PHYSICS 2204
Unit 1: Kinematics
Worksheet 6: Scalars and Vectors

STUDENT NAME:_____

Scalar Quantity   is one, which is fully defined by magnitude alone.
Important scalars: distance, speed, mass, time, work, energy, power, etc.

Vector Quantity   is fully defined by magnitude and direction. Direction can be shown in the following 4 ways:

Geography	Space	Vector	Sign (+/-)
North	Up	↑	+
South	Down	↓	-
East	Right	→	+
West	Left	←	-

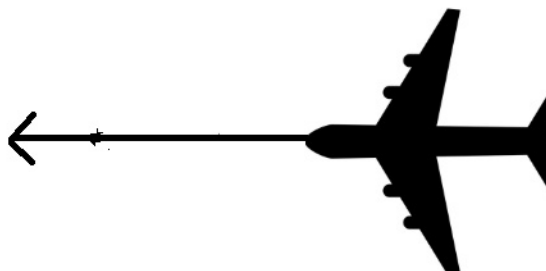Important vectors: displacement, velocity, acceleration, force, impulse, momentum,

Vectors are represented by arrows:
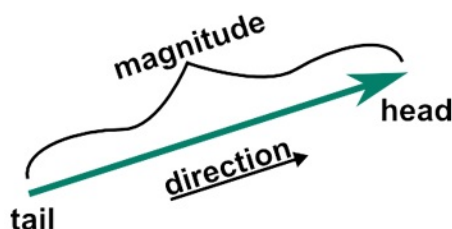
- Head of the arrow indicates direction

- The direction in which the arrow points gives the direction of the vector.
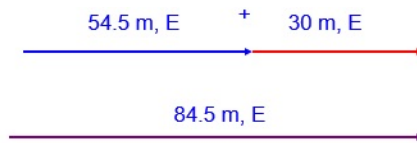
Plane flying 500 km North

Plane flying 1000 km West

VECTOR ADDITION – If 2 similar vectors point in the SAME direction, add them.

Example: A man walks 54.5 meters east, then another 30 meters east. Calculate his displacement relative to where he started

<div align="center">

54.5 m, E   +   30 m, E

84.5 m, E

</div>

VECTOR SUBTRACTION - If 2 vectors are going in opposite directions, you SUBTRACT.

Example: A man walks 54.5 meters east, then 30 meters west. Calculate his displacement relative to where he started?

<div align="center">

54.5 m, E   -

30 m, W

24.5 m, E

</div>
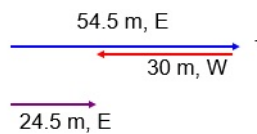
Some definitions:

Distance (d)	is a scalar quantity which refers to "how much ground an object has covered" during its motion.
Position ($\vec{d}$)	is a vector quantity which refers to the straight line distance and direction from a reference point. Location of an object at one instant.
Displacement ($\Delta \vec{d}$)	is a vector quantity which refers to "how far out of place an object is"; it is the object's change in position. Only concerned about the beginning and the end of the trip

Remember if a body returns to its original starting point its displacement is zero

$$\Delta \vec{d} = \vec{d}_2 - \vec{d}_1$$

Speed (v)   is a scalar quantity. It is the distance traveled per unit of time

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

Velocity ($\vec{v}$)   Is a vector quantity. It is defined to be the change in displacement divided by the time of travel.

Remember if a body returns to its original starting point its displacement is zero and its velocity is therefore zero

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

Example 1: One Dimension =>Adding Vectors

A person started from the zero position, moved 3.0 km East (or to the right), then moved backward 4.0 km West (or to the left) in a time of 0.25 hr.

(A)   What is the distance?

(B)   What is the displacement?

(C)   What is the speed?

(D)   What is the velocity?

Example 2

An ant walks 5.0 m [right] and turns to walk 2.0 m [Left] in 5.2 sec.

(A)   What is the distance?

(B)   What is the displacement?

(C)   What is the speed?

(D)   What is the velocity?

Example 3

It takes 30. minute for a round trip to the store which is 3.0 km away

(A)   What is the distance?

(B)   What is the displacement?

(C)   What is the speed?

(D)   What is the velocity?

PART A: MULTIPLE CHOICE

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided

1. Which of the following is true for vectors and scalars?

	Scalar	Vector
(A)	Magnitude only	Magnitude only
(B)	Magnitude only	Magnitude and Direction
(C)	Magnitude and Direction	Magnitude only
(D)	Magnitude and Direction	Magnitude and Direction

2. Which of the following pairs are both scalar quantities?

    (A) Speed and displacement
    (B) Speed and mass
    (C) Velocity and temperature
    (D) Velocity and displacement

3. The wind blows an airplane towards east. Which vector indicates the direction of the airplane?
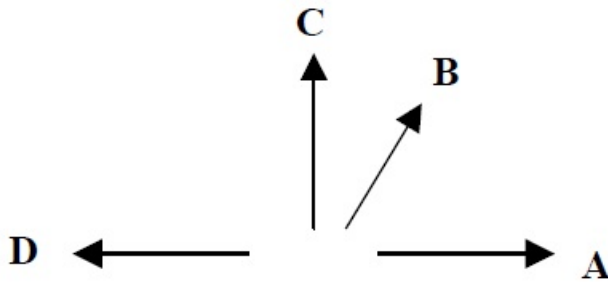
    (A) A
    (B) B
    (C) C
    (D) D

4. Which of the following is a physical quantity that has a magnitude but no direction?

    (A) Displacement
    (B) Resultant
    (C) Scalar
    (D) Vector

5. The speedometer in a car indicates

    (A) An average speed during a trip.
    (B) A vector quantity.
    (C) A scalar quantity.
    (D) The distance the car travels

6. Which of the following is a vector quantity?

    (A) 5.5 kg
    (B) 23 m
    (C) 35 m/s
    (D) 65 m/s [E]

7. John walks 4.0 km [East] and then turns and runs 3.0 km [South]. What is John's total distance?

   (A)   0 km
   (B)   7.0 km
   (C)   9.0 km
   (D)   25 km

8. A girl runs once around a circular track with a radius of 65m at a speed of 2.0 m/s. What distance did she cover?

   (A)   0
   (B)   410m west
   (C)   410m east
   (D)   410m

9. A car moves to the right 100 m then goes to the left for 150 m. What is the displacement (assuming motion to the right is positive)?

   (A)   250 m
   (B)   50 m
   (C)   -50 m
   (D)   100 m

10. A student walks 30m [E], 15m [W], and then 40m [E]. What is the student's total displacement?

   (A)   55 m [E]
   (B)   55 m
   (C)   85 m
   (D)   85 m [W]

11. Mary walks 6 m [E] then 10 m [W] then 8 m [E]. What is her displacement?

   (A)   4 m [E]
   (B)   4 m [W]
   (C)   24 m [E]
   (D)   24 m [W]

12. A hiker walks 3.00 km [N] then 4.00 km [S]. What is the magnitude of her displacement?

   (A)   1.00 km
   (B)   5.00 km
   (C)   7.00 km
   (D)   25.0 km

13. A cyclist rides a bicycle 4.0 km West, then 5.0 km East. What was the total displacement travelled from the person's stating point?

   (A)   1.0 km [E]
   (B)   1.0 km [W]
   (C)   7.0 km [E]
   (D)   7.0 km [W]

14. A square race track has each side 100 m long. A jogger at the southeast corner starts running northward and runs one lap completely around the track, returning to the original position in 50 s. What is the jogger's average velocity?

   (A)   0 m/s
   (B)   1.0 m/s [W]
   (C)   2.0 m/s [W]
   (D)   4.0 m/s [W]

15. Hiker walks 12 km North and then 5 km South. What is her displacement from her starting position?

    (A)   7 km [N]
    (B)   7 km [S]
    (C)   17 km [N]
    (D)   17 km [S]

16. A dog walks 7.0 m [E] and then 5.0 m [W]. What is the displacement of the dog?

    (A)   2.0 m [E]
    (B)   2.0 m [W]
    (C)   12.0 m [E]
    (D)   12.0 m [W]

17. A ball is thrown vertically up and is caught at the starting point; what is the displacement of the ball?

    (A)   0
    (B)   Double the height
    (C)   Half of the height
    (D)   The height squared

18. What is the distance for the same ball in question #17?

    (A)   0
    (B)   Double the height
    (C)   Half of the height
    (D)   The height squared

19. A boy runs once around a circular track with a radius of 45m at a speed of 2.5 m/s. What is the boys displacement?

    (A)   0
    (B)   410m west
    (C)   410m east
    (D)   410m

20. A car travels 10 km [North] then turns and goes 8 km [South]. Which statement is correct?

    (A)   The distance is 18 km and the displacement is 2 km.
    (B)   The distance is 2 km and the displacement is 18 km.
    (C)   Both the distance and the displacement are 18 km.
    (D)   Both the distance and the displacement are 2 km.

21. Which statement is true?

    (A)   Displacement can never be equal to distance.
    (B)   Displacement can never be greater than distance.
    (C)   Displacement can never be less than distance.
    (D)   Displacement is always equal to distance.

22. A plane flies 775 km West, then 325 km West. What was the total displacement travelled?

    (A) 4.50×10^2 km
    (B) 4.50×10^2 km [W]
    (C) 1.10×10^2 km
    (D) 1.10×10^2 km [W]

23. Tom throws a baseball with an average speed of 150km/h. Calculate the time in hours for the ball to travel over a distance of 20m.

    (A)   7.5h
    (B)   300h
    (C)   150h
    (D)   0.00013h

24. A car travels [North] at 100 km/h for 1.0 hour then turns and travels [South] at 70 km/h for 2.0 h. What is the average speed for the trip?

    (A)   -13.3 km/h
    (B)   15.0 km/h
    (C)   80.0 km/h
    (D)   85.0 km/h

25. What is the average velocity of a car that moved 40 km East and 80 km West in 2 hours?

    (A)   60 km/h [East]
    (B)   60 km/h [West]
    (C)   20 km/h [East]
    (D)   20 km/h [West]

26. A boat goes 15 km [North] then turns and goes 10 km [South]. The trip takes 5 hours. What is the average velocity?

    (A)   1.0 km/h
    (B)   3.0 km/h
    (C)   5.0 km/h
    (D)   25 km/h

PART B: WRITTEN RESPONSE

1. For each of the following, determine if the measurement is a scalar quantity or a vector quantity.

    a.   50 km/h   g.   453 s
    b.   6 km [N]   h.   8700 m [W]
    c.   2000 J   i.   1200 g
    d.   6 years   j.   25 °C
    e.   20 m/s [S]   k.   100 km/h [W]
    f.   400 N [E]   l.   250 mol

2. Give the distance and displacement in each of the following:

a.) Jim walks 4.00km[N] then 5.00km[S]

b) Tracey cycles 50.0km[W] then 20.0km[E] and then a further 25.0km[E]

c) Joey drives his Skidoo 7 kilometres north. He stops for lunch and then drives 5 kilometres east.

e) Mr Chard runs one complete lap around a track with a radius of 50m

d) Brandon buys a new Seadoo. He goes 12 km north from the beach. He jumps wakes for 6 km to the east. Then chases a boat 10 km north.

3.   A motorcycle travels 200km[N] and then 350km[S] in 3h. Calculate the following:

a)   distance the motorcycle travelled
b)   displacement of the motorcycle
c)   the speed of the motorcycle
d)   the velocity of the motorcycle.

4.   Mr. Fifield drives is Porsche in a straight line with an average velocity of 200 km [N] for the 2.5 h. He then turned and travelled 60 km [North] for 1.5 h. Calculate the following:

a)   Distance
b)   Displacement
c)   Speed
d)   Velocity

5.   A runner makes one lap around a 200 m track in a time of 25.0 s. What was the runner's average speed and average velocity ?

6.   How long will it take a firecracker to travel 950.0m [W] at an average velocity of 19 m/s [W]?

7.   Tom travels at a speed of 30.0km/h for 25.0min around a circular track and ends where he started. What is Tom's distance and displacement in m?

8.   A person travels at 50.0km/h[W] by car for 2.00hours and 4.00 x 10^2 km/h[E] by plane for 3.00hours. Find the person's average speed and velocity.

9.   Susann is training to be apart of the cross country team at Crescent Collegiate. As a part of her training she runs 22 km [N] and then 32 km [S]. Assuming the trip takes 4.2 hours.

        (A)   What is the total distance traveled?   **[1]**

        (B)   What is the total displacement for the trip?   **[1]**

        (C)   What is the average speed? (in m/s)   **[1]**

        D)   What is the average velocity for the trip? (In m/s)   **[2]**