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شركة تدريب هندسي

E.CAMP

الطريق الدائري بجوار المدرسة المعمارية

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PHYSICS 1

Final - Revision 3

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Temperature and Thermodynamic

1-In order for two objects to have the same temperature, they must

a. be in thermal equilibrium. b. be in thermal contact with each other.
c. have the same relative "hotness" or "coldness" when touched.
d. have all of the properties listed above. e. have only properties (b) and (c) above.

0.01c°

2- A pressure of 10 mm Hg is measured at the triple-point of water using a constant-volume gas thermometer, what will the pressure be (in mm Hg) at 50°C?

a. 68.3 b. 1.8 c. 31.8 d. 11.8 e. 8.5

يسجل

3- A thermometer registers a change in temperature of 100°F. What change in temperature does this correspond to on the Kelvin Scale?

a. 453 b. 328 c. 180 d. 55.6 e. 24.5

يتكثف

4- Helium condenses into the liquid phase at approximately 4 K. What temperature, in degrees Fahrenheit, does this correspond to?

a. -182 b. -269 c. -118 d. -452 e. -484

كوبرى شريحة

5- A bridge is made with segments of concrete 50 m long. If the linear expansion coefficient is 12×10^{-6} $(°C)^{-1}$, how much spacing (in cm) is needed to allow for expansion during an extreme temperature change of 150°F?

a. 10 b. 2.5 c. 7.5 d. 5.0 e. 9.5

6- A building made with a steel structure is 650 m high on a winter day when the temperature is 0°F. How much taller (in cm) is the building when it is 100°F? (The linear expansion coefficient of steel is $11 \times 10^{-6} (°C)^{-1}$.)

a. 71 b. 36 c. 40 d. 46 e. 65

7- A helium-filled balloon has a volume of 1 m^3. As it rises in the earth's atmosphere, its volume expands. What will its new volume be (in m^3) if its original temperature and pressure are 20°C and 1 atm, and its final temperature and pressure are –40°C and 0.1 atm?

a. 4 b. 6 c. 8 d. 10 e. 1.5

فقاعة هواء حمام سباحة

* 8- A bubble having a diameter of 1.00 cm is released from the bottom of a swimming pool where the depth is 5.00 m. What will the diameter of the bubble be when it reaches the surface? The temperature of the water at the surface is 20.0°C, whereas it is 15.0°C at the bottom. (The density of water is 1.00×10^3 kg/m^3.)

a. 1.05 b. 1.15 c. 1.45 d. 1.65 e. 1.35

* 9- Two identical containers, A and B, hold equal amounts of the same ideal gas at the same P_o, V_o and T_o. The pressure of A then decreases by a half while its volume doubles; the pressure of B doubles while its volume decreases by a half. Which statement correctly describes the temperatures of the gases after the changes?

a. $T_A = 0.5T_B = T_o$. b. $T_B = 0.5T_A = T_o$. c. $T_B = T_A = T_o$.

$T \propto PV$ For A: $\frac{1}{2}P(2V) = PV$

For B: $2P(\frac{1}{2}V) = PV$

ليست خاصية حرارية

10- Which of the following is not a possible thermometric property of a body?

a. The change in length of a solid.
b. the change in volume of a gas at constant pressure.
c. The change in pressure of a gas at constant volume.
d. The change in weight at constant pressure and volume.
e. The change in electrical resistance of a conductor.

*

11- Two bodies can be in thermal equilibrium with one another when they are at the same temperature even if they حتى وإن

a. absorb different quantities of thermal energy from their surroundings in equal time intervals.
b. have different masses.
c. have diffetent volumes.
d. have any of the properties listed above.
e. have any of the properties listed above and one of them is contact with a third body at a different temperature.

12- A student has written the equation below to convert a temperature in degrees Fahrenheit into Kelvins. What is wrong with this equation? $T_K = \frac{9}{5}T_F + 32$

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

$\therefore T_C = \frac{5}{9}(T_F - 32)$

a. The factor in front of T_F should be $\frac{5}{9}$.

b. The numerical factor $\frac{5}{9}$ should multiply $(T_F - 32)$. $\therefore T_K = \frac{5}{9}(T_F - 32) + 273.15$

c. An additional 273.15 Kelvins must be added to the right side of the equation.

d. All the corrections above are required.
e. Only corrections (b) and (c) are required.

* 13- Steel blocks A and B, which have equal masses, are at $T_A = 300$ °C and $T_B = 400$ °C. Block C, with $m_C = 2m_A$, is at $T_C = 350$ °C. Blocks A and B are placed in contact, isolated, and allowed to come into equilibrium. Then they are placed in contact with block C. At that instant,

a. $T_A = T_B < T_C$.
b. $T_A = T_B = T_C$.
c. $T_A = T_B > T_C$.
d. $T_A + T_B = T_C$.
e. $T_A - T_B = T_C$.

14-How many calories of heat are required to raise the temperature of 4 kg of water from 50°F to the boiling point? $100 C^{o} \rightarrow$ $C_W = 1\ Cal/g.C^{o}$

a. 6.5×10^5
b. 3.6×10^5
c. 15×10^5
d. 360
e. 4×10^4

15- How much heat (in kilocalories) is needed to convert 1.00 kg of ice at 0°C into steam at 100°C? $C_W = 1\ Cal$ $L_F = 80\ Cal$ $L_V = 540\ Cal$

a. 23.9
b. 79.6
c. 564
d. 643
e. 720

زحليق

16- If 25 kg of ice at 0°C is combined with 4 kg of steam at 100°C, what will be the final equilibrium temperature (in °C) of the system?

a. 40
b. 20
c. 60
d. 100
e. 8

الشرط ΔX معزولة من جميع الاتجاهات

17- A cup of coffee is enclosed on all sides in an insulated cup 1/2 cm thick in the shape of a cube 10 cm on a side. The temperature of the coffee is 95°C, and the temperature of the surroundings is 21°C. Find the rate of heat loss (in J/s) due to conduction if the thermal conductivity of the cup is 2×10^{-4} cal/s · cm · °C.

a. 62 b. 74 c. 230 d. 160 e. 12

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18- A child has a temperature of 101°F. If her total cross-sectional area is 2 m^2, find the energy lost each second (in W) due to radiation, assuming the emissivity is 1. (Assume the room temperature is T_s 70°F.) 192 $\sigma = 5.7 \times 10^{-8}$

a. 217 b. 180 c. 90 d. 68 e. 850

19- The work done in the expansion from an initial to a final state

a. is the area under the curve of a PV diagram.
b. depends only on the end point.
c. is independent of the path.
d. is the slope of a PV curve.
e. equals $P(V_F - V_i)$.

20- In an adiabatic free expansion

a. no heat is transferred between a system and its surroundings.
b. the pressure remains constant.
c. the temperature remains constant.
d. the volume remains constant.
e. the process is reversible.

21- In an isothermal process

a. the volume remains constant.
b. the temperature remains constant.
c. no heat is transferred between a system and its surroundings.
d. the pressure remains constant.
e. the internal energy is not constant.

*

22- An 8,000-kg aluminum flagpole 100-m long is heated by the sun from a temperature of 10°C to 20°C. Find the work done (in J) by the aluminum if the linear expansion coefficient is 24×10^{-6} $(°C)^{-1}$. α (The density of aluminum is 2.7×10^3 kg/m^3 and 1 atm = 1.0×10^5 N/m^2.)

a. 287 b. 425 c. 213 d. 710 e. 626

23- If an object feels cold to the touch, the only statement that you can make that must be correct is that

a. the object has a smaller coefficient of thermal conductivity than your hand.
b. the volume of the object will increase while it is in contact with your hand.
c. the object contains less thermal energy than your hand.
d. the object is at a lower temperature than your hand.
e. the object cannot be a liquid.

24- Which of the following statements is correct?

a. You only need to know the amount of thermal energy a body contains to calculate its temperature.
b. The temperature of a body is directly proportional to the amount of work the body has performed.
c. The quantity of thermal energy exchanged by two bodies in contact is inversely proportional to the difference in their temperatures.
d. The quantity of thermal energy exchanged by two bodies in contact is directly proportional to the difference in their temperatures.
e. Different amounts of thermal energy are transferred between two bodies in contact if different temperature scales are used to measure the temperature difference between the bodies.

25- In which process will the internal energy of the system *NOT* change?

a. An adiabatic expansion of an ideal gas.
b. An isothermal compression of an ideal gas.
c. An isobaric expansion of an ideal gas.
d. The freezing of a quantity of liquid at its melting point.
e. The evaporation of a quantity of a liquid at its boiling point.

* 26- For an astronaut working outside a spaceship, the greatest loss of heat would occur by means of

a. conduction. b. convection. c. radiation.
d. conduction and convection. e. conduction and radiation.

27- Which statement below regarding the First Law of Thermodynamics is most correct?

a. A system can do work externally only if its internal energy decreases.
b. The internal energy of a system that interacts with its environment must change.
c. No matter what other interactions take place, the internal energy must change if a system undergoes a heat transfer.
d. The only changes that can occur in the internal energy of a system are those produced by non-mechanical forces.
e. The internal energy of a system cannot change if the heat transferred to the system is equal to the work done by the system. $\Delta E_{int} = 0$ if $Q + W = 0$

* 28- If a person in Alaska were locked out of his house on a day when the temperature outside was - 40°C, he would be most likely to lose the most thermal energy by

a. conduction. b. convection. c. radiation.
d. all of the above. e. convection and radiation.

تستقبل

29- The Earth intercepts 1.27×10^{17} W of radiant energy from the Sun. Suppose the Earth, of volume $1.08 \times 10^{21}\ m^3$, was composed of water. How long would it take for the Earth at 0°C to reach 100°C, if none of the energy was radiated or reflected back out into space?

a. 26.9 y b. 113 y c. 2.69×10^4 y d. 1.13×10^5 y
e. 2.69×10^7 y

30- If two objects are in thermal equilibrium with each other:

A. they cannot be moving
B. they cannot be undergoing an elastic collision
C. they cannot have different pressures
D. they cannot be at different temperatures

31- When two gases separated by a diathermal wall are in thermal equilibrium with each other:

A. only their pressures must be the same
C. they must have the same number of particles
D. they must have the same pressure and the same volume
E. only their temperatures must be the same

32- A balloon is filled with cold air and placed in a warm room. It is NOT in thermal equilibrium with the air of the room until:

A. it rises to the ceiling
B. it sinks to the floor
C. it stops expanding
D. it starts to contract

33- Suppose object C is in thermal equilibrium with object A and with object B. T thermodynamics states:

A. that C will always be in thermal equilibrium with both A and B
B. that C must transfer energy to both A and B
C. that A is in thermal equilibrium with B
D. that A cannot be in thermal equilibrium with B

34- The zeroth law of thermodynamics allows us to define:

A. pressure
B. temperature
C. thermal equilibrium
D. internal energy

35- If the zeroth law of thermodynamics were not valid, which of the following could not be considered a property of an object?

A. Pressure
B. Center of mass energy
C. Internal energy
D. Momentum
E. Temperature

36- The international standard thermometer is kept:

A. near Washington, D.C.
B. near Paris, France
C. near the north pole
D. nowhere (there is none)

37- In constructing a thermometer it is NECESSARY to use a substance that:

A. expands linearly with rising temperature
B. will not freeze
C. will not boil
D. undergoes some change when heated or cooled

38- The "triple point" of a substance is that point for which the temperature and pressure are such that:

A. only solid and liquid are in equilibrium
B. only liquid and vapor are in equilibrium
C. only solid and vapor are in equilibrium
D. solid, liquid, and vapor are all in equilibrium

39- Constant-volume gas thermometers using different gases all indicate nearly the same temper- ature when in contact with the same object if:

A. the volumes are all extremely large
B. the volumes are all the same
C. the pressures are all extremely large
D. the pressures are the same
E. the particle concentrations are all extremely small

40- A constant-volume gas thermometer is used to measure the temperature of an object. When the thermometer is in contact with water at its triple point (273.16 K) the pressure in the thermometer is 8.500×10^4 Pa. When it is in contact with the object the pressure is 9.650×10^4 Pa. The temperature of the object is:

A. 37.0 K
B. 241 K
C. 310 K
D. 314 K

* 41- When a certain constant-volume gas thermometer is in thermal contact with water at its triple point (273.16 K) the pressure is 6.30×10^4 Pa. For this thermometer a kelvin corresponds to a change in pressure of about:

A. 4.34×10^2 Pa
B. 2.31×10^2 Pa
C. 1.72×10^3 Pa
D. 2.31×10^3 Pa

42- There is a temperature at which the reading on the Kelvin scale is numerically:

A. equal to that on the Celsius scale
B. lower than that on the Celsius scale
C. equal to that on the Fahrenheit scale
D. less than zero

$T = \frac{5}{9}(T-32) + 273.15$

*43 Fahrenheit and Kelvin scales agree numerically at a reading of:
A. -40 B.0 C.273 D. 301 E. 574

$\therefore T = 574.6^\circ$ K/F

44- Which one of the following statements is true?

A. Temperatures differing by 25° on the Fahrenheit scale must differ by 45° on the Celsius scale
B. 40K corresponds to −40° C
C. Temperatures which differ by 10° on the Celsius scale must differ by 18° on the Fahrenheit scale
D. Water at 90° C is warmer than water at 202° F
E. 0° F corresponds to −32° C

45- A Kelvin thermometer and a Fahrenheit thermometer both give the same reading for a certain sample. The corresponding Celsius temperature is:

$T_c = 574.6 - 273.15 = 301$

A. 574° C B. 232° C C. 301° C D. 614° C E. 276° C

46- Room temperature is about 20 degrees on the:

A. Kelvin scale
B. Celsius scale
C. Fahrenheit scale
D. absolute scale
E. major scale

47- A thermometer indicates 98.6° C. It may be:

A. outdoors on a cold day
B. in a comfortable room
C. in a cup of hot tea
D. in a normal person's mouth
E. in liquid air

48- The air temperature on a summer day might be about:

A. 0° C B. 10° C C. 25° C D. 80° C E. 125° C

49- The two metallic strips that constitute some thermostats must differ in:

A. length
B. thickness
C. mass
D. rate at which they conduct heat
E. coefficient of linear expansion

* 50- Thin strips of iron and zinc are riveted together to form a bimetallic strip that bends when heated. The iron is on the inside of the bend because:

A. it has a higher coefficient of linear expansion
B. it has a lower coefficient of linear expansion
C. it has a higher specific heat
D. it has a lower specific heat
E. it conducts heat better

51- It is more difficult to measure the coefficient of volume expansion of a liquid than that of a solid because:

A. no relation exists between linear and volume expansion coefficients
B. a liquid tends to evaporate
C. a liquid expands too much when heated
D. a liquid expands too little when heated
E. the containing vessel also expands

مساح اراضي

52- A surveyor's 30-m steel tape is correct at 68° F. On a hot day the tape has expanded to 30.01 m. On that day, the tape indicates a distance of 15.52 m between two points. The true distance between these points is:

A. 15.50 m B. 15.51 m C. 15.52 m D. 15.53 m E. 15.54 m

53- When the temperature of a copper penny is increased by 100°C, its diameter increases by 0.17%. The area of one of its faces increases by:

A. 0.17% B. 0.34% C. 0.51 % D. 0.13% E. 0.27%

54- Possible units for the coefficient of volume expansion are: $\overset{\circ}{C}^{-1}$

A. mm/C° B. mm^3/C° C. $(C°)^3$ D. $1/(C°)^3$ E. 1/C°

55- The mercury column in an ordinary medical thermometer doubles in length when its temper- ature changes from 95°F to 105°F. Choose the correct statement:

A. the coefficient of volume expansion of mercury is 0.1 per F°
B. the coefficient of volume expansion of mercury is 0.3 per F°
C. the coefficient of volume expansion of mercury is (0.1/3) per F°
D. the vacuum above the column helps to "pull up" the mercury this large amount
E. none of the above is true

A مكعب

56- The coefficient of linear expansion of iron is 1.0×10^{-5} per C°. The surface area of an iron cube, with an edge length of 5.0 cm, will increase by what amount if it is heated from 10°C to 60°C?

A. 0.0125 cm^2 B. 0.025 cm^2 C. 0.075 cm^2 D. 0.15 cm^2 E. 0.30 cm^2

57- The coefficient of linear expansion of steel is $\overset{\alpha}{11} \times 10^{-6}$ per C°. A steel ball has a volume of exactly 100 cm^3 at 0°C. When heated to 100°C, its volume becomes: $V = V_0 + \Delta V$

A. 100.33 cm^3 B. 100.0011 cm^3 C. 100.0033 cm^3 D. 100.000011 cm^3

$3\alpha \leftarrow \beta V_0 \Delta T$

58- The coefficient of linear expansion of a certain steel is 0.000012 per C°. The coefficient of volume expansion, in $(C°)^{-1}$, is: $\beta = 3\alpha$

A. $(0.000012)^3$ B. $(4\pi/3)(0.000012)^3$ C. 3 × 0.000012 D. 0.000012
E. depends on the shape of the volume to which it will be applied

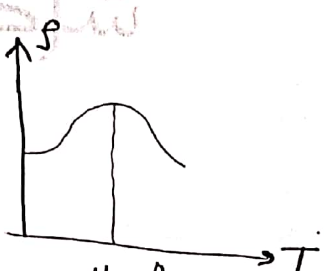
الأنابيب المعدنية تنفجر

59- Metal pipes, used to carry water, sometimes burst in the winter because:

A. metal contracts more than water
B. outside of the pipe contracts more than the inside
C. metal becomes brittle when cold
D. ice expands when it melts
E. water expands when it freezes

60- A gram of distilled water at 4°C:

A. will increase slightly in weight when heated to 6°C
B. will decrease slightly in weight when heated to 6°C
C. will increase slightly in volume when heated to 6°C
D. will decrease slightly in volume when heated to 6°C
E. will not change in either volume or weight



ρ_{max} at 4c°

60- A gram of distilled water at 4°C:

A. will increase slightly in weight when heated to 6°C
B. will decrease slightly in weight when heated to 6°C
C. will increase slightly in volume when heated to 6°C
D. will decrease slightly in volume when heated to 6°C
E. will not change in either volume or weight

1- Heat is:

(A) energy transferred by virtue of a temperature difference
B. energy transferred by macroscopic work
C. energy content of an object
D. a temperature difference
E. a property objects have by virtue of their temperatures

62- Heat has the same units as:

A. temperature (B) work C. energy/time D. heat capacity E. energy/volume

63- A calorie is about:

A. 0.24 J B. 8.3 J C. 250 J (D) 4.2 J E. 4200 J

64- The heat capacity of an object is:

(A) the amount of heat energy that raises its temperature by 1°C
B. the amount of heat energy that changes its state without changing its temperature
C. the amount of heat energy per kilogram that raises its temperature by 1°C
D. the ratio of its specific heat to that of water
E. the change in its temperature caused by adding 1 J of heat

65- . The specific heat of a substance is:

A. the amount of heat energy to change the state of one gram of the substance
B. the amount of heat energy per unit mass emitted by oxidizing the substance
C. the amount of heat energy per unit mass to raise the substance from its freezing to its boiling point
(D) the amount of heat energy per unit mass (1 kg) to raise the temperature of the substance by 1°C
E. the temperature of the object divided by its mass

66- Two different samples have the same mass and temperature. Equal quantities of energy are absorbed as heat by each. Their final temperatures may be different because the samples have different:

A. thermal conductivities
B. coefficients of expansion
C. densities
D. volumes
(E) heat capacities

* 67- The same energy Q enters five different substances as heat.

$Q = mc\Delta T$

$c \propto \frac{1}{m\Delta T}$

The temperature of 3 g of substance A increases by 10 K
The temperature of 4 g of substance B increases by 4 K
The temperature of 6 g of substance C increases by 15 K
The temperature of 8 g of substance D increases by 6 K
The temperature of 10 g of substance E increases by 10 K

Which substance has the greatest specific heat? B

68- For constant-volume processes the heat capacity of gas A is greater than the heat capacity of gas B. We conclude that when they both absorb the same energy as heat at constant volume:

A. the temperature of A increases more than the temperature of B
(B) the temperature of B increases more than the temperature of A
C. the internal energy of A increases more than the internal energy of B
D. the internal energy of B increases more than the internal energy of A
E. A does more positive work than B

69- The heat capacity at constant volume and the heat capacity at constant pressure have different values because:

A. heat increases the temperature at constant volume but not at constant pressure
B. heat increases the temperature at constant pressure but not at constant volume
C. the system does work at constant volume but not at constant pressure
(D) the system does work at constant pressure but not at constant volume
E. the system does more work at constant volume than at constant pressure

70- A cube of aluminum has an edge length of 20 cm. Aluminum has a density 2.7 times that of water (1 g/cm^3) and a specific heat 0.217 times that of water (1 cal/g · C°). When the internal energy of the cube increases by 47000 cal its temperature increases by:

A. 5 C° B. 10 C° C. 20 C° D. 100 C° E. 200 C°

71- An insulated container, filled with water, contains a thermometer and a paddle wheel. The paddle wheel can be rotated by an external source. This apparatus can be used to determine:

A. specific heat of water
B. relation between kinetic energy and absolute temperature
C. thermal conductivity of water
D. efficiency of changing work into heat
E. mechanical equivalent of heat

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72- Take the mechanical equivalent of heat as 4 J/cal. A 10-g bullet moving at 2000 m/s plunges into 1 kg of paraffin wax (specific heat 0.7 cal/g · C°). The wax was initially at 20° C. Assuming that all the bullet's energy heats the wax, its final temperature (in °C) is:

A. 20.14 B. 23.5 C. 20.006 D. 27.1 E. 30.23

73- The energy given off as heat by 300 g of an alloy as it cools through 50 C° raises the temperature of 300 g of water from 30° C to 40° C. The specific heat of the alloy (in cal/g · C°) is:

A. 0.015 B. 010 C. 0.15 D. 0.20 E. 0.50

74- The specific heat of lead is 0.030 cal/g · C°. 300 g of lead shot at 100° C is mixed with 100 g of water at 70° C in an insulated container. The final temperature of the mixture is:

A. 100° C B. 85.5° C C. 79.5° C D. 74.5° C E. 72.5° C

75- Object A, with heat capacity C_A and initially at temperature T_A, is placed in thermal contact with object B, with heat capacity C_B and initially at temperature T_B. The combination is thermally isolated. If the heat capacities are independent of the temperature and no phase changes occur, the final temperature of both objects is:

A. $(C_A T_A - C_B T_B)/(C_A + C_B)$
B. $(C_A T_A + C_B T_B)/(C_A + C_B)$
C. $(C_A T_A - C_B T_B)/(C_A - C_B)$
D. $(C_A - C_B)|T_A - T_B|$
E. $(C_A + C_B)|T_A - T_B|$

$C_B = 2 C_A$

76- The heat capacity of object B is twice that of object A. Initially A is at 300 K and B is at 450 K. $Q = C\Delta T$
They are placed in thermal contact and the combination is isolated. The final temperature of both objects is:

A. 200 K B. 300 K C. 400 K D. 450 K E. 600 K

الطاقة الحرارية للتحوّل

$C_A (T_F - T_A) = C_B (T_B - T_F)$

77- A heat of transformation of a substance is:

$T_F - 300 = 2(450 - T_F)$

A. the energy absorbed as heat during a phase transformation
B. the energy per unit mass absorbed as heat during a phase transformation
C. the same as the heat capacity
D. the same as the specific heat
E. the same as the molar specific heat

78- The heat of fusion of water is 80 cal/g. This means 80 cal of energy are required to:

A. raise the temperature of 1 g of water by 1 K
B. turn 1 g of water to steam
C. raise the temperature of 1 g of ice by 1 K
D. melt 1 g of ice
E. increase the internal energy of 80 g of water by 1 cal

9- Solid A, with mass M, is at its melting point T_A. It is placed in thermal contact with solid B, with heat capacity C_B and initially at temperature T_B ($T_B > T_A$). The combination is thermally isolated. A has latent heat of fusion L and when it has melted has heat capacity C_A. If A completely melts the final temperature of both A and B is:

A. $(C_A T_A + C_B T_B - ML)/(C_A + C_B)$
B. $(C_A T_A - C_B T_B + ML)/(C_A + C_B)$
C. $(C_A T_A - C_B T_B - ML)/(C_A + C_B)$
D. $(C_A T_A + C_B T_B + ML)/(C_A - C_B)$
E. $(C_A T_A + C_B T_B + ML)/(C_A - C_B)$

80- During the time that latent heat is involved in a change of state:

A. the temperature does not change
B. the substance always expands
C. a chemical reaction takes place
D. molecular activity remains constant
E. kinetic energy changes into potential energy

تكوين

81- The formation of ice from water is accompanied by:

A. absorption of energy as heat
B. temperature increase
C. decrease in volume
D. an evolution of heat
E. temperature decrease

82- How many calories are required to change one gram of 0° C ice to 100° C steam? The latent heat of fusion is 80 cal/g and the latent heat of vaporization is 540 cal/g. The specific heat of water is 1.00 cal/g · K.

A. 100
B. 540
C. 620
D. 720
E. 900

83- Ten grams of ice at −20° C is to be changed to steam at 130° C. The specific heat of both ice and steam is 0.5 cal/g · C°. The heat of fusion is 80 cal/g and the heat of vaporization is 540 cal/g. The entire process requires:

A. 750 cal
B. 1250 cal
C. 6950 cal
D. 7450 cal
E. 7700 cal

84- Steam at 1 atm and 100° C enters a radiator and leaves as water at 1 atm and 80° C. Take the heat of vaporization to be 540 cal/g. Of the total energy given off as heat, what percent arises from the cooling of the water?

A. 100
B. 54
C. 26
D. 14
E. 3.6

85- A certain humidifier operates by raising water to the boiling point and then evaporating it. Every minute 30 g of water at 20° C are added to replace the 30 g that are evaporated. The heat of fusion of water is 333 kJ/kg, the heat of vaporization is 2256 kJ/kg, and the specific heat is 4190 J/kg · K. How many joules of energy per minute does this humidifier require?

A. 3.0×10^4
B. 8.8×10^4
C. 7.8×10^4
D. 1.1×10^5

86- According to the first law of thermodynamics, applied to a gas, the increase in the internal energy during any process:

$\Delta E_{int} = Q + W$

A. equals the heat input minus the work done on the gas
B. equals the heat input plus the work done on the gas
C. equals the work done on the gas minus the heat input
D. is independent of the heat input
E. is independent of the work done on the gas

* 87- During an adiabatic process an object does 100 J of work and its temperature decreases by 5 K. During another process it does 25 J of work and its temperature decreases by 5 K. Its heat capacity for the second process is:

A. 20 J/K
B. 24 J/K
C. 5 J/K
D. 15 J/K
E. 100 J/K

88- A system undergoes an adiabatic process in which its internal energy increases by 20 J. Which of the following statements is true? $+W$

A. 20 J of work was done on the system
B. 20 J of work was done by the system
C. the system received 20 J of energy as heat
D. the system lost 20 J of energy as heat
E. none of the above are true

89- In an adiabatic process:

A. the energy absorbed as heat equals the work done by the system on its environment
B. the energy absorbed as heat equals the work done by the environment on the system
C. the absorbed as heat equals the change in internal energy
D. the work done by the environment on the system equals the change in internal energy
E. the work done by the system on its environment equals to the change in internal energy

90- In a certain process a gas ends in its original thermodynamic state. Of the following, which is possible as the net result of the process?

$\Delta T = 0$, $T_i = T_F$

$\Delta E_{int} = 0$

$Q + W = 0$

A. It is adiabatic and the gas does 50 J of work
B. The gas does no work but absorbs 50 J of energy as heat
C. The gas does no work but loses 50 J of energy as heat
D. The gas loses 50 J of energy as heat and does 50 J of work
E. The gas absorbs 50 J of energy as heat and does 50 J of work

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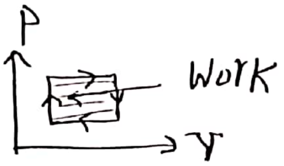
91- Of the following which might NOT vanish over one cycle of a cyclic process?



A. the change in the internal energy of the substance
B. the change in pressure of the substance
C. the work done by the substance
D. the change in the volume of the substance
E. the change in the temperature of the substance

92- The unit of thermal conductivity might be:

A. cal · cm/(s · C°)
B. cal/(cm · s · C°)
C. cal · s/(cm · C°)
D. cm · s · C°/cal
E. C°/(cal · cm · s)

93- A slab of material has area A, thickness L, and thermal conductivity k. One of its surfaces (P) is maintained at temperature T_1 and the other surface (Q) is maintained at a lower temperature T_2. The rate of heat flow by conduction from P to Q is:

A. $kA(T_1 - T_2)/L^2$
B. $kL(T_1 - T_2)/A$
C. $kA(T_1 - T_2)/L$
D. $k(T_1 - T_2)/(LA)$
E. $LA(T_1 - T_2)/k$

$P = KA \frac{\Delta T}{L}$

94- The rate of heat flow by conduction through a slab does NOT depend upon the:

A. temperature difference between opposite faces of the slab
B. thermal conductivity of the slab
C. slab thickness
D. cross-sectional area of the slab
E. specific heat of the slab

$P = KA \frac{\Delta T}{L}$

95- The rate of heat flow by conduction through a slab is P_{cond}. If the slab thickness is doubled, its cross-sectional area is halved, and the temperature difference across it is doubled, then the rate of heat flow becomes:

A. $2P_{cond}$
B. $P_{cond}/2$
C. P_{cond}
D. $P_{cond}/8$
E. $8P_{cond}$

96- Inside a room at a uniform comfortable temperature, metallic objects generally feel cooler to the touch than wooden objects do. This is because:

A. a given mass of wood contains more heat than the same mass of metal
B. metal conducts heat better than wood
C. heat tends to flow from metal to wood
D. the equilibrium temperature of metal in the room is lower than that of wood
E. the human body, being organic, resembles wood more closely than it resembles metal

97- An iron stove, used for heating a room by radiation, is more efficient if:
A. its inner surface is highly polished
B. its inner surface is covered with aluminum paint
C. its outer surface is covered with aluminum paint
D. its outer surface is rough and black خشن و أسود
E. its outer surface is highly polished

98- To help keep buildings cool in the summer, dark colored window shades have been replaced by light colored shades. This is because light colored shades:
A. are more pleasing to the eye
B. absorb more sunlight
C. reflect more sunlight
D. transmit more sunlight
E. have a lower thermal conductivity

99- Which of the following statements pertaining to a vacuum flask (thermos) is NOT correct?
A. Silvering reduces radiation loss
B. Vacuum reduces conduction loss
C. Vacuum reduces convection loss
D. Vacuum reduces radiation loss
E. Glass walls reduce conduction loss

100- A thermos bottle works well because:
A. its glass walls are thin
B. silvering reduces convection
C. vacuum reduces heat radiation
D. silver coating is a poor heat conductor
E. none of the above

101- Strain can be measured in:
A. N/m^2 B. $N \cdot m^2$ C. N/m D. $N \cdot m$ E. none of these

102- Young's modulus can be correctly given in:
A. $N \cdot m$ B. N/m^2 C. $N \cdot m/s$ D. N/m E. joules

103- Young's modulus can be used to calculate the strain for a stress that is:
A. just below the ultimate strength
B. just above the ultimate strength
C. well below the yield strength
D. well above the yield strength
E. none of the above

104- The ultimate strength of a sample is the stress at which the sample:
A. returns to its original shape when the stress is removed
B. remains underwater C. breaks D. bends 180° E. does none of these

105- Two supports, made of the same material and initially of equal length, are 2.0m apart. A stiff board with a length of 4.0m and a mass of 10 kg is placed on the supports, with one support at the left end and the other at the midpoint. A block is placed on the board a distance of 0.50m from the left end. As a result the board is horizontal. The mass of the block is:
A. zero B. 2.3kg C. 6.6kg D. 10 kg E. 20 kg

106- The bulk modulus is a proportionality constant that relates the pressure acting on an object to:
A. the shear
B. the fractional change in volume
C. the fractional change in length
D. Young's modulus
E. the spring constant

107- A force of 5000N is applied outwardly to each end of a 5.0-m long rod with a radius of 34.0 cm and a Young's modulus of 125×10^8 N/m². The elongation of the rod is:
125 X 10^8
A. 0.0020mm
B. 0.0040mm
C. 0.14mm
D. 0.55mm
E. 1.42mm

108- To shear a cube-shaped object, forces of equal magnitude and opposite directions might be applied:
A. to opposite faces, perpendicular to the faces
B. to opposite faces, parallel to the faces
. to adjacent faces, perpendicular to the faces
D. to adjacent faces, neither parallel or perpendicular to the faces
E. to a single face, in any direction

109- A shearing force of 50N is applied to an aluminum rod with a length of 10 m, a cross-sectional area of 1×10^{-5}
10--5 m, and a shear modulus of 2.5×10^{10} N/m2. As a result the rod is sheared through a distance of:
A. zero
B. 1.9mm
10^{10}
C. 1.9 cm
D. 19 cm
E. 1.9m

110- The equation of continuity for fluid flow can be derived from the conservation of:
A. energy
B. mass
C. angular momentum
D. volume
E. pressure

111- Water flows through a cylindrical pipe of varying cross section. The velocity is 3.0m/s at a point where the pipe diameter is 1.0 cm. At a point where the pipe diameter is 3.0 cm, the velocity is:
A. 9m/s
B. 3m/s
C. 1m/s
D. 0.33m/s
E. 0.11m/s

112- Water flows from a 6.0-cm diameter pipe into an 8.0-cm diameter pipe. The speed in the 6.0-cm pipe is 5.0m/s. The speed in the 8.0-cm pipe is:
A. 2.8m/s
B. 3.7m/s
C. 6.6m/s
D. 8.8m/s
E. 9.9m/s

113- A lawn sprinkler is made of a 1.0-cm diameter garden hose with one end closed and 25 holes, each with a diameter of 0.050 cm, cut near the closed end. If water flows at 2.0m/s in the hose, the speed of the water leaving a hole is:
A. 2.0m/s
B. 32m/s
C. 40m/s
D. 600m/s
E. 800m/s

114- Bernoulli's equation can be derived from the conservation of:
A. energy
B. mass
C. angular momentum
D. volume
E. pressure

115- A non-viscous incompressible liquid is flowing through a horizontal pipe of constant cross section. Bernoulli's equation and the equation of continuity predict that the drop in pressure along the pipe:
A. is zero
B. depends on the length of the pipe
C. depends on the fluid velocity
D. depends on the cross-sectional area of the pipe
E. depends on the height of the pipe

116- . Consider a pipe containing a fluid, with the fluid being at rest. To apply Bernoulli's equation to this situation:
A. set v equal to zero because there is no motion
B. set g equal to zero because there is no acceleration
C. set v and g both equal to zero
D. set p equal to the atmospheric pressure
E. cannot be done, Bernoulli's equation applies only to fluids in motion

7- Water (density = 1.0×10^3 kg/m3) flows through a horizontal tapered pipe. At the wide end ts speed is 4.0m/s. The difference in pressure between the two ends is 4.5×10^3 Pa. The speed of the water at the narrow end is:
A. 2.6m/s B. 3.4m/s C. 4.0m/s D. 4.5m/s E. 5.0m/s

118- The mercury column in an ordinary medical thermometer doubles in length when its temperature changes from 95° F to 105° F. Choose the correct statement:
A. the coefficient of volume expansion of mercury is 0.1 per F°
B. the coefficient of volume expansion of mercury is 0.3 per F°
C. the coefficient of volume expansion of mercury is (0.1/3) per F°
D. the vacuum above the column helps to "pull up" the mercury this large amount
E. none of the above is true

119- The coefficient of linear expansion of iron is $1.0 \times 10{-}5$ per C° . The surface area of an iron cube, with an edge length of 5.0 cm, will increase by what amount if it is heated from 10° C to 60° C?
A. 0.0125 cm^2 B. 0.025 cm^2 C. 0.075 cm^2
D. 0.15 cm^2 E. 0.30 cm^2

120- True or False: Dimensional analysis can give you the numerical value of constants of proportionality that may appear in an algebraic expression.

False

" answers, For some " problems

$\boxed{2}$ $P_1 = 10 mm\,Hg$ $T_1 = 273.16\,K$ Triple Point $0.01^\circ C$

$P_2 = ??$ $T_2 = 50 + 273.15 = 323.15$

$$\because \frac{P_2}{P_1} = \frac{T_2}{T_1}$$

$$\therefore P_2 = \frac{P_1 T_2}{T_1} = \frac{10 \times 323.15}{273.16} = \boxed{11.83\,mmHg}$$

$\boxed{3}$ $dT_F = 100^\circ F$ $dT_K = ??$

$$dT_F = \frac{9}{5} dT_C \Rightarrow dT_C = \frac{5 \times 100}{9}$$

$$\therefore dT_K = dT_C = \boxed{55.556}$$

$\boxed{4}$ $T_K = 4K$ $T_F = ??$

$$T_C = 4 - 273.15 = -269.15^\circ C$$

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

$$= \frac{9}{5}(-269.15) + 32 = \boxed{-452.47}$$

5 $L_0 = 50\,m \qquad \alpha = 12 \times 10^{-6}\ (^\circ C)^{-1}$

$\Delta L = ??\ (cm) \qquad \Delta T_F = 150^\circ F$

$\Delta L = \alpha L_0 \Delta T_C$

$\Delta T_F = \frac{9}{5} \Delta T_C \Rightarrow \Delta T_C = \frac{5 \times 150}{9} = 83.3$

$\therefore \Delta L = 12 \times 10^{-6} \times 50 \times 83.3 = 0.05\,m$

$\therefore \Delta L = \boxed{5\,cm}$

---

6 $L_0 = 650\,m \qquad T_0 = 0^\circ F$

$\Delta L = ??\ cm \qquad T = 100^\circ F \qquad \alpha = 11 \times 10^{-6}$

$\Delta L = \alpha L_0 \Delta T_C$

$\Delta T_F = \frac{9}{5} \Delta T_C \Rightarrow \Delta T_C = \frac{100 \times 5}{9} = \frac{500}{9}$

$\therefore \Delta L = 11 \times 10^{-6} \times 650 \times \frac{500}{9} = 0.397\,m$

$\therefore \Delta L = 39.7\,cm \simeq \boxed{40\,cm}$

---

7 $V_1 = 1\,m^3 \qquad T_1 = 20^\circ C \qquad P_1 = 1\,atm$

$V_2 = ?? \qquad T_2 = -40^\circ C \qquad P_2 = 0.1\,atm$

$$\because \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\therefore V_2 = \frac{P_1 V_1 T_2}{P_2 T_1} = \frac{1 \times 1 \times (-40 + 273.15)}{0.1 \times (20 + 273.15)}$$

$$= 7.953 \simeq \boxed{8\, m^3}$$

$\boxed{8}$ $D_1 = 1\,cm$ $\quad T_1 = 15^\circ C$ $\quad P_1 = P_a + \rho g \underset{5m}{h}$

$D_2 = ??$ $\quad T_2 = 20^\circ C$ $\quad P_2 = P_a$

$$\because \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\therefore \frac{V_2}{V_1} = \frac{P_1 T_2}{P_2 T_1}$$

$$\therefore \frac{V_2}{V_1} = \frac{[10^5 + 10^3 \times 9.8 \times 5] \times [20 + 273.15]}{[10^5] \times [15 + 273.15]}$$

$$\therefore \frac{\cancel{\frac{4}{3}} \pi \left(\frac{D_2}{\cancel{2}}\right)^3}{\cancel{\frac{4}{3}} \pi \left(\frac{D_1}{\cancel{2}}\right)^3} = 1.5159$$

$$\therefore D_2^3 = 1.5159\, D_1^3 = 1.5159 \times (1)^3$$

$$\therefore D_2 = (1.5159)^{\frac{1}{3}} = 1.149 \simeq \boxed{1.15\,cm}$$

13 $T_A = 300°C$ $C_A = C_B$ $T_C = 350°C$

$T_B = 400°C$ $M_A = M_B$

$$Q_{lost} = -Q_{gained}$$

$$\cancel{M_B}\,\cancel{C_B}(400 - T_F) = \cancel{M_A}\,\cancel{C_A}(T_F - 300)$$

$$\therefore T_F = 350°C = T_C$$

---

14 $C_w = 1\ cal/g = 1000\ cal/kg$

$T_1 = 50°F$ $m = 4\,kg$

$$\therefore T_F = \frac{9}{5}T_C + 32 \Rightarrow T_C = 10°C$$

$T_2 = 100°C$

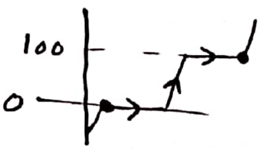
$$\therefore Q = mC\Delta\theta = 4 \times 1000 \times (100 - 10)$$

$$= 360000 = \boxed{3.6 \times 10^5\ cal}$$

---

15 $M_{ice} = 1\,kg$ $0°C \longrightarrow$ steam $100°C$

$C_w = 1\ cal/g$ $L_F = 80\ cal/g$ $L_V = 540\ cal/g$



$$Q = mL_F + m\underbrace{C_w\Delta T}_{100°C} + mL_V = 1(80 + 100 + 540) \times 10^3$$

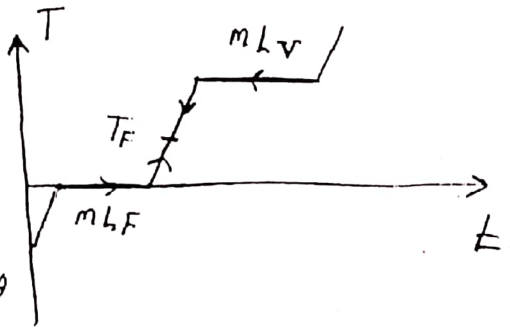
$$= \boxed{720\ KCal}$$

$\boxed{16}$

$m_{ice} = 25\,kg \qquad T_{ice} = 0\,^\circ C$

$m_s = 4\,kg \qquad T_s = 100\,^\circ C$

$Q|_{lost} = -Q|_{gained}$



$m_s L_V + m_s c_w \Delta\theta = m_{ice} L_F + m_{ice} c_w \Delta\theta$

$4 \times 540 \times 1000 + 4 \times 1 \times 1000 \times (100 - T_F)$

$= 25 \times 80 \times 1000 + 25 \times 1000 \times (T_F - 0)$

$\therefore T_F = 19.3 \simeq \boxed{20\,^\circ C}$

$\boxed{17}$ $P = \frac{Q}{t} = kA \frac{\Delta}{\Delta X_L} \rightarrow (95 - 21) \simeq \boxed{74}$

$(2 \times 10^{-4} \times 4.2)$ $\quad 6(10)^2$ $\quad \frac{1}{2}\,cm$ $\quad L = 10\,cm$

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$\boxed{18}$ $P = \frac{E}{t} = \sigma e A (T^4 - T_s^4)$

$= 5.7 \times 10^{-8} \times 1 \times 2 \times \left[(T)^4 - (T_s)^4 \right]$

$T_K = \frac{5}{9}(T_F - 32) + 273.15$

$T = \frac{5}{9}(101 - 32) + 273.15 = 311.48\,K$

$T_s = \frac{5}{9}(70 - 32) + 273.15 = 296.48\,K \qquad \therefore P = 192.3$

22 $W = P\Delta V$ or $W = -P(V_f - V_i)$ "isobaric"

$$V_0 = \frac{m}{\rho} = \frac{8000}{2.7\times10^3} = 2.9629629$$

$$\Delta V = \beta V_0 \Delta T = 3\alpha V_0 \Delta T$$

$$= 3\times 24\times10^{-6}(20-10)$$

$$= 0.002133$$

$$\because P = 1\,atm = 10^5\,Pa$$

$$\therefore W = P\,\Delta V$$

$$= 10^5 \times 0.002133$$

$$= \boxed{213\,J}$$

---

29 $P = 1.27\times10^{17}\,W$ $t = ??$

$V = 1.08\times10^{21}\,m^3$ $\rho = 1000$ $\Delta T = 100$

$$\because Q = mC\Delta T = (\rho V)C\Delta T$$

$$\therefore Q = (1000\times1.08\times10^{21})\times4200\times100$$

$$t = \frac{Q}{P} = 3.57\times10^{12}\,Sec = \boxed{1.13\times10^{5}\ year}$$

$\div\ 60\times60\times24\times356$

$P = \frac{Q}{t}$

40

$$273.16 \longrightarrow 8.5 \times 10^4 \text{ Pa} \qquad \frac{T_2}{T_1} = \frac{P_2}{P_1}$$

$$T_2 = ?? \longrightarrow 9.65 \times 10^4$$

$$T = \frac{273.16 \times (9.65 \times 10^4)}{8.5 \times 10^4} = 307.22 \simeq 310 K$$

41

$$P_1 = 6.3 \times 10^4 \qquad T_1 = 273.16$$

$$\Delta T = a\, Kelvin = 1K \Rightarrow \Delta P = ??$$

$$T_2 = T_1 + 1 = 274.16$$

$$\because \frac{P_2}{P_1} = \frac{T_2}{T_1} \longrightarrow P_2 = \frac{P_1 T_2}{T_1}$$

$$\therefore P_2 = \frac{274.16 \times (6.3 \times 10^4)}{273.16} = 63232.94$$

$$\therefore \Delta P = P_2 - P_1 = 63232.94 - (6.3 \times 10^4)$$

$$= 232.94 = 2.32 \times 10^2 \simeq 2.31 \times 10^2$$

52

$$30m \longrightarrow 30.01m$$

$$\ell = ?? \longrightarrow 15.52$$

$$\ell = \frac{15.52 \times 30}{30.01} = 15.51m$$

53

$$\because \gamma = 2\alpha$$

$$\therefore \frac{\Delta A}{A} = 2\frac{\Delta D}{D} = 2 \times 0.17\% = 0.34\%$$

56 $\alpha = 1\times10^{-5}$ $A = 5cm \times 5cm = 25cm^2$

$A_{l\,\text{surface}} = 6A = 6\times25 = 150\,cm^2$

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$\Delta T = 60 - 10 = 50$

$\Delta A = \gamma A_0 \Delta T = (2\alpha) A_0 \Delta T$

$= 2\times10^{-5} \times 150 \times 50 = \boxed{0.15}$

---

70 $l_{AL} = 20\,cm$ $\rho_{AL} = 2.7\times1\ g/cm^3$

$C_{AL} = 0.217\ cal/g.^\circ C$

$\Delta E_{int} = \Delta U = \Delta Q = 47000\ cal$

$\Delta T = ??$ $\because \Delta Q = mC\Delta T$

$\therefore 47000 = (\rho V)\,C\,\Delta T$

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$\therefore 4700 = [2.7\times(20)^3]\times0.217\,\Delta T$

$\therefore \boxed{\Delta T = 10^\circ C}$

$\boxed{72}$ $1\ Cal = 4J$

$m_1 = 10\ g = 10 \times 10^{-3} = 0.01\ kg$

$v_1 = 2000\ m/s$

$\therefore K.E = \frac{1}{2} m v^2$ طاقة حركة الرصاصة bullet

* **For wax:** الشمع

$m_2 = 1\ kg$ $\quad C_2 = 0.7 \times 4 = 2.8\ J/g.^\circ C$

$= 2800\ J/kg.^\circ C$

$T_i = 20^\circ C$ $\quad T_F = ??$

$K.E|_{bullet} = Q|_{wax}$

$\therefore \frac{1}{2} m_1 v_1^2 = m_2 C_2 \Delta T_2$

$\therefore \frac{1}{2} \times 0.01 \times (2000)^2 = 1 \times 2800 \times (T_F - 20)$

$\therefore \boxed{T_F = 27.1^\circ C}$

79 $T_A < T_B$ $\quad A \longrightarrow$ melt

$$Q_A = Q\Big|_{gained} = ML + C_A(T_F - T_A)$$

$$Q_B = Q\Big|_{Lost} = C_B(T_B - T_F)$$

$$\because \left| Q\Big|_{Lost} \right| = \left| Q\Big|_{gained} \right|$$

$$\therefore ML + C_A(T_F - T_A) = C_B(T_B - T_F)$$

$$\therefore ML + C_A T_F - C_A T_A = C_B T_B - C_B T_F$$

$$\therefore T_F(C_A + C_B) = C_B T_B + C_A T_A - ML$$

$$\therefore \boxed{T_F = \frac{C_B T_B + C_A T_A - ML}{C_A + C_B}}$$

84 steam $100^\circ C \Longrightarrow$ water $80^\circ C$

$$\% \frac{Q_{water}}{Q_{total}} = \frac{m C_w \Delta T}{m L_v + m C_w \Delta T}$$

$$= \frac{1 \times (100-80)}{540 + 1 \times (100-80)} \times 100\%$$

$$= \frac{20}{540+20} \times 100\% \simeq \boxed{3.6\%}$$

---

85 $t = 60$ sec $\quad m = 30$ g

$20^\circ C \longrightarrow$ steam $100^\circ C \quad Q = ??$

$L_v = 2256 \times 10^3$

$C_w = 4186$

$$Q = m C_w \Delta T + m L_v$$

$$= 30 \times 10^{-3} \left[4186 \times (100-20) + 2256 \times 10^3 \right]$$

$$\simeq \boxed{7.8 \times 10^4 \, J}$$

87 $W = -100\,J \qquad \Delta T = -5\,K$

adiabatic $\quad \therefore \Delta Q = 0$

$\therefore \Delta E_{int} = W = -100\,J$

$\Rightarrow W = -25\,J \qquad \Delta T = -5$

$\therefore \Delta E_{int} = -100\,J$

$\because \Delta E_{int} = Q + W$

$\therefore Q = \Delta E_{int} - W$

$= -100 - (-25)$

$= -75\,J$

$\because Q = C' \Delta T$

$\therefore C' = \dfrac{Q}{\Delta T} = \dfrac{-75}{-5} = \boxed{15\,J/K}$