CHAPTER 2 Review

REFLECTING ON CHAPTER 2

- An object is in motion if it changes position in a particular frame of reference or coordinate system.
- A motion diagram documents an object's position in a frame of reference at particular instants in time.
- Vector quantities are described in terms of their magnitude and direction.
- A position vector locates an object with a magnitude and direction from the origin of a frame of reference.
- A displacement vector designates the change in position of an object.
  $\Delta\vec{d} = \vec{d}_f - \vec{d}_i$
- A time interval t is the time elapsed between two instants in time.
  $\Delta t = t_f - t_i$
- Velocity is the rate of change of position or the displacement of an object over a time interval.
  $\vec{v}_{ave} = \frac{\Delta\vec{d}}{\Delta t}$
- Acceleration is the rate of change of velocity of an object over a time interval.
  $\vec{a}_{ave} = \frac{\Delta\vec{v}}{\Delta t}$
- Position-time graphs reveal patterns of uniform and non-uniform motion. Uniform motion or constant velocity appears as a straight slope. The average velocity during a time interval is determined by finding the slope of the line connecting the initial and the final positions of the object for the time interval. The instantaneous velocity is calculated by finding the slope of the tangent to the line of the graph at a particular instant in time.
- Velocity-time graphs reveal patterns of uniform and non-uniform acceleration. Uniform or constant acceleration appears as a straight slope. The average acceleration during a time interval is determined by finding the slope of the line connecting the initial and the final velocities of the object for the time interval. The instantaneous acceleration is calculated by finding the slope of the tangent to the line of the graph at a particular instant in time.
- The displacement of an object during a particular time interval can be found by determining the area under the curve of a velocity-time graph.

Knowledge/Understanding

1. Define the following: **(a)** kinematics **(b)** dynamics **(c)** mechanics **(d)** velocity **(e)** acceleration **(f)** frame of reference **(g)** centre of mass **(h)** vector **(i)** scalar
2. What is meant by the illusion of motion while watching a movie or video?
3. In terms of graphing distinguish between the following:
   (a) average velocity and instantaneous velocity
   (b) average acceleration and instantaneous acceleration
4. Describe, using dynamics, how one could produce a non-uniform acceleration of an object?
5. Describe how to determine the area under a velocity-time curve with a non-uniform acceleration (i.e. increasing or decreasing slope).
6. Distinguish between position and displacement.
7. Identify the quantity that is changing every second when an object is accelerating.
8. Describe some practical applications of acceleration.
9. What does a negative area calculation under a velocity-time graph mean?

Inquiry

10. You are given the results of a 60 Hz recording ticker tape timer experiment of a cart rolling down a ramp onto a level lab bench. By

analyzing the dots on the ticker tape describe how you know the cart was

(a) moving with a positive uniform acceleration
(b) moving with a negative uniform acceleration
(c) moving with constant velocity
(d) at rest.

11. A student's school is directly north of her home. While she roller blades to school she accelerates uniformly from rest to a modest velocity and then maintains this velocity, until she meets a friend half way to school at which point she stops for a while. She then continues to move at the same constant velocity until she gets near the school, where she slows uniformly until she stops.

(a) Sketch a position-time graph for her motion
(b) Sketch a velocity-time graph for her motion.

Communication

12. Explain what physical quantity is measured by a car's speedometer.

Making Connections

13. Refer to kinematics principles to suggest solutions to improve road safety. Consider such aspects as: vehicle design and safety features, driver training, reaction time, roadway design, construction and maintenance, road signs, maximum driving speed, and road safety enforcement.

14. Make a list of the of the advantages and disadvantages of the following means of transportation: **(a)** train **(b)** plane **(c)** car **(d)** ship. Which means of transportation do you feel is adapting the most and least to meet the needs of our Canadian society.

Problems for Understanding

15. A truck is transporting new cars to a car dealership. There are 8 cars on the truck's trailer. Describe a frame of reference in which a car is:

(a) moving.
(b) at rest.

16. Draw a dot diagram to illustrate the motion of a car travelling from one traffic light to the next. When the traffic light turns green the car's speed increases, it then travels at a constant speed, and then brakes to slow down to a stop at the next traffic light.

17. A girl is taking her dog for a walk. They walk 5.0 km[N] and then turn around and walk 12 km[S].

(a) What is the total distance that they travelled?
(b) What is their displacement?
(c) What displacement would they have to walk to get back to their starting point?

18. A cyclist is travelling with an average velocity of 5.9 m/s[W]. What will be his displacement after 1.2 h?

19. A canoeist paddles 1.6 km downstream and then turns around and paddles back upstream for 1.2 km. The entire trip takes 45 minutes.

(a) What is the displacement of the canoeist?
(b) Calculate the average velocity of the canoeist.

20. The closest star to our solar system is Alpha Centauri, which is 4.12×10^{16} m away. How long would it take light from Alpha Centauri to reach our solar system if the speed of light is 3.00×10^{8} m/s? (Provide an answer in both seconds and in years.)

21. Vectorville and Scalartown are 20.0 km apart. A cyclist leaves Vectorville and heads for Scalartown at 20.0 km/h. A second cyclist leaves Scalartown for Vectorville at exactly the same time at a speed of 15.0 km/h.

(a) Where will the two cyclists meet between the two towns?
(b) How much time passes before they meet (in minutes)?

22. Describe each of the situations below as either uniform motion or non-uniform motion.

(a) a car on the highway travels with its cruise control set at 90 km/h
(b) a skydiver jumps from a plane and falls faster and faster through the air
(c) a piece of paper that is dropped, flutters to the ground
(d) a satellite travels in a circular orbit above the earth at a constant speed
(e) you sit quietly, enjoying an autumn day.

23. Graph the following data. Find the slope at different intervals and sketch a speed-time graph of the motion.

t (s)	d (m)	t (s)	d (m)
0	0	11	41
1	4	12	43
2	8	13	44.5
3	12	14	45.5
4	16	15	46
5	20	16	46
6	24	17	46
7	28	18	46
8	32	19	46
9	35.5	20	46
10	38.5		

24. A car is travelling at 14 m/s when the traffic light ahead turns red. The car brakes and comes to a stop in 5.0 s. Calculate the acceleration of the car.

25. A runner starts a race from rest and reaches a velocity of 5.4 m/s in a time interval of 12 s. If the runner's acceleration was constant, what was his average velocity and his acceleration?

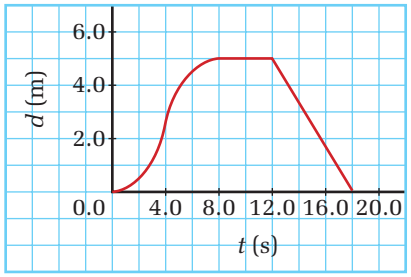
26. A bowling ball is rolling with an average velocity of 2.7 m/s[E]. If it started at a position 0.45 m from the foul line, where was the ball after 7.5 s?

27. When the traffic light turns green the car's speed increases, it then travels at a constant speed, and then brakes to slow down to a stop at the next traffic light.

(a) Sketch a position-time graph to represent the car's motion.

(b) Sketch a velocity-time graph to represent the car's motion.

28. A woman walks her dog to an off leash area in a park then sits on a park bench. At time zero, the dog (1) slowly begins to walk away from the woman. Suddenly the dog sees a squirrel and (2) begins running after it. The squirrel runs up a tree. The dog (3) reaches the tree and stops and looks up at the squirrel. The woman calls the dog and (4) it trots back over to her at the park bench. The figure shows the position of the dog over the period of time described above.



(a) Examine the figure and state the time intervals that fit the actions of the dog that are labelled 1 through 4 in the discussion. Explain how you knew how the time intervals fit the actions.

(b) Sketch graphs of velocity versus time and acceleration versus time for the motion of the dog.

29. Sketch graphs of position, velocity, and acceleration versus time for the scenario described here. A runner is jogging at a constant velocity when he decides to sprint. He speeds up and then runs at a constant velocity for a few seconds. On a nearby baseball diamond, a batter hits a foul ball that comes directly toward the runner. He stops, catches the ball and throws it back to the pitcher. He continues at a walking pace briefly. Soon, he turns and jogs back home at a gentle pace.

30. Jocelyn drove north at 45 km/h for 20 min then turned west and drove at 54 km/h for 27 min. Finally she drove south at 18 km/h for 6.4 min. Find

(a) the distance that Jocelyn drove

(b) her displacement

(c) her average speed

(d) her average velocity