Student #: _____ Student Name: _____

Physics 11 Unit 1: Introduction and Equations of Motion

PART A: Short Answer Questions

1. Can an object ever be accelerating and experiencing an instantaneous velocity of $0m/s$? Explain.

2. Is it possible to have an average velocity of $\vec{0}$ for some motion but an average speed of $120km/h$ for that same motion? Provide a quantitative example.

3. What is the displacement of Earth after a time interval of $365\frac{1}{4}$ days?

4. Sketch an impossible position-time graph and explain why it is impossible. Then, sketch an impossible velocity-time graph and explain why it is impossible.

5. Describe the similarities and difference between:

   (a) Time and time interval

   (b) Position, displacement and distance

   (c) Speed and velocity

PART B: Problem Solving

6. To get to the net, a soccer ball must travel $35m$ $[\text{South}]$. If one player kicks it $25m$ $[\text{East}]$, what displacement must be achieved by the second player's kick?

7. A rock is thrown straight upward from the edge of a $30m$ cliff, rising $10m$ then falling all the way down to the base of the cliff. Find the rock's displacement.

8. A rocket powered sled accelerates a jet pilot in training from rest to $270km/h$ in $12.1s$. Find:
   (a) the average acceleration of the sled
   (b) the time it takes to reach the speed limit on the highway, $100km/h$
   (c) the distance travelled when it reaches the final speed

9. Alex is sitting at a bus stop facing north. Darcy walks by heading west. Jennifer jogs by going east. Draw dot diagrams of the motion of each person from:
   (a) Alex's frame of reference
   (b) Darcy's frame of reference
   (c) Jennifer's frame of reference

10. A basketball player gains the ball at centre court. He then dribbles down to the opponents' basket and scores $6.0s$ later. After scoring, he runs back to guard his own team's basket, taking $9.0s$ to run down the court. Using centre court as his reference position, calculate his average velocity

    (a) while he is dribbling up the opponents' net, and
    (b) while he is running down from the opponents' net to his own team's net.

    (A basketball court is $30.0m$ long)

11. A runner runs in the $400m$ track and completes it in $53s$. Find her average speed and the magnitude of her average velocity.

12. An Indy 500 race car's velocity increases from $+6.0m/s$ to $+38m/s$ over a $4.0s$ time interval. What is its average acceleration?

13. A stalled car starts to roll backward down a hill. At the instant that it has a velocity of $4.0m/s$ down the hill, the driver is able to start the car and start accelerating backup. After accelerating for $3.0s$, the car is travelling uphill at $3.5m/s$. Determine the car's acceleration once the driver got it started. (Assume that the acceleration was constant.)

14. In a long distance race, Michael is running at $3.8m/s$ and is $75m$ behind Robert, who is running at a constant velocity of $4.2m/s$. If Michael accelerates at $0.15m/s^2$, how long will it take him to catch Robert? (Hint: When Michael catches up to Robert, what is the distance covered by Robert? If Michael was initially $75m$ behind Robert, how far would he have to run?)

15. A canoeist starts from her campsite, paddles $3.0km$ due north, and then $4.0km$ due west.
    (a) Determine her displacement for the trip.
    (b) In what direction would she have to head her canoe in order to paddle straight home?

PART C: Multiple Choice Questions

17. A ball is thrown towards the north. What are the directions of acceleration and instantaneous velocity, respectively, of the ball at maximum height (i.e. the peak of its trajectory)?
    (a) north, north
    (b) up, north
    (c) down, north
    (d) north, down
    (e) down, down

18. A cyclist cycles $40.0km$ [N] and then $30.0km$ [E]. The total time taken for the trip is $3.00h$. What is its average velocity?
    (a) $50km/h$ [37° N of E]
    (b) $70km/h$ [37° E of N]
    (c) $35km/h$ [37° N of E]
    (d) $17km/h$ [37° E of N]
    (e) None of these choices

19. A car is travelling west and approaching a stop sign. As it is slowing to a stop, the directions associated with the object's velocity and acceleration, respectively, are
    (a) [W], [E]
    (b) [W], [W]
    (c) [E], [E]
    (d) [E], [W]
    (e) There is not enough information to tell.

20. An athlete runs around a $400m$ oval track 4 times. Her distance and displacement are, respectively, are
    (a) 0, 0
    (b) $1600m$, 0
    (c) 0, $1600m$
    (d) $1600m$, $1600m$ [forward]
    (e) $100m$, 0

21. If a car travelling at $60.0km/h$ [S] stops in a time of $3.50s$, its acceleration is:
    (a) $4.77m/s^2$ [S]
    (b) $4.77m/s^2$ [N]
    (c) $16.7m/s^2$ [S]
    (d) $16.7m/s^2$ [N]
    (e) $17.1m/s^2$ [S]

22. Which of the following objects are in “free-fall”?
    (a) a ball that was thrown horizontally
    (b) a ball that was thrown at an angle above horizontal
    (c) a ball that was thrown at an angle below horizontal
    (d) a ball that was dropped
    (e) all of the above

23. A baseball player is trying to determine her maximum throwing distance. She must release the ball:
    (a) at an angle that lets the ball reach the highest possible height
    (b) horizontally
    (c) at an angle of 45°
    (d) so that it has maximum possible speed, regardless of angle
    (e) at an angle between 45° and 90°

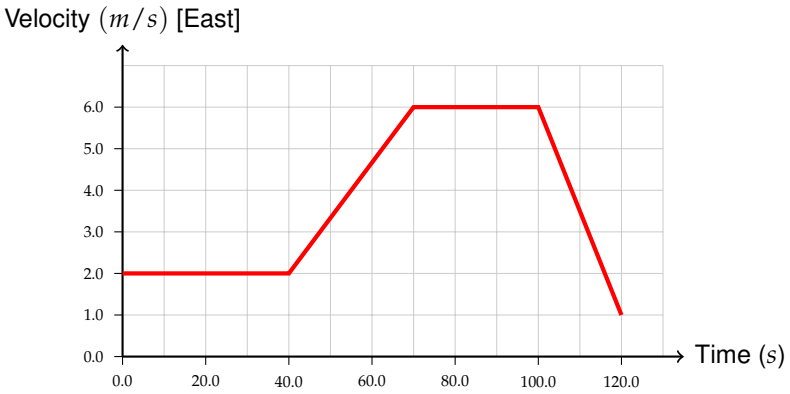
24. A car travels $35km$ [N] in $30min$ and then hits a traffic jam and spends $1.5h$ travelling $16.7km/h$ [N]. The average velocity of the car is:
    (a) $43.35km/h$ [N]
    (b) $51.7km/h$ [N]
    (c) $16.7m/s$ [N]
    (d) $8.34m/s$ [N]
    (e) 0

25. A ball is thrown up in the air and then caught at the same height. The acceleration is $9.8m/s^2$ [down]:
    (a) on the way up
    (b) on the way down
    (c) at the peak of its trajectory
    (d) two of A, B, and C are correct
    (e) all of A, B, and C are correct

26. A boy throws a ball straight up off a second floor balcony and it then lands on the ground. Neglecting air resistance, the magnitude of velocity is greatest:
    (a) just after it leaves the boy’s hand
    (b) at the peak of the ball’s trajectory
    (c) just before it hits the ground
    (d) it remains the same throughout the motion
    (e) impossible to tell without knowing the angle of projection

PART D: Interpreting Graphs

27. Use the velocity-time graph below to answer the questions that follow.



(a) Describe the motion of the object (use words and numbers):

i. from $t = 0.0s$ to $40.0s$

ii. from $t = 40.0s$ to $70.0s$

(b) How do the motions of the object from $t = 20.0s$ to $35.0s$ and $t = 50.0s$ to $60.0s$ compare?

(c) What is the velocity of the object at $t = 10.0s$?

(d) What is the acceleration of the object at $t = 30.0s$? Does this represent the maximum magnitude of acceleration of the object?

(e) What is the displacement of the object after the first $20.0s$?

28. Draw conclusions about the acceleration of the motion represented by the following 4 graphs on the right. (The 4 graphs are 4 different questions. Pay attention to the y axis.)