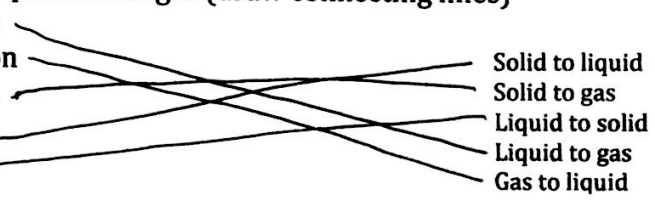
Name: Key Date: _____

Physical Science Final Review Packet

Matter:

Describe how **solids**, **liquids**, and **gases** are different in terms of movement, energy, and arrangement.

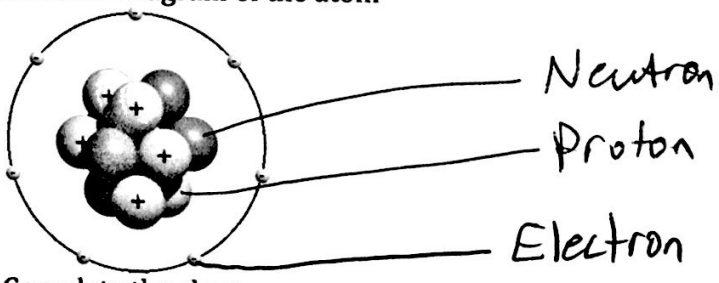
1. Put the states of matter in order from the least amount of energy to the most energy.
   Solids → Liquids → Gases
2. How do the particles in matter move in each state of matter?
   a. Solid Vibrate in place
   b. Liquid Slide past eachother
   c. Gas move quickly + bounce off one another
3. Match the terms for phase changes (draw connecting lines)



4. Which 2 states of matter can more easily change shape? gas + liquid
5. Which state of matter can more easily change volume? gas
6. Particles speed up when you add more energy

Determine the composition of an atom and the characteristics of its **subatomic particles**.

7. Label the diagram of the atom



8. Complete the chart

Subatomic Particle	Charge	Mass	Location
Proton	+1	1	Nucleus
Neutron	0	1	Nucleus
Electron	-1	0	Orbiting nucleus

Distinguish between elements and compounds

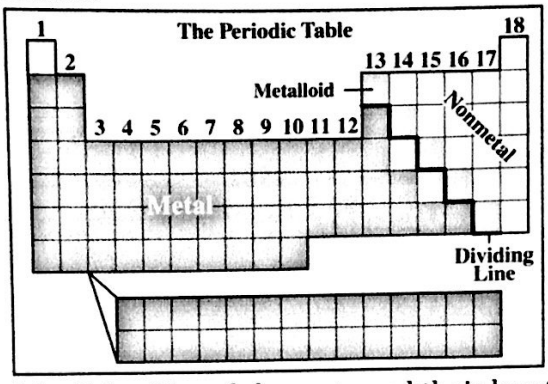
9. How can you tell the difference between elements and compounds? Elements are on the periodic table (1 capital letter) compounds are 2 or more
10. Label the following as elements or compounds, also write the common name of the element or compound.
    a. Na Sodium
    b. H_2O Water
    c. NaCl Salt
    d. Ca Calcium
    e. CO_2 Carbon Dioxide
    f. Fe Iron
    g. H Hydrogen
    h. N Nitrogen
    i. Fe_3O_2 Iron oxide (rust)
    j. $C_6H_{12}O_6$ Glucose

Compare the properties of **metals**, **metalloids**, and **nonmetals**. (image on next page)

- The **metal** elements are located to the left of the dividing line. These elements are all solids at room temperature with the exception of mercury (Hg). Metals are notable for their shiny luster, ability to conduct electricity, and that they are malleable (bendy).

Name: _____ Date: _____

- The **nonmetal** elements are located to the right. Nitrogen (N), oxygen (O), fluorine (F), chlorine (Cl), and the noble gases (in the last column) are gases at room temperature. Bromine (Br) is a liquid, while all other nonmetals are solid. Nonmetals do not conduct electricity, are brittle, and are dull.
- **Metalloids** have both metallic and nonmetallic properties. These are solid at room temperature. They are located between the metals and nonmetals and straddle the diagonal dividing line. Metalloids are useful as part of electronic circuits.

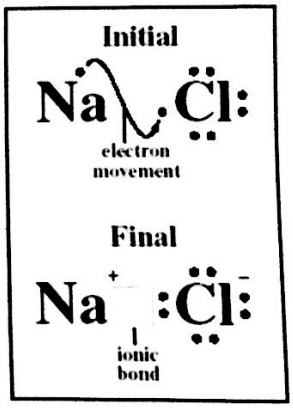


11. Describe the properties of the 5 families of elements and their location in the periodic table.
    a. Alkali Metals group 1, highly reactive, 1 valence electron, rarely found in pure form
    b. Alkaline Earth Metals group 2 reactive metals, 2 valence electrons, Sometimes found in pure form
    c. Transition Metals Metals, range of valence electrons, commonly found in pure form, Slightly reactive
    d. Halogens Highly reactive gases, 7 valence electrons, group 17
    e. Noble Gases group 18, nonreactive gases

12. What is an isotope? ~~Element~~ An atom of an element with different numbers of neutrons

Classify chemical bonds in compounds as **ionic** or **covalent**

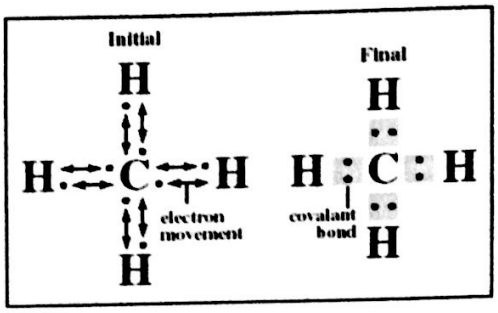
- Electrons in the outermost energy level, or **valence electrons** determine how the element will chemically react with other elements. Stable elements have 8 valence electrons. You can tell the number of valence electrons in an element based on its group in the periodic table (excluding the transition metals). Group 1 has 1 valence electron, group 2 has 2, group 13 has 3, group 14 has 4, group 15 has 5, group 16 has 6, group 17 has 7, and group 18 has 8 (nonreactive noble gases)



- Valence electrons are completely transferred from one atom to another in an **ionic bond**. An ionic bond forms between metal and nonmetal atoms. For example, a sodium (Na) atom, a metal, combines with a chlorine (Cl) atom, a nonmetal, to form an ionic bond. The process is shown in the diagram on the right. Both atoms are most stable when they have eight electrons in their outermost energy levels. Sodium has one electron in the outermost energy level, while chlorine has seven electrons. Chlorine accepts one electron from the sodium atom, giving it eight electrons in the outermost energy level. This leaves sodium with its lower energy level of eight electrons. After the electrons have been transferred, the two atoms now have unbalanced charges, forming **ions**. The sodium has a positive charge and the chlorine has a negative charge. The attraction from these opposite charges creates the **ionic bond**.

Name: _____ Date: _____

- **A covalent bond** is usually formed between two nonmetal atoms. Unlike ionic bonds, the nonmetal atoms share their valence electrons usually in such a way that each atom has eight valence electrons surrounding it. Hydrogen is an exception; it needs only two valence electrons. The example below shows four hydrogen atoms (nonmetal atoms) reacting with a single carbon atom (another nonmetal atom) to form four covalent bonds. Each hydrogen atom shares an electron with the carbon atom. The carbon atom in turn shares its four electrons, one with each hydrogen atom. These electrons are shared back and forth. In this way, both the carbon atom and hydrogen atoms have the maximum number of electrons in their outermost energy levels. Together they form a molecule of methane, CH_4.



13. How many valence electrons make elements stable?
8

14. What is an ionic bond?
A transfer of electrons when bonding between a metal and a nonmetal

15. What is a covalent bond? A sharing of electrons when bonding between a nonmetal and a nonmetal

16. Label the following compounds as ionic or covalent

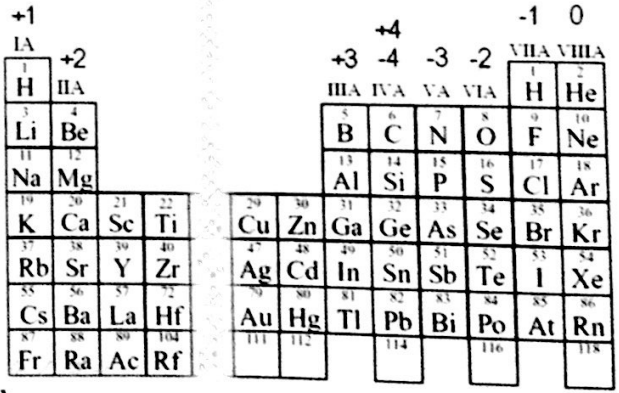
a. H_2O C
b. CH_4 C
c. NaCl I
d. CuCl I
e. PCl_3 C
f. KBr I
g. CO_2 C
h. FeS I
i. NaS_2 I
j. Ca_2O I
k. Na_2O I
l. CsAt I

Construct the **chemical formula** of a compound using the periodic table.

Oxidation Numbers are numbers assigned to an individual ion or atom present in a compound. The oxidation number is the resulting charge of gaining or losing valence electrons. Alkali Metals have 1 valence electron and loose the electron to another atom during a chemical reaction. Therefore, alkali metals have an oxidation number of +1 (lose 1 electron = 1 more proton than electrons). Halogens have 7 valence electrons and gain 1 electron from another atom during a chemical reaction. Therefore, the halogens have an oxidation number of -1 (gain 1 electron = 1 more electron than protons).

17. What is the oxidation number of each element? (notice the elements in group 14 (IVA) have an oxidation number of either +4 or -4. Also hydrogen can be +1 when reacting with a nonmetal and -1 when reacting with a metal)

a. Ca +2
b. N -3
c. K +1
d. Al +3
e. F -1
f. O -2
g. Be +2
h. C +4/-4
i. Ne 0
j. Na +1



In order to construct the chemical formula, the oxidation numbers need to add up to 0. In every compound, unless otherwise noted, the total charge is 0. As an example, if beryllium, Be (+2) were to react with chlorine, Cl (-1), 2 chlorine atoms would be needed to take both of beryllium's valence electron. The chemical formula would be $BeCl_2$

18. Write the chemical formulas for the following compounds

a. Na + Cl → NaCl
b. Ca + F → CaF_2
c. C + O → CO_2
d. H + O → H_2O

Name: _____ Date: _____

e. Mg + O → MgO
f. Ca + Br → CaBr2
g. Na + S → Na2S
h. K + F → KF

Distinguish among synthesis, decomposition, single-replacement, and double-replacement reactions

19. Write the generic variable form for each of the reactions (example A + B → AB)
    a. Synthesis: A + B → AB
    b. Decomposition: AB → A+B
    a. Single replacement: AB + C → AC + B or BC + A
    b. Double replacement: AB + CD → AC + BD or AD + BC

20. Label the following as Synthesis (S), Decomposition (D), Single replacement (SR) or double replacement (DR).
    a. 2 NaBr + 1 $Ca(OH)_2$ → 1 $CaBr_2$ + 2 NaOH DR
    b. 3 Pb + 2 H_3PO_4 → 3 H_2 + 1 $Pb_3(PO_4)_2$ SR
    c. $CaCO_3$ → CaO + CO_2 D
    d. P_4 + 3 O_2 → 2 P_2O_3 S
    e. $MgCl_2$ + Li_2CO_3 → $MgCO_3$ + 2 LiCl DR
    f. Pb + $FeSO_4$ → $PbSO_4$ + Fe SR
    g. 2 $AgNO_3$ + Cu → $Cu(NO_3)_2$ + 2 Ag SR
    h. 2 C_5H_5 + Fe → $Fe(C_5H_5)_2$ S

Balance chemical equations to explain the law of conservation of mass. (attach another sheet if needed)

21.
    a. 1 N_2 + 3 H_2 → 2 NH_3
    b. 2 $KClO_3$ → 2 KCl + 3 O_2
    c. 2 NaCl + 1 F_2 → 2 NaF + 1 Cl_2
    d. 2 H_2 + 1 O_2 → 2 H_2O
    e. 1 $Pb(OH)_2$ + 2 HCl → H_2O + 2 $PbCl_2$

Identify a substance as acidic, basic, or neutral based on its pH or response to an indicator. Recognize the effect of acid rain on the environment

22. What is the pH of a neutral substance? 7
23. What is the pH range of an acid? Below 7
24. What is the pH range of a base? Above 7
25. What is an indicator? A compound/substance that changes color in solution, usually in presence of an acid or base
26. Describe the color changes of litmus paper Base → Blue, Acid → Red
27. What causes acid rain? pollution, CO_2, other
28. What are some negative effects of acidification of the oceans? Streams/rivers? In ocean, Acid can damage shells or make it difficult for animals to survive. Streams + rivers, increased erosion.

Vocabulary

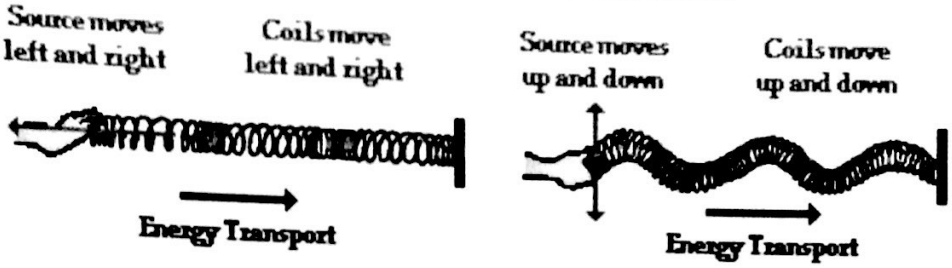
Atom	Nonmetals	Double Replacement
Proton	Metalloids	Law of conservation of mass
Neutron	Oxidation Number	Endothermic
Electron	Ionic Bond	Exothermic
Element	Covalent Bond	Indicator
Isotope	Ion	Acid
Compound	Synthesis	Base
Mixture	Decomposition	
Metals	Single Replacement	

Name: _____

Energy: Date: _____

Classify waves as **transverse** and **longitudinal**. Compare and contrast **sound** and **light** waves.

29. Label 1 diagram as longitudinal and the other as transverse



30. Below is a list of waves, classify them as transverse (T) or longitudinal (L)
    a. L Sound
    b. T Light
    c. T Ripple waves on water
    d. T Electromagnetic
    e. T Fans at a stadium
    f. L Waves created by an explosion
    g. T Strumming a guitar string

31. Label the following as a property of light (L), sound (S), or both (B)
    h. L Travels at 300,000 km/s
    i. S Travels at 340 m/s
    j. S Travels faster in denser medium because matter is closer together
    k. L Can travel through a vacuum
    l. L Electromagnetic waves
    m. B Travels though the atmosphere
    n. B Transports energy
    o. B Varies in wavelength, frequency, and amplitude

Distinguish between **mechanical** and **electromagnetic** waves.

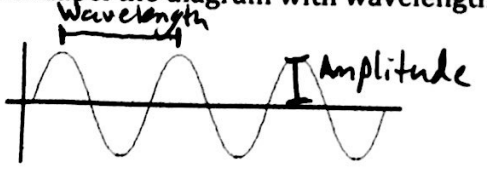
32. Describe electromagnetic waves and use the word vacuum in your description. Waves that can travel through a vacuum.

33. Describe mechanical waves and use the word matter in your description. Mechanical waves require a medium to travel through

34. What are 3 examples of mechanical waves and 3 examples of electromagnetic waves? Answers may vary. Mechanical – Sound, earthquake, ocean. ~~EF~~ Electromagnetic – light, radio, Infrared, X-ray.

Wavelength Frequency and Amplitude.

35. Label the diagram with wavelength and amplitude



36. What is wavelength? Distance from 1 wave to ~~the~~ the next

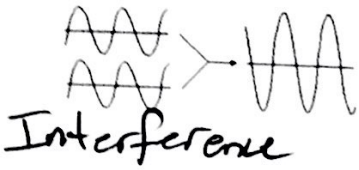
37. What is frequency? the ~~the~~ number of waves in a given time

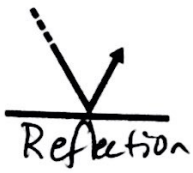
38. What is amplitude? Distance from top or bottom of a wave to the middle

Name: _____ Date: _____

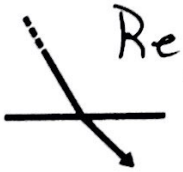
Distinguish between reflection, refraction, diffraction, and interference

39. Label the pictures as reflection, refraction, diffraction, and interference


Interference


Reflection


Diffraction


Refraction

Identify the boiling point and freezing point of water in Celsius, Kelvin, and Fahrenheit.

40.

	Celsius	Fahrenheit	Kelvin
Freezing Point	0°C	32°F	273 K
Boiling Point	100°C	212°F	373 K

Classify heat transfer as conduction, convection, and radiation.

41. What is conduction? Transfer of energy between objects in contact

42. What is convection? The movement of energy between fluids of different temperatures (Air is fluid because it moves easily)

43. What is radiation? Transfer of energy by electromagnetic ~~rays~~ waves

44. Some types of birds (vultures, eagles, etc...) use rising heat in the natural world to gain height and save energy. The warm rising air pushes the birds up so that they don't need to flap their wings. Which type of heat transfer are they using? convection

45. When you are sitting next to the window on a cold day and the sun is shining you can feel the heat from the sun. Which type of energy transfer is this? Radiation

46. When a spoon is left in a hot cup of tea, the spoon will get hot. Which type of energy transfer is this? Conduction

Solve problems related to specific heat ($Q=mC\Delta t$).

47. What do the symbols in $Q=mC\Delta t$ mean with their units? Q - Energy, M - mass, C - Specific heat, D - change, t - temperature

48. A pot of water with a mass of 0.8 kg changes temperature from 15°C to 100°C. The specific heat of water is 4180 J/kg•°C. How much energy did the water absorb?

$Q = (0.8\text{kg})(4180\text{J/kg}\cdot^\circ\text{C})(100 - 15^\circ\text{C})$ 284,240 J

49. A brick is left out in the sun and absorbs 5040 J of energy. The brick has a specific heat capacity of 840 J/kg•°C and it changes temperature from 20°C to 30°C. What is the mass of the brick?

$5040\text{J} = (m)(840\text{J/kg}\cdot^\circ\text{C})(30 - 20^\circ\text{C})$ 0.6 kg

$\frac{5040}{840 \cdot 10}$

Law of conservation of energy

50. What is the law of conservation of energy? Energy cannot be created or destroyed, only changed from one form to another

Vocabulary

Transverse waves
Longitudinal waves
Mechanical waves
Electromagnetic waves
Wavelength
Frequency
Amplitude
Reflection
Refraction
Diffraction
Interference
Specific Heat
Kelvin
Celsius
Convection
Conduction
Radiation
Law of conservation of energy

Name: _____ Date: _____

Motion:

Distinguish and calculate **speed**, **velocity**, and **acceleration**.

51. Describe the difference between velocity and speed: Velocity includes a direction

52. Define acceleration: The change in velocity divided by the time interval in which the change occurred

53. Circle any of the following that are correct units for velocity:

m/s mph m/s^2 km/hr km/hr^2 km m s

54. Circle any of the following that are correct units for acceleration:

m/s mph m/s^2 km/hr km/hr^2 km m s

55. What is the equation for velocity? $\text{Velocity} = \frac{\text{Distance}}{\text{Time}}$

56. What is the velocity **in km/hr** of a car that travels 50 km north for 0.5 hours?

$V = \frac{50\ km}{0.5\ hr} = 100\ km/hr$

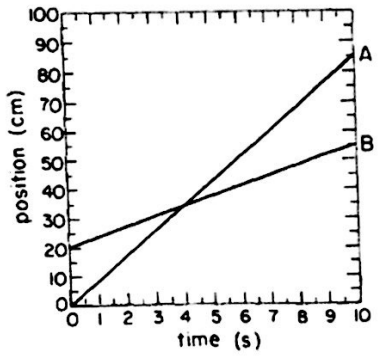
57. What is the velocity **in m/s** of a person who jogs 5000 m in 24 minutes (convert to seconds)?

$V = \frac{5000\ m}{1440\ s}$ 3.47 m/s

Interpret **velocity-time** and **position-time graphs.**

This was probably the most challenging topic that was covered all year. Some helpful hints are to look at the axis of the graph to look at the units. The x (horizontal) axis will always have time. The y (vertical) axis will either have a position/distance unit or a velocity unit. Most of the mistakes I saw during this were because people weren't looking at the units on the graph. You will only be asked to interpret the graph, not to make a graph based on data or convert graphs between velocity-time and position-time graphs. Some sample questions are below.

58. Below is a position vs. time graph of turtles A and B.



a. Which turtle is traveling faster? How do you know?
A, the line is steeper

b. What is the velocity of turtle A? $V = \frac{85\ cm}{10\ s}$ $V = 8.5\ cm/s$

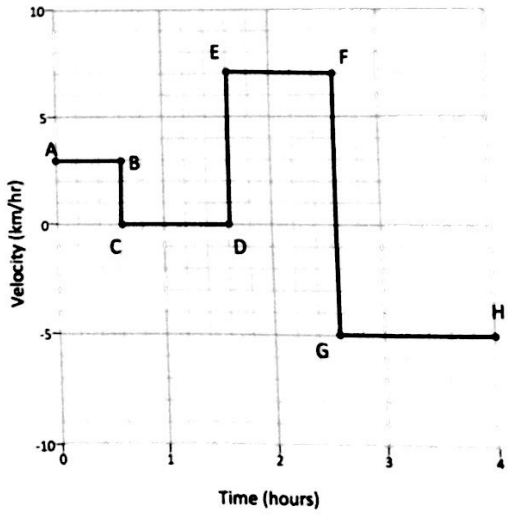
c. What is the velocity of turtle B? $V = \frac{85-20\ cm}{10\ s} = \frac{35\ cm}{10\ s}$ $V = 3.5\ cm/s$

59. To the right is a velocity vs. time graph of a bird.

a. At what interval was the bird moving the fastest? E-F

b. At what interval was the bird moving the slowest, **but still moving?** A-B

c. At which interval was the bird moving back where it started? G-H



Name: _____ Date: _____

Newton's laws of motion.

60. What is Newton's 1st law of motion? An object in motion ~~sta~~ or at rest, stays in the same motion unless acted upon by a force

61. What is Newton's 2nd law of motion? force = mass × acceleration

62. What is Newton's 3rd law of motion? for every force there is an equal and opposite reaction

Circle the correct law that each scenario is describing.

63. You step out of a canoe onto a dock and the canoe moves away from the dock
Newton's 1st Law Newton's 2nd Law (Newton's 3rd Law)

64. An empty shopping cart accelerates faster than a loaded cart when equal forces are applied to them
Newton's 1st Law (Newton's 2nd Law) Newton's 3rd Law

65. You left a book on the kitchen table overnight. When you return in the morning, it was still there.
(Newton's 1st Law) Newton's 2nd Law Newton's 3rd Law

66. A spaceship accelerates up by burning rocket fuel, which is forced out of the bottom of the rocket.
Newton's 1st Law Newton's 2nd Law (Newton's 3rd Law)

67. An athlete hits a golf ball and a bowling ball with the same amount of force. The golf ball accelerates more than the bowling ball.
Newton's 1st Law (Newton's 2nd Law) Newton's 3rd Law

The law of conservation of momentum and calculating momentum.

Equation for momentum $P = mv$

Law of conservation of momentum $m_1v_1 + m_2v_2 = m_1v_1 + m_2v_2$

68. How much momentum does a train have that has a mass of 13,000 kg and is traveling at a velocity of 75 km/hr? $P = 13{,}000\ kg \cdot 75\ km/hr$ 975000 kg·km/hr

69. According to the law of conservation of momentum, the momentum before and after a collision needs to be the same. Astronauts have a basketball (600 grams) and a tennis ball (50 grams). Predict the velocity that the basketball will travel when it is struck by the tennis ball. They want to make this an inelastic collision so they add Velcro to both balls so that they stick together. They throw the tennis ball at 32.5 m/s at basketball which is not moving and they stick together. How fast will the tennis ball and the basketball travel?

~~600~~ $50g \cdot 32.5\ m/s + 600g \cdot 0\ m/s = 50g \cdot X + 600g \cdot X$

$1625\ g \cdot m/s = 650g \cdot X$

$2.5\ m/s = X$

2.5 m/s

Calculate the efficiency of simple machines using work, power, and mechanical advantage.

70. Define work and write the equation: Quantity of energy transfered by a force resulting in movement Work = force × distance

71. Define power and write the equation: The rate at which work is done Power = work / time

72. What is a scenario where a force is applied but no work is done? Answers may vary pushing a wall. Nothing moves when force is applied

73. You pull your sled through the snow a distance of 550m with a force of 225N. What is the work done in joules? $Work = 550\ m \cdot 225\ N$

123750 J

74. You did 175 J of work lifting a 150 N backpack. How high did you lift the bag in meters?

$175 = 150 \cdot$ ~~the~~ distance

1.17 m

Name: _____ Date: _____

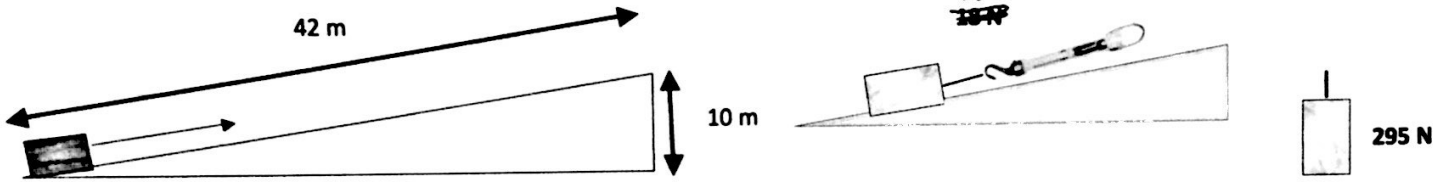
75. A crane does 63, 000 J of work to lift a boulder a distance of 37 m. How much does the boulder weigh in Newtons? (Remember weight is a type of force due to gravity).

63,000 J = Force × 37 1702.7 N

76. What is mechanical advantage? The quantity ~~by which~~ that measures how much easier a machine makes work

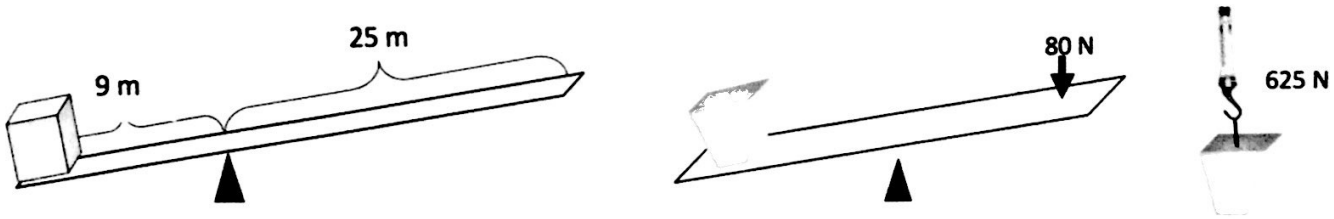
77. Below is an inclined plane. Calculate the ideal mechanical advantage using the length/height, then find the output work, input work, and efficiency of the inclined plane

Input – effort and distance put into using simple machine
Output – load and distance that is lifted (as if simple machine was not being used)
MA = length x height
Work = force x distance
Efficiency = Output work/Input work



Input distance	Output distance	Mechanical advantage	Input force	Output force	Input work	Output work	Efficiency
42 m	10 m	4.2	18 N	295N	7560J	2950 J	39%

78. Below is a 1st class lever. Calculate the ideal mechanical advantage using the effort arm/load arm, then find the output work, input work, and efficiency of the lever.



Input distance	Output distance	Mechanical advantage	Input force	Output force	Input work	Output work	Efficiency
25m	9 m	2.78	80 N	625N	2000J	720J	36%

<u>Vocabulary</u>

Speed
Velocity
Acceleration
Newton's 1st law of motion
Newton's 2nd law of motion
Newton's 3rd law of motion
Momentum
Simple machines
Mechanical advantage
Efficiency (simple machines)
Work
Power