Name: _____

1) Which process requires the addition of energy to water?
   A) vaporization of water
   B) condensation of water
   C) freezing of water
   D) cooling of water

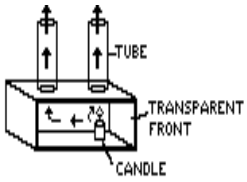
2) According to the *Earth Science Reference Tables*, which material would require the most heat energy to increase the temperature of 1 gram of the material one Celsius degree?
   A) ice
   B) water
   C) basalt
   D) granite

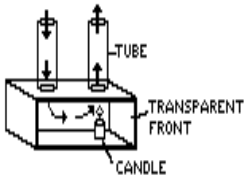
3) Which type of surface would most likely be the best reflector of electromagnetic energy?
   A) light-colored and rough
   B) dark-colored and rough
   C) dark-colored and smooth
   D) light-colored and smooth

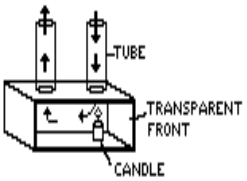
4) Which statement is the best example of heat energy transfer by conduction?
   A) Heat energy is transferred from the bottom to the top of the lake.
   B) Heat energy is transferred from the surface soil to the rocks below.
   C) Heat energy is transferred from the Sun to the Earth.
   D) Heat energy is transferred from the Earth's surface to the upper atmosphere.

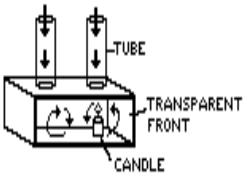
5) An object that is a good radiator of electromagnetic waves is also a good
   A) insulator from heat
   B) reflector of heat
   C) retractor of electromagnetic energy
   D) absorber of electromagnetic energy

6) The diagrams below represent a laboratory model used to demonstrate convection currents. Each model shows a burning candle in a closed box with two open tubes at the top of the box. Which diagram correctly shows the air flow caused by the burning candle?

A)


B)


C)


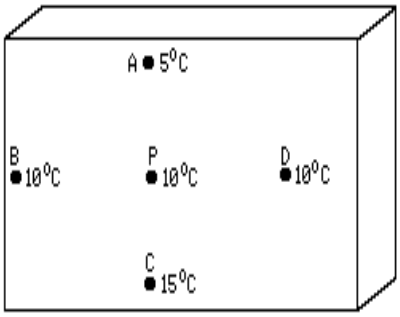
D)


7) What is the total amount of energy required to melt 100 grams of ice at 0° C to liquid water at 0° C?
   A) 5,400 cal
   B) 80,000 cal
   C) 8,000 cal
   D) 54,000 cal

8) How many calories of heat energy must be added to 10 grams of iron to raise its temperature 10 C°?
   A) 110 cal
   B) 1.1 cal
   C) 0.11 cal
   D) 11 cal

9) Which process results in a release of latent heat energy?
   A) evaporation of water
   B) condensation of water vapor
   C) heating of liquid water
   D) melting of ice

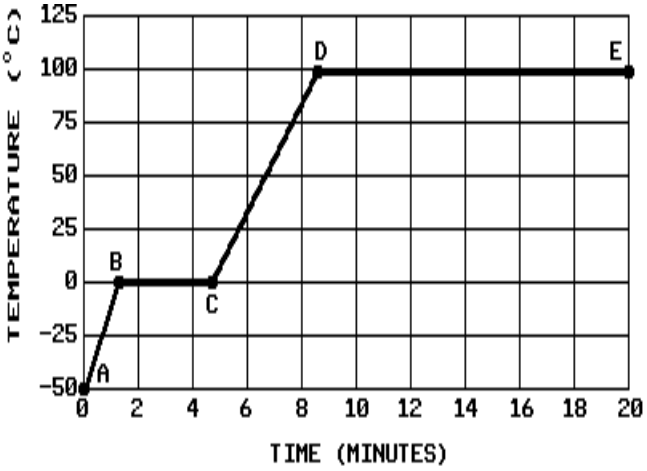
10) The diagram below shows temperature values at various point in a solid piece of aluminum. Toward which point will heat flow from point *P*?



A) *D* B) *B* C) *C* D) *A*

Questions 11 through 15 refer to the following:

The graph below shows the temperatures recorded when a sample of water was heated at a constant rate from -50° C to 100° C during a 20-minute period.



11) The *greatest* amount of energy is required to heat the sample from point

A) *A* to point *B* C) *C* to point *D*
B) *D* to point *E* D) *B* to point *C*

12) How many calories of heat would be used to change the temperature of 20 grams of the water from the temperature at point *C* to the temperature at point *D*?

A) 200 calories C) 800 calories
B) 540 calories D) 2,000 calories

13) The water temperature reached 65° C after the sample had been heated for approximately how many minutes?

A) 9 min C) 7 min
B) 5 min D) 3 min

14) Between which points was the temperature changing at the *greatest* rate?

A) *C* and *D* C) *D* and *E*
B) *B* and *C* D) *A* and *B*

15) Between points *D* and *E* the water most likely was

A) vaporizing C) melting
B) condensing D) freezing

16) Which energy transformation occurs as a rock falls freely from the top of a vertical cliff?

A) The rock's potential energy and kinetic energy decrease.
B) The rock's potential energy increases and the rock's kinetic energy decreases.
C) The rock's potential energy and kinetic energy increase.
D) The rock's potential energy decreases and the rock's kinetic energy increases.

17) Which characteristics of a material have the *greatest* effect on the amount of insolation that the material will absorb?

A) density and hardness
B) roughness and color
C) age and roughness
D) hardness and age

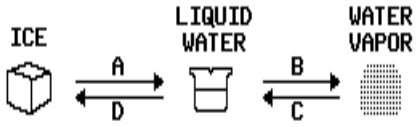
18) How much heat energy is required to raise the temperature of 10. grams of granite from 20.° C to 50.° C?

A) 500 cal C) 1.9 cal
B) 57 cal D) 300 cal

19) An object was added to a beaker of water. Using a thermometer, a student observed an immediate increase in water temperature. What is the best interpretation of this observation?

A) The object was an energy source to the water and to the thermometer.
B) The thermometer was an energy sink to the water, but an energy source to the object.
C) The object and the thermometer were energy sinks to the water.
D) The object was an energy sink to the water, but an energy source to the thermometer.

20) A sample of water undergoes the phase changes from ice to vapor and back to ice as shown in the model below. During which phase change does the sample gain the *greatest* amount of energy?

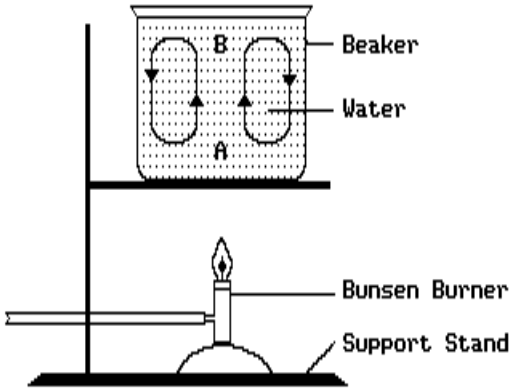


A) *D* B) *A* C) *B* D) *C*

21) According to the heat energy formula in the *Earth Science Reference Tables*, how many calories of heat energy must be added to 20 grams of cold water to raise its temperature 5° C?

A) 120 calories C) 20 calories
B) 100 calories D) 4 calories

22) The diagram below represents a large beaker of water being heated to demonstrate convection.



The movement of water upward from *A* toward *B* results primarily from

A) capillary action within the water
B) air movement across the surface of the water
C) the shape of the beaker
D) differences in density in the water

23) Infrared, ultraviolet, and visible light are all part of the solar spectrum. The basic difference between them is their

A) wavelength
B) source
C) temperature
D) speed

24) How much heat energy will be lost by a 200-gram mass of water as it cools from 40° C to 35° C?

A) 108,000 cal
B) 16,000 cal
C) 205 cal
D) 1,000 cal

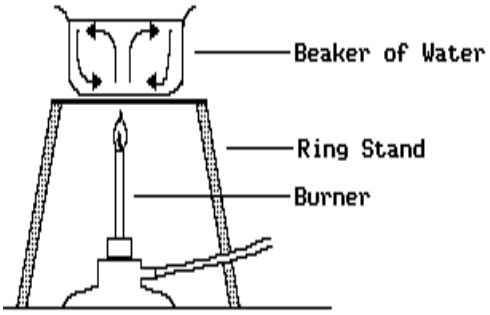
25) Which example of heat transfer is due mainly to convection?

A) heat energy transferred by air moving from the Earth's surface to the upper atmosphere
B) heat energy transferred through a solid metal door
C) heat energy transferred from the Sun to the Earth
D) heat energy transferred by being reflected from a lake surface to the air above

26) If equal masses of water in various phases (states) are compared, which phase will contain the *greatest* amount of stored energy (latent heat)?

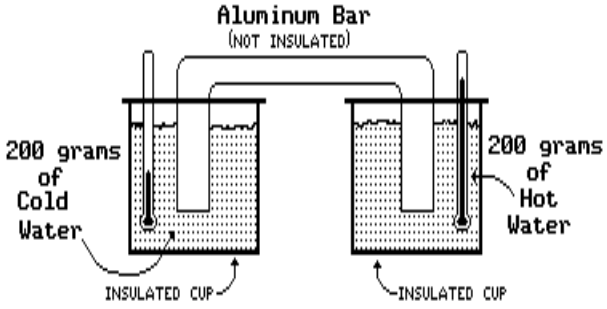
A) solid ice
B) water vapor
C) liquid water

27) The diagram shows a container of water that is being heated. The movement of water shown by the arrows is most likely caused by



A) the Earth's rotation
B) insolation
C) the Coriolis effect
D) density difference

28) The diagram below illustrates equipment used to perform an open-system heat transfer investigation under ordinary classroom conditions.



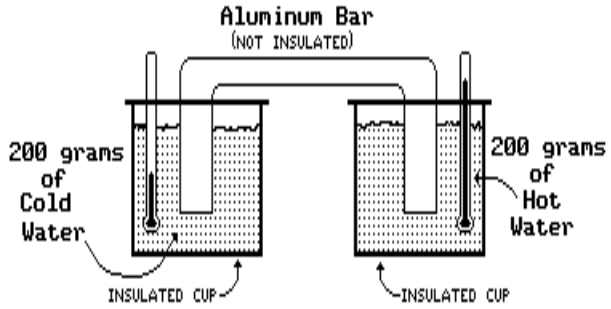
If the initial temperature of the cold water was 10° C and the initial temperature of the hot water was 86° C, what were the most likely temperature readings after 12 minutes?

A) 4° C for the cold water and 92° C for the hot water
B) 22° C for the cold water and 74° C for the hot water
C) 6° C for the cold water and 82° C for the hot water
D) 16° C for the cold water and 74° C for the hot water

29) How many calories of latent heat would have to be absorbed by 100 grams of liquid water at 100° C in order to change all of the liquid water into water vapor at 100° C?

A) 8,000 cal
B) 54,000 cal
C) 100 cal
D) 1,000 cal

30) The diagram below illustrates equipment used to perform an open-system heat transfer investigation under ordinary classroom conditions.



The *greatest* amount of heat energy transferred between the hot and cold water is transferred by the process of

A) radiation
B) absorption
C) convection
D) conduction

31) At which temperature will iron radiate the *least* electromagnetic energy?

A) 0°C
B) 230 K
C) 32°F
D) 0°F

32) Which material would require the *greatest* amount of heat energy to raise its temperature from 5°C to 10°C? [Refer to the *Earth Science Reference Tables*.]

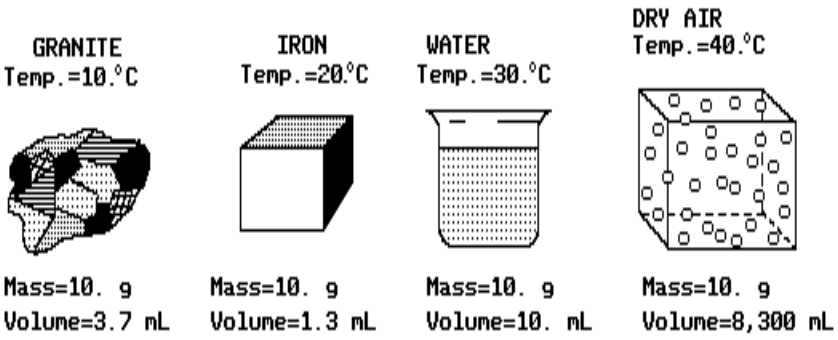
A) 10 g of iron
B) 10 g of lead
C) 10 g of granite
D) 10 g of dry air

33) Two insulated cups are connected by an aluminum bar. Cold water is placed in one cup and an equal mass of hot water is placed in the other cup. The temperature of the hot water decreases more rapidly than the temperature of the cold water increases. Which statement best explains this observation?

A) Hot water has a lower specific heat than cold water.
B) Some heat passes from the aluminum bar to the air.
C) The cold water is undergoing a change of phase.
D) The cold water gains heat from the air.

Questions 34 through 37 refer to the following:

The diagram below shows equal masses of four different earth materials at different temperatures.



34) Convection currents may be produced most easily in the samples of

A) iron and dry air
B) granite and iron
C) water and dry air
D) water and granite

35) If 100 calories of heat is added to each sample, the *smallest* change in temperature will occur in the

A) iron
B) dry air
C) granite
D) water

36) Which statement best describes the relationship between a heat sink and a heat source if the samples are placed in contact with each other?

A) The granite will be a heat source for the dry air.
B) The water will be a heat sink for the iron.
C) The dry air will be a heat source for the water.
D) The iron will be a heat sink for the granite.

37) How much heat is needed to raise the temperature of the iron sample to 30°C?

A) 30 cal
B) 33 cal
C) 11 cal
D) 22 cal

Questions 38 through 41 refer to the following:

Diagram I represents a light source located at an equal distance from two air-filled metal cans. One can is shiny and the other is black. Diagram II represents two insulated cups, each filled with equal masses of water. One insulated cup contains cold water and the other contains warm water. A metal bar is inserted into the water of each insulated cup.

DIAGRAM I

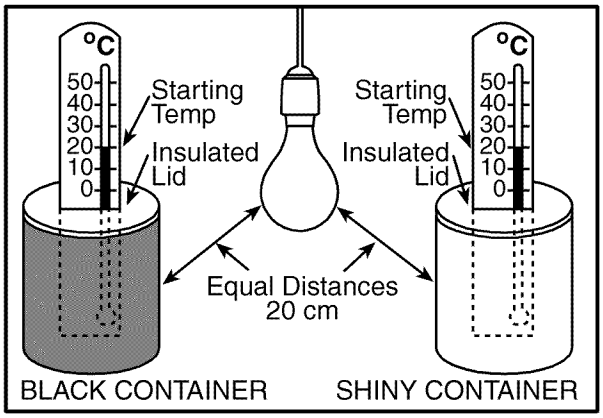
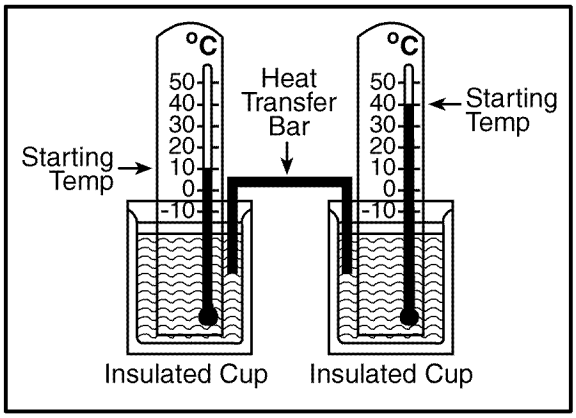


DIAGRAM II



38) When the light source is on (diagram *I*), the amount of radiant energy striking the black container, as compared to the amount striking the shiny container, is

A) less
B) more
C) the same

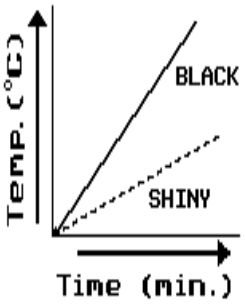
39) In the equipment shown in diagram *II*, heat energy will be transferred through the bar from the hot water to the cold water primarily by

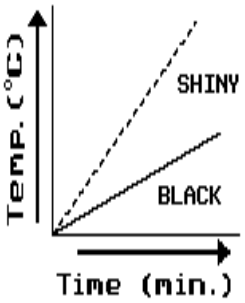
A) flowing currents
B) molecular collisions
C) density differences
D) electromagnetic rays

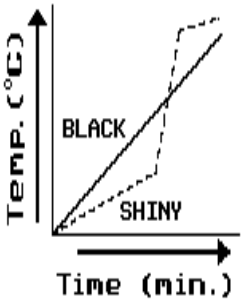
40) In diagram *II*, if all the energy lost by the warm water is gained by the cold water, what will be the temperature of the water in both insulated cups following the energy transfer?

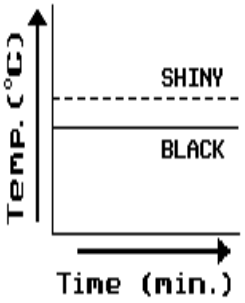
A) 50°C
B) 25°C
C) 10°C
D) 40°C

41) With reference to diagram *I*, which graph best represents the change in temperature during the first 10 minutes after the light source is turned on?

A)


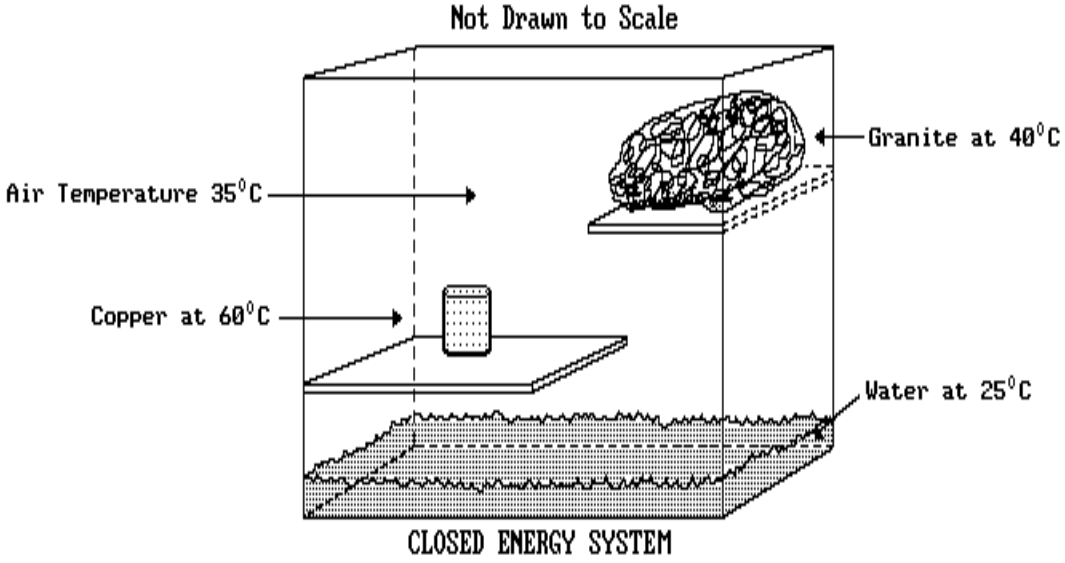
B)


C)


D)


Questions 42 through 46 refer to the following:

The diagram below represents a closed energy system consisting of air and equal masses of copper, granite, and water in a perfectly insulated container. The temperatures were taken at the time the materials were placed inside the closed system.



42) As time passes, the total energy in the system will
A) increase
B) decrease
C) remain the same

43) Which material in the energy system has the highest specific heat?
A) copper
B) granite
C) water
D) dry air

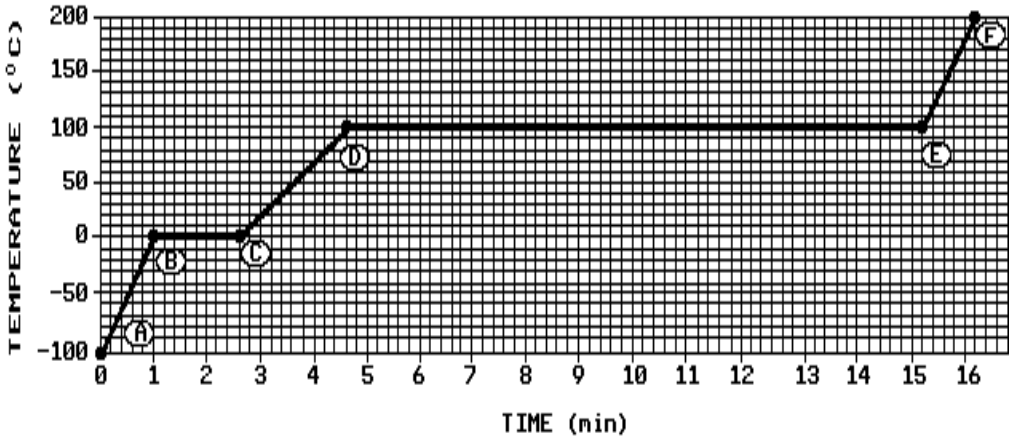
44) The mass of the granite is 2,000 grams. How much heat would have to be added to raise its temperature 20 C°?
A) 5,400 cal
B) 4,000 cal
C) 7,600 cal
D) 76 cal

45) In the first day after the materials were placed in the system, the temperature of the water would probably
A) increase
B) decrease
C) remain the same

46) In this system, which material is a heat sink for another material?
A) The granite is a heat sink for the water.
B) The copper is a heat sink for the granite.
C) The copper is a heat sink for the air.
D) The water is a heat sink for the air.

Questions 47 through 50 refer to the following:

The graph below indicates the temperatures recorded when a sample of water was heated from -100° C to 200° C. The water received the same amount of heat every minute.



47) At which point in time would most of the water be in the liquid phase?

A) 16 minutes C) 1 minute
B) 14 minutes D) 4 minutes

48) For the time on the graph represented by the line from point *B* to point *C*, the water was

A) condensing C) melting
B) freezing D) boiling

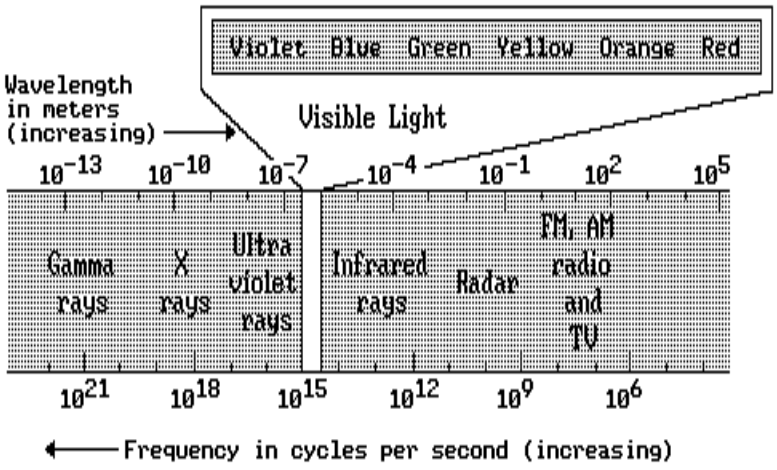
49) The *greatest* amount of energy was absorbed by the water between points

A) *D* and *E* C) *C* and *D*
B) *B* and *C* D) *A* and *B*

50) How many calories were required to change 10. grams of liquid water at point *D* to water vapor at point *E*?

A) 800 cal C) 1,000 cal
B) 500 cal D) 5,400 cal

51) The diagram below shows part of the electromagnetic spectrum.

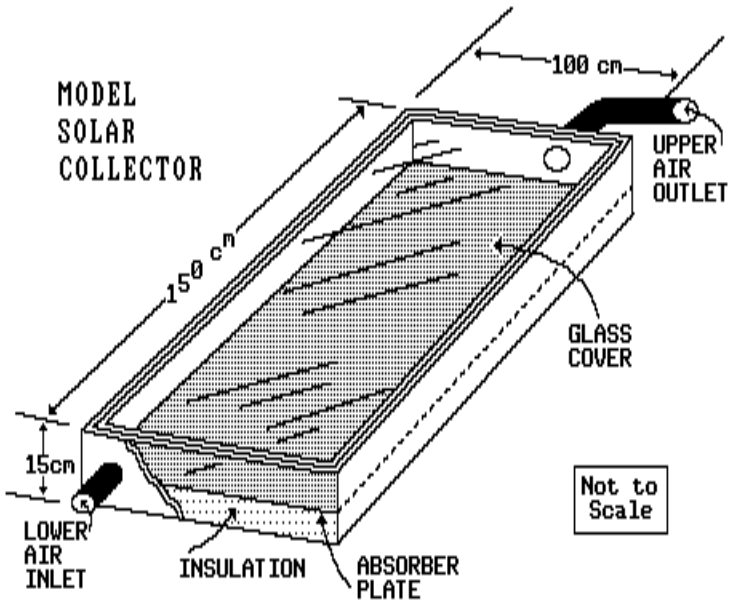


Which form of electromagnetic energy shown on the diagram has the *lowest* frequency and *longest* wavelength?

A) gamma rays B) red light C) AM radio D) infrared rays

Questions 52 through 54 refer to the following:

The diagram below represents a hot-air solar collector consisting of a wooden box frame, an absorber plate, a glass cover, and insulation.



52) Which paint should be used on the absorber plate if it is designed to absorb the *greatest* possible amount of insolation?

A) white paint
B) black paint
C) yellow paint
D) red paint

53) Why does the air usually enter the collector at the lower air inlet and leave the collector at the upper air outlet?

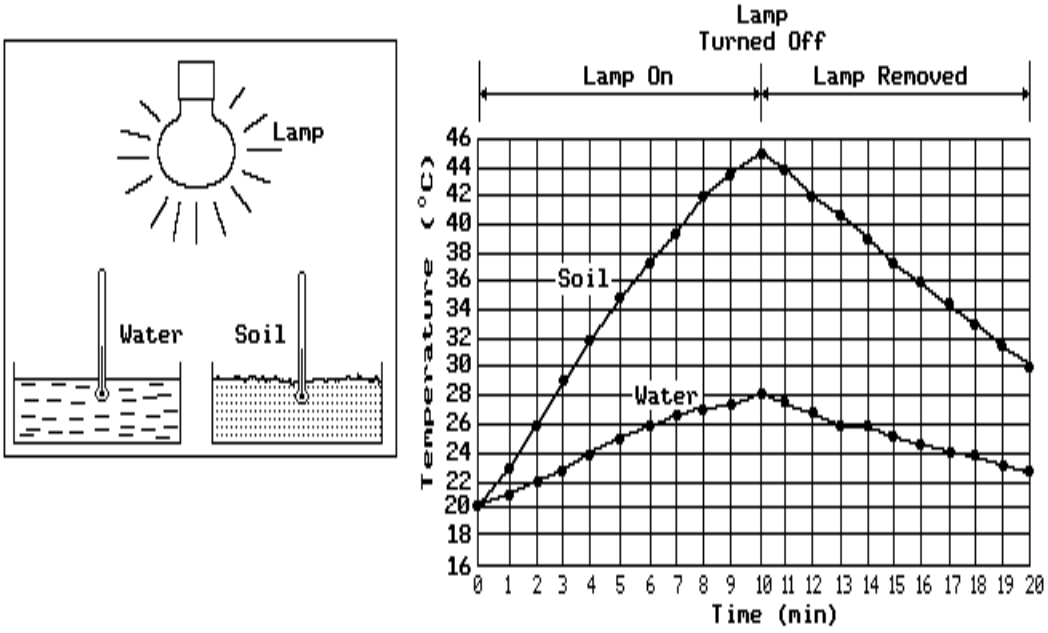
A) The air inside the collector is less dense than the air in the lower air inlet.
B) The air inside the collector is cooler than the air in the lower inlet.
C) The air inside the collector has less moisture than the air in the lower air inlet.
D) The mass of the air inside the collector is greater than the mass of the air in the lower inlet.

54) The main purpose of the insulation behind the absorber plate is to

A) decrease the amount of energy lost through the back of the collector
B) increase the amount of energy reflected by the absorber plate
C) decrease the amount of energy received by the collector
D) increase the rate of energy transfer through the absorber plate

Questions 55 through 58 refer to the following:

In the diagram below, equal masses of water and soil are located at identical distances from the lamp. Both were heated for ten minutes and then the lamp was removed. The water and soil were then allowed to cool for ten minutes. The graph shows the temperature data obtained during the investigation.



55) By which process was most of the energy transferred between the lamp and the water during the first 10 minutes of the investigation?

A) convection
B) reflection
C) radiation
D) conduction

56) What were the temperature readings of the water and soil at the time the lamp was turned off?

A) The water was 45° C and the soil was 28° C.
B) The water was 20° C and the soil was 20° C.
C) The water was 23° C and the soil was 30° C.
D) The water was 28° C and the soil was 45° C.

57) Compared to the water, the soil became warmer during the heating period because the soil

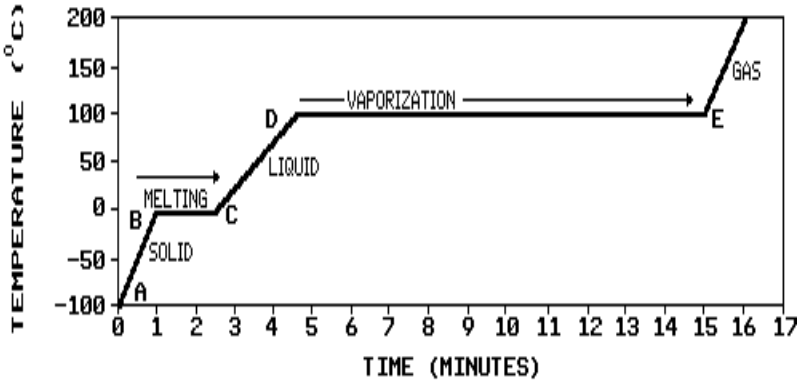
A) was closer to the lamp
B) reradiated less heat
C) has a lower density
D) has a lower specific heat

58) What was the rate at which the soil temperature changed during the first ten minutes of the investigation?

A) 25 C°/min
B) 2.5 C°/min
C) 8 C°/min
D) 0.8 C°/min

Questions 59 through 63 refer to the following:

The graph below shows the results of heating 10 grams of water from -100° C to +200° C. The same amount of heat was added during each minute.



59) In which phase does water have its highest specific heat?

A) gas B) liquid C) solid

60) During which time interval was the rate of temperature change the *greatest*?

A) *C* to *D*
B) *A* to *B*
C) *D* to *E*
D) *B* to *C*

61) Approximately how long did it take to completely change the 10 grams of water from a solid at -100° C to a gas at +100° C?

A) 11 minutes
B) 15 minutes
C) 1 minute
D) 5 minutes

62) What is the most probable explanation for the constant temperature between points *D* and *E* on the graph?

A) The added heat changed liquid water to water vapor.
B) The added heat was lost to the surroundings.
C) The added heat changed water vapor to liquid water.
D) The added heat was radiated as fast as it was absorbed.

63) During which change would the 10 grams of water gain the most energy?

A) Liquid water at 100° C changes to water vapor at 100° C.
B) Ice at -100° C changes to ice at 0° C.
C) Liquid water at 0° C changes to liquid water at 100° C.
D) Ice at 0° C changes to liquid water at 0° C.