***Fall Semester Objectives***

**Unit 1A *Objectives:***

* Define the following terms:
  + Distance
  + Displacement
  + Speed
  + Velocity
  + Acceleration
  + Force
  + Net force
  + Free body diagram
* Explain the implications of the following models
  + constant velocity motion
  + constant acceleration motion
  + Tension
  + Normal force
  + frictional force
* Give real-world examples of the following
  + constant velocity motion
  + constant acceleration motion
* Describe motion using various representations
  + *Position* vs. *time* graph
  + *Velocity* vs. *time* graph
  + Motion map
* Find slope and vertical intercept of a line
* Explain the physical significance of slope and vertical intercept on the following graphs
  + *position* vs. *time*
  + *velocity* vs. *time*
* Determine the following from a *position* vs. *time* graph
  + starting position
  + position at any specified time
  + distance traveled during specified time interval
  + displacement during specified time interval
  + speed at specific time
  + average speed during specified time interval
  + velocity at specific time
  + average velocity during specified time interval
  + sign (+ or -) of acceleration
* Determine the following from a *velocity* vs. *time* graph
  + displacement during specified time interval
  + starting velocity
  + velocity at any specified time
  + acceleration
* Explain significance of intersection of two curves lines on the following graphs
  + *position* vs. *time*
  + *velocity* vs. *time*
* Articulate the conditions on sign (+ or -) of velocity and sign (+ or -) of acceleration for increasing and decreasing speed
* State and apply Newton’s Second Law
* Draw free body diagrams (FBDs) for assorted situations
* Determine resultant (net) force when multiple forces act on a single object

**Unit 1B *Objectives:***

* *Define the following terms:*
  + *Momentum*
  + *Impulse*
  + *Elastic collision*
  + *Inelastic collision*
* *State what is meant by ‘conservation of momentum’*
* *Using impulse/momentum ideas, describe how forces may be reduced during collisions*
* *Predict qualitative outcome of various collisions*
  + *Equal mass carts*
  + *Unequal mass carts*
* *Solve quantitative problems using: F x ∆*t = m x *∆v = ∆p*
* *Solve quantitative problems by applying conservation of momentum*
  + *Objects collide and stick together*
  + *Objects collide and separate*

***Sample Questions***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Distance vs. Displacement** | |  |  | | --- | --- | | **1.** | **A truck travels one hundred meters East and then turns around and travels forty meters West.  What is the truck’s total distance and displacement?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | distance =60 meters; displacement =140 meters East | |  |  | **B.** | distance =140 meters; displacement =60 meters West | |  |  | **C.** | distance =60 meters; displacement =140 meters West | |  |  | **D.** | distance =140 meters; displacement =60 meters East |  |  |  | | --- | --- | | **2.** | Jamal lived exactly 500 meters due north of a store.  He decided to walk to the store to buy a soda.  When he was half way there, he realized he forgot his wallet.  He went home, got his wallet, and walked to the store.  When Jamal was finally at the store, what distance had Jamal walked and what was his displacement? |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | distance = 1000m; displacement = 500m south | |  |  | **B.** | distance = 500m south; displacement = 1000m | |  |  | **C.** | distance = 750m; displacement = 0 | |  |  | **D.** | distance = 500m; displacement = 500 m south | |
| **Velocity** | |  |  | | --- | --- | | **3.** | **Which of these best represents a velocity?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | Light travels at | |  |  | **B.** | A racecar speeds along a track at 300 km/h | |  |  | **C.** | The wind is blowing from the northwest at 7 km/h | |  |  | **D.** | The tennis champion serves the ball in excess of 130 km/h |  |  |  | | --- | --- | | **4.** | **Use the chart below to answer the following question.**  **Which of the following gives the average speed of the object traveling over the 40 second time period?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | 5 m/sec | |  |  | **B.** | 2.5 m/sec | |  |  | **C.** | 40 m/sec | |  |  | **D.** | 100 m/sec |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  | | --- | --- | | **5.** | **If the average speed of a drag racing car is 0.050 km per second, how long would it take the car to complete ¼ km (0.25km) straight track?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | 5.0 seconds | |  |  | **B.** | 0.20 seconds | |  |  | **C.** | 0.30 seconds | |  |  | **D.** | 0.125 seconds | |  |  |  | | --- | --- | | **6.** | A runner ran a 600. m race at an average speed of 3.00 m/sec.  What was the runner's time? |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | 0.500 s | |  |  | **B.** | 180. s | |  |  | **C.** | 200. s | |  |  | **D.** | 1800. s | |
| **Motion Maps** | |  |  | | --- | --- | | **7.** | Use the diagram below to answer the following question  **Which of the following statements is true about "Scenario A" in the above drawing?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | The acceleration is increasing at a constant rate. | |  |  | **B.** | The velocity is increasing at a constant rate. | |  |  | **C.** | The acceleration is zero. | |  |  | **D.** | The velocity is zero. |  |  |  | | --- | --- | | **8.** | Use the following diagram to answer the questin below  **The acceleration in "Scenario B" can be described as which of the following?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | zero | |  |  | **B.** | positive | |  |  | **C.** | negative | |  |  | **D.** | gravitational | |
| **Acceleration** | |  |  | | --- | --- | | **9.** | **A ball starts at rest and has a velocity of 6 m/s by the end of the four seconds. What is the acceleration of the object over this time period?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | 10 meters per second squared | |  |  | **B.** | 1.5 meters per second squared | |  |  | **C.** | 24 meters per second squared | |  |  | **D.** | 0.66 meters per second squared |  |  |  | | --- | --- | | **10.** | If an object is moving at a speed of 30.0 m/sec and 5.00 seconds later it is moving at a speed of 50.0 m/sec, what is the car's acceleration? |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** |  | |  |  | **B.** |  | |  |  | **C.** |  | |  |  | **D.** |  |  |  |  | | --- | --- | | **12.** | If a car is moving at a speed of 60 km/hour and it comes to rest in 3.0 seconds, what is the acceleration of the car? |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | 20 km/h/s | |  |  | **B.** | -20 km/h/s | |  |  | **C.** | 180 m/h/s | |  |  | **D.** | -180 m/h/s |  |  |  | | --- | --- | | **13.** | **Use the drawing below to answer the following question**  **The ball in the above drawing is dropped from rest and is falling to the ground. If its acceleration is a constant 9.8 meters per second squared, what is its velocity by the end of the 2nd second?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | 0 m/s | |  |  | **B.** | 9.8 m/s | |  |  | **C.** | 19.6 m/s | |  |  | **D.** | 29.4 m/s | |
| **Graphs** | |  |  | | --- | --- | | **14.** | **The graph below represents the motion of a car.**  **Which of the statements below is TRUE for the graph above?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | The car is turning. | |  |  | **B.** | The car is speeding up. | |  |  | **C.** | The car is slowing down. | |  |  | **D.** | The car is traveling at a constant speed. |  |  |  | | --- | --- | | **15.** | **Use the graph below to answer the question below.**  **Which of the following statements best represents a comparison of the two motions shown on the graph?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | Series 2 is turning more than series 1. | |  |  | **B.** | Series 1 is turning more than series 2. | |  |  | **C.** | Series 2 has a greater positive acceleration than series 1. | |  |  | **D.** | Series 1 has a greater negative acceleration than series 2. |  |  |  | | --- | --- | | **16.** | **Use the graph below to answer the question below.**  **Which of the following statements best represents a comparison of the two motions shown on the graph?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | the top line represents a greater acceleration | |  |  | **B.** | the bottom line represents a greater acceleration | |  |  | **C.** | the top line represents a greater velocity | |  |  | **D.** | the bottom line represents a greater velocity |   17. Describe the motion between the following points:     |  |  | | --- | --- | | Points | Motion Description | | AB |  | | BC |  | | CD |  | | DE |  |   18. Calculate the speed of the object from the position vs. time graph shown below.    19. Which *velocity* vs. *time* graph represents a car moving in the positive direction at a constant speed? |
| **Forces** | |  |  | | --- | --- | | **20.** | **In the picture below, a girl is sitting motionless on swing.  Her weight of 245 N is exerting a downward force on the swing.**  **What is the net force on the swing?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | 0 Newtons | |  |  | **B.** | 245 Newtons upwards | |  |  | **C.** | 490 Newtons upwards | |  |  | **D.** | 490 Newtons downwards |  |  |  | | --- | --- | | **21.** | **If the same force is applied to each of these balls, which one will have the LEAST acceleration?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | baseball m=1.0kg | |  |  | **B.** | bowling ball m=7.3kg | |  |  | **C.** | golf ball m = 0.75kg | |  |  | **D.** | tennis ball m= 0.5kg |  |  |  | | --- | --- | | **22.** | **Which of these best represents an action-reaction pair of forces?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | An object remains at rest for an hour | |  |  | **B.** | An object increases in speed as it falls | |  |  | **C.** | An object is accelerated across a smooth surface | |  |  | **D.** | A student pushes on a wall and the wall pushes back on the student |  |  |  | | --- | --- | | **23.** | **Use the graphic below to answer question**  **At the 10 second mark in the above picture, the man is pushing the box so that it accelerates at a rate of .2 m/s/s. What is the force being exerted on the box?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | 2 Newtons | |  |  | **B.** | 5 Newtons | |  |  | **C.** | 20 Newtons | |  |  | **D.** | 50 Newtons |  |  |  | | --- | --- | | **24.** | How much force is necessary to accelerate a 50.0kg object at a rate of |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | 500. N | |  |  | **B.** | 5.0 N | |  |  | **C.** | 100. N | |  |  | **D.** | 10.0 N |  |  |  | | --- | --- | | **25.** | What is the net force being exerted on a 5.00kg object that is accelerating at a rate of 100m/s/s? |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | 50.0N | |  |  | **B.** | 0.050N | |  |  | **C.** | 20.0N | |  |  | **D.** | 500.0N |   26. A 2-kg toy car experiences the following forces.    Find the acceleration of the car. |
| **Mass & Weight** | |  |  | | --- | --- | | **27.** | **Use the graphic below to answer question**  **The man in the above picture is pushing a box with a mass of 100 kg. When subjected to the gravitational acceleration of 9.8 m/s^2, what is the weight of this box?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | 10.2 Newtons | |  |  | **B.** | 9.8 Newtons | |  |  | **C.** | 980 Newtons | |  |  | **D.** | 10,200 Newtons |  |  |  | | --- | --- | | **28.** | Which statement best describes the weight of an object? |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | Weight is the amount of force that gravity exerts on an object. | |  |  | **B.** | Weight is the amount of matter that makes up an object. | |  |  | **C.** | Weight is the rate that gravity accelerates an object as it falls. | |  |  | **D.** | Weight is the same as mass. |  |  |  | | --- | --- | | **29.** | Which of the following is true concerning mass and weight? |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | Both mass and weight are a measure of force. | |  |  | **B.** | The more mass an object has, the greater its weight will be. | |  |  | **C.** | The greater the force of gravity at a particular location, the greater an object's mass. | |  |  | **D.** | The amount of mass an object has does not influence the amount of weight it has. |  |  |  | | --- | --- | | **30.** | **A 60-kilogram object from Earth is sent to the Moon.  The moon has less mass than Earth.  Which statement is more likely?** |  |  |  |  |  | | --- | --- | --- | --- | |  |  | **A.** | The object has less weight on the moon. | |  |  | **B.** | The object has more weight on the moon. | |  |  | **C.** | The object is weightless on the moon. | |  |  | **D.** | The object has the same weight on Earth and on the moon. | |
| **Momentum** | 31. On a smooth, level surface, a red marble of mass 0.02 kg moving at 2.0 m/s collides with a stationary yellow marble of equal mass. After the collision, the red marble stops completely, and the yellow marble moves in the direction the red marble was moving.   1. Calculate the momentum of both marbles before the collision. Show your calculations and include units in your answer. 2. Calculate the momentum of both marbles after the collision. Show your calculations and include units in your answer. 3. If the red marble had more mass than the yellow marble, how would the momentum of the yellow marble change after the collision?   32. A rubber ball moving at a speed of 5 m/s hit a flat wall and returned to the thrower at 5 m/s. The magnitude of the momentum of the rubber ball  a. increased. c. remained the same.  b. decreased. d. was not conserved.  33. The two carts shown below collide and stick together. Which direction would they move immediately after the collision and why?    a. left; the cart moving that direction is faster  b. right; the cart moving that direction has more inertia  c. left; the cart moving that direction has more momentum  d. neither, they will stop; the forces on the two carts must be equal |