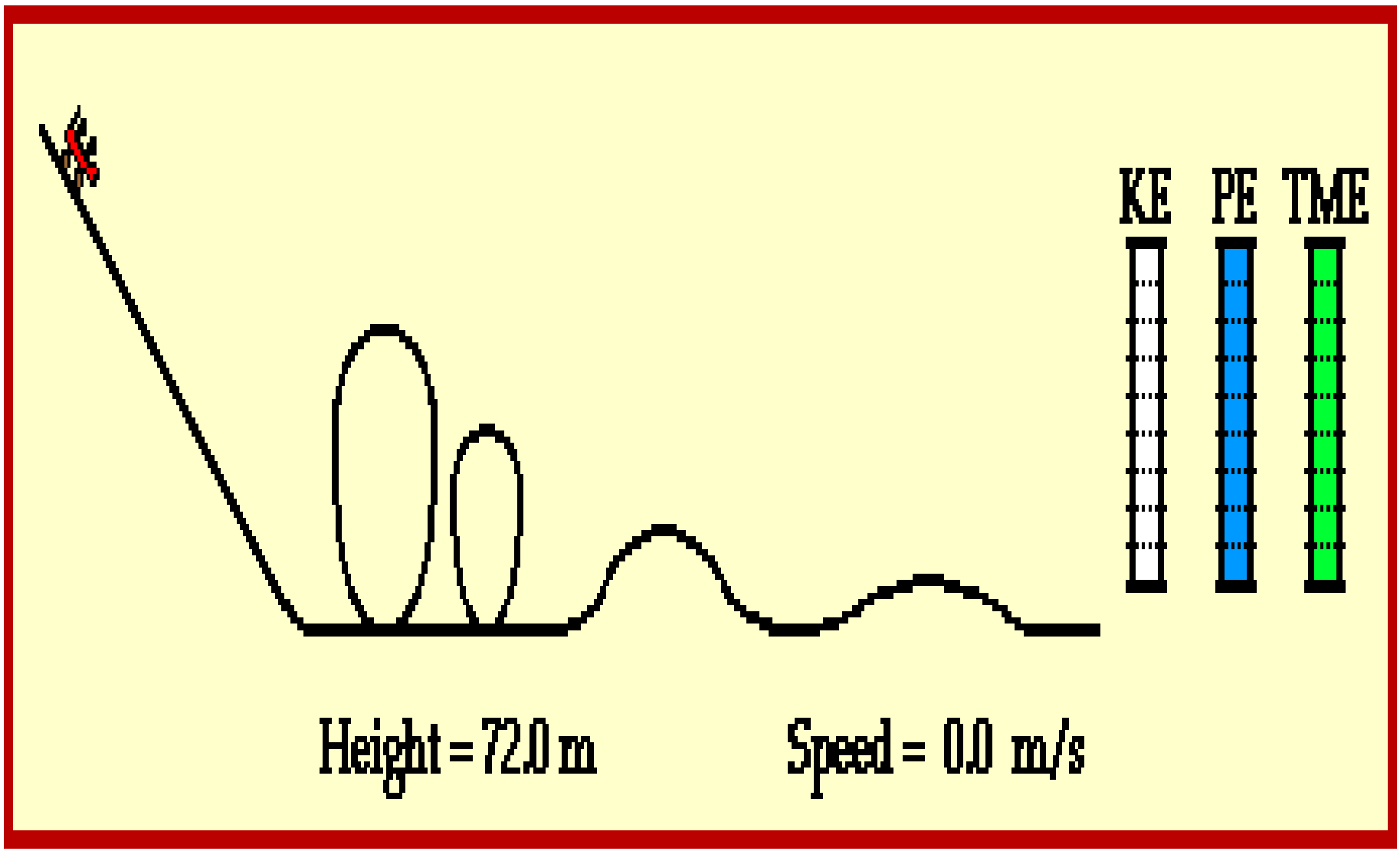
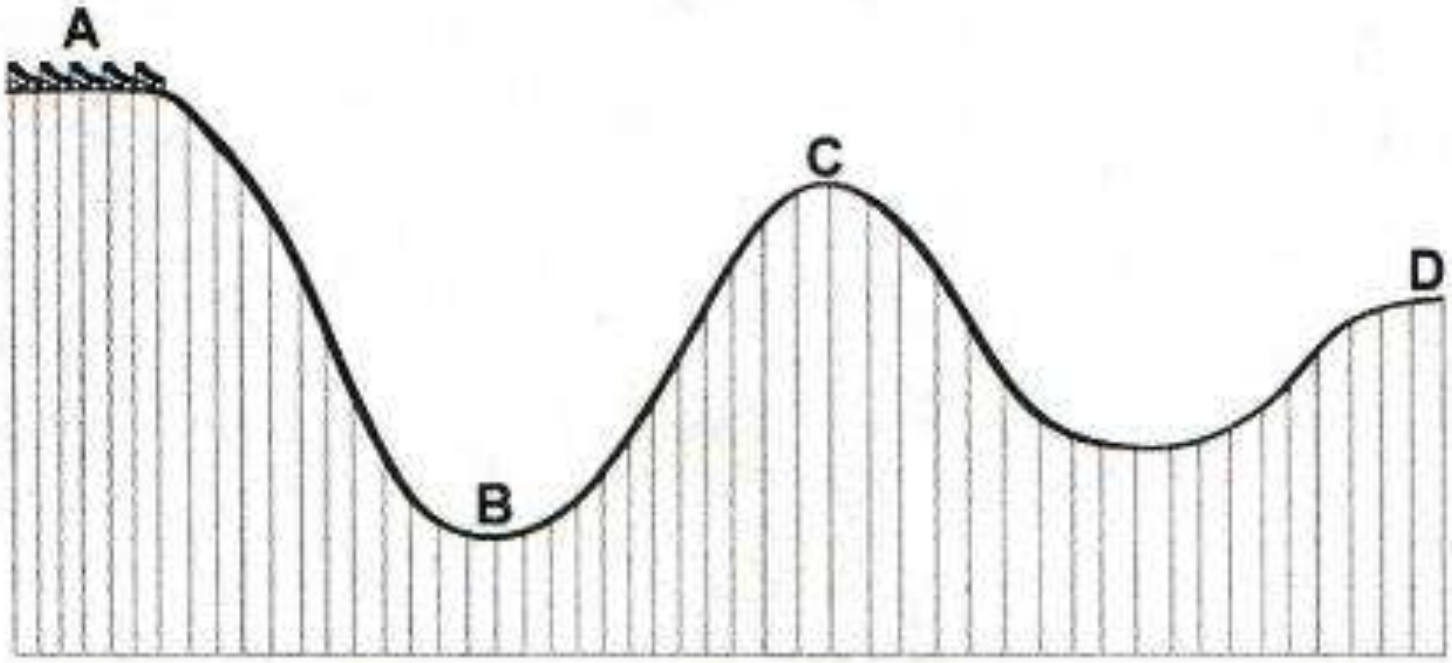
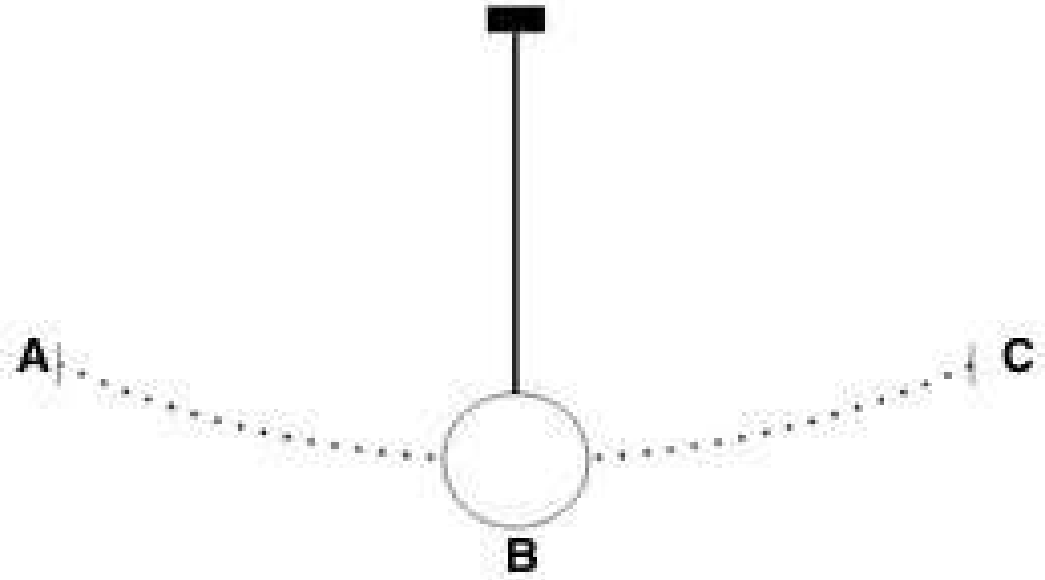

KE
PE
TME
Height = 72.0 m
Speed = 0.0 m/s

Question 1: For the positions labeled on the image, list in order from highest to lowest potential energy of the roller coaster. How is the kinetic energy of the roller coaster related to these values?

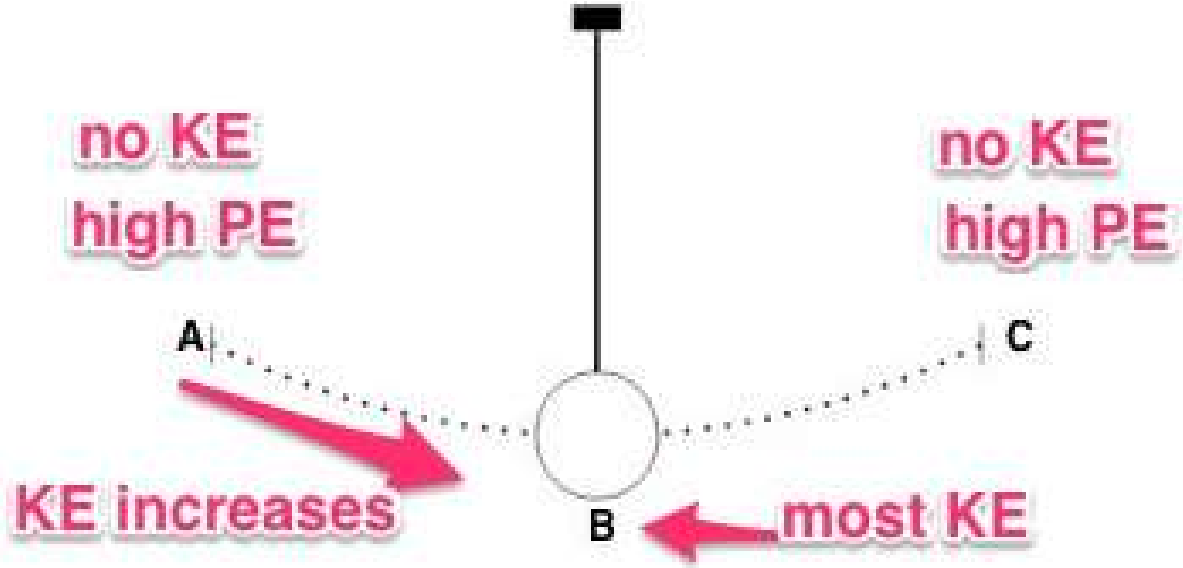


Question 1 Answer: The potential energy from highest to lowest is A,C,B,D.
The rank of kinetic energy would be opposite because the potential energy is transformed into kinetic energy as the roller coaster falls.

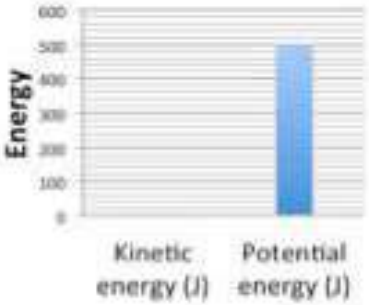


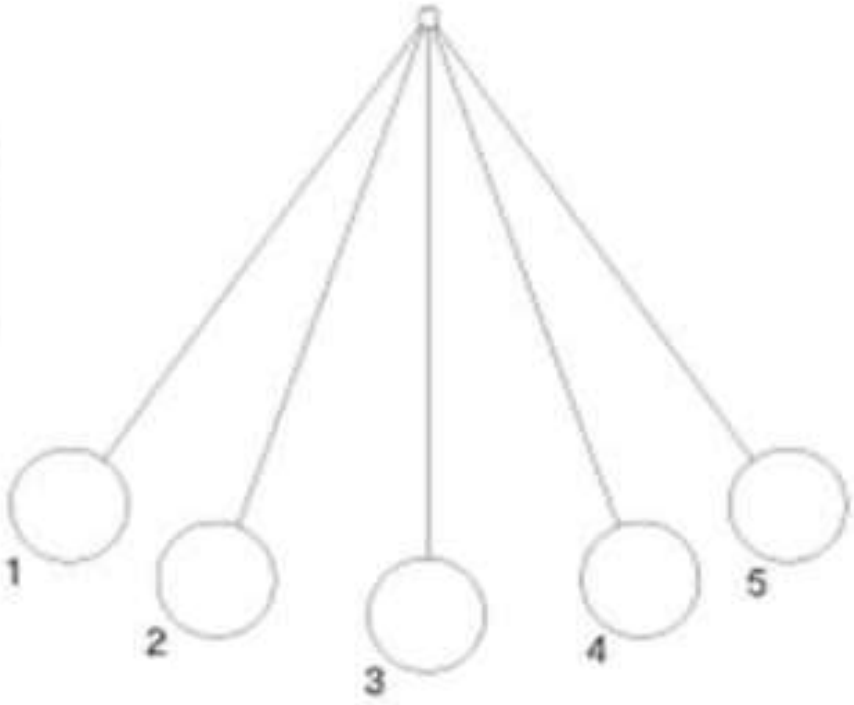
Question 2: Consider the pendulum seen here. You pull the pendulum bob up to point A and release it. Redraw the model. Show the location(s) where:

1. potential energy is highest
2. kinetic energy is highest
3. there is a change in kinetic energy.


no KE
high PE
no KE
high PE
A
C
KE increases
B
most KE

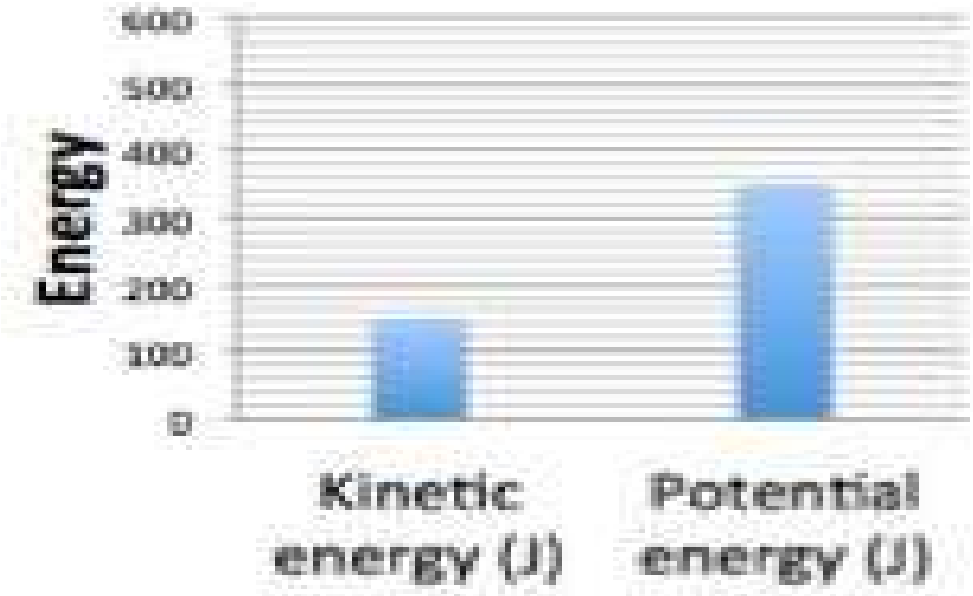
Questions 3: The image shows the possible positions for a person swinging. Using the picture, complete the following.





A. At position 4, if the kinetic energy is 240 J, what is the potential energy of the swinger?

B. At position 5, if this is the highest the swinger goes in the forward direction, what can be said about the kinetic energy at this point?



Question 3 Answer:
A. 260 J

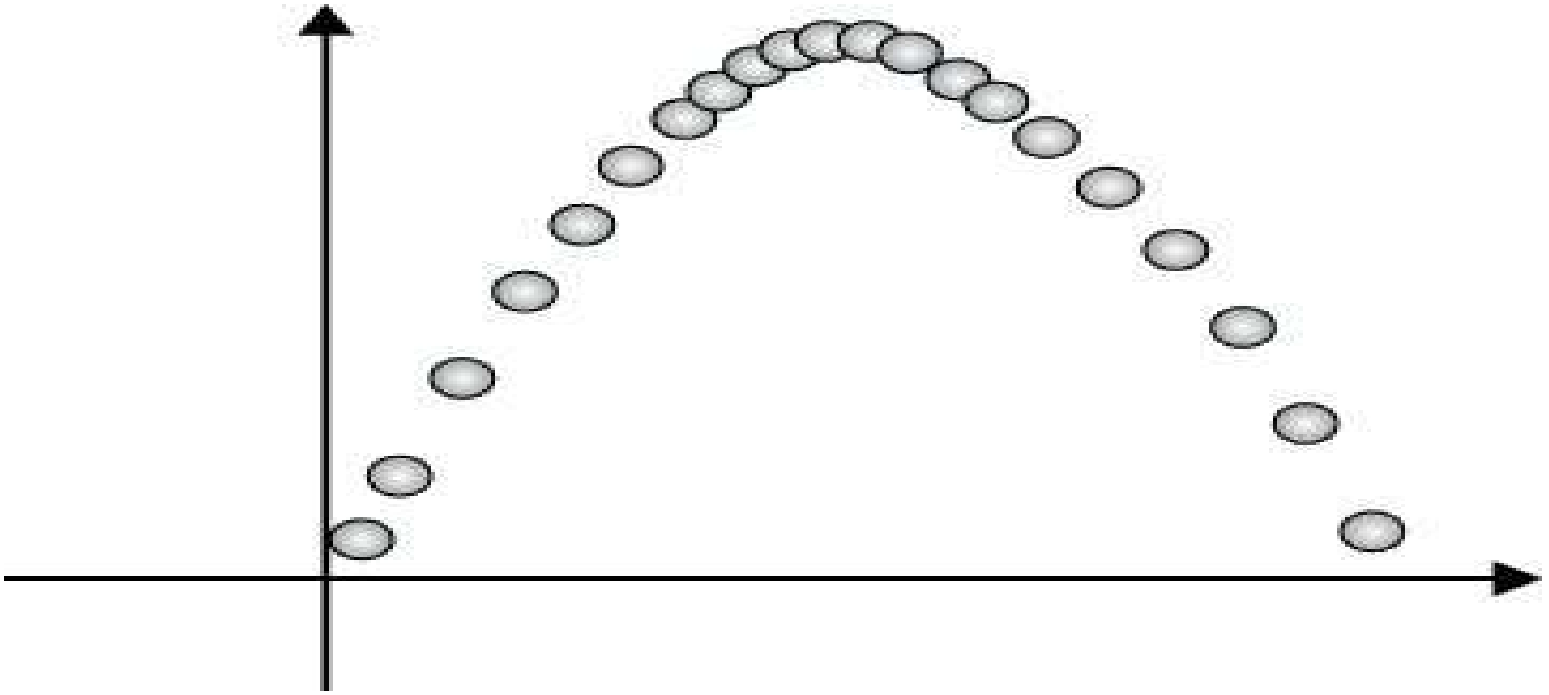
B. The kinetic energy will be zero at this point and the potential energy will be at its maximum.

A 60-kg bungee jumper stands at the top of a 50-m tall bridge. The jumper has a bungee secured to his ankles. The original length of the bungee is 25 meters. After falling 25 meters, the jumper reaches a maximum speed of 22m/s. He continues to fall until he comes to rest instantaneously and then is pulled back up by the bungee.

Question 4: Describe the energy transformations during the fall and return trip upward. Also, calculate the maximum kinetic energy and explain why this is not the total energy of the bungee jumper system.

As the jumper steps off the bridge, he starts with Gravitational potential energy. Until he falls to the un-stretched length of the bungee, the potential is transformed into kinetic energy. As the bungee begins to stretch, the gravitational potential energy and kinetic energy is transform into elastic potential energy. At the bottom, all the energy is stored as elastic potential energy. This elastic potential energy is transformed back into kinetic and gravitational potential energy as it rises again.

The maximum kinetic energy using the formula K=1/2mv2 yields 14,520 joules of energy. This is not the total energy because the jumper also has gravitational potential energy at this point.

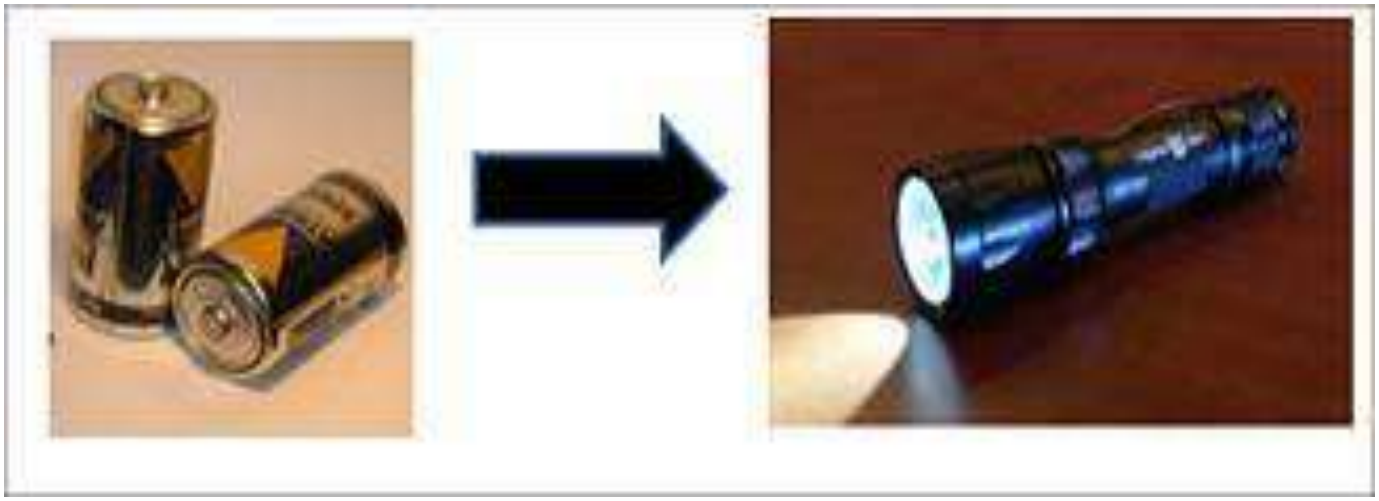


Question 5: Elijah and Grace are tossing the ball up to each other. Describe the changes in potential and kinetic energy as the ball is tossed between them.

Question 5 Answer: As the ball is tossed up the potential energy increases and kinetic energy decreases. The ball reaches a maximum potential energy and minimum kinetic energy at the peak of the arc. Then as the ball falls back toward to ground the kinetic energy increases and potential energy decreases.

Question 6: It's cold outside and you begin to rub your hands together to get yourself warm. Starting with the chemical potential energy stored in your muscles, describe the energy transformations that occur.

Question 6 Answer: The chemical potential energy stored in your muscles is transformed into kinetic energy of your hands which is then transformed into thermal/heat energy. The energy is merely transformed from one form to another.



Question 7: Sam and Maria put two batteries into this flashlight. Once the flashlight was turned on, what two types of energy were produced? Describe the energy transformations.

Question 7 Answer: The batteries contain chemical energy. Once the switch is turned on, the chemical energy is converted into light energy. After the light has been on for a short time, the light energy produces heat energy.

Question 8: When a light bulb is turned on, electrical energy is transformed into two other types of energy. What are they and support your answer with evidence.

Question 8 Answer: Electrical energy in a light bulb is transformed into light energy and thermal energy (heat).

Evidence for light energy is supported by the fact that the light bulb gives off light visually.

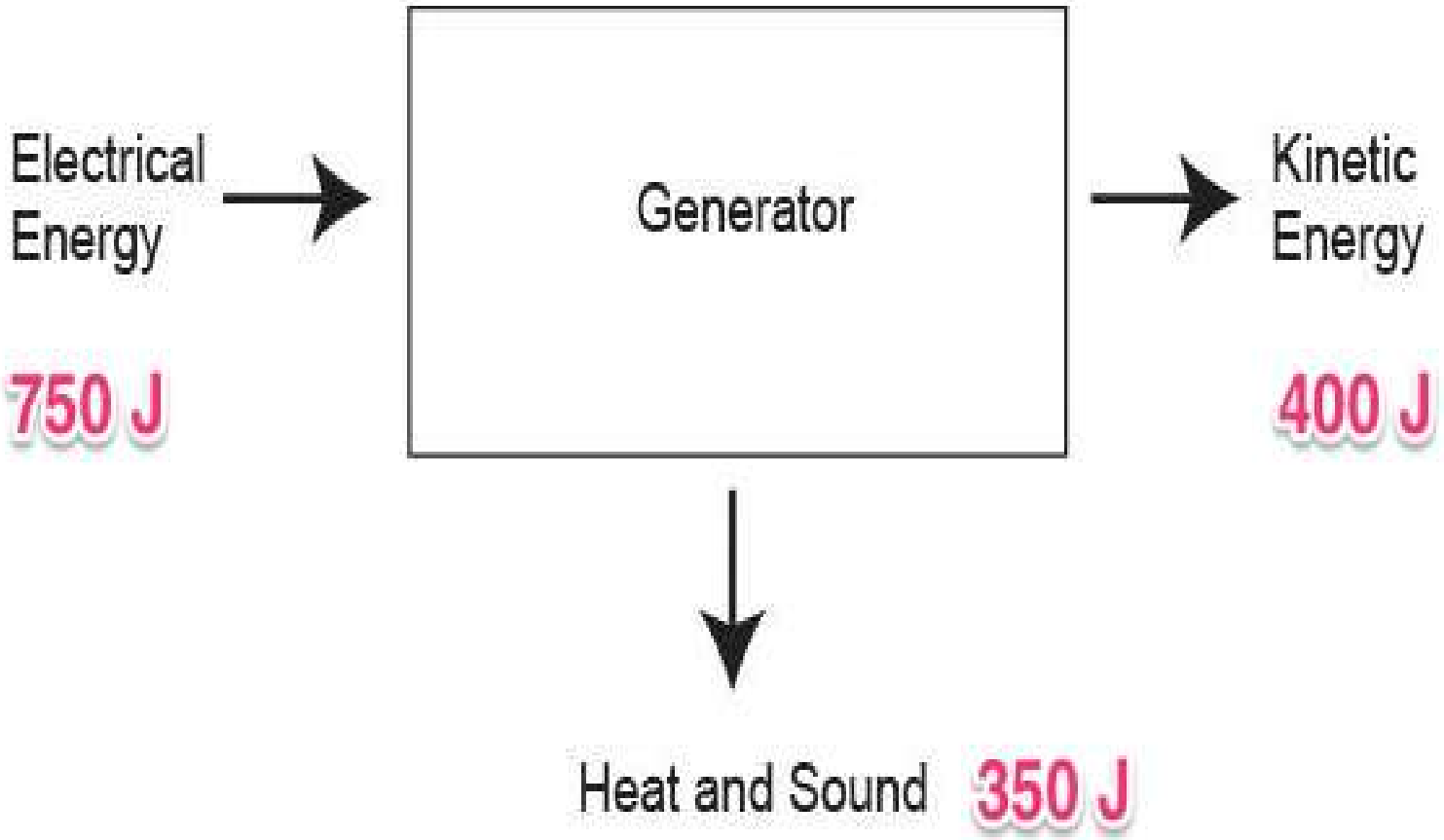
Evidence for thermal energy (heat) is that the light bulb feels warm to the touch.

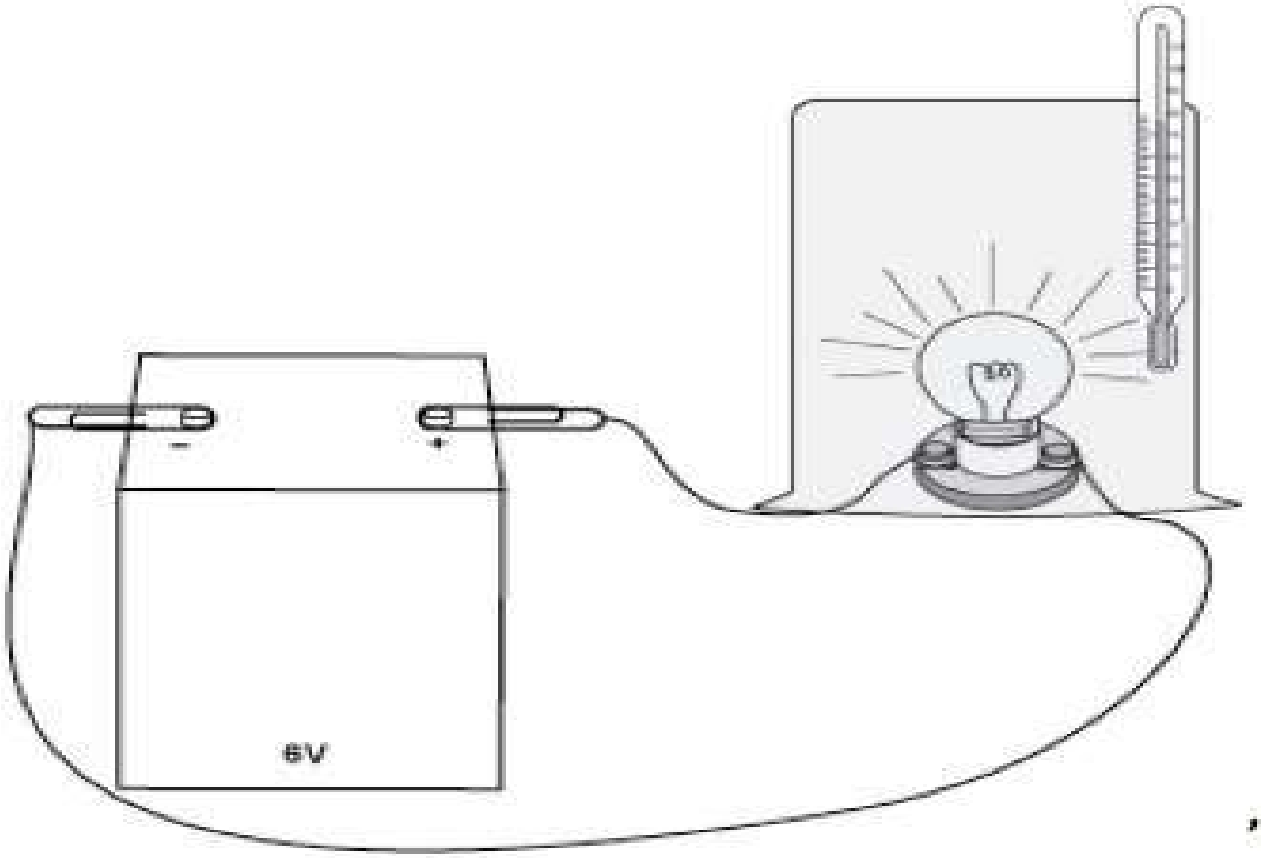
Question 9: A teacher assigns a project in class. The project is to design a solar oven that is capable of cooking a hotdog to a specified temperature. Describe the energy conversion that is taking place and suggest a way or ways that the effciency of the solar oven could be evaluated.

Question 9 Answer: Explain that the energy transformation is from solar to thermal energy. The efficiency could be evaluated by the time it takes for the hotdog to reach the specified temperature or the maximum temperature reached in a specified time.

Conservation of energy: energy is neither created or destroyed. It changes form.
750 J of electrical energy is used to cause a ceiling fan to spin (kinetic energy).
The 750 J of electrical is transformed into 400 J of kinetic energy.

Question 10: Draw a diagram to show what happens in this energy transformation. Be sure to include ALL of the energy, types and amounts.


Electrical Energy
750 J
Generator
Kinetic Energy
400 J
Heat and Sound
350 J



Question 11: Sam and Joe set up this circuit in class. They hooked a light bulb to a battery. They also set a thermometer close to the light bulb. Describe the flow of energy starting with the battery.

Question 12: Energy flows from battery through wire to light bulb.
Heat energy is transmitted through air (radiates) from light bulb to thermometer.

Question 12: When you place a battery in a flashlight and turn it on, the bulb lights. Explain the transfer of energy that causes the light bulb to turn on. Identifying the types of energy involved. What is necessary for this process to occur?

Question 12 Answer: Student responses should accurately describe the types of energy involved in this process as well as the requirements for an electric circuit.

Energy Transfer

-electricity

-light

-heat

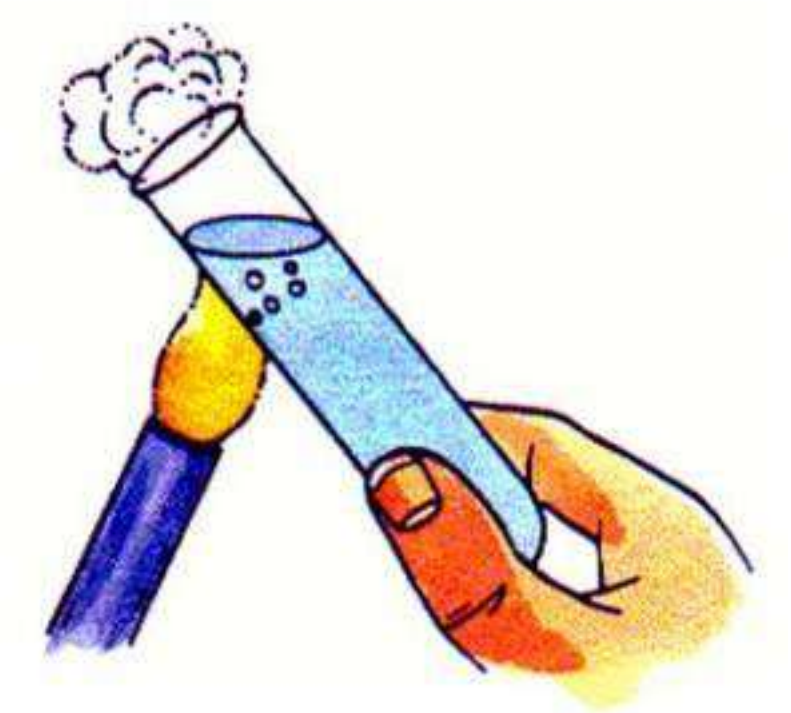
-energy source

-closed circuit

In the picture, you will find part of a Rube Goldberg project being demonstrated.

Question 13: Describe the energy transformation(s) that is(are) taking place as the dominoes fall.

Question 13 Answer: As the dominoes fall, potential energy is being converted to kinetic energy. As the dominoes collide, this produces sound energy, a little thermal energy as well more potential being converted to kinetic energy. When the domino hits the ball, more kinetic energy is being produced along with kinetic energy when the ball drops. When the ball hits the next object, it will likely create sound energy, a little friction and constantly change potential and kinetic back and forth until it comes to rest.



Question 14: Suppose a test tube of water is heated from the top. Explain how the heat is transferred through the water, and why the person can continue to hold the test tube.

Question 14 Answer: If the water is heated from the top, the water on top will become less dense than the cooler water on the bottom. Thus, the warmer water on top will remain on top and will not sink. Therefore, in order for the heat energy to be transferred throughout the beaker of water, the water molecules will have to touch and collide via conduction.

Question 15: Explain how a microwave oven heats a cup of water.

Question 15 Answer: The vibrating electrical field of the microwave causes the polar water molecules to rotate rapidly back and forth. This rotation causes friction between the water molecules that generates thermal energy. It is this thermal energy produced by the interaction between the water molecules that causes the water to heat up.

Question 16: Susan needs to bake lots of cookies for a party. Explain why the temperature in the kitchen became uncomfortably high by the time Susan was ready to cook her fourth batch of cookies.

Question 16: As the oven warms and stays warm, the kinetic energy of the particles near the oven increases. The kinetic energy is transferred when these particles collide via conduction with neighboring particles. Thermal energy is then transferred by the collisions between particles and not the movement of matter. So, the thermal energy created by the oven is transferred from hotter to colder regions in the kitchen.

Betsy was stirring a pot of hot soup with a large, metal spoon. The phone rang, so she left the spoon in the soup to go answer it. When she came back, the spoon felt very hot.

Question 17: Explain why the metal spoon felt hot. Would a wooden spoon left in hot soup feel warm too? Why or why not? Use the terms insulator and conductor in your response.

Question 17 Answer:

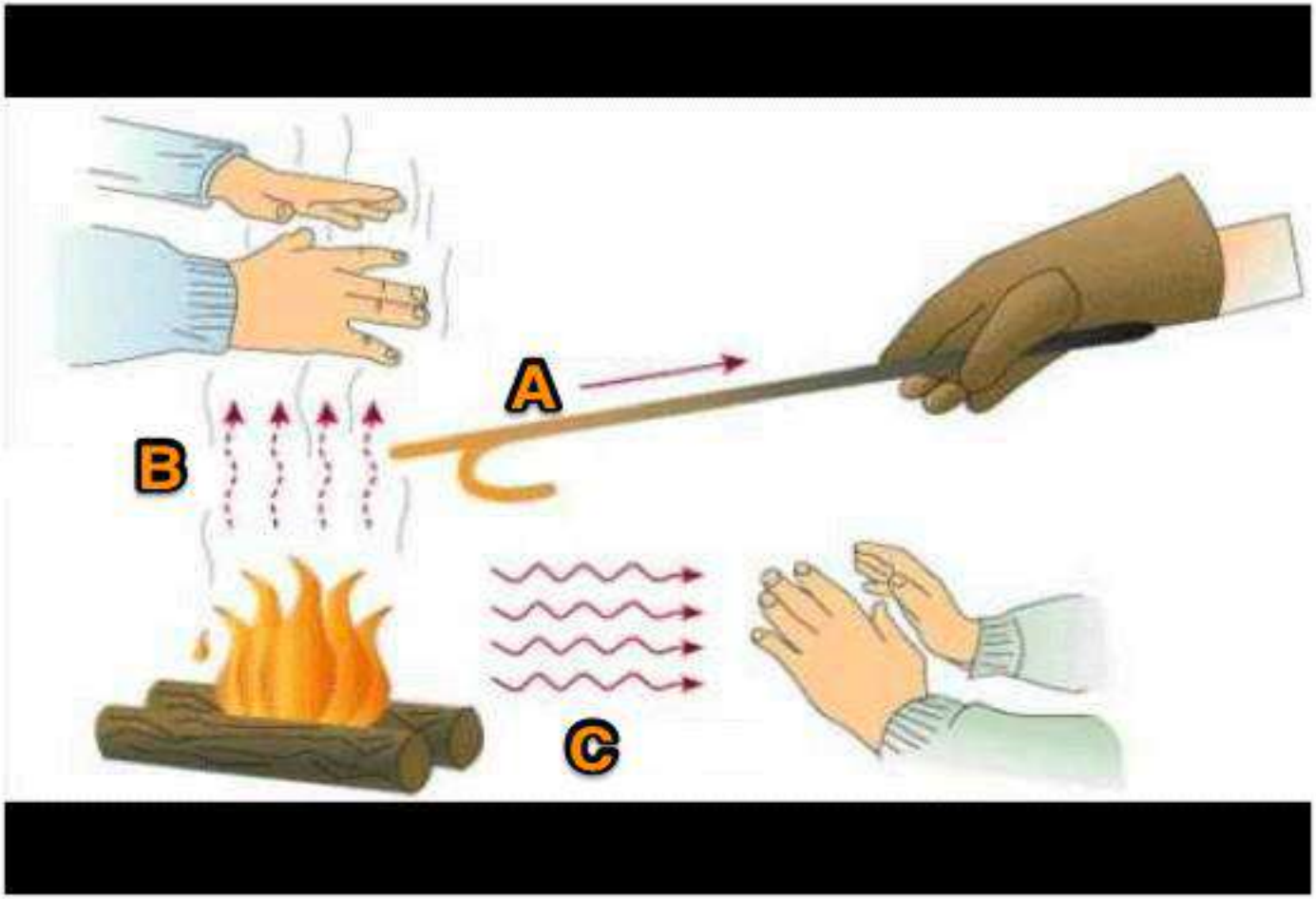
A. The metal in the spoon is a conductor. The heat from the soup traveled easily from the soup through the metal spoon, making it warmer.

B. The wood in the wooden spoon is an insulator.

C. Heat would not move easily through the wooden spoon, so it would not feel warm if it was left in the hot soup.

Question 18: We cook or heat our food by supplying energy into it. A stove, convection oven and microwave oven transfer this energy in different ways. Explain what kind of energy is transferred and the different ways that it is transferred using a stove, convection oven and microwave oven.

Question 18 Answers: Thermal energy is the internal energy or heat energy transferred to the food. A stove uses conduction or heat transfer through direct contact. Convection ovens use convection to transfer thermal energy through the movement of a fluid. Finally, microwaves transfer thermal energy by radiation or pure energy waves.



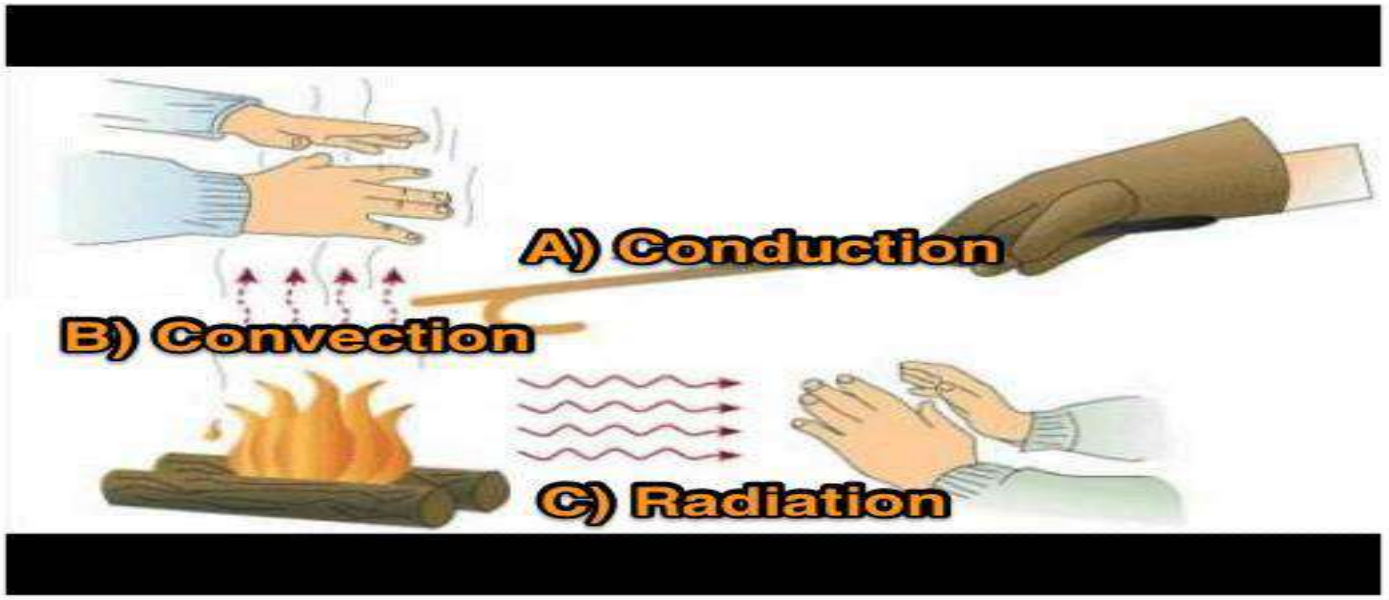
Question 19: Identify the correct type of heat transfer for A, B, and C in the picture. Using the picture, cite evidence for your choices.

Question 19 Answers:

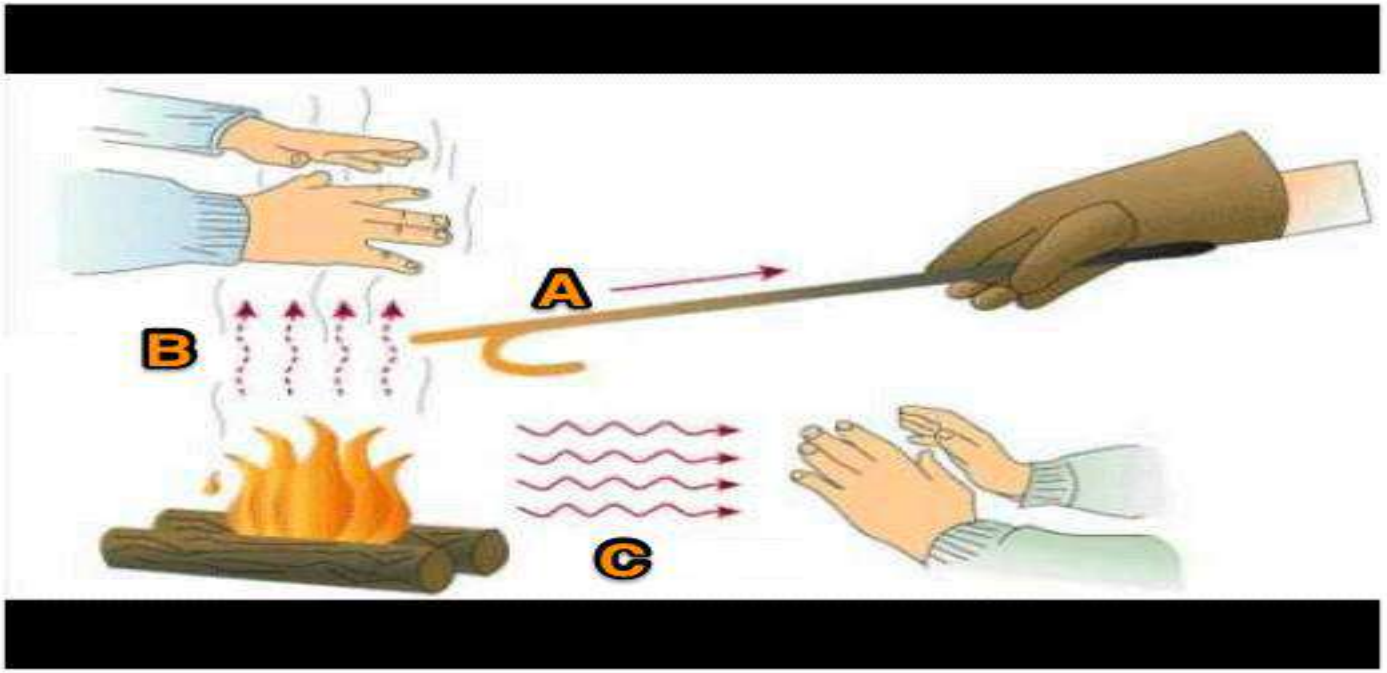
A - conduction since the heat is transferred by direct contact with an object.

B - convection because the heat is transferred by the motion of molecules (generally heat rising but water currents are good example too)

C - radiation because heat is transferred by electromagnetic radiation. The object gives off electromagnetic radiation in all directions.



Question 20: Consider the three ways that heat energy is transferred: convection, conduction, and radiation. Conduction occurs in the solid poker held in the fire. Heat energy moves up through the poker. That's why the person holding the poker is wearing an insulting glove. Explain how heat energy moves through the poker.



Answer Question 20:

1. Heat can be transferred by conduction only in solids. As one end of a solid is heated, the particles of the solid gain kinetic energy. This means that they move faster.
2. In a solid the particles are held together by strong forces of attraction. The only way in which the particles can move is to vibrate back and forth.
3. When the solid is heated, the amount by which the particles vibrate is increased; those particles have gained kinetic energy.
4. The increase in energy (heat) is passed on to the next particle as the now more-rapidly vibrating particle bumps into another, which in turn starts to vibrate more.

Question 21: How is conduction related to heat transfer in a solid?

Question 21 Answer: Conduction is the process of heat transfer or energy transport through a solid due to molecular motion, or molecular vibration, and interaction. Heat can be transferred by conduction only in solids. If one end of a solid is heated, the particles of the solid gain kinetic energy. This means that the particles move faster - i.e. they vibrate forwards and backwards. So the increase in heat energy is passed on to the next particle, which in turn starts to vibrate more.