Physics ~ Learning Guide Name: ____________________

Instructions:

Using a pencil, complete the following notes as you work through the related lessons. Show ALL work as is explained in the lessons. You are required to have this package completed BEFORE you write your unit test. Do your best and ask questions if you don't understand anything!

What is Energy?

1. Energy is the ability to do _____________.
2. Energy is a property of objects that can be ____.
3. The unit for energy is the _____________.
4. What is your highest score in What is Energy – Gameshow? _________
5. What is your highest score in Potential & Kinetic – Gameshow? _________
6. What do you always know about the direction of friction? _____________________________
7. Friction creates ________________ energy.
8. Using a dictionary/online, "kinetic" means ____________________.
9. Using a dictionary/online, "static" means ____________________.
10. Friction while moving is called ____________ friction.
11. Friction while not moving is called ____________ friction.
12. List (in your own words), 5 situations that give friction a "bad reputation"
    a) ____
    b) ____
    c) ____
    d) ____
    e) ____
13. List (in your own words), 5 situations that give friction a "good reputation"
    a) ____
    b) ____
    c) ____
    d) ____
    e) ____
14. The greater your __________________, the greater the wind resistance on you.
15. By increasing the gradient of the ramp, you increase the _____________ energy of the truck.
16. By releasing the truck, you convert the ______________ energy into ___________energy.
17. With the gradient = 2 (rather than one), the truck goes further because there was more ____________energy to convert into _____________energy.
18. No matter what the gradient, the truck eventually stops since the _______________ energy is converted into _________________ energy (due to friction).

Conservation of Energy (concept):

1. Saying that "Energy is Conserved" means that energy never _______________ or _______________.
2. When we say that something "lost energy" we really mean that some of the energy was converted into a form that is _______________ to us.
3. A skier at the bottom of a hill has 900J of kinetic energy. After sliding a ways along the flat, the kinetic energy is 300J.

   a) With a decreased kinetic energy, what do you know about the skier's velocity? Why?

   b) With the skier sliding on a flat surface, is there any change in gravitational potential energy? How do you know?

   c) How much energy was lost due to friction? (Use $E_{before} = E_{after}$). Show all steps.

4. A skier on a hill has 4000J of kinetic energy and 3000J of potential energy. After sliding down the hill a ways, their potential energy is 2000J.

   a) Since they slid "down" the hill, what do you expect for change in potential energy (greater or less)? Why?

   b) Assuming that there is no loss due to friction, what would be the kinetic energy at the second position? (Use $E_{before} = E_{after}$ and show all steps)

   c) Since there's always "some" friction loss, would the "actual" kinetic energy be less or more than your answer in b)?

5. What is the equation used for calculating efficiency?

6. In this equation, what do we mean by "Useful Energy Out?"

7. In the equation, what do we mean by "Energy In?"

8. Because we know that energy never "appears," we know that efficiency can never be greater than ________________%

9. A particular light bulb, converts energy so that every 100J of electrical energy coming in, creates 8J of light energy and 92J of heat energy.
   a) Draw a Sankey diagram showing the energy flow through this device.

   b) What would (normally) be considered the "useful energy?" __________J
   c) What would be the "Energy in?" ___________J
   d) What is the efficiency of this light? Show original equation and steps.

   e) If you were using this bulb to "heat" then what would be the "useful energy?" __________J
   f) If you were using this bulb to "heat" then what would be the "efficiency?" Show original equation and steps.

10. A roller coaster uses 800 000 J of energy to get to the top of the first hill. During this climb, it gains 500 000 J of potential energy and pauses (velocity = 0) for a fraction of a second at the very top before heading down the other side.
    a) Draw a Sankey diagram for the roller coaster's climb.

    b) What's the kinetic energy at the very top? How do you know?

    c) What would be the "useful energy" during its climb to the top? How do you know?

    d) How much energy was lost due to friction? (Use $E_{before} = E_{after}$).

    e) Calculate the efficiency of the roller coaster during this part of the ride (the climb).

11. The roller coaster goes over the top of the first hill and heads downwards. The roller coaster heads down and levels out as it hits the original level.
    a) Since they are back at the original level, what do we know about the potential energy at this point? Why? ____
    b) If we know that we lost 200 000J to heat energy, what is the kinetic energy at the bottom? (Use $E_{before} = E_{after}$)

    c) What is the efficiency of the roller coaster during this part of the ride?

12. Find EnerGuide labels on two appliances in your house and complete the following table.

	Appliance #1	Appliance #2
What is the Appliance?		
What is the "Energy In"?		
What is the "Useful Energy"?		
What is the "Lost Energy"?		
Is this a fairly efficient model of this type of appliance? You may have to look-up new ones to get a feel for what others are available.		

13. Provide an example of how improving energy "efficiency" can change the world. Provide examples.

Our Energy Future:

1. Currently, the majority of our energy is generated using Fossil Fuels. What are the problems with this situation?

2. What is "renewable energy?" What are the advantages of renewable energy?

3. Describe the two standard types of solar energy conversions.

4. Describe (generally) a typical process of converting wind energy into electrical energy.

5. Improving our use of both solar energy and wind energy will depend on the development of batteries. Why are these two energy sources particularly dependent on improving batteries?

6. Describe (generally) a typical process of converting water energy into electrical energy.

7. Describe the two standard types of nuclear energy conversions.

8. What are the main concerns behind the use of nuclear energy production?

9. Describe your ecological footprint. What do the results mean? What are some things you could do to reduce your footprint?

10. What is FNEMC and what is its mandate?

11. What do you think will be different in our world in 10 years? There is no right answer for this, but a creative and thoughtful answer is required.

Work:

1. Show and explain the equation we use for calculating work. Explain the parts and units.

2. Work is usually measured in _____________, which is the same thing that __________ is measured in.
3. Provide 3 examples of where someone might think that work is being done, but it really isn't (don't use same examples as lessons). Clarify what's missing in each.

4. Provide 3 examples of where work is actually being done (not same examples as lessons). Clarify both the F and d in each.

5. If you push an object with a force of 220N for a distance of 3.0 meters, what is the work done? Show your equation and work the same as in the lesson.

6. An arrow is pulled back in a bow. It is pulled back 35 cm with an average force of 160N. What was the work done on the arrow to get it into position? Show your equation and work the same as in the lesson.

7. Two people are being pulled up out of the water by a helicopter. The helicopter pulls up on them with a force of 1200 Newtons and lifts them 20 meters. Determine the Work done by the helicopter. Show your equation and work the same as in the lesson. Is this work turned into Kinetic or Potential energy?

8. A horse is pulling a sleigh with a force of 2000 N. Determine the Work done by the horse after pulling the sleigh 50 meters. Show your equation and work the same as in the lesson.

9. Carol is bench pressing 85 kg. If each rep requires her to lift the bar about 1 m, how much work does Carol do in each rep?

10. If you lifted an 80kg rock onto a trailer that is 2.0 meters off the ground, what is the work done? Show your equation and work the same as in the lesson.

11. Two students try to move a heavy box. One pushes with a force of 80N while the other pulls with a force of 40N in the same direction. What is the work done by each boy after the box is moved 10 meters? Show your equation and work the same as in the lesson.

12. Two younger students try to move a heavy box. One pushes with a force of 20N while the other pulls with a force of 30N in the same direction. What is the work done by each boy after 10 seconds if the box can't be moved? Show your equation and work the same as in the lesson.

Calculating Energy:

1. Why is E_k (kinetic energy) considered the “energy of motion?” Provide the equation and explain the parts.

2. What is the E_p (potential energy) and what is the general formula for it (explain the parts)?

3. Gravitational potential energy is a specific kind of E_p that we use a LOT. Using the general equation from the previous question, along with your knowledge of the force of gravity, derive a handy formula for gravitational potential energy.

4. A 15000kg locomotive is moving at 12 m/s. What is its kinetic energy?

5. What is the potential energy of a 0.40 kg ball at a height of 9.2 m?

6. A 0.30 kg pendulum is swinging. At the very top of its swing, it has no velocity (comes to a stop). At the bottom of its swing, it has a velocity of 6.5 m/s. What is the kinetic energy in each position?

7. An arrow is pulled back with an average force of 30N over a distance of 25 cm. What is the potential energy of the arrow?

8. The same arrow (0.16 kg) is released and flying at 22 m/s. What is the arrow's kinetic energy?

9. What is the increase in potential energy cause by lifting a 60. kg box to a height of 2.3 m?

10. At the first stage of a roller coaster ride, the 1200kg roller coaster ends up 50 m above its starting height. What was increase in potential energy of the roller coaster?

Problem Solving:

1. Usually, when we say that something has "lost energy" we really mean that some of the energy was converted into a form that is not _______________ to us.
2. Mechanical forms of energy include _______________________ and ____________________ .
3. __________ allows you to calculate the energy added or removed from a system using a force.
4. A 2.6 kg rock is dropped from a height of 10 m. With what speed will it strike the ground. Ignore air resistance. Solve using conservation of energy (start with Ebefore = Eafter).

5. A ball is thrown straight up leaving the player's hands at at 7.5 m/s. If air resistance is ignored, how high can the ball travel? Show all work starting with Ebefore = Eafter.

6. Explain the energy transfers involved in pole vaulting.

7. A skier starts from rest at the top of a frictionless incline of height 20 m as shown here. How fast is the skier travelling at the bottom of the hill? Show all work starting with Ebefore = Eafter.

8. Professor Lewin releases the ball from his waist (h = 1.2m).
   a) If he ensures that the ball has zero motion when released from position A, what would be the ball's velocity at its lowest point? Show all work starting with Ebefore = Eafter.

   b) How high would the ball go on the other side (assuming no energy lost to heat)?

   c) Since it WILL lose a tiny bit of energy, what do you know about the maximum heights each swing?

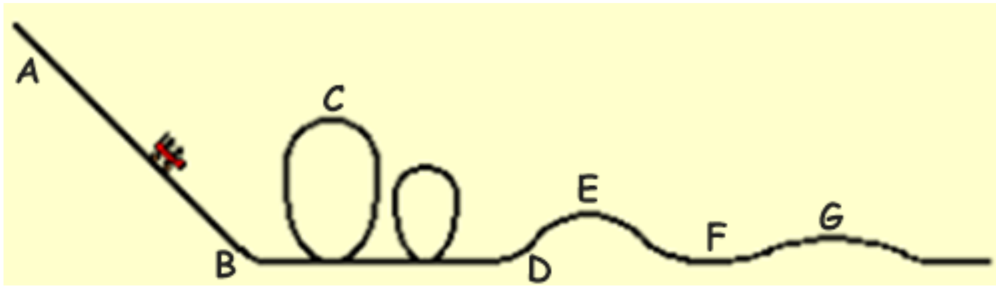
   d) How can professor Lewin be so confident that he won't be going to the hospital?

   e) Why was he SO careful about how he released the ball?

9. A girl runs at top speed (6.5 m/s) and grasps a 5.0 m rope hanging vertically from a tall tree at the edge of a lake. Show all work starting with Ebefore = Eafter.
   a) how high can she swing upward?

   b) does her mass affect the answer? How do you know?

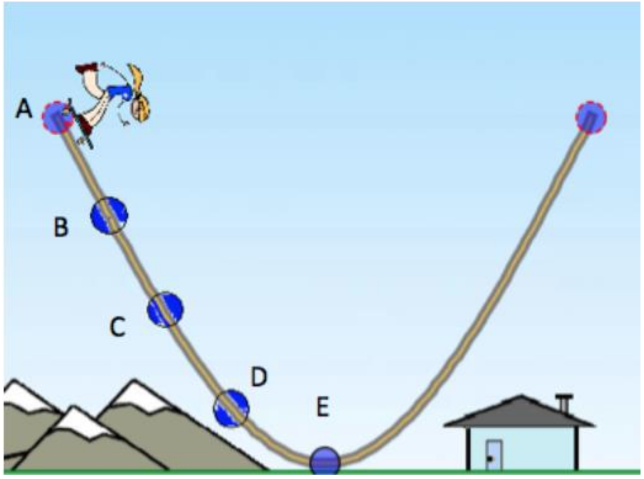
10. Explain (in terms of energy), what is happening in the following track (assuming no friction loss).



a) A to B: __________________ is being converted into ________________________
b) B to C: __________________ is being converted into ________________________
c) D to E: __________________ is being converted into ________________________
d) E to F: __________________ is being converted into ________________________
e) F to G: __________________ is being converted into ________________________
f) At position E, the coaster has more _________________ than at G.
g) At position E, the coaster has less _________________ than at G.
h) Which position has the greatest potential energy? _____________.
i) Which position has the least potential energy? _____________.
j) Which position(s) have the greatest kinetic energy? ____________.
k) In reality (since there is friction loss), which position has the greatest kinetic energy? ________. Why?

11. A pendulum bob is moving 1.8 m/s at the bottom of its swing. To what height above the bottom of the swing will the bob travel? Draw a diagram to show this height and show all work starting with Ebefore = Eafter. *(ans. 0.17 m).*

12. Consider the following ramp positions and identify the position that best represents each energy bar chart:



Bar Chart of Energy	Position