Part 1: *(1 point each)*

For the following questions, please circle ◯ the correct answer to the nearest number.

1. When is the average acceleration of an object equal to the instantaneous acceleration?

A) always B) never C) only when the acceleration is constant
D) only when the acceleration is increasing at a constant rate
E) only when the acceleration is decreasing at a constant rate

2. Car A is traveling at **22.0 m/s** and car B at **29.0 m/s**. Car A is **300 m** behind car **B** when the driver of car **A** accelerates his car with an acceleration of **2.40 m/s^2**. How long does it take car **A** to overtake car **B**?

A) 5.5 s B) 12.6 s C) 19.0 D) 316 s E) Car **A** never overtakes **B.**

3. Vector $\vec{A}$ = 8.0 m and points 30° north of east, Vector $\vec{B}$ = 6.0 m and points 30° west of north, and vector $\vec{C}$ = 5.0 m and points 30° west of south. The resultant vector $\vec{A} + \vec{B} + \vec{C}$ is given by

A) 2.7 m at an angle 74° north of east. B) 5.9 m at an angle 74° north of east.
C) 4.8 m at an angle 74° east of north. D) 5.1 m at an angle 74° north of east.
E) 2.1 m at an angle 66° east of north.

4. A ball rolls off the edge of a table with an initial velocity of **20 m/s**. The height of the table above the ground is **2.0 m**. How long does it take the ball to reach the ground?

A) 0.49 s B) 0.98 s C) 0.64 s D) 2.0 s E) 0.32 s

5. A **10.0-kg** picture is held in place by two wires, one hanging at **50.0°** to the left of the vertical and the other at **45.0°** to the right of the vertical. What is the tension in the second wire??

A) 71.8 N B) 75.4 N C) 98.1 N D) 69.4 N E) 23.8 N

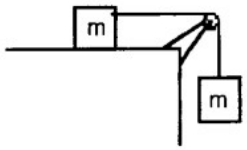
6. A 1.0-kg object moving in a certain direction has a kinetic energy of 2.0 J. It hits a wall and comes back with half its original speed. What is the kinetic energy of this object at this point?

A) 2.0 J B) 1.0 J C) 0.50 J D) 0.25 J E) 4.0 J.

7. A **50.0-kg** box is being pushed along a horizontal surface by a force of **250 N** directed **28.0°** below the horizontal. The coefficient of kinetic friction between the box and the surface is **0.300**. What is the acceleration of the box (in $\mathbf{m/s^2}$)?

A) 0.769. B) 1.77. C) 3.16. D) 6.31 E) 8.53

8. Two identical masses are attached by a light string that passes over a small pulley, as shown in the figure below. The table and the pulley are frictionless. The masses are moving



A) with an acceleration less than g. B) at constant speed.
C) with an acceleration greater than g. D) with an acceleration equal to g.
E) with an acceleration that cannot be determined without additional information.

9. Two identical vertical springs $\mathbf{S_1}$ and $\mathbf{S_2}$ have masses $\boldsymbol{m_1}$ **= 400 g** and $\boldsymbol{m_2}$ **= 800 g** attached to them. If $\boldsymbol{m_1}$ causes spring $\mathbf{S_1}$ to stretch by **4 cm**, what is the ratio of the potential energy of $\mathbf{S_1}$ and $\mathbf{S_2}$ **(**P.E.$\mathbf{S_1}$ **/** P.E.$\mathbf{S_2}$)? Use $\boldsymbol{g}$ **= 10** $\mathbf{m/s^2}$.

A) 2:1 B) 1:2 C) 1:3 D) 4:1 E) 1:4

10. A railroad car of mass $\boldsymbol{m}$ and speed $\boldsymbol{v}$ collides and sticks to an identical railroad car that is initially at rest. After the collision, the kinetic energy of the system

A) is the same as before. B) is half as much as before.
C) is one third as much as before. D) is one fourth as much as before.
E) is one quarter as much as before.

11. A **0.140-kg** baseball is dropped from rest from a height of **2.00 m** above the ground. What is the magnitude of its momentum just before it hits the ground?

A) 0.280 kg·m/s B) 0.877 kg·m/s C) 0.439 kg·m/s D) 0.620 kg·m/s
E) 1.37 kg·m/s

12. In a collision between two **unequal masses**, how does the impulse passed on to the smaller mass by the larger mass compare with the impulse passed on to the larger mass by the smaller one?

A) It is larger. B) It is smaller. C) They are equal.
D) The answer depends on the ratio of the masses.
E) The answer depends on how fast they are moving.

13. Two ice skaters push off against one another starting from a stationary position. The **45-kg** skater acquires a speed of **0.375 m/s**. What speed does the **60-kg** skater acquire?

A) 0.500 m/s B) 0.281 m/s C) 0.375 m/s D) 0.750 m/s
E) 0 m/s

14. In the absence of an external force, a moving object will

A) stop immediately. B) slow down and eventually come to a stop.
C) move faster and faster. D) move with constant velocity.
E) move with constant velocity for a while and then slow to a stop.

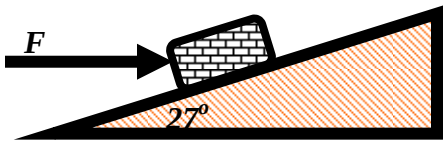
15. A simple pendulum, consisting of a mass m and a string of length L, swings upward, making an angle θ with the vertical. The work done by the tension force is

A) zero. B) mgL. C) mgL cos θ. D) mgL sin θ. E) mgL sin θ.

Part 2:

Please read each question carefully and show your work in the space provided. Your answer should include with the appropriate units.

1.. A ***250-N*** force is directed horizontally as shown to push a ***29-kg*** box up an inclined rough plane at a constant speed. **(5 points)**

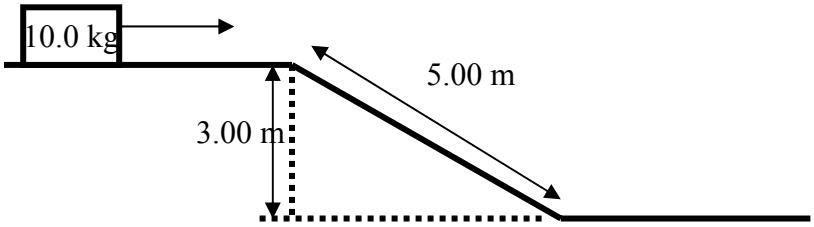


A) Draw a clear Free Body Diagram for the box while it is in motion

B) Determine the magnitude of the normal force, F_N, and the coefficient of kinetic friction, μ_k.

Answer (F_N)_____
μ_k_____

2. A **10.0-kg** crate slides along a horizontal frictionless surface at a constant speed of **4.00 m/s**. The crate then slides down a frictionless incline and across a second horizontal surface as shown in the figure.
What is the speed of the crate when it arrives at the lower surface? **(3 points)**



Answer_____

3. A **0.10-kg** steel ball is dropped straight down onto a hard horizontal floor and bounces straight up. Its speed just before and just after impact with the floor is **10 m/s**. Determine the magnitude of the **impulse** delivered to the floor by the steel ball. **(3 points)**

Answer_____

4. An airplane is traveling at **225 m/s** when it strikes a weather balloon (**m = 1.82 kg**), which can be considered to be at rest relative to the ground below. After the collision, the balloon is caught on the fuselage and is traveling with the airplane. The collision takes place over a time interval of **4.44×10^{-3} s**. What is the **average force** that the balloon exerts on the airplane? **(4 points)**

***Answer*_____**