Student #: _____ Student Name: _____

Grade 11 Physics Unit 1: Kinematics in One-Dimension

INTRUCTIONS: For *vector* quantities (i.e. position, displacement, velocity or acceleration), be sure to anwswer with a *magnitude* and a *direction*. Scalar quantities do not require a direction. When expressing directions using +/- sign, be sure to indicate which direction is positive. Write neatly. Underline or put a box around your answers. Answer with the appropriate number of significant figures.

1. Can an object ever be accelerating and experiencing an instantaneous velocity of $0\,\mathrm{m/s}$? Explain, or give an example.

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

3. A rock is thrown straight upward from the edge of a $30\,\mathrm{m}$ cliff, rising $10\,\mathrm{m}$ then falling all the way down to the base of the cliff.
   (a) What is the *distance* that the rock travelled?
   (b) What is it *displacement* after it hits the base of the cliff?

4. A student athlete runs around a $400\,\mathrm{m}$ track and completes it in $53\,\mathrm{s}$. Find her average speed and velocity.

5. An object is free-falling near the surface of the Earth. At a certain instant in time, it is falling downward at a rate $25\,\mathrm{m/s}$. 2.5 seconds later,
   (a) what is its acceleration?
   (b) what is its velocity?

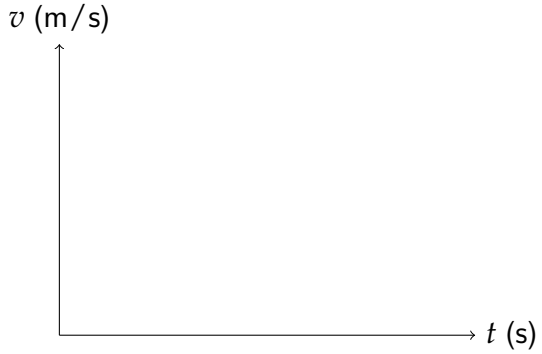
6. A stalled car starts to roll backward down a hill. At the instant that it has a velocity of $4.0\,\mathrm{m/s}$ down the hill, the driver restarts it starts accelerating backup. After accelerating for $3.0\,\mathrm{s}$, the car is travelling uphill at $3.5\,\mathrm{m/s}$. Determine the car's acceleration once the driver got it started. Assume constant acceleration.

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

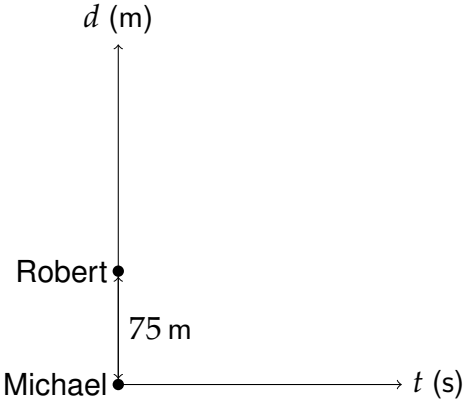
8. Sanna rolls a ball up to another person along a smooth ramp $19.6\,\mathrm{m}$ away from her. The ball reaches the other person's hands when it is travelling $4.9\,\mathrm{m/s}$ uphill. If the ramp angle slows the ball down by $3.7\,\mathrm{m/s}$ each second it travels up the ramp, find the initial velocity of the ball.

9. A porpoise jumps straight up and crashes back into the water at $8.9\,\mathrm{m/s}$. The drag and buoyancy forces of the water slow the porpoise down with an acceleration of $-9.3\,\mathrm{m/s^2}$ as the porpoise finally slows to a stop. Find the depth the porpoise reaches.

10. A car waits at a red light for a few seconds, and then accelerates straight ahead to $54\,\mathrm{km/h}$ in $3.1\,\mathrm{s}$ and then cruises at a constant speed for $75\,\mathrm{m}$. The road is straight. Express the motion of the car in a velocity-time graph, then find the total distance travelled.



11. In a long-distance race, Michael is running at $3.8\,\mathrm{m/s}$ and is $75\,\mathrm{m}$ behind Robert, who is running at a constant velocity of $4.2\,\mathrm{m/s}$. If Michael accelerates at $0.15\,\mathrm{m/s^2}$, how long will it take him to catch Robert? Draw motion graphs of Robert's and Michael's motion. Their starting position are provided. (Hint: When Michael catches up to Robert, what is the distance covered by Robert? If Michael was initially $75\,\mathrm{m}$ behind Robert, how far would he have to run?)



_____ 12. Which of the following is not an example of uniform motion?

(a) A car travelling down a long, gently sloped highway at $100\,\text{km/h}$.
(b) A very large boulder in the middle of a farmer's field.
(c) A BASE jumper who has just plummeted off a cliff edge.
(d) A train going uphill on a straight track at $30\,\text{km/h}$.
(e) None of the above.

_____ 13. 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.

_____ 14. An athlete runs around a $400\,\text{m}$ oval track 4 times. Her distance and displacement are, respectively,

(a) 0, 0
(b) $1600\,\text{m}$, 0
(c) 0, $1600\,\text{m}$
(d) $1600\,\text{m}$, $1600\,\text{m}$ [forward]
(e) $100\,\text{m}$, 0

_____ 15. If a car travelling at $60.0\,\text{km/h}$ [S] stops in a time of $3.50\,\text{s}$, its acceleration is:

(a) $4.77\,\text{m/s}^2$ [S]
(b) $4.77\,\text{m/s}^2$ [N]
(c) $16.7\,\text{m/s}^2$ [S]
(d) $16.7\,\text{m/s}^2$ [N]
(e) $17.1\,\text{m/s}^2$ [S]

_____ 16. 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

_____ 17. A car travels $35\,\text{km}$ [N] in 30 minutes and then hits a traffic jam and spends 90 minutes travelling $16.7\,\text{km/h}$ [N]. The average velocity of the car is:

(a) $43.35\,\text{km/h}$ [N]
(b) $51.7\,\text{km/h}$ [N]
(c) $16.7\,\text{m/s}$ [N]
(d) $8.34\,\text{m/s}$ [N]
(e) 0

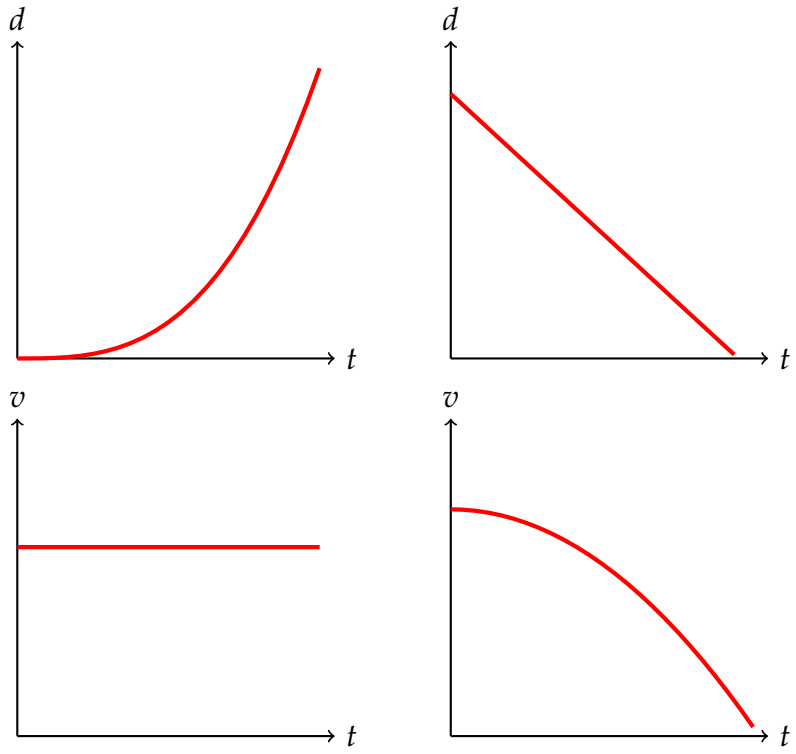
_____ 18. A ball is thrown straight up in the air and then caught at the same height. The acceleration is $9.8\,\mathrm{m/s^2}$ [down]:

(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

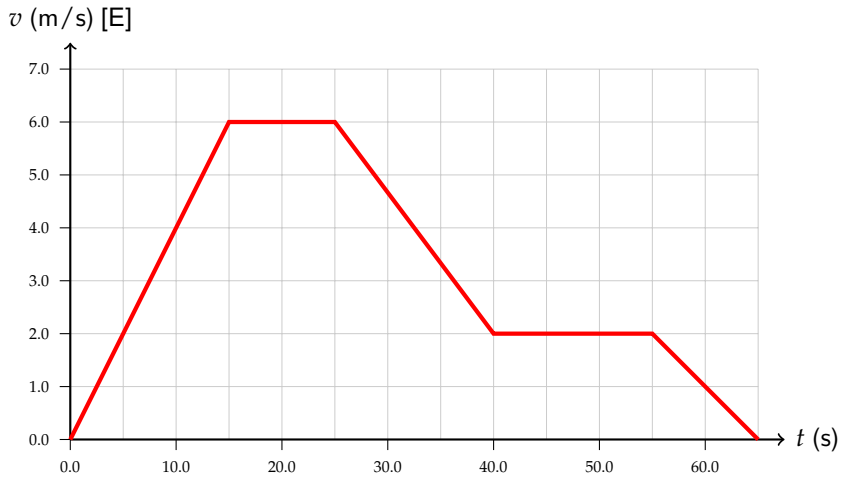
_____ 19. A boy throws a ball straight up off a second floor balcony and it then lands on the ground. Neglecting air resistance, the magnitude of velocity is greatest:

(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

20. Draw conclusions about the *velocity* and *acceleration* of the motion represented by the following four graphs. (The four graphs are four different questions. Pay attention to the y-axis.)



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



(a) Use words and numbers to describe the motion of the object. (Remember to include both magnitude and direction for vectors.)

i. from $t = 0.0\,\text{s}$ to $15.0\,\text{s}$

ii. from $t = 25.0\,\text{s}$ to $35.0\,\text{s}$

(b) How do the motions of the object from $t = 15.0\,\text{s}$ to $30.0\,\text{s}$ and $t = 35.0\,\text{s}$ to $55.0\,\text{s}$ compare?

(c) What is the velocity of the object at $t = 10.0\,\text{s}$?

(d) During which time interval does the maximum magnitude of acceleration of the object occur? What is the acceleration during the interval?

(e) What is the displacement of the object after $30.0\,\text{s}$?