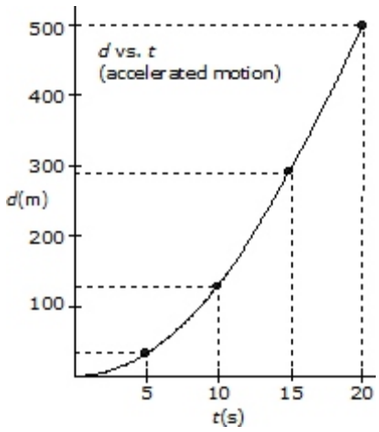
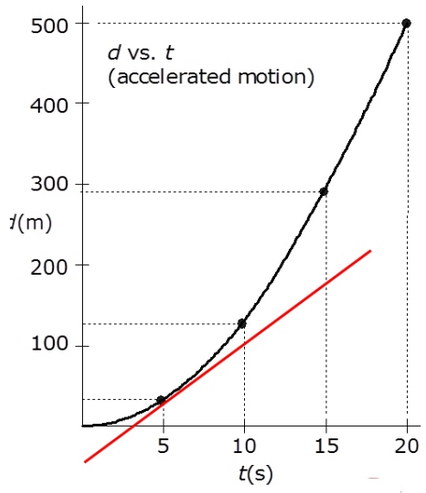
Physics 2204
Worksheet 12: Graphical Analysis of Non- Uniform Motion

D-T GRAPH OF NON-UNIFORM MOTION (ACCELERATING) :

- The d-t graph for uniformly Accelerated motion is definitely not the same as a d-t graph for uniform motion The d-t graph for uniformly accelerated motion is a curve known as a **parabola**.



- To find the instantaneous velocities on the d-t graph, we draw **tangents**. Tangent is a straight line that touches a curve at only one point. Each tangent on a curve has a unique slope, which represents the velocity at that instant. In order for the object to be at that position, at that time, it must have an instantaneous velocity equal to the slope of the tangent at that point

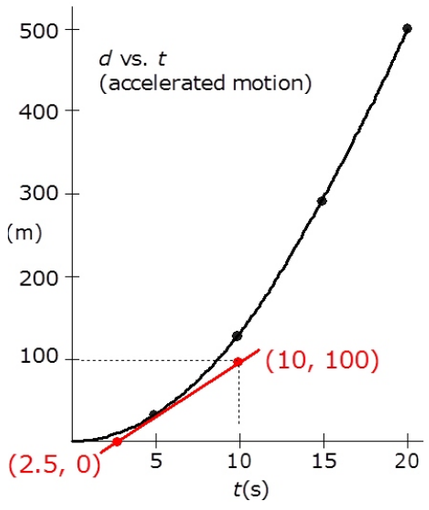


Example:

Choose two points on the tangent and find the slope of the tangent. The two points shown here are (10,100) and (2.5, 0).

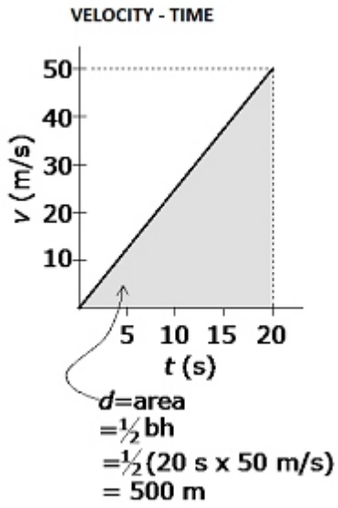
$$v_5 = \text{slope}$$
$$= \frac{100\,\text{m} - 0\,\text{m}}{10\,\text{s} - 2.5\,\text{s}}$$
$$= \frac{100\,\text{m}}{7.5\,\text{s}} = 13\,\text{m/s}$$

The instantaneous velocity at 5s is 13 m/s



V-T GRAPH OF NON-UNIFORM MOTION (ACCELERATING) :

- The area under a velocity-time graph is the displacement.



- The slope of a velocity-time graph is the acceleration

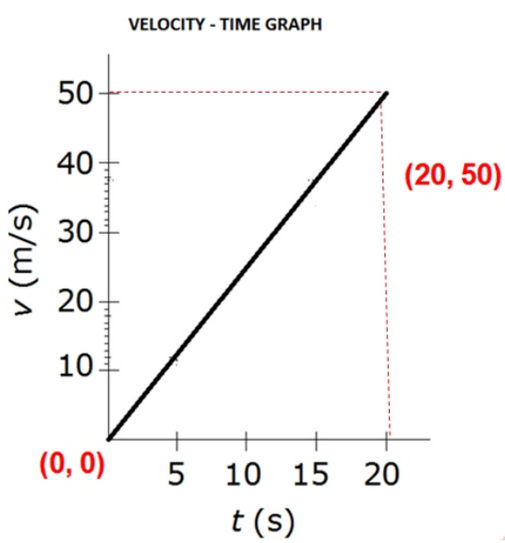
$$Slope = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{(50m/s) - (0m/s)}{(20s) - (0s)}$$

$$= \frac{(50m/s)}{20s}$$

$$= 2.5m/s$$

$$= 2.5m/s^2$$



Summary

1) Displacement-time graph of uniform acceleration is a parabola.

2) Slope of tangent on a displacement-time graph is instantaneous velocities

3) Greater the slope of the tangent on a displacement-time graph the greater the instantaneous velocities

4) Velocity-time graph of uniform acceleration is a linear line

5) Area under a velocity-time graph is the displacement of the object

6) Slope of a velocity-time graph is the acceleration of the object.

PART A:

1. Which of the following is used to determine the instantaneous velocity on a d-t graph for an object undergoing non-uniform motion?

   (A) Area under the curve from zero to that time
   (B) Height of the curve at that time
   (C) Slope of the tangent to the curve at that time
   (D) Total length of the curve

2. What does the slope of a tangent drawn to a point on a curved **displacement versus time** graph represent?

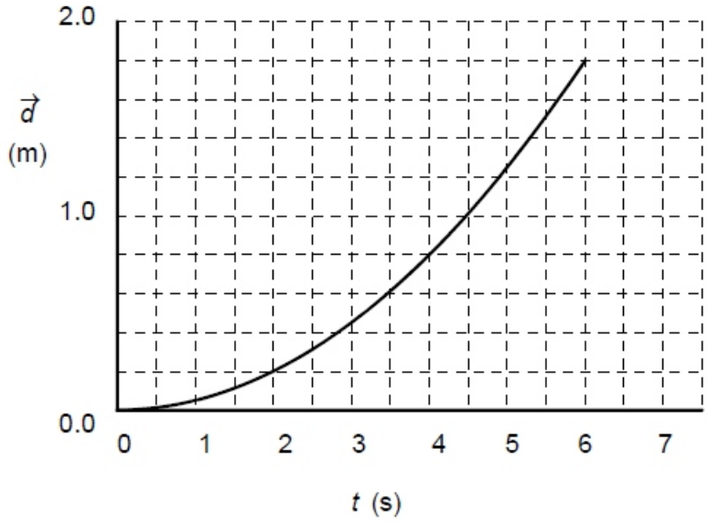
   (A) Average speed
   (B) Average velocity
   (C) Instantaneous speed
   (D) Instantaneous velocity

3. Which of the following would most likely be the units from the slope of a tangent drawn to a point on a curved **displacement versus time** graph?

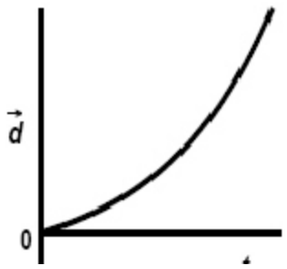
   (A) m
   (B) s
   (C) m/s
   (D) m/s^2

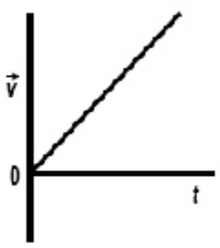
4. Examine the graph shown at the right. What is the instantaneous speed at t = 4 s?

   (A) 0.8 m/s
   (B) 2 m/s
   (C) 4 m/s
   (D) 0.4 m/s

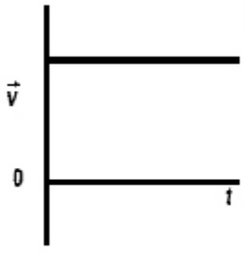


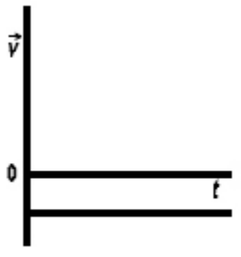
5. Which velocity-time graph matches the displacement-time graph shown below?



(A)


(B)


(C)


(D)


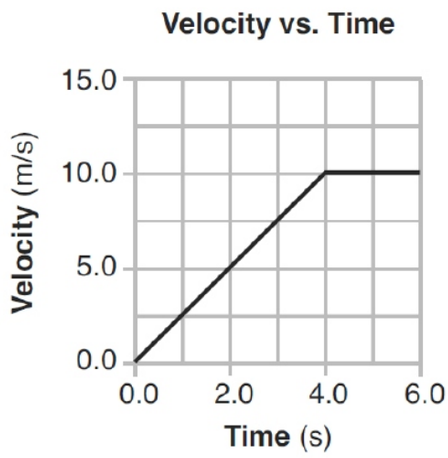
6. Which of the following represents the initial velocity on a velocity-time graph?

(A) The x-intercept
(B) The y-intercept
(C) The slope of the line
(D) The area under the graph

Use the velocity-time graph below to answer questions 7 and 8

7. What is the total displacement for the car during this 6.0-second interval?

(A) 10 m
(B) 20 m
(C) 40 m
(D) 60 m

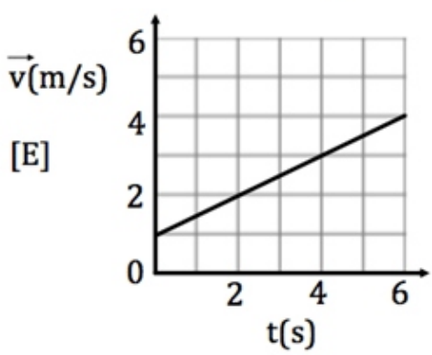


8. What is the acceleration of the car at t = 5.0 seconds?

(A) 0.0 m/s^2
(B) 2.0 m/s^2
(C) 2.5 m/s^2
(D) 10 m/s^2

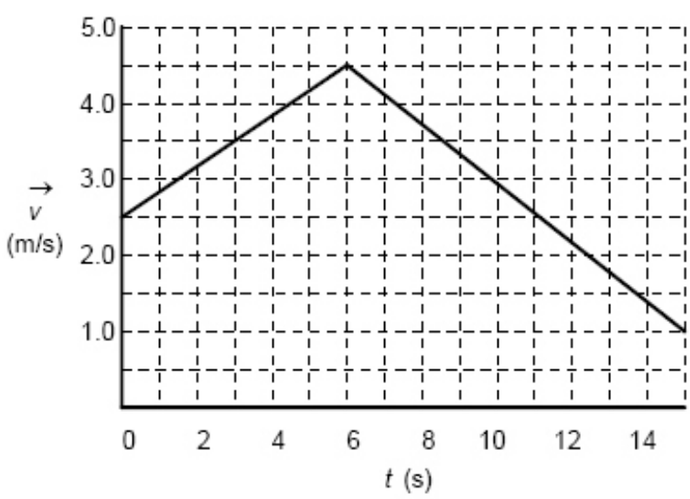
9. What is the magnitude of the acceleration of the object?

(A) 0.5 m/s^2
(B) 0.7 m/s^2
(C) 1 m/s^2
(D) 2 m/s^2



10. Examine the v-t- graph shown at the right. What is the acceleration at t = 10 s?

(A) -.3 m/s^2
(B) -.39 m/s^2
(C) -.50 m/s^2
(D) +.3 m/s^2

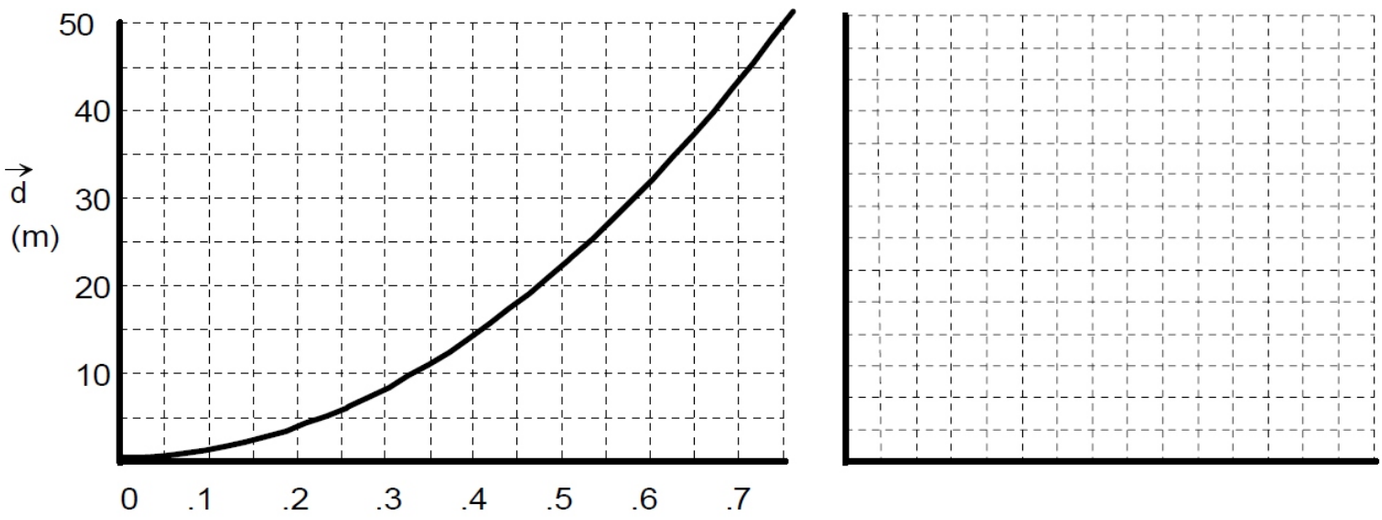


11. Which of the following would most likely be the units from finding the area under a velocity- time graph?

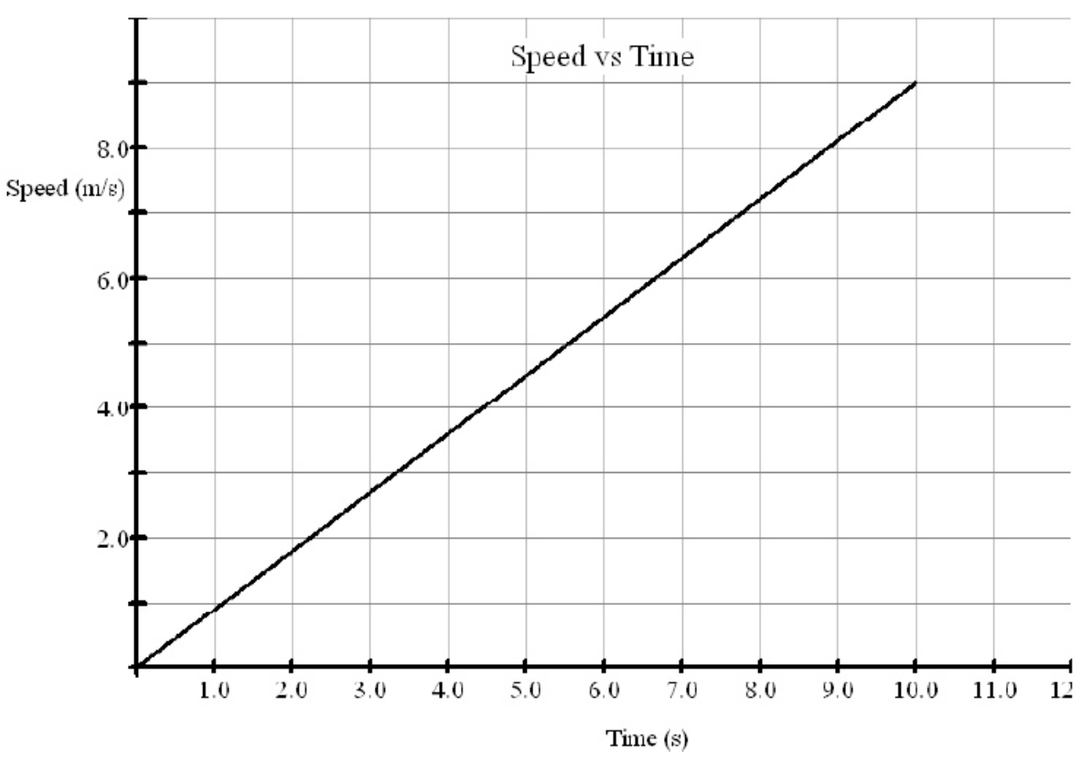
(A) m
(B) s
(C) m/s
(D) m/s^2

PART B: WRITTEN RESPONSE

1. Use the position-time graph below appropriately to construct a neat velocity-time graph on the grid provided. You may wish to construct a velocity-time table to help you with your graph. (5 marks)



2. The graph below shows the speed of a bicycle as it accelerates from rest.



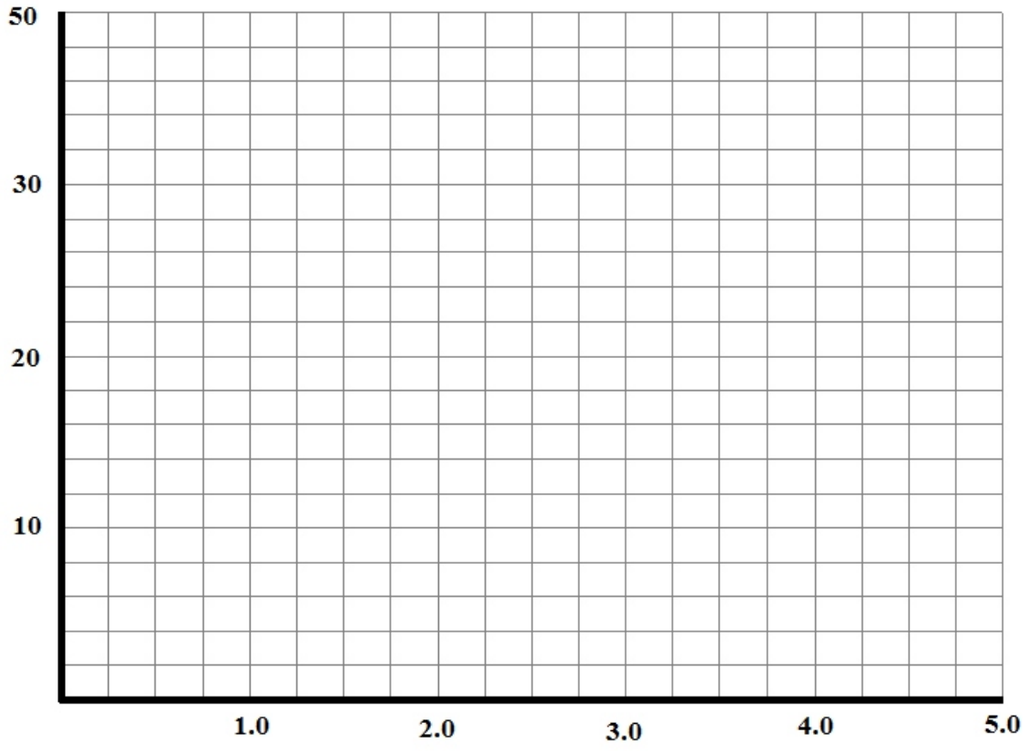
a) Construct a distance-time chart showing the distance travelled after each of the times listed in the table

t(s)	1.0	2.0	3.0	4.0
d(m)				

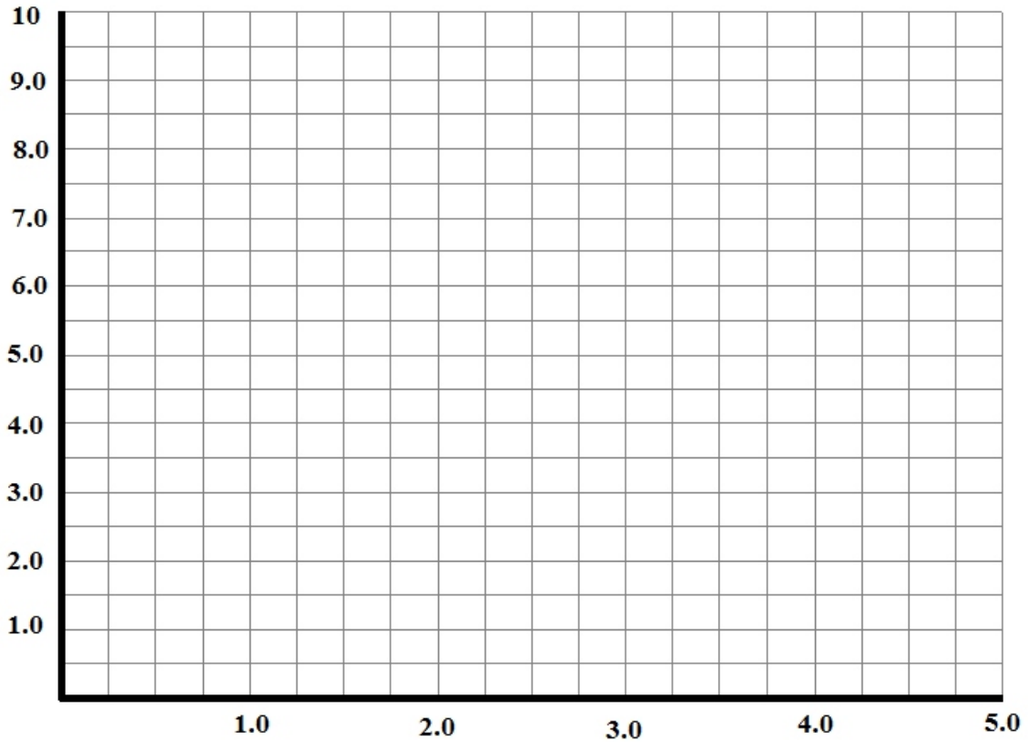
b) What is the acceleration of the bicycle?

3. Use the position-time chart below to graph both a position-time graph and a velocity-time graph for this uniformly accelerated motion. For the velocity-time graph, do not assume the object started from rest

t(s)	0.0	1.0	2.0	3.0	4.0	5.0
d(m)	0.0	3.0	8.0	15.0	24.0	35.0

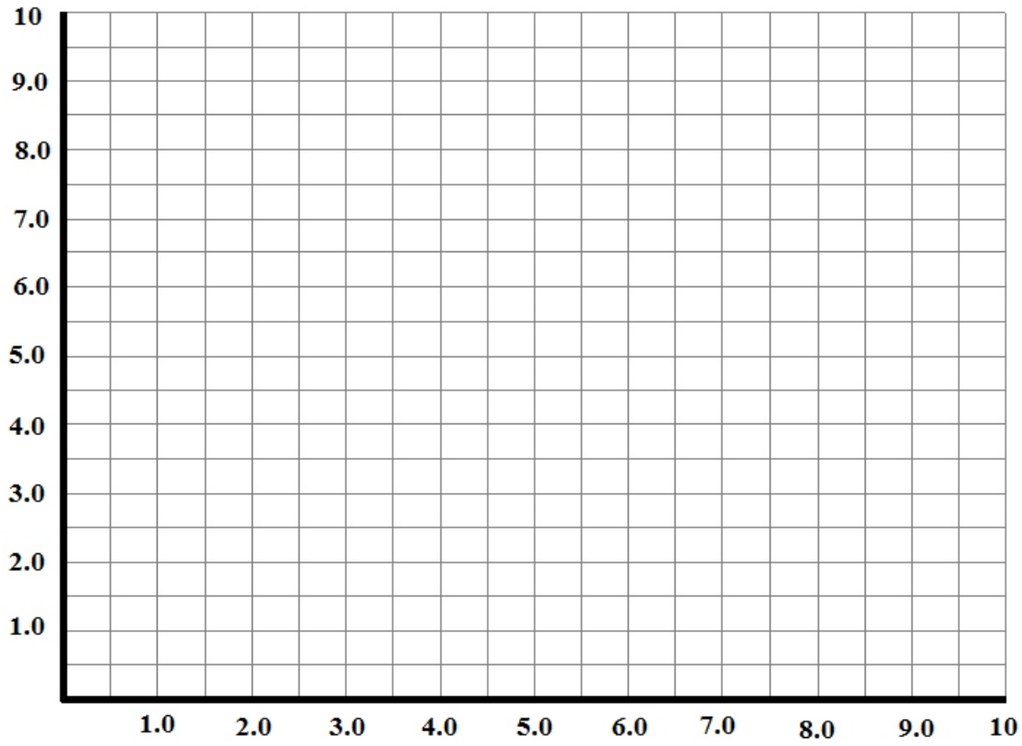


Calculate three tangents:



4. A car is moving at a velocity of 8.0 m/s [north] and comes to a stop in 10.0 s while experiencing uniform acceleration. (This is still acceleration even if the car slows down).

(a) Construct a speed vs time graph to show this motion.



(b) What is the car's displacement during the 10.0 s? Show your work.

(c) What is the acceleration of the car?