

Name \_\_\_\_\_

## PHY2048C, Practice Quiz 2

**A- Read all the quiz once, or twice, before beginning to write. Make sure to comprehend all questions and start with those you fell most confident.**

**B – Be clear and concise. There are no extra points for being verbose or writing extra.**

**C –Only use the white pages that I will provide. You have 50 minutes to answer the quiz.**

### Problem 1

Silvia spends 5 times as much as Carlos. Silvia spent B./948 more than Carlos. (a) What is the ratio of the amount of money Silvia spent to the amount of total money they spent together? (b) How much did Carlos and Silvia spent each?

Dean has some local and foreign stamps. The ratio of the number of local stamps to the number of foreign stamps is 3:4. He gave away 28 foreign stamps, and hence the ratio between the number of local stamps to foreign stamps became 9:8 (c) How many local stamps did Dean had at the beginning? (d) how many foreign stamps does Dean have in the end.

### Problem 2

There are two forces acting on the 2.00 kg box in the overhead view of Fig. 1, but only one is shown. For  $F_1=20.0\text{ N}$ ,  $a=13.0\text{ m/s}^2$ , and  $\theta=30^\circ$ . (a) Find the second force in unit-vector notation and as (b) a magnitude and (c) an angle relative to the positive direction of the x-axis.

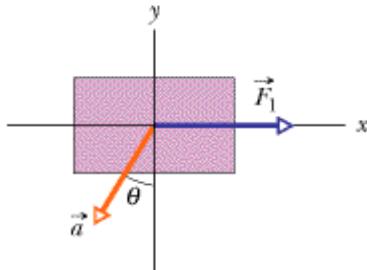
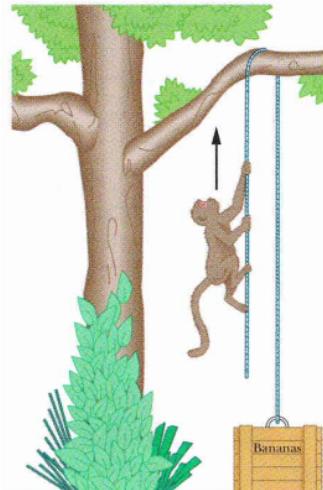


Figure 1

### Problem 3

A 10 kg monkey climbs up a massless rope that runs over a frictionless tree limb and back down to a 15 kg package on the ground (Figure) (a) What is the magnitude of the least acceleration the monkey must have if it is to lift the package off the ground? If, after the package has been lifted, the monkey stops its climb and holds onto the rope, what are the (b) magnitude and (c) direction of the monkey's acceleration and (d) the tension in the rope.



**End of Quiz**

## Key Concepts to Understand:

- (1) Decomposition of force and acceleration into components
- (2) How to use the relation between force and acceleration vectors to solve for components of the force and the acceleration
- (3) how contact/action-reaction works: Newton's third law
- (4) Free-body diagrams. How to draw them. How to use them to visualize forces and accelerations.

**Problem 4 (Extra).** ChatGPT's Answer to Problem 3. What did ChatGPT do wrong?

### **(a) Least acceleration for the monkey to lift the package**

For the package to be lifted off the ground, the tension in the rope must be greater than or equal to the weight of the package. Let's start by finding the force required to lift the package.

The weight of the package is:

$$W_{\text{package}} = m_{\text{package}}g = 15 \text{ kg} \times 9.8 \text{ m/s}^2 = 147 \text{ N.}$$

Now, let's find the minimum tension required in the rope to lift the package. The monkey exerts a force by climbing, which creates tension in the rope. To lift the package, the tension in the rope must exceed the weight of the package. The monkey climbs with an acceleration  $a_{\text{monkey}}$ , and the force exerted by the monkey is:

$$T = m_{\text{monkey}} (g + a_{\text{monkey}}).$$

For the package to just begin to lift, the tension must be at least equal to the weight of the package, so:

$$m_{\text{monkey}} (g + a_{\text{monkey}}) = W_{\text{package}}.$$

Substituting the known values:

$$10 \text{ kg} \times (9.8 \text{ m/s}^2 + a_{\text{monkey}}) = 147 \text{ N.}$$

Solving for  $a_{\text{monkey}}$ :

$$98 + 10a_{\text{monkey}} = 147,$$

$$10a_{\text{monkey}} = 49,$$

$$a_{\text{monkey}} = 4.9 \text{ m/s}^2.$$

Thus, the least acceleration the monkey must have to lift the package is  $4.9 \text{ m/s}^2$ .

### **(b) Magnitude of the monkey's acceleration after the package is lifted**

Once the monkey stops climbing and holds onto the rope, the system will reach equilibrium, meaning the forces acting on the monkey and the package will balance.

At this point:



- The monkey's weight is  $W_{\text{monkey}} = m_{\text{monkey}}g = 10 \text{ kg} \times 9.8 \text{ m/s}^2 = 98 \text{ N}$ .
- The package's weight is  $W_{\text{package}} = 147 \text{ N}$ .

If the monkey is simply holding onto the rope and not climbing, the tension in the rope  $T$  must balance the forces on both the monkey and the package. The total tension in the rope equals the weight of the package, as the monkey is just holding still. Thus:

$$T = W_{\text{package}} = 147 \text{ N}.$$

Now, let's find the acceleration of the monkey. The net force on the monkey is given by:

$$F_{\text{net, monkey}} = T - W_{\text{monkey}} = 147 \text{ N} - 98 \text{ N} = 49 \text{ N}.$$

Using Newton's second law, the acceleration of the monkey is:

$$a_{\text{monkey}} = \frac{F_{\text{net, monkey}}}{m_{\text{monkey}}} = \frac{49 \text{ N}}{10 \text{ kg}} = 4.9 \text{ m/s}^2.$$

Thus, the magnitude of the monkey's acceleration is  $4.9 \text{ m/s}^2$ .

### (c) Direction of the monkey's acceleration

The direction of the monkey's acceleration depends on the relative magnitudes of the forces acting on it. Since the net force on the monkey is  $49 \text{ N}$  upward, the monkey will accelerate upward. Therefore, the direction of the monkey's acceleration is **upward**.

### (d) Tension in the rope

The tension in the rope is still equal to the weight of the package, as the package is suspended and not moving. Therefore, the tension in the rope is:

**Final Answers:**

$$T = W_{\text{package}} = 147 \text{ N}.$$

- The least acceleration the monkey must have is  $4.9 \text{ m/s}^2$ .
- The magnitude of the monkey's acceleration after the package is lifted is  $4.9 \text{ m/s}^2$ .
- The direction of the monkey's acceleration is **upward**.
- The tension in the rope is  $147 \text{ N}$ .

### Problem 5: inclined plane with a spring.

In the Figure, a block weighing  $14.0 \text{ N}$ , which can slide without friction on an incline at angle of  $40.0$  degrees, is connected to the top of the incline by a massless spring of outstretched length  $0.450 \text{ m}$  and spring constant  $k=120 \text{ N/m}$ . How far from the top of the incline is the block's equilibrium point? (The force due to a spring is equal to  $F=-kx$  where  $x$  is the distance for equilibrium)

