

Student #: \_\_\_\_\_

Student Name: \_\_\_\_\_

## Grade 12 Physics (Take Home) Midterm Test

This midterm test has **ten** multiple-choice questions, and **nine** long-answer questions. Each question is assigned different mark values. There is also **one** bonus question worth **10** marks. The maximum mark that you can get is therefore **110 out of 100**. Please put a box around all your answers. Answer all questions to **three significant figures**. Attached additional work on separate sheets of paper if you require more space.

Total mark:

/100

**Part A: Multiple Choice** [2 marks each] Read each question carefully and select the *best* response for each question.

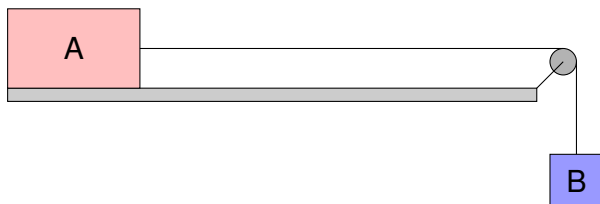
- \_\_\_\_\_ A.1 Comparing an object that is *dropped*, and an identical object *thrown horizontally* from the same height at the same time, we find that the time it takes to hit the ground
- (a) is less for the thrown object
  - (b) is the same for each object
  - (c) is greater for the thrown object
  - (d) depends on the initial velocity of each object
  - (e) cannot be calculated without additional information
- \_\_\_\_\_ A.2 A car travels with a constant speed around a curve in the road. The curve is banked. Which of the following forces is in the direction of the net force on the car?
- (a) the horizontal component of the force of gravity
  - (b) the frictional force
  - (c) the horizontal component of the normal force
  - (d) the force of gravity
  - (e) the centrifugal force
- \_\_\_\_\_ A.3 When an object undergoes uniform circular motion, the direction of the acceleration is:
- (a) directed tangent to the circle
  - (b) directed towards the centre of the circle
  - (c) changing depending on its position in the circle
  - (d) directed outward from the centre of the circle
  - (e) opposite to the direction of centripetal force
- \_\_\_\_\_ A.4 If the mass of a car is double and its speed is tripled, then the kinetic energy changes by a factor of:
- (a) 0.67
  - (b) 6
  - (c) 1.5
  - (d) 18
  - (e) 6

- \_\_\_\_\_ A.5 To catch a water-filled balloon without breaking it, people allow their hands to move with the balloon upon catching it. This works because:
- (a) the balloon's momentum changes more slowly
  - (b) there is less force applied
  - (c) there is less impulse
  - (d) two of A, B, and C
  - (e) all of A, B, and C
- \_\_\_\_\_ A.6 You throw a rock straight up into the air. While it rises and falls, its kinetic energy:
- (a) remains constant
  - (b) increases steadily
  - (c) changes direction only
  - (d) decreases then increases
  - (e) increases then decreases
- \_\_\_\_\_ A.7 The planet Jupiter orbits the Sun at a nearly constant speed. Which of the following statements are true? (*Select two answers.*)
- (a) There is a force on Jupiter towards the centre of the orbit.
  - (b) There is a force on Jupiter pulling it out from the centre of the orbit.
  - (c) There is a force on Jupiter in the direction of its motion.
  - (d) Jupiter is accelerating toward the center of the orbit.
  - (e) There are no forces on Jupiter.
- \_\_\_\_\_ A.8 Two satellites orbit the Earth at the same speed in identical orbits. Satellite A is twice the mass of Satellite B. How does the centripetal acceleration of Satellite A compare with that of Satellite B?
- (a) Four times as much
  - (b) Twice as much
  - (c) The same
  - (d) One-half as much
  - (e) One-fourth as much
- \_\_\_\_\_ A.9 Which of the following is defined as “the rate of change of velocity”?
- (a) Distance
  - (b) Displacement
  - (c) Acceleration
  - (d) Jerk
  - (e) Speed
- \_\_\_\_\_ A.10 Which of the following is defined as “the change in position of an object relative to a reference point”?
- (a) Distance
  - (b) Displacement
  - (c) Velocity
  - (d) Acceleration

**Part B: Problem Solving**

B.1 **[12 marks]** A 440 g wooden block (A) on a horizontal table top is connected to a suspended 125 g mass (B) by a string passing over a friction-less pulley. The coefficient of friction between A and the table is 0.08.

- (a) Draw free-body diagrams of the blocks at the moment they are released.
- (b) What is the acceleration of the blocks?
- (c) How long will it take Block A to travel 0.85 m?
- (d) What is the tension of the string?



B.2 **[10 marks]** You are a passenger on an airplane and you decide to measure its acceleration as it speeds up along the runway during take-off. You take out a yo-yo and notice that when you suspend it, it makes an angle of  $25^\circ$  with the vertical. The airplane's take-off mass is  $2.54 \times 10^5$  kg.

- (a) What is the acceleration of the airplane?
- (b) If the yo-yo's mass is 65 g, what is the tension in the string?

- B.3 **[10 marks]** An amusement park ride consists of a large cylinder that rotates around a vertical axis. People stand on a ledge inside. When the rotational speed is high enough, the ledge drops away and people “stick” to the wall. If the period of rotation is 2.5 s and the radius is 2.5 m, what is the minimum coefficient of friction required to keep the riders from sliding down?
- B.4 **[10 marks]** Blue Jay slugger Jose Bautista hits a home run at the Roger’s Centre in Toronto. The ball’s velocity as it leaves the bat is 45 m/s at an angle of  $36.9^\circ$  above horizontal. At the point of impact with the bat, the ball is 1.0 m above ground level, and it just clears the 11 m fence. Neglect air resistance, how far from home plate is the fence at this point?
- B.5 **[6 marks]** A simple pendulum swings freely and rises at the end of its swing to a position 8.5 cm above its lowest point. What is its speed at its lowest point?

- B.6 **[6 marks]** A spring with a spring constant of  $450 \text{ N/m}$  hangs vertically from the ceiling of a house. You attach a  $2.2 \text{ kg}$  block to it and allow the mass to fall. What is the maximum distance the block will fall before it begins moving upward?
- B.7 **[10 marks]** You and a colleague are on a spacewalk, repairing your spacecraft that has stalled in deep space. Your  $69.0 \text{ kg}$  colleague, initially at rest, asks you to throw her a hammer, which has a mass of  $3.0 \text{ kg}$ . You throw it to her with a forward velocity of  $4.5 \text{ m/s}$ .
- (a) What is her velocity after catching the hammer?
  - (b) What impulse does the hammer exert on her?
  - (c) What percentage of kinetic energy is lost when your colleague caught the hammer?
- B.8 **[10 marks]** In a billiards game, the  $0.165 \text{ kg}$  cue ball, travelling  $0.62 \text{ m/s}$  forward, hits a stationary  $0.155 \text{ kg}$  eight ball. After impact, the cue ball rolls away at an angle of  $40.0^\circ$  counter-clockwise from its initial direction, with a speed of  $0.37 \text{ m/s}$ . What is the final *velocity* of the eight ball? (Note that the masses of the balls are not the same.)

- B.9 [6 marks] A **white dwarf** is a collapsed star with roughly the Sun's mass compressed into the size of Earth. What would be the orbital speed and period for a spaceship in orbit just above the surface of a white dwarf?

**BONUS—The Following Is A Bonus Question—BONUS**

- S.1 [10 marks] A 200 g block is released from rest at a height of 25 cm on a friction-less  $30^\circ$  incline. It slides down the incline and then along a friction-less surface until it collides elastically with an 800 g block at rest 1.4 m from the bottom of the incline (see diagram). How much later do the blocks collide again? Attach extra paper if more room is needed for your calculations.

