CP Chemistry
Energy and Energy Calculations Test

Name: Key

Provide the correct answer as a word, phrase or sentence. (3 points each)

1) Define Matter.
Matter is anything with mass and volume

2) What is ENERGY?
The ability to do work.

3) Give an example of an endothermic process.
Any example where energy is absorbed:
melting ice, burning your finger, cooking pasta

4) Give an example of an exothermic process.
Any example where energy is released.
freezing water, burning campfire,

5) Give an example of an element.
Any from periodic table
Hydrogen, oxygen, carbon, silver, aluminum, helium

6) Given an example of a compound.
Water, Carbon dioxide, Carbon monoxide, sulfuric acid
hydrochloric acid

7) Describe filtration.
a process of mixture separation that uses particle size to separate.

8) Describe distillation
a process of mixture separation that uses boiling point to separate

9) What is the difference between a mixture and a pure substance?
a mixture has variable composition
a pure substance has fixed composition

10) Describe the relationship between movement of particles and the phases of matter: solid, liquid and gas. (how much are particles moving in each phase)
Solid - least movement; vibration
liquid - moderate movement
gas - most movement; freely moving

11) Describe the three phases of matter in regard to shape and volume.
Solid - defined shape and volume
liquid - defined volume; takes shape of container
gas - takes shape & volume of container.

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12) If I am heating metal rods made of different materials with the same amount of energy, which be the hottest and **why**? The rods are Aluminum (specific heat 0.89 J/g°C), Gold (0.13 J/g°C) and Iron (0.45 J/g°C).

Gold will be the hottest because it takes the least amount of energy /g°C

13) Choose a substance and describe it with a chemical property and a physical property.

Substance: iron

Chemical Property: rusts easily

Physical Property: silver color

14) Choose a substance and describe how you would change it chemically and how you would change it physically.

Substance: paper

Chemical Change: burn it

Physical Change: tear in half

15) Describe what the Tyndall Test would show for the following mixtures:

Colloid: light beam would scatter

Solution: light beam would not scatter

Suspension: light beam would scatter

16) Explain the difference between a Calorie and a calorie.

Calorie: 1000 calories or a kilocalorie
Nutritional unit

calorie: unit of energy
amt. of energy needed to raise temp. of 1 gram of water 1°C

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Answer the question. (2 points each)

17) Which is larger, a calorie or a joule?

Calorie (there are 4.184 J in 1 cal)

18) Physical changes involve overcoming what type of force?

Intermolecular forces

19) What happens to the density of water as it freezes?

it becomes less dense

20) Describing an object's density is what type of property?

physical property

21) If an object "resists rusting", this is describing what type of property?

Chemical property

22) If a change occurs and a new substance is formed. This describes what type of change?

Chemical Change

Define the following (2 points each)

23) What is the normal freezing point of water? 0°C

24) What is the normal boiling point of water? 100°C

25) Define Heat of Fusion.

the amount of energy needed to melt solid to liquid
or the amount of energy that must be removed to freeze liquid to solid

26) Define Heat of Vaporization.

the amount of energy needed to vaporize liquid to gas
or the amount of energy that must be removed to condense gas to liquid

27) Define Temperature

measure of the relative movement of particles

28) Define Heat

flow of energy due to a temperature difference

29) Define Homogeneous mixture

a mixture that is the same throughout

30) Define Heterogeneous mixture

a mixture that is not the same throughout.

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Solve the following problems. Round to proper significant digits. Show your work!

31) Convert 85.7 kilojoules to calories. (3 points)

$85.7\ kJ \left| \frac{1000\ J}{1\ kJ} \right. = 85700\ J \qquad 85700\ J \left| \frac{1\ cal}{4.184\ J} \right. = 20482.79$

20500 cal

32) Convert 36.7 kilocalories to joules. (3 points)

$36.7\ Kcal \left| \frac{1000\ cal}{1\ Kcal} \right. = 36700\ cal \qquad 36700\ cal \left| \frac{4.184\ J}{1\ cal} \right. = 153552.8$

154000 J

33) Convert 32.1 joules to calories. (3 points)

$31.2\ J \left| \frac{1\ cal}{4.184\ J} \right. = 7.456978967$

7.46 cal

34) Convert 56.7 calories to joules(3 points)

$56.7\ cal \left| \frac{4.184\ J}{1\ cal} \right. = 237.2328$

237 J

35) Convert 45.7 kilocalories to kilojoules(3 points)

$45.7\ kcal \left| \frac{1000\ cal}{1\ kcal} \right. = 45700\ cal \qquad 45700\ cal \left| \frac{4.184\ J}{1\ cal} \right. = 191208.8\ J$

$191208.8\ J \left| \frac{1\ kJ}{1000\ J} \right. = 191.2088$

191 kJ

36) Convert 67.2 kilojoules to kilocalories(3 points)

$67.2\ kJ \left| \frac{1000\ J}{1\ kJ} \right. = 67200\ J \qquad 67200\ J \left| \frac{1\ cal}{4.184\ J} \right. = 16061.18547\ cal$

$16061.18547\ cal \left| \frac{1\ kcal}{1000\ cal} \right. = 16.06118547$

16.1 kcal

37) Convert 85.7 joules to kilocalories. (3 points)

$85.7\ J \left| \frac{1\ cal}{4.184\ J} \right. = 20.48279159\ cal$

$20.48279159\ cal \left| \frac{1\ kcal}{1000\ cal} \right. = 0.020482792$

0.0205 kcal

38) Convert 36.7 calories to kilojoules. (3 points)

$36.7\ cal \left| \frac{4.184\ J}{1\ cal} \right. = 153.5528\ J \qquad 153.5528\ J \left| \frac{1\ kJ}{1000\ J} \right. = 0.1535528$

0.154 kJ

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Solve the following problems. Round to proper significant digits. Show your work!

39) How many joules are needed to heat 275 grams of gold from 34.8°C to 45.8 °C? The specific heat of gold is 0.130 J/g°C. (4 points) $Q = s \times m \times \Delta T$

$Q = ?$
$s = 0.130$
$m = 275$
$\Delta T = 45.8 - 34.8 = 11°C$

$Q = 0.130 \times 275 \times 11$

$Q = 393.25$

393 J

40) If I heat a block of carbon (specific heat = 0.710 J/g°C) using 450 joules of energy and the temperature increases 23.8 °C, what is the mass of my block? (4 points) $Q = s \times m \times \Delta T$

$Q = 450$
$s = 0.710$
$m = ?$
$\Delta T = 23.8$

$450 = 0.710 \times m \times 23.8$

$\frac{450}{0.710 \times 23.8} = m = 26.63037046$

26.6 g

41) If I heat a 34.6 gram block of silver (specific heat = 0.240 J/g°C) using 50 joules of energy, what temperature change will the block experience? (4 points) $Q = s \times m \times \Delta T$

$Q = 50$
$s = 0.240$
$m = 34.6$
$\Delta T = ?$

$50 = .240 \times 34.6 \times \Delta T$

$\frac{50}{.240 \times 34.6} = \Delta T = 6.021194605$

6.02 °C

42) If the starting temperature of the block in question #41 is 25°C what is the final temperature? HINT: final temp = starting temp + temp change. (3 points)

$25 + 6.02 = 31.02$

31 °C

43) If it takes 856 joules of energy to heat a 134 gram sample from 21°C to 30°C, what is the specific heat of my sample? (4 points) $Q = s \times m \times \Delta T$

$Q = 856$
$s = ?$
$m = 134$
$\Delta T = 30 - 21 = 9°C$

$856 = s \times 134 \times 9$

$\frac{856}{134 \times 9} = s = 0.709978$

0.710 J/g°C

44) If the specific heat of iron is 0.45 J/g°C and the specific heat of carbon is 0.71 J/g°C is the sample in Question #25 iron or carbon? (3 points)

Carbon

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You may need the following information to answer the questions:

Specific heat of water= 4.184 J/g°C **Specific heat of steam= 1.84 J/g°C**
Specific heat of ice= 2.09 J/g°C
Heat of fusion of water= 6.02 kJ/18 grams **Heat of vaporization of water= 40.6 kJ/18 grams**

45) How much energy is needed to vaporize 35.6 grams of water at 100.00 °C? (4 points)

$35.6\,g \times \frac{40.6\,kJ}{18\,g} = 80.2977778$

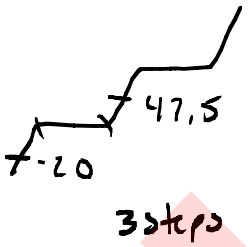
80.3 kJ

46) How much energy must be removed to freeze 35.6 grams of water? (4 points)

$35.6\,g \times \frac{6.02\,kJ}{18\,g} = 11.9062222$

11.9 kJ

47) How many JOULES are needed to heat a 3.93 gram block of ice from -20.0°C to water at 47.5 °C? (7 points)



① $Q = s \times m \times \Delta T$ ICE
$Q = 2.09 \times 3.93 \times 20$
$Q = 164.274\,J$

② HOF
$3.93\,g \times \frac{6.02\,kJ}{18\,g} = 1.314367$

$\frac{1.314367\,kJ \mid 1000\,J}{1\,kJ} = 1314.367\,J$

③ $Q = s \times m \times \Delta T$ water
$Q = 4.184 \times 3.93 \times 47.5$
$Q = 781.0482$

$164.274 + 1314.367 + 781.0482$

2259.6892

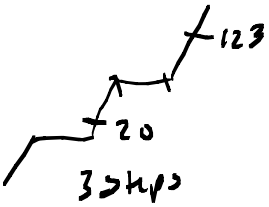
2260 J

48) How many JOULES are needed to heat a 92.6 gram sample of water from 20.0°C to steam at 123 °C? (7 points)

① $Q = s \times m \times \Delta T$ water
$Q = 4.184 \times 92.6 \times 80$
$Q = 30995.072\,J$

② HOV
$92.6\,g \times \frac{40.6\,kJ}{18\,g} = 208.86444\,kJ$

$\frac{208.86444\,kJ \mid 1000\,J}{1\,kJ} = 208864.44\,J$



③ $Q = s \times m \times \Delta T$ Steam
$Q = 1.84 \times 92.6 \times 23$
$Q = 3918.832\,J$

$30995.072 + 208864.44 + 3918.872$

243778.344

244000 J

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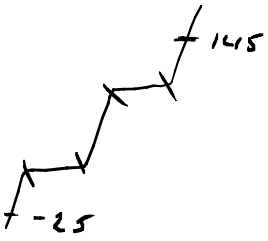
49) How many KILOJOULES are released when 256 grams of steam at 145°C are cooled to -25°C? (11 points)



5 step.

① $Q = s \times m \times \Delta T$ steam

$Q = 1.84 \times 256 \times 45$

$Q = 21196.8\ J$

$\frac{21196.8\ J \mid 1\ kJ}{1000\ J} = 21.1968\ kJ$

② HOV

$256\ g \times \frac{40.6\ kJ}{18\ g} = 577.42222\ kJ$

③ $Q = s \times m \times \Delta T$ water

$Q = 4.184 \times 256 \times 100$

$Q = 107110.4\ J$

$\frac{107110.4\ J \mid 1\ kJ}{1000\ J} = 107.1104\ kJ$

④ HOF

$256\ g \times \frac{6.02\ kJ}{18\ g} = 85.61778\ kJ$

⑤ $Q = s \times m \times \Delta T$ ICE

$Q = 2.09 \times 256 \times 25$

$Q = 13376\ J$

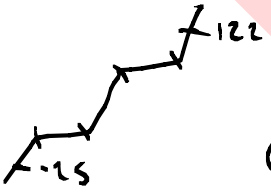
$\frac{13376\ J \mid 1\ kJ}{1000\ J} = 13.376\ kJ$

$21.1968 + 577.42222 + 107.1104 + 85.61778 + 13.376 =$

$804.7232\ kJ$

804 KJ

50) How many JOULES are needed to heat a 56.8 block of ice from -25°C to steam at 122°C? (11 points)



5 step.

① $Q = s \times m \times \Delta T$ ICE

$Q = 2.09 \times 56.8 \times 25$

$Q = 2967.8\ J$

② HOF

$56.8\ g \times \frac{6.02\ kJ}{18\ g} = 18.99644\ kJ$

$\frac{18.99644\ kJ \mid 1000\ J}{1\ kJ} = 18996.44\ J$

③ $Q = s \times m \times \Delta T$ water

$Q = 4.184 \times 56.8 \times 100$

$Q = 23765.12\ J$

④ HOV

$56.8\ g \times \frac{40.6\ kJ}{18\ g} = 128.115556\ kJ$

$\frac{128.115556\ kJ \mid 1000\ J}{1\ kJ} = 128115.556\ J$

⑤ $Q = s \times m \times \Delta T$ steam

$Q = 1.84 \times 56.8 \times 22$

$Q = 2299.264\ J$

$2967.8 + 18996.44 + 23765.12 + 128115.556 + 2299.264 =$

176144.18

176000J