of “borrowed goods” is being secured by a single rope to keep it in place. This rope, however, cannot support an infinite amount of force, and will snap when the amount of tension through it is too high. The crate has a mass of 20 kg.

4. If the surface between the truck and the crate is frictionless, then what is the minimum amount of tension the rope must support?

- a. 100 N
- b. 200 N
- c. 300 N
- d. 400 N

5. If the surface between the truck and the crate has a static friction coefficient of 0.5, then what is the minimum amount of tension the rope must support? Use $g = 10 \text{ m/s}^2$.

- a. 100 N
- b. 200 N
- c. 300 N
- d. 400 N

6. Now the rope is replaced by a spring of constant 500 N/m. The surface also becomes frictionless again. How far will the spring stretch in order to keep the block accelerating with the truck?

- a. 0.15 m
- b. 0.30 m
- c. 0.60 m
- d. 1.20 m

7. What does an ideal fixed pulley mainly do?

- a. Increases the force
- b. Decreases the force
- c. Changes the direction of the force
- d. Removes gravity

Free-Response Questions

1. Take a look at the following scenario. Block A has a mass of 10 kg and block B has a mass of 5 kg. All surfaces are frictionless for now. (Ignore block C until part c)
 - a. What is the acceleration of the system?
 - b. What is the tension in the string?
 - c. Block C of mass 3 kg is placed on top of block B. If the coefficient of static friction between the two blocks is 0.45 but all other surfaces remain frictionless, will the system slip or stay together?

2. Take a look at the following scenario. Spring 1 has a constant of 450 N/m and Spring 2 has a constant of 200 N/m. Mass 1 is 12 kg and Mass 2 is 6 kg. The system is at rest and all surfaces are frictionless.
- Draw the free-body diagram, showing all the forces acting on m_1 and m_2 .
 - How much is spring 1 stretched?
 - How much is spring 2 stretched?

Day 3: Dynamics 2/2 - Homework Answer Key

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Multiple-Choice Questions

1. D
2. B
3. B
4. C
5. B
6. C
7. C

Free-Response Questions

We will grade this by hand once you submit your PDF.