1. In your own words, explain why a person feels weightless in a space station orbiting the earth.

When Gravity is the only force acting on your body you can't feel it!

2. Explain why one feels heavier than normal at the *lowest* point in the motion of both an UP and a DOWN elevator. Also explain why one feels lighter than normal at the *highest* point in the motion of both an UP and a DOWN elevator.

At lowest point you --
begin to move upward, or moving downward slow to stop (for both accel., **a** is positive)
Elevator Floor's force on your feet is LARGER than your weight. Compression of body is GREATER than normal.

At highest point you --
begin to move downward, or reduce upward motion to stop. (for accel., **a** is negative)
Elevator Floor's force on your feet is SMALLER than your weight. Compression of body is LOWER than normal.

3. Which statement is true about gravity?
(a) Affected by Earth's gravity, the larger of two masses has the larger acceleration.
(b) There is no gravitational force on an astronaut in orbit around the Earth.
(c) The Earth's gravitational force alone cannot be felt by a human being.
(d) The gravitational force between two masses is linear in the separation distance.
(e) The Earth's gravitational force is zero on a mass on the dark side of the moon.

4. How heavy do you feel in an elevator, moving downward at 5m/s, that stops in 0.5sec?

When moving downward with a constant speed and direction, the forces acting on your body are BALANCED, $\mathbf{F}_{net} = 0 = \mathbf{W} + \mathbf{C}$, with $\mathbf{W} = -mg$.

$$\boxed{\mathbf{W} = -mg \quad ; \quad \mathbf{C} = +mg}$$

Find the compression force acting on your feet for the stopping elevator. To stop, the elevator floor must supply an additional upward force, **F**, acting on your body.

$$\boxed{\mathbf{W} = -mg \quad ; \quad \mathbf{C} = +mg + \mathbf{F}}$$

Unbalanced force, **F**, causes upward acceleration, **a** .

Use Motion Equation 1: $\mathbf{v} = \mathbf{v}_0 + \mathbf{a}t$, to solve for acceleration.

$$\boxed{\mathbf{a} = \frac{\mathbf{v} - \mathbf{v}_0}{t} = \frac{0 - (-5\ \text{m/s})}{0.5\ \text{s}} = +10\ \text{m/s}^2\ (= +g)}$$

Use 2nd law to determine the unbalanced force:
$\mathbf{F} = m\mathbf{a} = m(+g)$

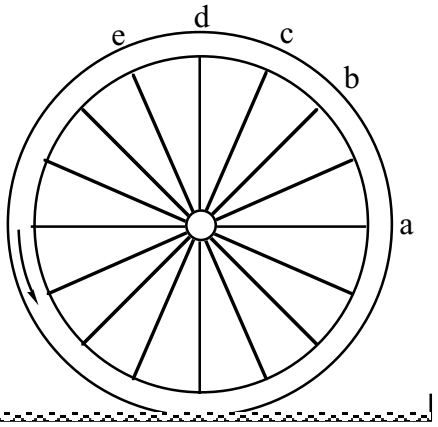
$$\boxed{\begin{aligned}\mathbf{C} &= (+mg) + \mathbf{F} \\ &= (+mg) + (+mg) = +2mg\end{aligned}}$$

a) 20% heavier b) 20% lighter c) 50% heavier d) 50% lighter e) twice as heavy

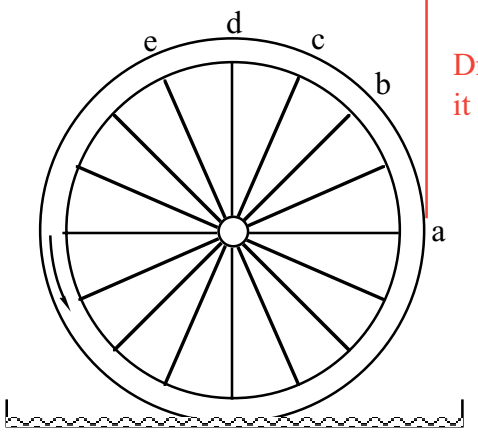
Show work for all questions. 1 **Attach extra sheets if necessary.**

5. A wheel shown at the right is turning rapidly in a shallow pan of water and throws water droplets off at various points around the circle. At which point is a drop released from the wheel if its initial motion is straight upward?

(a) , (b) , (c) , (d) , (e)



Wheel turns in a shallow pan of water.



Droplet moves in direction
it had when leaving the wheel!

6. When a moving mass hits a spring attached to a wall it compresses the spring. Which statement below is false?

a) the magnitude of the force on the wall is the same as the magnitude of the force on the mass.

b) the mass is compressed where it touches the spring

c) the mass will have an acceleration during the compression.

d) the magnitude of the force on the mass is the same as the magnitude of force on the spring

e) the mass has a uniform compression force within it.

7. The net force acting on a person is non-zero in which case below?

a) falling at a constant velocity.

b) lying on a soft mattress.

c) lying on a bed of 10,000 nails.

d) floating on the water in a pool.

e) none of the above