

Unit 9: Motion Study Guide

1. Explain the difference between speed and velocity. Speed is a scalar/measure, Velocity is a vector/has measure + direction

2. What is the formula for calculating velocity?

$$v = \frac{d}{t}$$

3. Give three examples of units of velocity.

m/s km/hr mi/hr
in./min. km/s m/min.

4. What is the formula for slope? rise / run

5. What does the slope of a line on a distance-time graph represent? average velocity

6. What is acceleration? rate of change in velocity over time

7. What is the formula for calculating acceleration?

$$a = \frac{\Delta v}{t}$$

8. Give three examples of units of acceleration.

m/s² m/s/s km/hr/s

9. What does the slope of a line on a velocity-time graph represent? average acceleration

10. What is a scalar? Give three examples. quantity 4m, 5s, 2g

11. What is a vector? Give two examples. quantity + direction 5 km/hr South, 8 m/s Up

Practice Problems (all numbers should have units!)

12. What is the average speed of a bus that traveled 2,000 miles in 26 hours?

$$d = 2000 \text{ mi}$$

$$t = 26 \text{ hr}$$

$$v = ?$$

$$v = \frac{d}{t}$$

$$v = \frac{2000 \text{ mi}}{26 \text{ hr}} = \boxed{76.9 \text{ mi/hr}}$$

13. What is the velocity of a runner who ran 50 meters west in 3 seconds?

$$d = 50 \text{ m}$$

$$t = 3 \text{ s}$$

$$v = ?$$

$$v = \frac{d}{t}$$

$$v = \frac{50 \text{ m}}{3 \text{ s}} = \boxed{16.7 \text{ m/s}}$$

14. A sprinter starts running at the starting line and has a velocity of 6 m/s in 12 seconds. What is her acceleration?

$$v_f = 6 \text{ m/s}$$

$$t = 12 \text{ s}$$

$$a = ?$$

$$v_i = 0 \text{ m/s}$$

$$a = \frac{v_f - v_i}{t}$$

$$a = \frac{6 - 0 \text{ m/s}}{12 \text{ s}} = \boxed{0.5 \text{ m/s}^2}$$

15. Describe the motion of the car below. speeding up, accelerating

0 s	1 s	2 s	3 s	4 s	5 s
0 m	5 m	20 m	45 m	80 m	125 m

a. What is the velocity of the car from 0m-5m? $v_i = \frac{d}{t} = \frac{5m}{1s} = \boxed{5m/s}$

b. What is the velocity of the car from 80m-125m? $v_f = \frac{d}{t} = \frac{45m}{1s} = \boxed{45m/s}$

c. What is the car's acceleration? $a = \frac{v_f - v_i}{t} = \frac{45 - 5m/s}{5s} = \frac{40m/s}{5s} = \boxed{8m/s^2}$

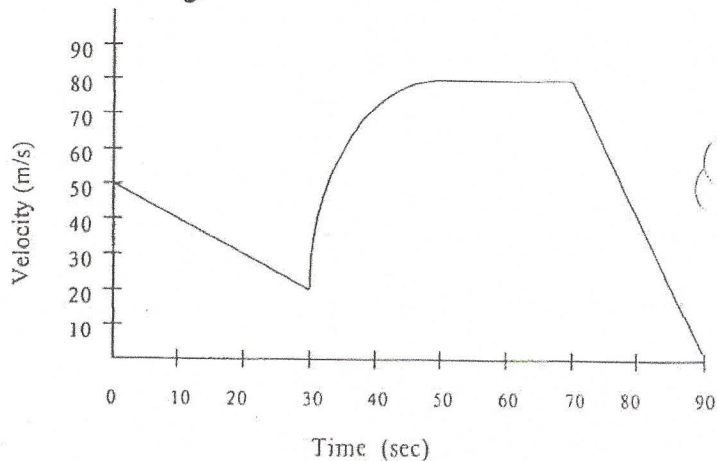
16. The slope of the velocity-time graph below indicates the average acceleration.

17. Describe the general motion of this graph.

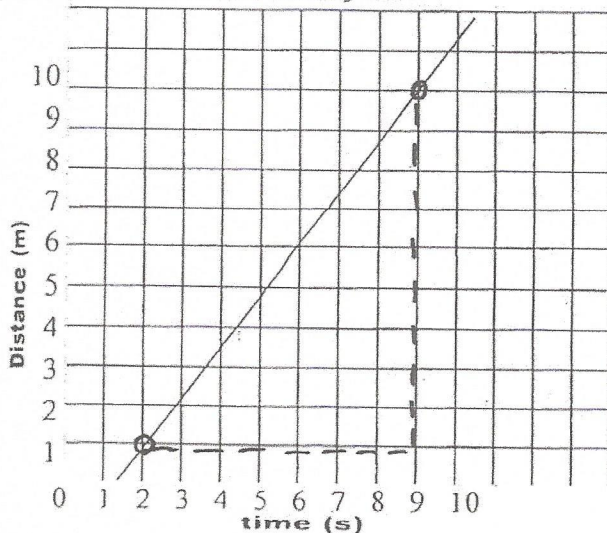
a. 1st 30 seconds constant deceleration

b. 30-50 seconds increasing (changing) acceleration

c. final 20 seconds decelerate to a stop



18. Calculate the slope of the bubble in this velocity tube.

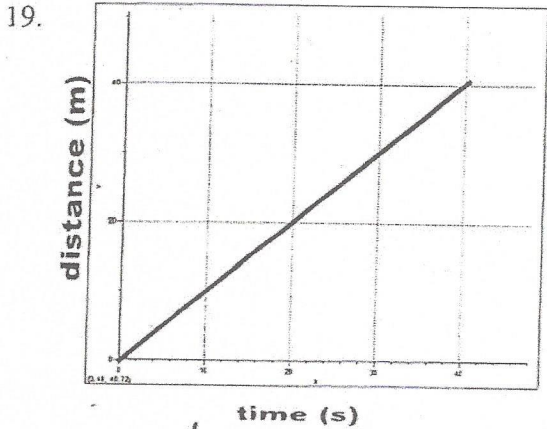


Slope = $\frac{\text{rise}}{\text{run}}$
 slope = $\frac{10 - 1m}{9 - 2s}$
 = $\frac{9m}{7s}$
 = $\boxed{1.3m/s}$

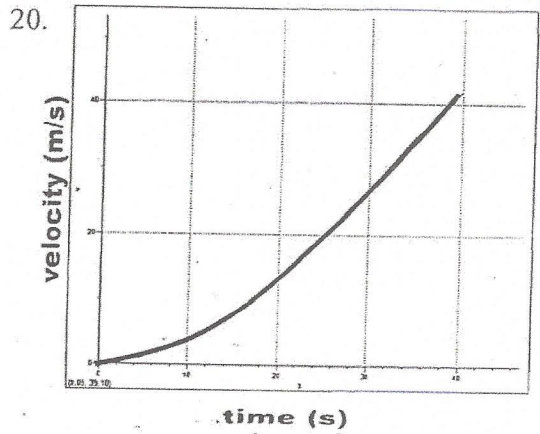
The slope of this distance-time graph gives the average velocity.

A List Identify the motion for each graph below.
 B List Describe the motion of the object.

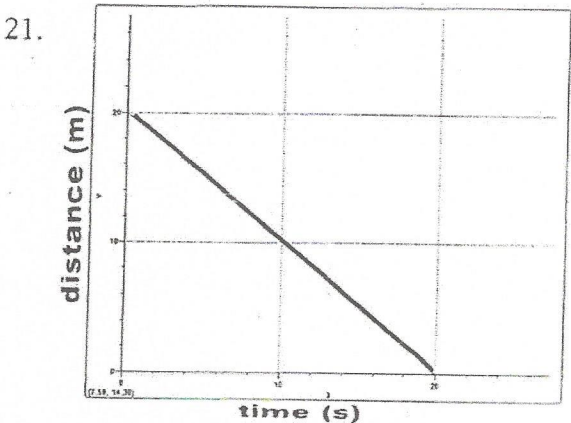
A List	B List
Acceleration	constant deceleration
Deceleration	constant velocity
Velocity	constant velocity in (+) direction
Velocity	constant velocity in (-) direction
No acceleration	increasing acceleration
No velocity	no motion



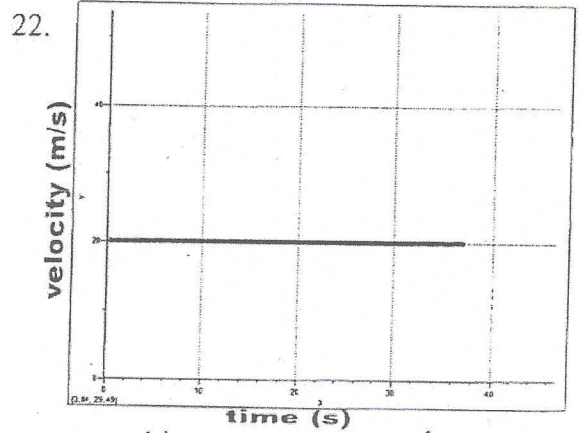
- a. velocity
 b. constant velocity (+)



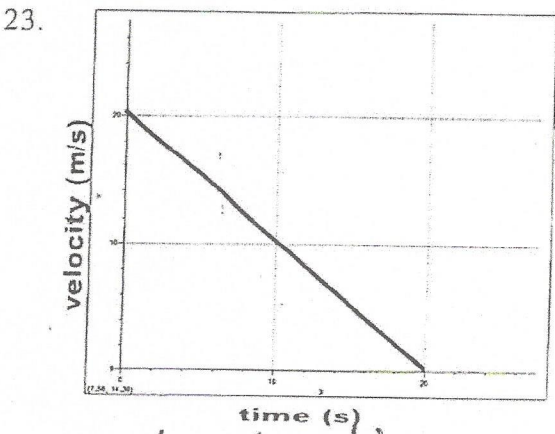
- a. acceleration
 b. increasing acceleration



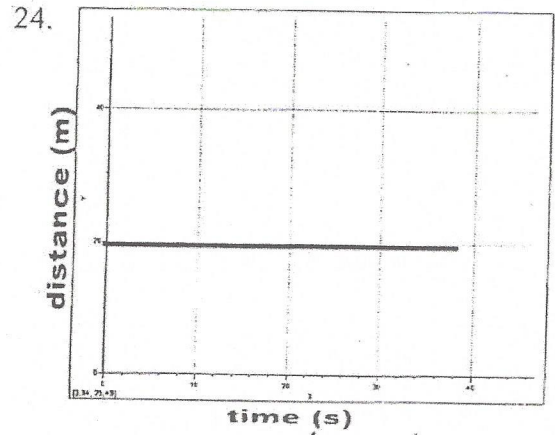
- a. velocity
 b. constant velocity (-)



- a. No acceleration
 b. Constant velocity



- a. deceleration
 b. constant deceleration



- a. No velocity
 b. no motion

25. Calculate Velocity from the Run the Race results.

Distance	5m	10m	15m	20m
Runner #1 Time	1.7 s	2.5 s	3.1 s	3.9 s
Runner #2 Time	1.1 s	2.2 s	3.3 s	4.5 s

$$V = \frac{D}{T}$$

	Runner #1	Runner #2
5m	2.9 m/s	4.5 m/s
10m	4 m/s	4.5 m/s
15m	4.8 m/s	4.5 m/s
20m	5.1 m/s	4.4 m/s

Which runner is fastest at 5m? #2 10m? #2 15m? #1 20m? #1

Which runner wins the race? #1

26. A car is going 90 m/s and slams on the brakes. The car comes to a complete stop in 7 seconds. The car had an acceleration of:

$$A = \frac{\Delta V}{\Delta T} = \frac{0 - 90}{7} = -\frac{90}{7} = -12.9 \text{ m/s}^2$$

27. A football player runs the 40 meter dash in 4.93 seconds, what is his velocity

$$V = \frac{D}{T} = \frac{40 \text{ m}}{4.93 \text{ s}} = 8.11 \text{ m/s}$$

28. The total distance from A101 to B321 at Hoover High School is 123 meters. If a student walks at an average speed of 4.5 m/s, how long will it take that student to get to class:

$$T = \frac{D}{V} = \frac{123 \text{ m}}{4.5 \text{ m/s}} = 27.3 \text{ s}$$

29. If a bus is traveling averaging a speed of 72 m/s for 4 hours and 30 minutes, what is going to be the total distance the bus travels?

$$D = VT = 72 \text{ m/s} (54000) = 3,888,000 \text{ m}$$

$4(60) = 240$ $60(30)$
 240×60
 $14,400 + 1800 = 54000$

30. A plane if averaging a velocity of 150 mph east. If the plane has a total flight of 525 miles, how long will it take him to make the flight?

$$T = \frac{D}{V} = \frac{525 \text{ mi}}{150 \text{ mph}} = 3.5 \text{ hrs}$$

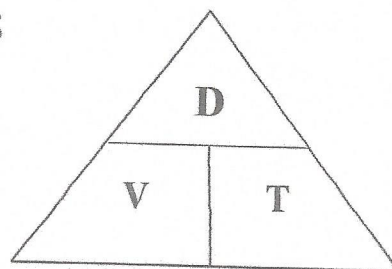
31. A Rocket traveling at 700m/s fires its booster rockets until the craft reaches 780m/s. IF the boosters fire for 20 seconds, what is the acceleration of the rocket?

$$A = \frac{\Delta T}{\Delta V} = \frac{780 - 700}{20} = \frac{80}{20} = 4 \text{ m/s}^2$$

VELOCITY PRACTICE PROBLEMS

Show your work.

$$V = D/T$$



1. A runner goes 400 meters on the track in 26 seconds. What is their velocity?

$$V = \frac{D}{T} \quad \frac{400 \text{ m}}{26 \text{ s}}$$

$$15.4 \text{ m/s}$$

2. A car is traveling 25 m/s for 15 seconds. How far did it go?

$$D = VT \quad 25 \text{ m/s} (15 \text{ s})$$

$$375 \text{ m}$$

3. A turtle goes 15 meters in 6 minutes. What is its velocity in m/s?

$$V = \frac{D}{T} \quad \frac{15 \text{ m}}{360 \text{ s}} = 0.04 \text{ m/s} \quad 6 \text{ min} = 360 \text{ s}$$

4. A car moving at 30 m/s for 60 seconds has moved how many meters?

$$D = VT \quad 30 \text{ m/s} (60 \text{ s}) \quad 1,800 \text{ m}$$

5. Timmy runs 40 yards at a speed of 11.8 yards per second. What is his finishing time?

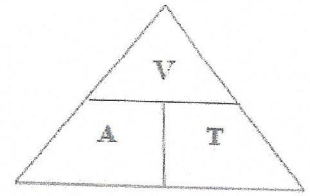
$$T = \frac{D}{V} \quad \frac{40 \text{ y}}{11.8 \text{ y/s}} = 3.39 \text{ s}$$

6. An ostrich can run for 120 meters in 16 seconds. How fast is it running?

$$V = \frac{D}{T} \quad \frac{120 \text{ m}}{16 \text{ s}} \quad 7.5 \text{ m/s}$$

Acceleration Practice Problems
 Show all work to receive credit.

$$A = \frac{\Delta V}{\Delta T}$$



- 1) A car starts from a stoplight and is traveling with a velocity of 10 m/sec east in 20 seconds. What is the acceleration of the car?

$$\frac{10 \text{ m/s}}{20 \text{ s}} = 0.5 \text{ m/s/s}$$

- 2) A ball is rolled at a velocity of 12 m/sec. After 36 seconds, it comes to a stop. What is the acceleration of the ball?

$$\frac{12 \text{ m/s}}{36 \text{ s}} = 0.33 \text{ m/s}^2$$

- 3) A falling object is accelerated by gravity at 9.8 m/sec². If it takes 15 seconds for the object to hit the ground after it has been released, with what velocity will the object impact the ground?

$$V = AT \quad 9.8 \text{ m/s}^2 (15 \text{ s}) = 147 \text{ m/s}$$

- 4) A rocket traveling at 400 m/sec fires its booster rockets until the craft reaches 550 m/sec. If the boosters fire for 30 seconds, what was the acceleration of the rocket?

$$A = \frac{\Delta V}{\Delta T} = \frac{550 \text{ m/s} - 400 \text{ m/s}}{30 - 0} = \frac{150 \text{ m/s}}{30 \text{ s}} = 5 \text{ m/s/s}$$

- 5) After applying its brakes, a car accelerates at rate of -15 m/sec/sec. If the car was traveling at a rate of 25 m/sec, how long will it take the car to stop?

$$T = \frac{V}{A} = \frac{25 \text{ m/s}}{-15 \text{ m/s}^2} = -1.67 \text{ s}$$

- 6) What will be the final velocity of a boat leaving its dock on Smith Lake at 0.5 m/sec/sec if it travels for 2 minutes?

$$V = AT \quad 0.5 \text{ m/s}^2 (120 \text{ s}) = 60 \text{ m/s}$$

$2 \text{ min} = 120 \text{ s}$