Answer Key

PHYSICS TEST REVIEW 6.6-6.8

1. What is the difference between thermal energy, heat, and temperature?

Thermal Energy = the total Kinetic energy of all molecules

Heat = Energy transfer due to temperature difference
↳ ALWAYS moves from warmer object to cooler one

Temperature = Average Kinetic energy of molecules in a Substance

2. Describe how something that is 15°C can have more thermal energy than something that is 30°C.

For example, a bathtub @ 15°c will have more thermal energy than a cup of water @ 30°c, because it has more molecules. Therefore, total Kinetic energy will be higher!

Substance	Specific heat capacity (J/kg°C)
Water	4200
Air	990
Copper	390
Iron	450
Concrete	3400
Cotton	1400

3. What are the units for specific heat capacity?

J/Kg °c

4. What is the unit for energy?

Joules (J)

5. How much energy is needed to heat up 1kg of water by 15°C?

$Q = ?$
$m = 1\ kg$
$c = 4200\ J/kg°C$
$\Delta t = 15°C$

$Q = mc\Delta t$
$= (1)(4200)(15)$
$= 63,000\ J$

6. How much energy would be needed to raise the temperature of a 5kg block of concrete by 10°C?

$Q = ?$
$m = 5\,kg$
$c = 3400\ J/kg°c$
$\Delta t = 10°c$

$Q = mc\Delta t$
$= (5)(3400)(10)$
$= 170,000\ J.$

7. Can you calculate the energy needed to increase the temperature of 100kg of iron by 40°C?

$Q = ?$
$m = 100kg$
$c = 450\ J/kg°c$
$\Delta t = 40°c$

$Q = mc\Delta t$
$= (100)(450)(40)$
$= 1,800,000\ J$

8. A 20kg concrete block is at 20°C and is heated to 65°C. What is the energy used to heat this block?

$Q = ?$
$m = 20kg$
$c = 3400\ J/kg°c$
$\Delta t = 45°c$

$Q = mc\Delta t$
$= (20)(3400)(45)$
$= 3,060,000\ J$

9. A 250g copper pipe is heated from 10°C to 31°C. What is the energy needed to heat the pipe?

$m = 250g = 0.250\ kg$
$Q = ?$
$c = 390\ J/kg°c$
$\Delta t = 21°c$

$Q = mc\Delta t$
$= (0.250)(390)(21°)$
$= 2047.5\ J$

10. What will be the temperature change if you used 1125J of energy to heat a block of iron weighing 0.5kg?

$Q = 1125\ J$
$m = 0.5\ kg$
$c = 450\ J/kg°c$
$\Delta t = ?$

$Q = mc\Delta t$
$\Delta t = \frac{Q}{mc}$
$= \frac{1125}{(0.5)(450)}$
$= 5°c$

11. Given 132.8J of energy is required to heat 11.17g of aluminum from 15.73°C to 28.94°C find the specific heat capacity of aluminum.

$Q = 132.8\ J$

$m = 11.17g = 0.01117\ Kg$

$c = ?$

$\Delta t = 13.21°C$

$Q = mc\Delta t$

$c = \frac{Q}{m\Delta t}$

$= \frac{132.8}{(0.01117)(13.21)}$ $= 900\ J/Kg\,°C$

12. Given the specific heat capacity of lead is 0.129 J/g·K and that it takes 93.4J of energy to heat a sample of lead from 22.3°C to 40.4°C find the mass of the lead. * Hard one!!

$Q = 93.4\ J$

$m = ?$

$c = 0.129\ J/g \cdot K$

$\Delta t = 18.1°C = 291.1K$

$Q = mc\Delta t$

$m = \frac{Q}{c\Delta t}$

$= \frac{93.4}{(0.129)(291.1)}$

$= 2.49\ g$ or $0.00249\ Kg$

13. Given that the specific heat capacity of copper is 0.385J/g·K and if 81.2J of heat is applied to 17.8g of copper by how much will the temperature of the copper increase?

$Q = 81.2\ J$

$m = 17.8g$

$c = 0.385\ J/g \cdot K$

$\Delta t = ?$

$Q = mc\Delta t$

$\Delta t = \frac{Q}{mc}$

$= \frac{81.2\ J}{(17.8)(0.385)}$

$= 11.85\ K.$

14. If I have 2 blocks of Aluminium (one of 1kg and one of 10 kg) and heat them up. Which one heats up the fastest? Explain your answer.

- The 1Kg will heat up faster because it has less mass, so it requires less energy to change the temperature.

$Q = mc\Delta t$
$= (1)(900)(1)$
$= 900J$

$Q = mc\Delta t$
$= (10)(900)(1)$
$= 9000\ J$

15. What has a higher temperature, the metal seatbelt in your car on a sunny day, or the fabric of the seat? Explain.

They are the same temperature! They have been sitting in the same car, so molecules will have same amount of energy. The seatbelt <u>feels</u> hotter because it is a better conductor, so it is is able to transfer heat faster.

16. What is the temperature that water boils at in Kelvin?

$100°C + 273 = 373\ K$

17. What is the temperature that water freezes at in Kelvin?

$0°C + 273 = 273\ K$

18. If something is 302 K, what is the temperature in Celcius?

$302\ K - 273 = 29°C$

19. Discuss how specific heat capacity of the oceans affects Vancouver's climate.

- Has a high specific heat capacity, so it takes a lot of time & energy to change temperature
- In the summer, the ocean is still cool, so the air never gets too hot. In the winter, the ocean is warmer than the air, so it never gets too cold.

20. Why is the high specific heat capacity of water a **good** thing for the animals and plants living in the ocean?

- Takes a lot of time/energy to change temperature, so the ocean temp. fluctuates VERY little. This allows the fish, plants & animals to live in a very stable habitat – they don't need to adapt to different temperatures.