Name: _____

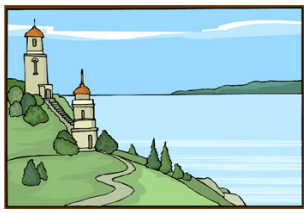
Period: _____

Heat and Water/ Heat Review

Heat and Water

Most people know that water is necessary for life, but most do not know that the properties of water in regard to heat and temperature are also essential for life on our planet.

Water has a high specific heat capacity (4186 J/ kg·ºC) It is hard to change water's temperature. This is why lakes and oceans do not change temperature quickly and why the temperature near large bodies of water do not fluctuate much.



Most people live by oceans because the weather is more temperate—it doesn't change much. Very hot and cold temperatures exist farther inland.

Water expands as it freezes. As objects cool, they contract (get smaller) except water, which starts to expand again below 4ºC. The expansion of freezing water causes erosion: rocks breaking. Also, ice (solid water) is less dense than liquid water, so it floats on water and is a better insulator than water.

As it freezes, ice floats to the top of water, insulating the water below it. This is why fish do not freeze in a pond or lake during the winter.

Funny, but not true.

1. What property of water helps it maintain its temperature?

2. A large swimming pool has a temperature of 60ºF at 6 a.m. in morning. The air temperature climbs to 100ºF during the day. That evening, will the swimming pool be at 100ºF?

3. A glass bottle is filled to the top with water and then sealed tightly. What will happen when the bottle is placed in the freezer?

   Why?

4. If solid iron is dropped into liquid iron, will the solid iron float or sink?

   If solid water is dropped into liquid water, will the solid water float or sink

   Which of the above is the exception: iron or water?

5. Which is a better insulator: ice or water?

   Why?

6. Why do roads break during the winter?

7. Why don't fish freeze under a frozen pond?

8. 75ºF is a comfortable temperature for humans. What temperature is that in degrees Celsius?

9. The hottest temperature ever recorded was on earth was 56.7ºC. How hot is that in degrees Fahrenheit?

10. What is the boiling point of water in Celsius?

    What is the boiling point of water in Kelvin?

11. Which equation: $Q = mc_p\Delta T$ or $Q = mL$?
    A. _____ Water changes from 20ºC to 50ºC.
    B. _____ Water melts.
    C. _____ A substance liquefies.
    D. _____ Water going from melting point to –10ºC.
    E. _____ During a phase change.
    F. _____ During a change of temperature?

12. +Q or –Q?
    A. ____ Endothermic
    B. ____ Ice melting to water.
    C. ____ Heat in.
    D. ____ For your hand when you touch something cold.
    E. ____ If ΔT is positive.

Name: _____

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13. Newton's Law of Cooling	A. Relates to the kinetic energy of the atoms inside a substance.
14. Specific Heat	B. Heat necessary to change a substance's state of matter.
15. Latent Heat	C. Objects cools faster if the temperature around them is colder.
16. Internal Energy	D. How much heat is necessary to change a substance's temperature.
17. Evaporation	A. Energy transferred between objects of different temperature.
18. Absolute Zero	B. All atoms stop moving here.
19. Heat	C. A cooling process because energy comes is drawn in.
20. Exothermal	D. Energy is given off in a process.

21. Which has more internal energy (U): a full cup of hot soup or the metal spoon in the soup?

22. 10 kg of steam is dropped 5ºC. 10 kg of ice is also dropped 5ºC. Which gives off more heat?

23. A new substance is discovered. It is determined that it has a Cp of 3560 J/ kg•ºC.
    A. Is it likely to be an insulator or conductor?

    B. Will it change temperature easily?

24. Conduction (N), Convection (V), or Radiation (R)?
    A. _____Cooks pasta in a pot of hot water.
    B._____Heats the water throughout the pot.
    C._____Heats your hand next to, but not touching the pot.

25. A heat lamp is placed near two objects, which one changes temperature faster?
    A. _____A black one or a white one?
    B._____The dull one or shiny one?
    C._____One made up of gold or aluminum?

26. A black cup and a white cup are both at 80ºC. Which one will cool down faster?

27. Does water have to be at 100ºC to turn to a gas?

28. A. Use arrows to show the direction of heat transfer.
    B. Draw 2 arrows for fast heat transfer.
    C. Which object has no internal energy?

0° C conductor	35° C conductor	10° C insulator

29. How much heat is necessary to raise the temperature of 8 kg of water 12 degrees?

30. How many kilograms of copper give off 2500 J of energy to cool from 140ºC to 70ºC?

31. How much of the heat is necessary to change 3 kg of water to steam?

32. 40kg of water at 110ºC is cooled to water at 85ºC. How much heat was given off?

+ or –?	Cp or L (give #)	Ti	Tf	Calculate Q
Q_{steam}				
Q_{vapor}				
Q_{water}				
Q_{fusion}				
Q_{ice}				

Total Q =

33. 28kg of iron at 150ºC is dropped into 30kg of water at 5ºC. What is the final temperature of the two?

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Water expands as it freezes. As objects cool they contract (get smaller) except water, which starts to expand again below 4°C. Ice (solid water) is less dense than liquid water, so it floats on water and is a better insulator than water.

As it freezes, ice floats to the top of water, insulating the water below it. This is why fish do not freeze in a pond or lake during the winter.

Funny, but not true.

1. What property of water helps it maintain its temperature?
   high specific heat (C_p)
2. A large swimming pool has a temperature of 60°F at 6 a.m. in morning. The temperature climbs to 100°F during the day. That evening, will the swimming pool be at 100°F?
   No – takes a long time + a lot of heat to chage water's T
3. A glass bottle is filled to the top with water and then sealed tightly. What will happen when the bottle is placed in the freezer?
   It will break the bottle.

   Why?
   water expands as it freezes
4. If solid iron is dropped into liquid iron, will the solid iron float or sink?

   If solid water is dropped into liquid water, will the solid water float or sink

   Which of the above is the exception: iron or water?
5. Which is a better insulator: ice or water?

   Why? less dense (more space in between molecules)

   Roads break because water freezes in the cracks and expands, breaking the road.
6. Why don't fish freeze under a frozen pond?
   Ice floats and is an insulator.
7. 75°F is a comfortable temperature for humans. What temperature is that in degrees Celsius?

   $T_F = \frac{9}{5} T_C + 32$

   $75 = \frac{9}{5} T_C + 32$ $\quad -32 \quad -32$

   $43 = \frac{9}{5} T_C$

   $\frac{5}{9}(43) = T_C$

   $T_C = 24°C$
8. The hottest temperature ever recorded was on earth was 56.7°C. How hot is that in degrees Fahrenheit?

   $T_F = \frac{9}{5}(56.7) + 32$

   $= 134°F$
9. What is the boiling point of water in Celsius?
   100°C

   What is the boiling point of water in Kelvin?
   373 K
10. Which equation: $Q = mc_p\Delta T$ or $Q = mL$?
    A. ΔT Water changes from 20°C to 50°C.
    B. mL Water melts.
    C. mL A substance liquefies.
    D. ΔT Water going from melting point to –10°C.
    E. mL During a phase change.
    F. ΔT During a change of temperature?
11. +Q or –Q?
    A. + Endothermic
    B. + Ice melting to water.
    C. + Heat in.
    D. – For your hand when you touch something cold.
    E. + If ΔT is positive. (temp. went up)

Name: _____

Period: _____

13. Newton's Law of Cooling C	A. Relates to the kinetic energy of the atoms inside a substance.
14. Specific Heat D	B. Heat necessary to change a substance's state of matter. (to change phase)
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19. Heat A	C. A cooling process because energy comes is drawn in.
20. Exothermal D	D. Energy is given off in a process.

21. Which has more internal energy (U): a full cup of hot soup or the metal spoon in the soup?

Soup - made up of mostly water, which has a very high spec. heat

22. 10 kg of steam is dropped 5°C. 10 kg of ice is also dropped 5°C. Which gives off more heat?

$C_{p_{ice}} = 2090$ Ice gives off more Q.

$C_{p_{steam}} = 2010$

23. A new substance is discovered. It is determined that it has a Cp of 3560 J/ kg·°C.

A. Is it likely to be an insulator or conductor?

high Cp

B. Will it change temperature easily?

No

24. Conduction (N), Convection (V), or Radiation (R)?

A. N Cooks pasta in a pot of hot water.
B. V Heats the water throughout the pot.
C. R Heats your hand next to, but not touching the pot.

25. A heat lamp is placed near two objects, which one changes temperature faster?

A. B A black one or a white one?
B. dull The dull one or shiny one? shiny reflects Q
C. G One made up of gold or aluminum? lower Cp

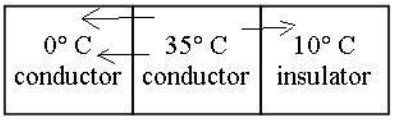
26. A black cup and a white cup are both at 80°C. Which one will cool down faster?

black - good absorbers are good emitters.

27. Does water have to be at 100°C to turn to a gas?

No - evaporation can happen at room temp. or lower (evap. is a cooling process)

28. A. Use arrows to show the direction of heat transfer.
B. Draw 2 arrows for fast heat transfer.
C. Which object has no internal energy? none - all have int. energy (ΔU)



29. How much heat is necessary to raise the temperature of 8 kg of water 12 degrees?

$Q = mC_p\Delta T$

$Q = 8(4186)(12) = 401856\ J$ or $4.02 \times 10^5\ J$

30. How many kilograms of copper give off 2500 J of energy to cool from 140°C to 70°C?

$Q = mC_p\Delta T$

$-2500 = m(387)(70-140)$

$-2500 = m(387)(-70)$ $m = .09\ kg$

$-2500 = -27090m$

31. How much of the heat is necessary to change 3 kg of water to steam?

$Q = mL_v$

$Q = 3(2.26 \times 10^6) = 6.78 \times 10^6\ J$

32. 40kg of water at 110°C is cooled to water at 85°C. How much heat was given off?

+ or −?	Cp or L (give #)	Ti	Tf	Calculate Q
$-Q_{steam}$	2010	110°	100°	$40(2010)(100-110) = -8.04 \times 10^5$
$-Q_{vapor}$	2.26×10^6	100	100	$40(-2.26 \times 10^6) = -9.04 \times 10^7$
$-Q_{water}$	4186	100	85	$40(4186)(85-100) = -2.5 \times 10^6$
Q_{fusion}				
Q_{ice}				

Total Q = $-9.37 \times 10^7\ J$

neg. because it is cooling

33. 28kg of iron at 150°C is dropped into 30kg of water at 5°C. What is the final temperature of the two?

$-Q_{hot} = Q_{cold}$

$-mC_p\Delta T_h = mC_p\Delta T_c$

$-28(448)(T_f - 150) = 30(4186)(T_f - 5)$

$-12544(T_f - 150) = 125580(T_f - 5)$

$-12544T_f + 1881600 = 125580T_f - 627900$

$+12544T_f \quad +627900 \quad +12544T_f \quad +627900$

$2509500 = 138124T_f$

div.

$T_f = 18.17°C$