UNIT 1 Review

Knowledge and Understanding

True and False

In your notebook, indicate whether each statement is true or false. Correct each false statement.

1. Average velocity equals distance over elapsed time.
2. On a velocity-time graph the slope equals the acceleration.
3. One walks 10 km north and then 10 km south. His displacement is 20 km.
4. An object falling freely experiences non-uniform acceleration.
5. The order of adding vectors does not matter in determining the resultant.
6. Vectors representing different kinds of quantities can be added and subtracted together.
7. The downstream velocity of a river that flows north has no effect on a boat's westward velocity.
8. A reference frame is a coordinate system.
9. Average velocity and instantaneous velocity are never the same.
10. The area under an acceleration versus time graph is the average velocity.

Multiple Choice:

In your notebook, write the letter of the best answer for each of the following questions.

11. If you are in a moving frame of reference but cannot see outside of your reference frame, you can detect which property of your reference frame?
    (a) position
    (b) displacement
    (c) velocity
    (d) acceleration
12. Displacement between two points is always
    (a) greater than distance
    (b) greater than or equal to distance
    (c) less than or equal to distance
    (d) less than distance
13. A negative acceleration means that
    (a) an object is moving in a negative direction
    (b) the object is slowing down
    (c) the acceleration vector is pointing in a negative direction
    (d) the object's velocity is negative
14. An object is slowing down when
    (a) its velocity is negative
    (b) the signs of the velocity and acceleration are opposite
    (c) the acceleration is negative
    (d) the displacement is negative
15. If an object is in uniform motion
    (a) its displacement is zero
    (b) its velocity is zero
    (c) its acceleration is zero
    (d) its speed is zero
16. On a position versus time graph, a straight horizontal line corresponds to motion at
    (a) zero speed
    (b) constant speed
    (c) increasing speed
    (d) decreasing speed

Short Answer

In your notebook, write a sentence or short paragraph to answer each of the following questions.

17. Explain the importance of a frame of reference in illustrating motion.
18. How does a coordinate system differ from a frame of reference?
19. State whether each of the following is a scalar or vector quantity: **(a)** velocity **(b)** mass **(c)** distance, **(d)** speed **(e)** acceleration **(f)** time interval **(g)** displacement.
20. Create an example that clearly depicts the contrast between distance and displacement.
21. Describe the type of information that you would need in order to verify that an object was moving with a constant velocity.
22. Using a dot diagram, illustrate the motion of runner who starts slowly, runs at a constant speed, then sprints to a finish.
23. Draw a properly labelled graph that illustrates uniformly decreasing acceleration.
24. Distinguish between the average velocity and the instantaneous velocity.

25. **(a)** What does the slope of the tangent to the curve on a position-time graph represent?
(b) What does the slope of the tangent to the curve on a velocity-time graph represent?
(c) What does the area under the curve on a velocity-time graph represent?

Inquiry

26. You and four of your friends live at five different locations in a large city. You want to find a central meeting place that minimizes the total travel of all five of you. Think of a way to solve this problem using elastic bands. When you have found a solution, try it out using a map of the locations of your residences. Can you explain the physics behind the way this works?
27. Review the meaning of the kinematic equations for constant acceleration by deriving them yourself. Begin with the following situation. In a time interval, Δt, a car accelerates uniformly from an initial velocity, v_i, to a final velocity, v_f. Sketch the situation in a velocity versus time graph. By determining the slope of the graph and the area under the graph, derive as many of the kinematic equations as possible. (Hint: What quantities do these properties of the graph represent?)
28. Design an experiment to demonstrate that the acceleration due to gravity is the same for all masses.

Communication

29. Explain the meaning of a graph of position versus time that is simply a vertical line. Why would it be impossible to achieve this type of motion?
30. A ball rolls down an inclined plane, across a horizontal surface, and then up another inclined plane that has a smaller slope than the first. Describe the type of motion that the ball undergoes on each of these surfaces.
31. You have been asked to make a presentation to a grade five class in which you are to teach them the difference between distance and displacement and the difference between speed and velocity. Prepare a speech and demonstration using any type of props that you need in order to communicate these concepts to grade five students.

Making Connections

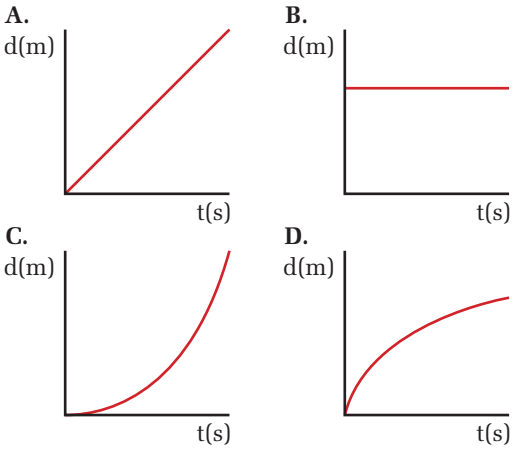
32. List and describe situations that occur in every day life that are examples in which an object or person is moving with **(a)** uniform motion **(b)** an acceleration without a change in speed **(c)** uniform acceleration **(d)** non-uniform acceleration.
33. Choose an Olympic sport and estimate the magnitude of realistic velocities and accelerations involved in the motion. For example, do research to find out the rate at which sprinters accelerate at the beginning of 10 m or 100 m dash. Compare this acceleration to that of a long distance runner. Explain why these rates differ.

Problems for Understanding

Show complete solutions for all problems that involve equations and numbers.

34. A delivery truck travels 15 km north, then 13 km east and finally heads south for 18 km. Determine the truck's displacement.
35. A car is traveling 5.0×10^1 km/h[N]. It turns a corner and heads down a side street at 4.0×10^1 km/h[E]. Determine the car's change in velocity.
36. A tourist is travelling north from Port Hood to Chéticamp late at night and has her car set on cruise control. On the highway she sees a sign that says "Chéticamp 90 km" and notices that it is 10:30 p.m. At 11:00 p.m. she sees a second sign that says "Chéticamp 35 km".
(a) How much time passed from when the tourist saw the first sign to when she saw the second sign?
(b) What is her displacement for the time interval?
(c) Calculate the velocity of the tourist.

37. Use the position-time graphs below to answer the following questions:



Which graph best describes each situation:

(i) A car is stopped at a stoplight.

(ii) The light turns green, so the car gradually increases in speed.

(iii) A car is travelling on a highway at a constant speed.

(iv) A car slows down as they approach a school zone.

38. A car travels directly north. The car is on a highway for 2.4 h travelling with a velocity of 85 km/h. It slows to 25 km/h for 45 min while going through a town. It reaches the highway north of town and travels another 1.6 h at 95 km/h.

(a) How far did the car travel?

(b) What was the car's average velocity for the entire trip?

39. A child on a sled starts from rest and accelerates down a snowy hill at 0.65 m/s^2. How long does it take the child to reach the bottom of the hill if it is 17 m away?

40. Sketch velocity versus time graphs for the following scenarios:

(a) A jogger is running at a constant velocity for 5.0 min then accelerates with a constant acceleration for 0.75 min.

(b) A girl on a bicycle starts from rest and accelerates rapidly for 6.0 s, then accelerates at a constant rate for 3.3 s, and then rides with uniform motion for 8.5 min. She then slows rapidly, coming to a stop in 2.8 s.

(c) A student is pacing back and forth in front of the school while waiting for the school bus.

41. A student is late for school. She runs out the door and starts down the street at 8.0 km/h. Three minutes later, her mom notices that she left her physics homework on the table and immediately runs after her at 12.0 km/h.

(a) How far does the student run in 3 minutes?

(b) How long does it take her mom to catch her (in minutes)?

(c) How far away from home does her mom catch her?

42. On a highway a car is travelling at 28 m/s[N] when it increases its speed to pass another car. Calculate the acceleration of the car if it reaches a speed of 33 m/s in 2.0 s.

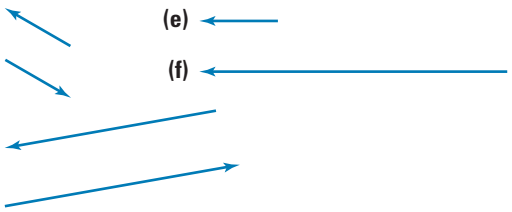
43. How far does a car travel while it is accelerating from 22 m/s[W] to 28 m/s[W] at a rate of 3.0 m/s^2?

44. How long does it take a race car, accelerating from a velocity of 6.0 m/s at 4.0 m/s^2 to travel a distance of 216 m?

45. A sprinter is running the 100 m dash. For the first 1.75 s of the race she accelerates from rest to a speed of 5.80 m/s. For the rest of the 100 m she continues at a constant speed. What time did the sprinter achieve for the race?

46. Two vectors X and Y are shown:

Choose from the choices below to answer the following questions:



(i) Which most accurately represents the sum of the vectors X and Y?

(ii) Which most accurately represents the difference of the vectors X and Y, (X – Y)?

(iii) Which most accurately represents the product $(\frac{1}{2}X)$?

47. A person in a kayak paddles across a calm lake at 2.5 m/s[S] for 3.0×10^1 minutes. He then heads east at 2.0 m/s for 2.0×10^1 min.

(a) Calculate the displacement of the kayak from its starting point.

(b) Determine the average velocity for the trip.

48. Jerry watches a stick float downstream in a river and notes that it moves 12 m[E] in 2.0×10^1 s. His friend Ben is starting on the south side of the river and is going to swim across. In still water Ben knows that he can swim with a speed of 1.7 m/s. What is Ben's velocity relative to the shore? If the river is 1.5 km wide, how long will it take Ben to cross the river? How far downstream will he land?

49. A passenger climbs aboard a northbound bus and walks toward the back at a rate of 1.8 m/s. The bus starts off up the street at 9.2 m/s. What velocity will the passenger appear to be walking relative to

(a) a person standing on the sidewalk.

(b) a person who is walking 2.1 m/s south along the sidewalk.

(c) a person who is walking 2.1 m/s north along the sidewalk.

50. The towns of Alta and Baker are 115 km apart. Carroll drives an old pick up truck from Alta to Baker at an average velocity of 45 km/h. Deke leaves 1.1 h later than Carroll but drives with an average velocity of 85 km/h.

(a) Who arrives in Baker first?

(b) How much later than the first person does the second person arrive?

51. Jenny jogs at 2.4 m/s. Jason starts out on the same route 3.0 minutes later than Jenny and jogs at 3.8 m/s. How far have they gone when Jason catches up with Jenny? (Hint: Jason's time is equal to Jenny's time minus 3.0 min.)

52. Plot a graph of position versus time for the data below. From your position/time graph, generate a velocity versus time graph and an acceleration versus time graph. State whether the motion is uniform, uniformly accelerated, or neither. Give reasons for your answer.

time (s)	0	1	2	3	4	5	6	7	8	9	10	11	12
position (m)	0	11	20	27	32	35	36	35	32	27	20	11	0

53. A speedboat is towing a water skier. At the beginning of the ride the skier is following straight along behind the boat which is traveling 68 km/h due north. The skier cuts out to the right side so that he is heading at an angle of 48° to the direction of the boat. Calculate the skier's change in velocity if his speed while cutting to the side is 76 km/h.

54. A sailboat is using its motor to travel with a velocity of 42 km/h[E 40.0°S] when a wind from the north starts blowing at 5.0 km/h. What will be the velocity of the sailboat relative to the shore?

55. A pilot wants to land at a small lake that is [N30.0°W] of the airport that she is starting from. The wind has a velocity of 25.0 m/s[W] and the air speed of the plane is 1.90×10^2 m/s. What direction will the plane have to fly to get to its destination? What will be the velocity of the plane relative to the ground?

56. A pitcher throws a baseball with a velocity of 26 m/s[S]. It strikes a player's bat and the velocity changes to 3.0×10^1 m/s[N]. If the player's bat was in contact with the ball for 3.0×10^{-3} s, determine the acceleration of the ball.

57. A cyclist is travelling at 12 m/s[E] when she turns a corner and continues at a velocity of 12 m/s[N]. If the cyclist took 2.5 s to complete the turn, calculate her acceleration.

58. A basketball player is running down the court at 3.0 m/s[N]. It takes him 2.0 s to change his velocity to receive a pass. His acceleration is 1.4 m/s^2[E 5.0° S]. Calculate the new velocity of the player.