**Year 10 - Energy**



**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Year 10 Oxford Unit 7.8 & 7.9**

![MCj02903950000[1]]()**Changing Forms of Energy**

|  |  |
| --- | --- |
| 1. Energy is most noticeable as it \_\_\_\_\_\_\_\_\_\_\_\_\_ from one type to \_\_\_\_\_\_\_\_\_\_\_\_\_.
2. What are some examples of transforming electrical energy?
	1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Electrical to Light)
	2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Electrical to Heat)
 | 1. Other forms of energy.
	1. Electrical
	2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - (petrol)
	4. Nuclear
	5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - (vibrations in the air)
	6. Heat
 |

**Kinetic Energy**

1. Definition - what an object has because it is \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Examples:
	1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

KE = 0.5 x mass x speed2

1. **Compare the pair:**
	1. A child (40kg) running at 5m/sec has \_\_\_\_\_\_\_\_ of kinetic energy
	2. An adult (80kg) running 5m/sec has \_\_\_\_\_\_\_\_\_ of kinetic energy
	3. Comparing the two we see that by \_\_\_\_\_\_\_\_\_\_\_\_\_ the mass (weight) gives \_\_\_\_\_\_\_\_\_\_\_ the kinetic energy.
2. **Compare the pair:**
	1. An 80kg adult running at \_\_\_\_\_\_\_\_\_\_\_\_ has \_\_\_\_\_\_\_\_\_\_\_ of kinetic energy.
	2. The same adult (80kg) running at \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (double the speed) has \_\_\_\_\_\_\_\_\_\_\_ of energy.
	3. ****Comparing the two situations we see that: If you double the \_\_\_\_\_\_\_\_\_\_ the kinetic energy increased \_\_\_\_\_\_\_\_\_\_\_\_ times.
3. **Conclusion:**
	1. An objects \_\_\_\_\_\_\_\_\_\_\_\_has a greater influence on kinetic energy than \_\_\_\_\_\_\_\_\_\_.
	2. When an object has stopped completely its kinetic energy is \_\_\_\_\_ even though it still has a \_\_\_\_\_\_\_.

**Potential Energy**

Definition - Energy an object has because of its \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

GPE = mass x gravity x height

1. **Examples of Potential Energy:**
	1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Potential Energy – potential for an object \_\_\_\_\_\_\_\_\_\_\_ due to gravity.
		1. E.g. a rock on the edge of a \_\_\_\_\_\_\_\_.
	2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Potential Energy - the potential in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ elastic band to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ into position.
	3. **![C:\Users\nathans\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\YMX37MVX\MC900355977[1].wmf]()**\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Potential Energy – Energy that is stored in chemicals. Like petrol and batteries.
2. The amount of potential energy depends on two factors
	1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Twig Video: Potential Energy***

1. **Bungee jumper:**
	1. When a person stands at the edge of the bridge he has a lot of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	2. When he jumps he has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	3. When the rope is fully stretched it has the potential to return the person upwards due to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Activity: The two basic types of energy**

Directions: Determine the best match between basic types of energy and the description provided. Put the correct letter in the blank.

|  |  |
| --- | --- |
| \_\_\_\_\_\_1. A skier at the top of the mountain \_\_\_\_\_\_2. Gasoline in a storage tank \_\_\_\_\_\_3. A race-car traveling at its maximum speed \_\_\_\_\_\_4. Water flowing from a waterfall before it hits the pond below\_\_\_\_\_\_5. A spring in a pinball machine before it is released\_\_\_\_\_\_6. Burning a match\_\_\_\_\_\_7. A running refrigerator motor | (a) Kinetic Energy(b) Potential Energy(c) Both forms of Energy |

**Calculating GPE and KE**

Determine whether the objects in questions 3-8 have kinetic or gravitational potential energy. Then choose the correct formula to use to solve. Solve for problems 9-16. (NOTE: use 10m/s2 for gravity)

KE = ½ x m x v2 OR GPE = mass x gravity x height

1. You serve a volleyball with a mass of 2.1 kg. The ball leaves your hand with a speed of 30 m/s. The ball has **KINETIC** energy. Calculate it.

Worked Answer: KE = 0.5 x (2.1kg x 30m/s squared) 🡪 945 J

1. A baby carriage is sitting at the top of a hill that is 21 m high. The carriage with the baby has a mass of 12 kg. The carriage has **POTENTIAL** energy. Calculate it.

Worked Answer: GPE = 12kg x 10m/s2 x 21meters 🡪 2520 J

1. A car is traveling with a velocity of 40 m/s and has a mass of 1120 kg. The car has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy. Calculate it.
2. A brick is sitting on a wall 20 m high. Its mass is 79kg. The block has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy. Calculate it.
3. There is a bell at the top of a tower that is 45 m high. The bell has a mass of 190kg. The bell has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy. Calculate it.
4. A roller coaster is at the top of a 72 m hill and has a mass of 966 kg. The coaster (at this moment) has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy. Calculate it.
5. If a 25 kg object is moving at a velocity of 5 m/s, the object has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy. Calculate it.
6. If a 25 kg object is moving at a velocity of 10 m/s, the object has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy. Calculate it.
7. What is the kinetic energy of a 25-kg object moving at a velocity of 2.5 m/s?
8. What is the kinetic energy of a **150-gram** object moving at a velocity of 100 m/s?
9. What is the kinetic energy of a 1500 kg object moving at a velocity of 10 m/s?
10. What is the gravitational potential energy of a 150-kg object suspended 5 m above the earth’s surface?
11. What is the gravitational potential energy of a 2.5 kg object that is 300 m above the surface of the earth?
12. What is the mass of an object that is hanging 12.6m above the earth’s surface and has a GPE of 2778.3 J?
13. An object has a GPE that is 833 J. Its height above the ground is 4.25 m. What is its mass?
14. An object has a gravitational potential energy of 41772.5 J and has a mass of 1550 kg. How high is it above ground?

**Changing forms of Energy**

***Twig Video: Energy Transformation***

1. An example of transforming chemical energy is a car engine.

Explain how…

**KE and PE**

1. In many situations, there is a conversion between potential and kinetic energy.
2. The \_\_\_\_\_\_\_\_\_\_\_ amount of potential and kinetic energy in a system is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy.
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Energy + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Energy

**Mechanical Energy**

1. Mechanical energy is due to the \_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_ of the object.
2. ![MCNA00179_0000[1]]()What happens to the mechanical energy of an apple as it falls from a tree?
	1. As the apple falls to the ground, its height decreases (position).
	2. Therefore, its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ decreases.
	3. But, because it is falling (motion), its \_\_\_\_\_\_\_\_\_\_\_ energy has increased.
	4. **To conclude:** The potential energy is not \_\_\_\_\_\_\_\_ … it is converted into kinetic energy as the \_\_\_\_\_\_\_\_\_\_\_ of the apple increases.
3. What happens to the mechanical energy?
	1. The mechanical energy does \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because the loss in potential energy is simply \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ into kinetic energy.

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| --- |
| **Example showing how total mechanical energy remains the same.** |
| **Image 1** | **Calculation 1** | **Image 2** | **Calculation 2** |
|  |  150 + 0 **Total**  150  | http://www.r-e-m.co.uk/logo/companion/iLOG/examples/apple.gif |     + **Total**   |

**THE ENERGY IN THE SYSTEM STAYS \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_!**

**Swinging Along**

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| --- |
| **Draw a side-view diagram of a person on a swing. Then answer the following questions.** |
|  |

**Answer the following questions referring to the swing diagram and label the diagram as appropriate.**

1. At what point does the person on the swing have the most potential energy? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. At what point does the person on the swing have the most kinetic energy? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. What happens to the mechanical energy? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**The Law of Conservation of Energy**

**Twig Video: Law of Thermodynamics**

1. The Law of Conservation of Energy states that energy \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. The big picture… the total energy in the universe \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. But how? If I stop pumping while I’m swinging, I stop!! So, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_?
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - As you swing, the hooks and the chain rub against each other.
5. Friction causes some of the mechanical energy of the swing to change to \_\_\_\_\_\_\_\_\_\_\_ energy and the temperature of the hooks and chain heat up a little.
6. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - Causes objects to slow down due to the friction of air on them. This resistance changes into \_\_\_\_\_\_\_\_\_\_.

**The energy is still there, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_!!**

![MCj01566630000[1]]()

**Energy Review Quiz**

1. What is the ‘conservation of energy’ definition?
2. What is the definition of kinetic energy?
3. What is the definition of potential energy?
4. What energies combine to create mechanical energy?
5. The higher an object is in relation to the ground increases what energy?
6. What is the kinetic energy of an object with 3kg of mass and travelling at 25m/s?

**Transformation of Energy Review**

Directions: Use the following forms of energy to fill in the table below: **mechanical, electrical, heat, radiant, chemical, nuclear, and sound**. The first one has been done for you.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **ORIGINAL ENERGY FORM** | **PRIMARY ENERGY FORM** | **SECONDARY ENERGY FORMS** |
| 1. Electric motor | electrical | mechanical | sound, heat |
| 2. A battery that runs a moving toy |  |  |  |
| 3. A solar panel on the roof of a house |  |  |  |
| 4. A person lifting a chair |  |  |  |
| 5. A nuclear power station |  |  |  |
| 6. A toaster |  |  |  |
| 7. A church bell |  |  |  |
| 8. Gasoline powering a car |  |  |  |
| 9. A light bulb |  |  |  |
| 10. A person sprinting  |  |  |  |

Calculating Efficiency and Energy

**Efficiency** describes how well energy is converted from one form into another. Energy is measured in Joules (J). A process is 100% efficient if no energy is “lost” due to friction, to create sound, or for other reasons. In reality, no process is 100% efficient.

Efficiency is calculated by dividing the output energy by the input energy. If you multiply the result by 100, you will get efficiency as a percentage. For example, if the answer you get is 0.50, you can multiply by 100 and write your answer as 50%.

$$\% efficiency= \frac{output energy}{input energy} × \frac{100}{1}$$

**Worked Example**

You drop a 2 kg box from a height of 3 m. Its speed is 7 m/s when it hits the ground. How efficiently did the potential energy turn into kinetic energy?

|  |  |
| --- | --- |
| **Calculate Energy** | **Calculate Efficiency** |
| GPE = 2kg x 10m/s x 3m ANSWER: 60 JKE = 0.5 x 2kg x 72  ANSWER: 49 J | $$\% efficiency= \frac{49 J}{60 J} × \frac{100}{1}$$ANSWER: 82% |

1. Jaz drops a 0.6kg basketball from a height of 10 m. Its speed is 8m/s when it hits the ground. How efficiently did the potential energy turn into kinetic energy?
2. Joshua has fired a bullet (0.01 kg) straight up into the air and it reaches its apex at 3000 meters. It hits the ground at 85m/s. How efficiently did the potential energy turn into kinetic energy?
3. Engineers who design battery-operated devices such as mobile phones and MP3 players try to make them as efficient as possible. An engineer tests a cell phone and finds that the batteries supply 10,000 J of energy to make 5,500 J of output energy in the form of sound and light for the screen. How efficient is the phone?
4. Elaine has created a nuclear-powered robot. An engineer tests and finds that the reactor supplies 22,000 J of energy to make 15,500 J of useful output energy to the advanced AI. How efficient is the robot?
5. What’s the efficiency of a car that uses 400,000 J of energy from petrol to make 48 000 J of kinetic energy?
6. A 1000-kilogram roller coaster goes down a hill that is 90 metres tall. Its speed at the bottom is 40 m/sec.
	1. What is the efficiency of the roller coaster? Assume it starts from rest at the top of the hill.
	2. What do you think happens to the “lost” energy?
	3. Use the concepts of energy and efficiency to explain why the first hill on a roller coaster is the tallest.

Draw an annotated diagram of the roller coaster scenario.