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Time Conversions:
$1 \mathrm{~min}=60 \mathrm{~s}$
1 hour $=60 \mathrm{~min}$
1 day $=24$ hours
1 year $=365.25$ days (365 days)

## Dimensional Analysis:

How many seconds are in 4 days?

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Scientific Notation:
$4500000000=$
$0.00003042=$
$\left(3.8 \times 10^{7}\right)\left(5.4 \times 10^{10}\right)=$



Significant Digits Continued:

## Add/Subtract Rules

Your answer should contain the same number of digits after the decimal as the smallest number of digits after the decimal in the question.

$$
\text { Ex.) } 5.4-3.24=?
$$

Answer: 2.16

Since the question had, at least, 1 sd after the decimal, the answer must only have 1 sd after the decimal.

Correct Answer : 2.2

Multiply/Divide Rules

When multiplying or dividing, you must have the same number of sd in your final answer as the least number of sd in your question.

Ex.) $2.45 \div 1.432=$ ?
$\qquad$ $?$

Since the question had a number with 3 Sig Digs and a number with 4 Sig Digs, we write our final answer with the lower number of Sig Digs, 3 Sig Digs.

Correct Answer : 1.71


Vectors vs. Scalars:

Scalar: no direction, only magnitude
Vector: magnitude and direction (an arrow is placed about vector quantities, ie. $\vec{v}$ )

Ex.) When driving in the Indy 500, drivers try to complete 200 laps of the course. If they finish the race, drivers will have driven 805 km ( 500 miles).

Distance: 805 km
Displacement: 0 km because drivers end up exactly where they started from
Ex.) A monkey walks 25 km East then walks 15 km West.
Distance: 40 km
Displacement: 10 km East
positive vectors: North, East, right, up
negative vectors: South, West, left, down

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### 2.2 Calculating with Scalars and Vectors

Recall: Scalars indicate a magnitude only while vectors indicate magnitude and direction.

Examples:
Scalars



Ex.) Andrea walks 275 m east and then turns around and walks 425 m west.
a) What is her distance travelled?
b) What is her displacement?


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Ex.) A truck travels west for 3.0 h . Its displacement is then $2.60 \times 10^{2} \mathrm{~km}$ west from its starting point.
a) What is the average velocity of the truck?

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Ex.) It takes 1.00 min for a sound wave to travel $2.0 \times 10^{1} \mathrm{~km}[\mathrm{~W}]$. What is the velocity of sound, in $\mathrm{m} / \mathrm{s}$ ?

2.3 Velocity: Non-Uniform Motion

Uniform Motion - an equal displacement in an equal time interval

| Ex.)time(s) distance $(m)$$\quad$ Graph: |  |
| :---: | :---: |
| 0 | 0 |
| 1 | 4 |
| 2 | 8 |
| 3 | 12 |
| 4 | 16 |

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Ex.) An animal walks 100 m in 50.0 s . What is its average speed?


Think like a mathematician: The animals' rate of change(slope) is $2 \mathrm{~m} / \mathrm{s}$.
Think like a physicist: The animals average speed is $2.00 \mathrm{~m} / \mathrm{s}$.


Ex.) Bob drove from Edmonton to Calgary, a distance of 320 km . If he drives at a constant speed of $80 \mathrm{~km} / \mathrm{h}$, how long with it take him?


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Ex.) Shelly walked at a constant speed of $2.00 \mathrm{~m} / \mathrm{s}$ for 3.00 min . If she walked in a straight line, how far did she travel?


$2.4 \mathrm{~V}_{\mathrm{f}}$ Formulas


This is the formula given on the formula sheet. We commonly use the following rearranged form of this:

$$
\overrightarrow{\boldsymbol{v}}_{f}=\vec{a} \boldsymbol{t}+\vec{v}_{i}
$$

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We use algebra to obtain the second form:


Ex.) A car is stopped at a red light. The light turns green and the car accelerates. After 6.00 s the car is travelling at a rate of $4.25 \mathrm{~m} / \mathrm{s}$. Determine the acceleration of the car.


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Ex.) A golf ball is sitting on a tee. At a time 0.53 s after the ball is hit it is travelling with a speed of $65.0 \mathrm{~km} / \mathrm{h}$. What is the acceleration of the ball during that period?



Ex.) A cannonball is fired from a cannon with an initial velocity of $150 \mathrm{~m} / \mathrm{s}$. It has an acceleration of $-2.50 \mathrm{~m} / \mathrm{s}^{2}$ due to air resistance. Determine the final velocity of the ball after 60 s of movement.


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Ex.) An object starts from rest and accelerates $1.30 \mathrm{~m} / \mathrm{s}^{2}[\mathrm{~N}]$ for 6.00 s . What is the final velocity of the object?



What if we were asked for time?

$$
\bar{a}=\frac{v_{f}-v_{i}}{t}
$$

Rearrange for $t$ :


Ex.) A track athlete runs at a velocity of $8.1 \mathrm{~m} / \mathrm{s}$, then slows down to $4.1 \mathrm{~m} / \mathrm{s}$. Her acceleration is at a rate of $-0.62 \mathrm{~m} / \mathrm{s}^{2}$. How long did this change in velocity take?


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Law of Conservation of Energy - energy cannot be created or destroyed; it can only be changed from one form to another, and the total amount of energy never changes
*the Sun is the source of all energy on Earth*

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We focus on potential and kinetic energy.

Potential Energy - energy that is stored and held in readiness; energy that has the potential to do work (eg. gravitational, elastic, and chemical)

Kinetic Energy - energy of a moving object (eg. light, heat, and electricity)


## Gravitational Potential Energy

$$
E_{p}=m g h
$$

- stored energy of an object in reference to its' height
- a force on a mass against gravity over a distance
$\vec{g}=9.81 \mathrm{~m} / \mathrm{s}^{2}$. This is the acceleration due to gravity (the acceleration objects fall to the ground at). It is a constant (found in your data booklet) and does not count towards sig digs!

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Ex.) Brad has a mass of 65 kg , what is his weight?
(Note: Mass and weight are different. Weight $=m g$ )



Ex.) A 7.0 kg box is sitting on a shelf 2.5 m above the ground. What is it's potential energy?


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Ex.) A 45.0 kg diver is standing on a platform, she has 5345 J of potential energy. How high is the platform?



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Ex.) A car ( $\mathrm{m}=1500 \mathrm{~kg}$ ) travels at $25.2 \mathrm{~m} / \mathrm{s}$, what is it's kinetic energy?



Ex.) An object has a speed of $14.2 \mathrm{~m} / \mathrm{s}$, and kinetic energy of 950 J . What is it's mass?


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Ex.) What is the speed of an 800 kg car with a kinetic energy of $9.00 \times 10^{4} \mathrm{~J}$ ?


2.7 Law of Conservation of Energy/Mechanical Energy

Recall: The Law of Conservation of Energy states that no energy is destroyed or lost it just changes from one form to another.

Mechanical Energy = Potential Energy + Kinetic Energy



Ex.) A baseball $(13 \mathrm{~g})$ is thrown at a speed of $16 \mathrm{~m} / \mathrm{s}$ at 2.0 m above the ground. What is the total energy at the instant the ball was released?


Ex.) A rock at the edge of a cliff is pushed and falls 17 m . If the rock has a mass of 2.5 kg , what speed does it hit the ground with?


Ex.) An object has a mass of 450 kg and falls off a cliff. At the bottom of the fall it has a speed of $28.5 \mathrm{~m} / \mathrm{s}$. How high is the cliff?

2.8 Force and Work

Force

$$
F=m a
$$

- an object moves when an unbalanced force acts upon it
- a push or pull on an object
- measured in Newtons (N)

$$
\begin{gathered}
\underline{\text { Work }} \\
\mathrm{W}=\mathrm{Fd} \\
\mathrm{~W}=\mathrm{mad}
\end{gathered}
$$

- a force applied over a distance
- the force has to be in the same direction as the object moves
- measured in Joules (J)


Ex.) A 30 kg kid is accelerated at $2.5 \mathrm{~m} / \mathrm{s}^{2}$, what is the force acted upon the kid?


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Ex.) A force of 800 N is acting on a 15 kg box, what is the acceleration of the box?



Ex.) A force of 300 N is required to move an object 3.0 m . What is the work done?


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Ex.) A force on 250 N moves an object. The work done is 1000 J , how far did it move?



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Ex.) A crane lifts an object with $4.5 \times 10^{5} \mathrm{~J}$ and the work done on the object is $3.8 \times 10^{4} \mathrm{~J}$. What is the efficiency of the crane?


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First Law of Thermodynamics

- total energy, including heat, in a system and its surroundings remains constant
- heat added to the a system can be transferred to a different form of energy



## Second Law of Thermodynamics

- heat naturally flows from a hot object to a cold object
- no system is $100 \%$ efficient(perpetual motion machine), energy is lost, usually due to heat/friction



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http://study.com/academy/lesson/first-law-of-thermodynamics-law-of-conservation-of-energy.html
http://study.com/academy/lesson/second-law-of-thermodynamics-entropy-andsystems.html

