Scientific Notation, Significant Figures, Unit Conversions
Write the following in scientific notation:

1. 156.90 _____
2. 12 000 _____
3. 0.0345 _____
4. 0.000890 _____

Expand the following numbers:

5. 1.23×10^{6} _____
6. 2.5×10^{-3} _____
7. 1.54×10^{4}_____
8. 5.67×10^{-1}_____

Solve the following and leave your answer in scientific notation:

9. $\frac{6.6 \times 10^{-8}}{3.3 \times 10^{-4}}$ = _____
10. $\frac{7.4 \times 10^{10}}{3.7 \times 10^{3}}$ = _____
11. $(1.56 \times 10^{-7}) \times (2.43 \times 10^{-8})$ _____
12. $(2.5 \times 10^{-6}) \times (3.0 \times 10^{-7})$ _____

Give the number of significant digits in each of the following measurements:

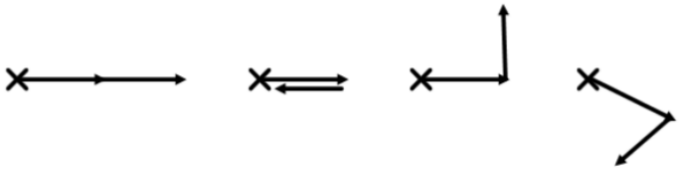
13. 2.9910 m_____
14. 5600 km _____
15. 0.00670 kg _____
16. 809 g _____

Convert the following

17. 4008 g = _____ mg
18. 48 mL = _____ L
19. 239 km = _____ m
20. 2.0×10^{6} μs = _____ s
21. 1.4 cg = _____ mg
22. 2.3×10^{3} m = _____Mm

1.	1.569×10^{2}	7.	15400	13.	5	19.	239 000 m
2.	1.2×10^{4}	8.	0.567	14.	2	20.	2.0 s
3.	3.45×10^{-2}	9.	2.0×10^{-4}	15.	3	21.	14 mg
4.	8.9×10^{-4}	10.	2.0×10^{7}	16.	3	22.	2.3×10^{-3} Mm
5.	123 0000	11.	3.79×10^{-15}	17.	4008000 mg		
6.	0.0025	12.	7.5×10^{-13}	18.	0.048 L		

1. Draw the **resultant** vector for the sets of vectors below. *(Remember that resultant or net vectors go from the beginning to the end and are usually drawn with a dashed line)*



2. Sketch each of the following vectors:

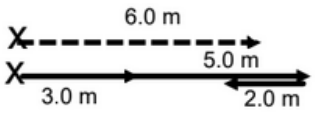
Vector	Diagram
10.0 m [E]	
25.0 m [W]	
12.0 m/s [N]	
15.0 m/s^2 [up]	

3. Draw a vector diagram for each of the following situations. Be sure to draw the resultant vector.
    a. 3.0 m [right] + 5.0 m [right] + 2.0 m [left]
    b. you move from p_1 = + 2.0 m to p_2 = - 3.0 m and then to p_3 = - 6.0 m

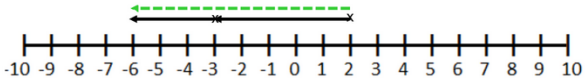
4. For a senior year scavenger hunt you begin at position p_1 = 2.0 m [East]. From there you move another 6.0 m [East]. From there you move 12.0 m [West]. The entire trip takes 14.0 s.
    a. Sketch the vector diagram of the motion.
    b. Calculate the total distance travelled, *d*
    c. Calculate the total displacement travelled, $\vec{d}$
    d. Calculate the average speed of the entire trip, and,
    e. Calculate the average velocity of the entire trip.

Answers:

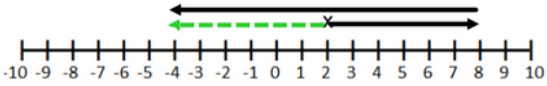
3. a)



b)



4. a)



b) d = 18 m
c) d = - 6.0 m
d) v = 1.3 m/s
e) v = -0.43 m/s

Kinematics:

1. A snowmobile on a frozen pond is moving at 15.0 m/s when the driver decides to pass a slow-moving sled. If the driver accelerates to a speed of 19.5 m/s in a time of 4.00 seconds, what was the acceleration? **[Ans = 1.13 m/s^2]**

2. Your friend is on a quad is moving at 14.0 m/s when you breeze by on your bike. Your friend accelerates at 2.0 m/s^2 for 3.0 seconds. How far does she travel during this time? **[Ans = 51 m]**

3. A Corvette can accelerate during high speeds at about 2.0 m/s^2. At this rate how long does it take the car to accelerate from 80.0 km/h to 160.0 km/h? **[Ans = 11s]**

4. A motorcycle with an initial speed of 2.2 m/s accelerates at 3.6 m/s^2 and covers a distance of 12.0 m. What is its final speed? **[Ans = 9.6 m/s]**

5. A hockey puck initially travelling to the right at 34 m/s is slowed down by rough ice at a rate of 4.2 m/s/s. It moves for 7.2 s, how far did it travel? **[Ans = 140 m]** *careful, what sign is *a*?

6. An object accelerates at 9.81 m/s^2 when falling. How long does it take an object to change its speed from 4.5 m/s to 19.4 m/s? **[Ans = 1.5 s]**

7. What is an object's final velocity if it accelerates at 2.0 m/s^2 for 2.3 s from a velocity of 50.0 km/h? **[Ans = 19 m/s]**

8. What is an object's initial velocity if it accelerates at 2.0 m/s^2 for 2.3 s, attaining a velocity of - 50.0 km/h? **[Ans = -19 m/s]**

9. Assuming no air resistance, how long does it take a penny to fall if it is dropped (dropped means $v_1 = 0$) from the CN Tower (553 m)? Acceleration due to gravity is -9.81 m/s^2. **[Ans = 10.6 s]**

10. A car travelling at 40.0 km/h accelerates at 2.3 m/s^2 for 2.7 s.
    (A) How far has it travelled in that time? **[Ans = 38 m]**
    (B) What is its final velocity? **[Ans = 17 m/s]**

11. An object thrown up from a cliff at 10.0 m/s reaches a velocity of 20.0 m/s down as it lands. If the acceleration due to gravity is - 9.81 m/s^2.
    (A) what is the object's displacement? **[Ans = - 15 m]**
    (B) How long did it take for the object to land from the time it was thrown up? **[Ans = 3.1 s]**

Freefall:

1. A tourist drops a rock from rest from a guard rail overlooking a valley. What is the velocity of the rock at 4.0 s? What is the displacement of the rock at 4.0 s?

2. Suppose the tourist in question #1 instead threw the rock with an initial velocity of 8.0 m/s [down]. Determine the velocity and displacement of the rock at 4.0 s (Remember the v_i is down and must become a -8.0 m/s)

3. Suppose the tourist in question #1 instead threw the rock with an initial velocity of 8.0 m/s [up]. Determine the velocity and displacement of the rock at 4.0 s (Remember the v_i is up and must become a +8.0 m/s)

4. A college student wants to toss a textbook to his roommate who is leaning out of a window directly above him. He throws the book upwards with an initial velocity of 8.0 m/s. The roommate catches it while it is travelling at 3.0 m/s [up].
   a) How long was the book in the air?
   b) How far vertically did the book travel?
   c) Redo the problem, and have the roommate catch the book as it is travelling 3.0 m/s [down]. What is the time and displacement now? Do you notice anything?

5. A man is standing on the edge of a 20.0 m high cliff. He throws a rock vertically with an initial velocity of 10.0 m/s.
   a) How high does the rock go? (Remember that at its max height v = 0 m/s)
   b) How long does it take to reach its max height?

Two-Part Kinematics:

1. A motorist is driving along a city street with a velocity of 50.0 km/h [W]. The motorist sees a soccer ball roll onto the street.
   (A) Determine the velocity of the motorist (in m/s). **[Ans = - 13.9 m/s]**
   (B) The motorist takes 0.460 s to react and then start to brake. What is the displacement of the vehicle before the motorist starts to brake? **[Ans = - 6.39 m]**
   (C) The acceleration of the car is 6.10 m/s^2 [E]. How **far** does the car travel while stopping? **[Ans = 15.8 m]**
   (D) What is the total displacement of the car before it comes to a stop? **[Ans = - 22.2 m]**

2. Police forensics visit the scene of an accident in which a car skidded into an intersection after failing to stop for a red light. The skid marks left by the vehicle in question was 30.0 m long. Forensics also determined that the car's deceleration, with the brakes fully applied, had a magnitude of 6.0 m/s^2. If the posted speed limit was 65 km/h, was the motorist speeding prior to applying the brakes? **[Ans = 68.3 km/hr, Was Speeding]**

3. A car travelling at 24 m/s can slow down at a rate of 8.0 m/s^2. If while driving this car you notice a child in the street 41 m in front of the car
   (A) Can the car stop without hitting the child? Give mathematical evidence. **[Ans = 36 m]**
   (B) Assuming your reaction time is 0.25 seconds, can the car still stop without hitting the child? Give mathematical evidence. **[Ans = 42 m]**

4. You are driving at a constant speed of 22 m/s, when a child suddenly steps into the path of your vehicle 52 m away. When you fully apply the brakes, your car then slows down at

a constant rate of 5.0 m/s^2. What is the minimum **reaction** time that is required so that the child will not be hit? **[Ans = 0.16 s]**

5. A model rocket blasts off vertically from rest with a constant acceleration of 5.57 m/s^2 until its fuel runs out 6.82 s later. It then enters free fall for the remainder of its flight (until it crashes back to Earth).
   (a) Calculate the height of the rocket above the ground when the fuel runs out. **[Ans = 130 m]**
   (b) How much higher does the rocket go before it reaches its maximum height? **[Ans = 74 m]**
   (c) How much time does it take the rocket to leave the ground and to reach its maximum height? **[Ans = 11 s]**
   (d) What is the total time that the rocket is in the air? **[Ans = 17 s]**

6. A rocket sled starts from rest on a track and experiences a uniform acceleration of 22.5 m/s^2 for 4.00s. After the rocket cuts off, the sled travels with uniform motion for 5.00 s before a parachute is deployed. The parachute slows the sled at 27.0 m/s^2. How far does the sled travel before the parachute brings the sled to rest? **[Ans = 780 m]**

7. A runner, starting at rest, accelerates at 1.3 m/s^2 for the first 5.8 seconds of a race. After reaching top speed at the end of the 5.8 s, she has enough energy to maintain this speed for the last 4.5 s of the run. How far did she run altogether? **[Ans = 56 m]**

Relative Motion:

1. Julia can swim at 1.5 km/hr in still water. She is swimming in a river which has a current of 0.50 km/hr [South].
   a) What is her resultant velocity relative to the ground if she swims:
      i) Upstream? (1.0 km/hr [N]) ii) Downstream? (2.0 km/hr [S])
   b) How long will it take her to swim 450 m
      i) Upstream? (1600 s) ii) Downstream? (810 s)

2. An aircraft has an airspeed of 230 km/hr [N].
   a) What is the plane's speed relative to the ground if it:
      i) Flies with a tailwind of 50.0 km/hr? (280 km/hr [N])
      ii) Flies into a headwind of 50.0 km/hr? (180 km/hr [N])
   b) What will be the displacement of the plane if it flies into the headwind for 2.5 hours? (450 km [N])

3. An aircraft leaves Albany for New York, which is due south. If the aircraft can fly at 450 km/hr, and the wind is blowing to the north at 40.0 km/hr, how long will it take the plane to reach New York, which is 285 km away? (0.695 hr)

4. A passenger train is moving slowly to the west at 15 km/hr. A passenger can walk briskly at 5.0 km/hr. The passenger walks towards the rear of the train for 2.0 minutes. What is the displacement of the passenger relative to:
   a) the train (+ 170 m)
   b) the ground (- 330 m)