Motion Review Name: _____

Answer ALL questions on separate paper. Draw diagrams to help you visualize each scenario. Show all steps, as we have in class, to solve math questions.

1. Complete the following table:

Term	Definition	Unit	Examples
Speed	rate distance changes	m/s	30 m/s
Velocity	speed with direction	m/s	30 m/s, N
Scalar	(magnitude only)	\	40 seconds
Vector	(magnitude & direction	\	50 m NE
Displacement	Δd change in position	m	60 m SW
Distance	length traveled	m	60 m

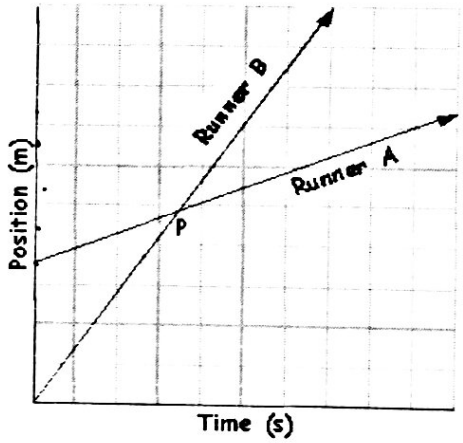
2. Differentiate between average and instantaneous velocity.

avg vel = total displacement / total time inst. vel = velocity at a specific instance in time

3. You and your friend leave the classroom at the same time and both are walking at 5 m/s. You turn right and your friend turns to the left. What is the relative velocity between you and your friend? EXPLAIN

10 m/s

4. Use the Graph to the right to answer the questions below:



a. Which runner is faster? How do you know this?

B (steeper slope)

b. If each box on the graph represents 10 meters, how far did Runner A run? 40m

c. If each box on the x-axis represents 10 seconds, how long did the runners run before they crossed paths?

35s

5. Using your newly learned knowledge, decide whether each of the following is a scalar (s) or vector (v) quantity. Be sure to briefly describe why you chose your answer.

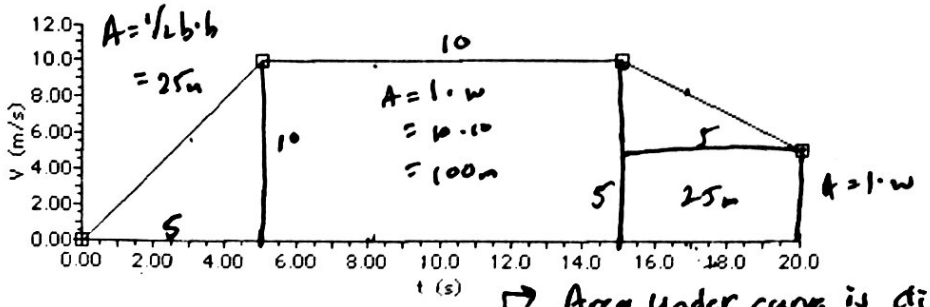
a. speed s
b. velocity v
c. 33 meters s
d. 132º to the northeast v
e. 6:30 P. M. s
f. 55 miles per hour s
g. displacement v

6. What quantity can you determine from the slope of a position-time graph?

velocity

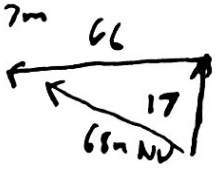
7. Your physics book is mysteriously moving across your desk. Can the book have:
(explain your answers)
   a. a constant speed and a changing velocity? yes (book could have same speed but turn)
   b. a constant velocity and a changing speed? no (if magnitude of speed changes velocity changes)

The velocity-time graph below depicts the motion of an automobile as it moves through Kennesaw during rush hour traffic. Use the graph to answer questions 8 and 9.



↳ Area under curve is displacement

8. Determine the displacement of the automobile during the following intervals of time.
   a. t = 0.0 s – 5.0 s 25m
   b. t = 5.0 s – 15.0 s 100m
   c. t = 15.0 s – 20.0 s 25m
9. Determine the velocity of the automobile at the following instant(s) in time.
   a. t= 3 s 6m/s
   b. t = 8 s 10m/s
   c. t = 17 s 8m/s
10. An object travels 80m W, 20m N, 14m E, and 3m S in 5 seconds. Determine the following.
   a. Distance = 80+20+14+3 = 117m
   b. Displacement = 68m, NW
   c. Velocity = 13.6m/s, NW
   d. Speed 23.4m/s

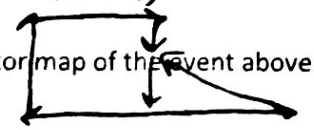


$v = \frac{\Delta d}{t}$ $r = \frac{d}{t}$

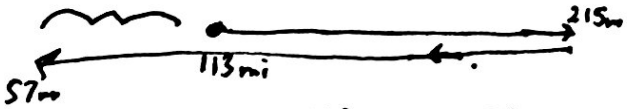
$= \frac{68\text{ m, NW}}{5\text{s}}$ $= \frac{117\text{m}}{5\text{s}}$

$= 13.6\text{m/s, NW}$ $= 23.4\text{m/s}$

11. Draw a vector map of the event above.



12. Art Zenkraftz is traveling along the New York State Thruway. He started at the 113 mile marker. At a time later, he notices a second sign of 215 miles and makes an illegal U-turn (and was issued a ticket by the State Trooper). He travels for a while and notices a 57 mile marker. What is his resultant displacement?



$\Delta d = 57 - 113 =$ 56mi West

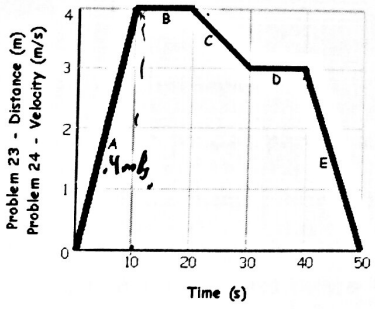
13. If an object is moving eastward and slowing down, then the direction of its velocity vector is ____.

   a. eastward b. westward c. neither d. not enough info to tell

22. The figure at the right is a graph that shows the distance an object traveled plotted against time. Calculate the average velocity of the object for each line segment.

A = .4 m/s, B = 0 m/s, C = -.1 m/s, D = 0

E = -.3 m/s



23. Using the same graph at right (but the vertical axis is now velocity), determine the distance that the object traveled over the entire 50 s interval.

OMIT

24. While driving North on I-75 at 65 mph you hit a bug that had an initial velocity of 7.8 mph South. After the collision, what is the approximate velocity of the bug? How does the force of the bug on the car compare to the force of the car on the bug?

65 mph, Forces are equal

25. The law of inertia states that no force is required to maintain motion. Why, then, do you have to keep pedaling your bicycle to maintain motion?

Friction

26. Your teacher challenges you and your best friend to each pull on a pair of scales attached to the ends of horizontal rope, in tug-of-war fashion, so that the readings on the scales will differ. Can this be done? Explain. No. Newton's 3rd Law

27. The law of inertia states that no force is required to maintain motion. Why, then, do you have to keep pedaling your bicycle to maintain motion? Friction

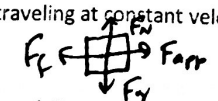
28. If you were in a spaceship and launched a cannonball into frictionless space, how much force would have to be exerted on the ball to keep it going? ON. No Friction

29. Does a 2-kilogram rock have twice the mass of a 1-kilogram rock? Twice the inertia? Twice the weight (when weighed in the same location)? Yes, Yes, Yes

30. An elephant and a mouse would both have zero weight in gravity-free space. If they were moving toward you with the same speed, would they bump into you with the same effect? Explain

No. Elephant more inertia

Draw a free body diagram for a car traveling at constant velocity with friction present.



Draw a free body diagram for an object falling at constant velocity.

14. Light from the Sun reaches the Earth in 8.3 minutes. The velocity of light is 3.00 x 108 m/s. How far is the Earth from the Sun?

$V = 3.0 \cdot 10^8 \text{ m/s}$ $\quad d = vt$

$t = (8.3 \text{ min}) \times \frac{60 \text{ s}}{1 \text{ min}} = 498 \text{ s}$ $\quad = (3.0 \cdot 10^8 \text{ m/s})(498)$

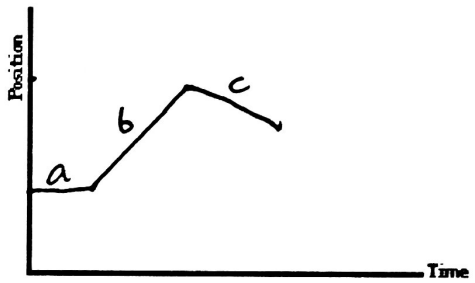
$= 1.494 \cdot 10^{11} \text{ m}$

15. On the position-time graph below, sketch a plot representing the motion of an object which is ... and then label each line with the corresponding letter (e.g., "a", "b", "c", etc.)

a. at rest

b. moving in the positive direction with constant speed

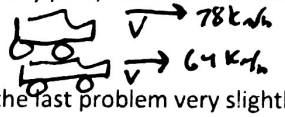
c. moving in the positive direction at a constant speed (slow)



16. Two cars approach each other on the highway. They are both headed westward. The first car is traveling at 78 km/h and the second at 64 km/h. Diagram the situation using vectors.

a. What is the velocity of the first car relative to (in the frame of reference of) the second car?

b. After they pass, will their relative velocity change?



a) $78 - 64 = 8 \text{ km/hr}$

b) No

17. Now, change the last problem very slightly – the cars are now traveling in opposite directions toward each other. The first car is still traveling at 78 km/h westward, but the second car is now traveling 64 km/h eastward. What is the velocity of the first car relative to the second car?

$78 + 64 = 142 \text{ km/hr}$

18. A train leaves the station at the 0.0 m marker traveling with a constant velocity of 42.0 m/s.

a. How many seconds later will the train pass the 3250.0 m marker? $t = d/v = 77.4 \text{ s}$

b. What is the velocity of the train in km/h? $v = 151 \text{ km/h}$ $\quad \frac{42 \text{ m}}{\text{s}} \cdot \frac{1 \text{ km}}{1000 \text{ m}} \cdot \frac{3600 \text{ s}}{1 \text{ hr}} =$

19. What is the displacement of the cross-country team if they begin at the school, run 10 miles and finish back at the school? Omi

20. A pitcher throws a baseball at 140 km/h. How much time does it take the ball to reach the batter 18.3 m away? $d = 18.3 \text{ m} = .0183 \text{ km}$ $\quad t = d/v = .00013 \text{ hrs} = .47 \text{ s}$

21. A boy on a bicycle travels 12 km in 40 min. Calculate the child's average speed.

$r = \frac{D}{t} = \frac{12 \text{ km}}{40 \text{ min}} = .3 \text{ km/min}$