Final Exam for Algebra-Based Physics-1: Mechanics (PHYS135A-01)

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1 Conceptual Questions

1.1 Kinematics and Angular Kinematics

1. If an object is dropped, it accelerates downward at g m/s^2 (no air resistance). If it is *thrown* downward, the acceleration downward

   - is less than g
   - is more than g
   - remains g

2. If an object is released from an aircraft moving at constant velocity (no air resistance), it accelerates downward, but travels along with the aircraft horizontally. An observer from the ground observes the object

   - traveling in a curved trajectory downward
   - traveling in a straight but diagonal trajectory forward
   - traveling straight downward
   - traveling in a straight but diagonal trajectory backward

3. An object accelerates with constant acceleration. The displacement versus time curve is quadratic. The velocity versus time plot should be _____ and the acceleration versus time plot should be _____.

   - quadratic, linear
   - linear, flat
   - flat, linear
   - linear, quadratic

4. A potter spins clay on a wheel, making a vase. She begins with an upright cylinder that spins at constant angular velocity. After squeezing the clay, the radius of the cylinder shrinks. What happens to the velocity of a point along the edge of the cylinder, if the angular velocity remains the same?

   - It increases.
   - It remains the same.
   - It decreases.
   - Depends on the initial and final radius.

5. A battleship fires simultaneously two shells at enemy ships (Fig. 1). If the shells follow the parabolic trajectories shown, which ship gets hit first?
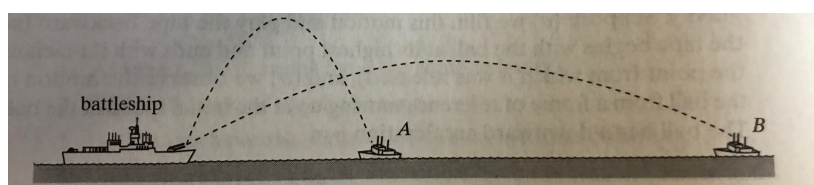
   - A
   - Both at the same time
   - B

Figure 1: Which ship is hit first?

1.2 Forces and Torque

1. An elevator contains a person standing on a scale. The elevator accelerates upward, then moves at constant velocity, then decelerates to a stop. The scale reads a weight that is _____, then _____, and then _____ the person's actual weight.

    - More than, equal to, less than
    - Less than, equal to, more than
    - equal to, equal to, equal to
    - More than, equal to, equal to

2. A crate is pushed across a floor at constant velocity against friction. If the crate is flipped so that a side with less surface area is on the bottom, and pushed again at constant velocity, the required force is

    - More than the first side
    - Less than the first side
    - Equal to the first side

3. A man needs to pull a rusty lever to release a mechanism, but he can't. His best bet is to

    - Tie a rope to the lever, and pull on the rope in the same direction. This will increase torque.
    - Bolt a metal rod to the level, and pull on the end of the rod. This will increase torque.
    - Suspend his whole weight on the lever by hanging from it with one hand. This will maximize torque.

4. A Formula 1 racecar makes a turn at constant velocity, and the road is flat. There is friction between the road and tires. Which of the following is true?

    - The car experiences centripetal acceleration, provided by friction.
    - The car experiences centripetal acceleration, provided by the normal force.
    - Moving at constant velocity, the car experiences no acceleration.

1.3 Work and Energy

1. In which of the follow situations would energy *not* be conserved?

    - An object is dropped from some height and experiences free-fall, neglecting air-resistance.
    - An oscillator is compressed by mass for a given displacement and then the mass is released.
    - A pendelum is pulled away from equilibrium and then released.
    - A rock slowly skids to a stop on top of a frozen pond.

2. A ball rolls down a hill that has a height h, attaining a speed v at the bottom. In order to attain a speed of $2v$ at the bottom, how tall would the hill have to be?

    - $2h$
    - $3h$
    - $4h$

1.4 Linear and Angular Momentum

1. A mine cart is moving along a track at constant speed, and passes under a vertical waterfall. Because the cart is filled with water, the speed of the cart

    - increases
    - decreases
    - remains constant (no net forces)

2. If ball 1 in the arrangement shown in Fig. 2 is pulled back and then let go, ball 5 bounces forward. If balls 1 and 2 are pulled back and released, balls 4 and 5 bounce forward, and so on. The number of balls bouncing on each side is equal because

    - of conservation of momentum.
    - the collisions are elastic.
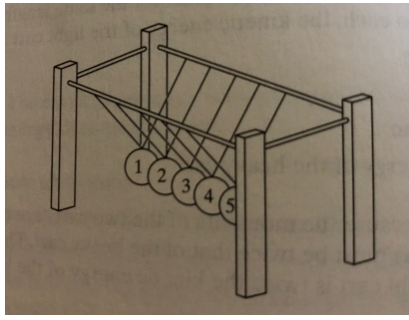   - neither of the above.

Figure 2: This object is known as a Newton's cradle.

3. A star undergoes a supernova, in which significant matter is blown away by a fusion reaction. The star also shrinks in size. Suppose the radius decreases by a factor of 100. By what factor does the angular velocity increase, if angular momentum is conserved?

- 10^2
- 10^3
- 10^4

2 Technical Questions

2.1 Kinematics and Angular Kinematics

1. Question

2.2 Forces and Torque

1. Question

2.3 Work and Energy

1. Question

2.4 Linear and Angular Momentum

1. Question