Science 10 Physics

2.1 Practice Assignment

Rounding, Significant Digits, Scientific Notation, Metric Conversion and Dimensional Analysis

A) Rounding – round to number indicated

Value	Round to nearest whole number, tenth or hundredth	Rounded Answer
0.1495	Nearest hundredth	0.150
29.95	Nearest tenth	30.0
139.49	(Nearest whole number	139
80.46	Nearest tenth	80
5.89	Nearest whole number	6
3.047	Nearest hundredth	3.0

B) Significant Digits – Count significant digits.

Number	Number of Significant Digits
12.42	4
0.01407	4
10.0	3
54.60	4
3.04	3
3.0×10^{3}	2
5.78×10^{-6}	3

C) Scientific Notation - Convert the following to Scientific Notation

Value	# of Significant Digits	Scientific Notation
0.00706	2	7.1×10^{-3}
4000000	3	4.00×10^{6}
43.059	3	4.31×10^{4}
0.00349	1	3×10^{-3}
0.000062	2	6.0×10^{-6}
5400000	2	5.4×10^{6}
6.7	1	7×10^{0}

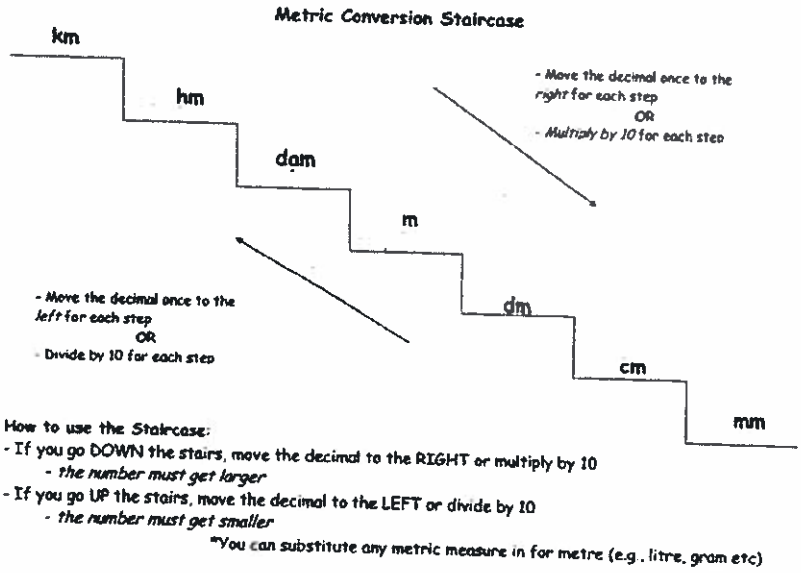
D) Metric Conversion - Complete the following conversions.

a) 95 km = 95000 m

b) 15 m = 0.015 km

c) 150 km = 15000000 cm

d) 35 mm = 0.035 m



How to use the Staircase:
- If you go DOWN the stairs, move the decimal to the RIGHT or multiply by 10
  - *the number must get larger*
- If you go UP the stairs, move the decimal to the LEFT or divide by 10
  - *the number must get smaller*

*You can substitute any metric measure in for metre (e.g., litre, gram etc)

E) Dimensional Analysis – Complete the following conversions. Show all the steps. (ONLY completed by students planning to take Physics 20)

a) 1 year → minutes

$$1\text{ year} \times \frac{365\text{ days}}{1\text{ year}} \times \frac{24\text{ hours}}{1\text{ day}} \times \frac{60\text{ min}}{1\text{ hour}} = 525\,600\text{ min}$$

2.2 Scalars and Vectors

1. Most of the quantities used to describe motion can be categorized as either *vectors or scalars*. A *vector* is a quantity that is fully described by both magnitude and direction. A *scalar* is a quantity that is fully described by magnitude alone. Categorize the following quantities by placing them under one of the two column headings.

displacement, distance, speed, velocity, acceleration

Vectors	Scalars
displacement velocity acceleration	distance speed

2. a. A quantity that is ignorant of direction is referred to as a scalar.

b. A quantity that is conscious of direction is referred to as a vector.

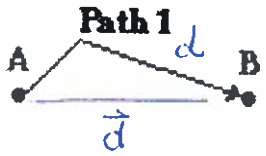
3. *True* or *False*: An object can be moving for 10 seconds and still have zero displacement.

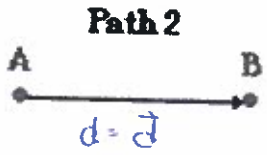
4. If the above statement is true, then describe an example of such a motion. If the above statement is false, then explain why it is false.

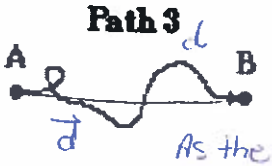
if the object returns to its starting position

eg. Connor McDavid is trying to beat the record for fastest skater by doing one lap of the rink. Start & finish at same location

5. Suppose that you run along three different paths from location A to location B. Along which path(s) would your distance traveled be different than your displacement? Path 1 & 3

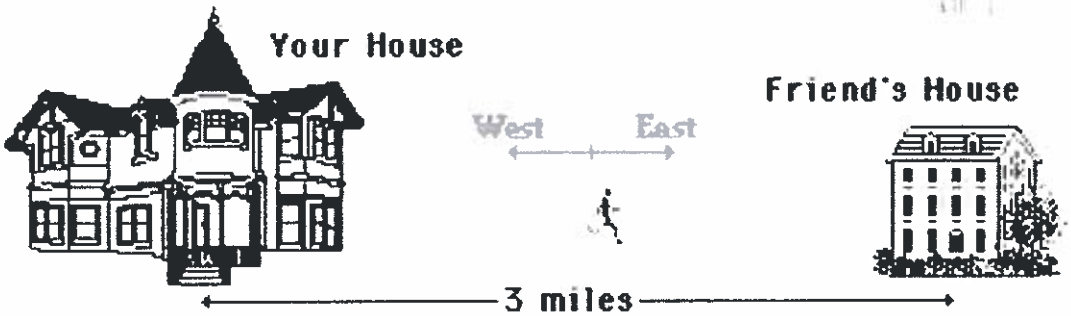






As the crow flies

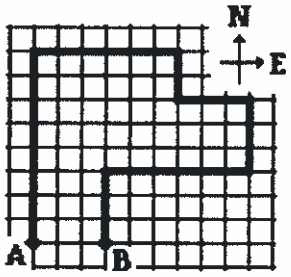
6. You run from your house to a friend's house that is 3 miles away. You then walk home.



a. What distance did you travel? __ 6 miles

b. What was the displacement for the entire trip? 0 miles
returned back where you started

7. Observe the diagram below. A person starts at A, walks along the bold path and finishes at B. Each square is 1 km along its edge. Use the diagram in answering the next two questions.



a. This person walks a distance of 31 km.

b. This person has a displacement of 3 km [East]

$\vec{V} = \frac{\vec{d}}{t}$

Key

Science 10 Physics

2.3 Velocity: Uniform Motion

1. A skateboarder travels 50.0 m in 12.0 s. What is the average speed of the skateboarder?

3SD 3SD

$d = 50.0\text{m}$
$t = 12.0\text{s}$
$V = ?$

$V = \frac{d}{t} = \frac{50.0\text{m}}{12.0\text{s}} = \boxed{4.17\text{m/s}}$

2. A baseball player throws a ball a distance of 45.0 m at a speed of 30.0 m/s. How long is the ball in flight?

3SD 3SD

$d = 45.0\text{m}$
$V = 30.0\text{m/s}$
$t = ?$

$V = \frac{d}{t}$ ↓ t

$t = \frac{d}{V} = \frac{45.0\text{m}}{30.0\text{m/s}} = \boxed{1.50\text{s}}$

3. An airplane flies at a speed of 990 km/h for 4.10 hours. How far does the airplane travel?

3SD 3SD

$V = 990\text{km/h}$
$t = 4.10\text{h}$
$d = ?$

$t \cdot V = \frac{d}{t} \cdot t$

$d = t \cdot v = (4.10\text{h})(990\text{km/h})$
$= 4059\text{ km}$
$= \boxed{4.06 \times 10^{3}\text{ km}}$

4. A bird is flying 6.00 km/h in a straight line at a constant rate. How long, in hours, will the bird take to travel 30.0 km?

3SD 3SD

$V = 6.00\text{km/h}$
$d = 30.0\text{km}$
$t = ?$

$t = \frac{d}{V} = \frac{30.0\text{km}}{6.00\text{km/h}} = \boxed{5.00\text{h}}$

5. A person walks 15.0 m in 5.00 s and then walks 12.0 m in 10.00 s. What is the average speed of the person?

$d = 15.0\text{m} + 12.0\text{m} = 27.0\text{m}$
$t = 5.00\text{s} + 10.00\text{s} = 15.00\text{s}$
$V = ?$

$V = \frac{d}{t} = \frac{27.0\text{m}}{15.00\text{s}}$

$= \boxed{1.80\text{m/s}}$

$\vec{a} = \frac{\vec{V}_f - \vec{V}_i}{t}$ $\vec{V}_f = \vec{a}t + \vec{V}_i$

2.4 V_f Formulas

1. A ball traveling west at 10 m/s increases in speed to 25 m/s in 8.0 s. Find the acceleration of the ball.

$\vec{V}_i = 10\text{m/s [W]}$
$\vec{V}_f = 25\text{m/s [W]}$
$t = 8.0\text{s}$
$\vec{a} = ?$

$\vec{a} = \frac{\vec{V}_f - \vec{V}_i}{t} = \frac{25\text{m/s [W]} - 10\text{m/s [W]}}{8.0\text{s}}$

$\vec{a} = 1.9\text{m/s}^2\text{ [W]}$

2. A bowling ball traveling at 8.0 m/s [N] is accelerated by 0.50 m/s^2 [N] for 5.0 s. Find the final velocity of the bowling ball.

$\vec{V}_i = 8.0\text{m/s [N]}$
$\vec{a} = 0.50\text{m/s}^2\text{ [N]}$
$t = 5.0\text{s}$
$\vec{V}_f = ?$

$\vec{V}_f = \vec{a}t + \vec{V}_i = (0.50\text{m/s}^2\text{ [N]})(5.0\text{s}) + (8.0\text{m/s [N]})$

$\vec{V}_f = 11\text{m/s [N]}$

3. A car traveling 14 m/s [E] comes to a stop in 12 s. Find the acceleration of the car.

$\vec{V}_i = 14\text{m/s [E]}$
$\vec{V}_f = 0\text{m/s}$
$t = 12\text{s}$
$\vec{a} = ?$

$\vec{a} = \frac{\vec{V}_f - \vec{V}_i}{t} = \frac{0\text{m/s} - 14\text{m/s [E]}}{12\text{s}}$

$\vec{a} = -1.2\text{m/s}^2\text{ [E]}$

4. A marble initially travels south at 12.0 m/s. It is accelerated at -2.25 m/s^2 [S] for 3.50 s. Find the velocity of the marble at that moment.

$\vec{V}_i = 12.0\text{m/s [S]}$
$\vec{a} = -2.25\text{m/s}^2\text{ [S]}$
$t = 3.50\text{s}$
$\vec{V}_f = ?$

$\vec{V}_f = \vec{a}t + \vec{V}_i = (-2.25\text{m/s}^2\text{ [S]})(3.50\text{s}) + (12.0\text{m/s [S]})$

$\vec{V}_f = 4.13\text{m/s [S]}$

5. A ball is thrown upwards at 20 m/s. How much time will have passed before the ball stops rising? Remember that acceleration due to gravity is a -9.81 m/s^2.

$\vec{V}_i = 20\text{m/s}$
$\vec{V}_f = 0\text{m/s}$
$\vec{a} = -9.81\text{m/s}^2$
$t = ?$

$\vec{a} = \frac{\vec{V}_f - \vec{V}_i}{t}$

$t = \frac{\vec{V}_f - \vec{V}_i}{\vec{a}} = \frac{0\text{m/s} - 20\text{m/s}}{-9.81\text{m/s}^2} = 2.0\text{s}$

6. An inch worm travels west at 0.15 m/s. He encounters a patch of mud that accelerates him at a rate of -0.052 m/s^2 [W]. How much time will have passed before the mud brings him to a stop?

$\vec{V}_i = 0.15 m/s [W]$

$\vec{a} = -0.052 m/s^2 [W]$

$\vec{V}_f = 0 m/s$

$t = ?$

$t = \frac{\vec{V}_f - \vec{V}_i}{\vec{a}} = \frac{0 m/s - 0.15 m/s [W]}{-0.052 m/s^2 [W]}$

$\boxed{t = 2.9 s}$

7. Clayton is racing for a puck. He starts from a dead stop at the boards and heads east. He allows his skating rate to increase by 6.0 m/s^2 [E] for 2.5 s. What is his final velocity?

$\vec{V}_i = 0 m/s$

$\vec{a} = 6.0 m/s^2 [E]$

$t = 2.5 s$

$\vec{V}_f = ?$

$\vec{V}_f = \vec{a}t + \vec{V}_i = (6.0 m/s^2 [E])(2.5 s) + (0 m/s)$

$= \boxed{15 m/s [E]}$

8. Cassie drives her golf cart 15 km/h [E]. There is a massive speed bump coming so Cassie slows the cart to 5.0 km/h. If this takes her 9.7×10^{-4} hr find the acceleration of the cart in m/s.

$\vec{V}_i = 15 km/h [E]$

$\vec{V}_f = 5.0 km/h [E]$

$t = 9.7 \times 10^{-4} hr$

$\vec{a} = ?$

$\vec{a} = \frac{\vec{V}_f - \vec{V}_i}{t} = \frac{5.0 km/h [E] - 15 km/h [E]}{9.7 \times 10^{-4} hr}$

$\boxed{\vec{a} = -1.0 \times 10^4 km/h^2}$

9. Andy kicks a soccer ball north towards the net. It leaves his foot at 18 m/s [N] and strikes the goal post 2.5 s later. If the speed of the ball was 10 m/s [N] when it struck the goal post, find the acceleration of the ball.

$\vec{V}_i = 18 m/s [N]$

$t = 2.5 s$

$\vec{V}_f = 10 m/s [N]$

$\vec{a} = ?$

$\vec{a} = \frac{\vec{V}_f - \vec{V}_i}{t} = \frac{10 m/s [N] - 18 m/s [N]}{2.5 s}$

$\boxed{\vec{a} = -3.2 m/s^2 [N]}$

$E_p = mgh$ $\quad \frac{E_p}{gh} = \frac{mgh}{gh}$

2.5 Potential Energy

1. Calculate the potential energy that a 55.0 kg diver has standing on a 10.0 m platform.

$E_p = ?$
$m = 55.0\,kg$
$g = 9.81\,m/s^2$
$h = 10.0\,m$

$E_p = mgh$ $\quad E_p = (55.0\,kg)(9.81\,m/s^2)(10.0\,m)$

$E_p = 5.4 \times 10^3\,J$

2. Determine the mass of a water balloon that is dropped from a height of 35 m with a potential energy of 515 J.

$m = ?$
$E_p = 515\,J$
$g = 9.81\,m/s^2$
$h = 35\,m$

$m = \frac{E_p}{gh}$ $\quad m = \frac{515\,J}{(9.81\,m/s^2 \times 35\,m)}$

$m = 1.5\,kg$

3. A 1.00×10^4 kg airplane lands, descending a vertical distance of 10.0 **km** while travelling 100.0 km measured along the ground. What is the plane's loss of potential energy?

must change to m

$E_p = ?$
$m = 1.00 \times 10^4\,kg$
$g = 9.81\,m/s^2$
$h = 10\,000\,m$

$E_p = mgh$ $\quad E_p = (1.00 \times 10^4\,kg)(9.81\,m/s^2)(10\,000\,m)$

$E_p = 9.81 \times 10^8\,J$

4. A coconut falls out of a tree 12.0 m above the ground and hits a bystander 3.00 m tall on the top of the head. If the mass of the coconut is 2.00 kg, calculate the potential energy of the coconut relative to the ground at each of the following sites:

$g = 9.81\,m/s^2$

(a) while it is still in the tree

$E_p = ?$
$m = 2.00\,kg$
$h = 12.0\,m$

$E_p = mgh$

$E_p = (2.00\,kg)(9.81\,m/s^2)(12.0\,m)$ $\quad E_p = 235\,J$

(b) when it hits the bystander on the head

$m = 2.00\,kg$
$h = 3.00\,m$

$E_p = (2.00\,kg)(9.81\,m/s^2)(3.00\,m)$ $\quad E_p = 58.9\,J$

(c) when it lands on the ground $h = 0\,m$

$E_p = 0\,J$

5. Calculate the potential energy of a 5.00 kg object sitting on a 3.00 metre high ledge.

$E_p = ?$
$m = 5.00\,kg$
$h = 3.00\,m$

$E_p = mgh$ $\quad E_p = (5.00\,kg)(9.81\,m/s^2)(3.00\,m)$

$E_p = 147\,J$

6. A 10.0 kg rock is at the top of a 20.0 m tall hill. How much potential energy does it have?

$E_p = ?$
$m = 10.0\,kg$
$h = 20.0\,m$

$E_p = mgh$
$E_p = (10.0\,kg)(9.81\,m/s^2)(20.0\,m)$
$E_p = 1.96 \times 10^3\,J$

$$E_k = \frac{1}{2}mv^2$$

2.6 Kinetic Energy

2:SD

1. Calculate the kinetic energy of a 0.45-kilogram golf ball travelling at:

a) 20.0 m/s

$E_k = \frac{1}{2}mv^2 = \left(\frac{1}{2}\right)(0.45\text{kg})(20.0\text{m/s})^2 = \boxed{90\text{J}}$

b) 40.0 m/s

$E_k = \frac{1}{2}mv^2 = \left(\frac{1}{2}\right)(0.45\text{kg})(40.0\text{m/s})^2 = 360\text{J} = \boxed{3.6\times10^2\text{J}}$

c) 60.0 m/s.

$E_k = \frac{1}{2}mv^2 = \left(\frac{1}{2}\right)(0.45\text{kg})(60.0\text{m/s})^2 = 810\text{J} = \boxed{8.1\times10^2\text{J}}$

$m_{total} = 60.0\text{kg}$

2. A 50.0 kg bicyclist on a 10.0 kg bicycle speeds up from 5.00 m/s to 10.0 m/s. 3:SD

a. What was the total kinetic energy before accelerating?

$E_k = \frac{1}{2}mv^2 = \left(\frac{1}{2}\right)(60.0\text{kg})(5.00\text{m/s})^2 = \boxed{750\text{J}}$

b. What was the total kinetic energy after accelerating?

$E_k = \frac{1}{2}mv^2 = \left(\frac{1}{2}\right)(60.0\text{kg})(10.0\text{m/s})^2 = 3000 = \boxed{3.00\times10^3\text{J}}$

3. A 4.00 kg rock is rolling 10.0 m/s. Find it's kinetic energy. 3:SD

$E_k = \frac{1}{2}mv^2 = \left(\frac{1}{2}\right)(4.00\text{kg})(10.0\text{m/s})^2 = \boxed{200\text{J}}$

4. An 8.0 kg cat is running 4.0 m/s. How much kinetic energy does it have? 2:SD

$E_k = \frac{1}{2}mv^2 = \left(\frac{1}{2}\right)(8.0\text{kg})(4.0\text{m/s})^2 = \boxed{64\text{J}}$

$W = Fd$ $W = mad$ $F = ma$ $F = m\frac{a}{a}$

2.8 Force and Work $\frac{W}{F} = \frac{Fd}{F}$ $\frac{F}{m} = \frac{ma}{m}$

1. Calculate the work done by a 47 N force pushing a pencil 0.26 m.

$W = ?$
$F = 47N$
$d = 0.26m$
$W = Fd$ $W = 47N \times 0.26m$ $\boxed{W = 12J}$

2. How much work is it to lift a 20 kg sack of potatoes vertically 6.5 m?

$W = ?$
$m = 20kg$
$a = 9.81 m/s^2$
$d = 6.5m$
$W = mad$ $W = (20kg)(9.81 m/s^2)(6.5m)$
$\boxed{W = 1.3 \times 10^3 J}$

3. A crane that loads ships must exert a force of 24 550 N on a crate and lift it 22.00 m. How much work is done on the crate?

$W = ?$
$F = 24550\ N$
$d = 22.00m$
$W = Fd$ $W = 24550N \times 22.00m$
$\boxed{W = 5.401 \times 10^5 J}$

4. A weight lifter does 420 J of work to lift a barbell a height of 0.35 m. What force did the weight lifter exert on the barbell?

$F = ?$
$W = 420J$
$d = 0.35m$
$F = \frac{W}{d}$ $F = \frac{420J}{0.35m}$ $\boxed{F = 1.2 \times 10^3 N}$

5. A farmer exerts a force of 12.00 N on a wheelbarrow. When the farmer has used 7198 J of energy how far has he pushed the wheelbarrow?

$d = ?$
$W = 7198J$
$F = 12.00N$
$d = \frac{W}{F}$ $d = \frac{7198J}{12.00N}$ $\boxed{d = 599.8m}$

6. Sally has a car that accelerates at 5.000 m/s^2. If the car has a mass of 1000 kg, how much force does the car produce?

$F = ?$
$m = 1000kg$
$a = 5.000 m/s^2$
$F = ma$ $F = 1000kg \times 5.000 m/s^2$ $\boxed{F = 5000N}$

7. What is the mass of a truck if it produces a force of 14 000 N while accelerating at a rate of 5.000 m/s^2?

$m = ?$
$F = 14000N$
$a = 5.000 m/s^2$
$m = \frac{F}{a}$ $m = \frac{14000N}{5.000 m/s^2}$ $\boxed{m = 2800\ kg}$

8. What is the acceleration of softball if it has a mass of 0.50 kg and hits the catcher's glove with a force of 25 N?

$a = ?$
$F = 25N$
$m = 0.50kg$
$a = \frac{F}{m}$ $a = \frac{25\ N}{0.50kg}$ $\boxed{a = 50 m/s^2}$