PHYSICS CLUB
STEM ASYUT

Grade 10

Physics LO>10 Questions Bank

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CHAPTER: 3

1- The Stanford linear accelerator contains hundreds of brass disks tightly fitted into a steel tube (see figure). The coefficient of linear expansion of the brass is 2.00×10^{-5} per C°. The system was assembled by cooling the disks in dry ice (-57° C) to enable them to just slide into the close-fitting tube. If the diameter of a disk is 80.00 mm at 43° C, what is its diameter in the dry ice?

A. 78.40 mm

B. 79.68 mm

C. 80.16 mm

D. 79.84 mm

E. None of these

2- The figure shows a rectangular brass plate at 0° C in which there is cut a rectangular hole of dimensions indicated. If the temperature of the plate is raised to 150° C:

A. x will increase and y will decrease

B. both x and y will decrease

C. x will decrease and y will increase

D. both x and y will increase

E. the changes in x and y depend on the dimension z

3- 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

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

A. work

B. pressure

C. temperature

D. thermal equilibrium

E. internal energy

5- Fahrenheit and Kelvin scales agree numerically at a reading of:

A. -40

B. 0

C. 273

D. 301

E. 574

6- The diagram shows four rectangular plates and their dimensions. All are made of the same material. The temperature now increases. Of these plates:

A. the vertical dimension of plate 1 increases the most and the area of plate 1 increases the most

B. the vertical dimension of plate 2 increases the most and the area of plate 4 increases the most

C. the vertical dimension of plate 3 increases the most and the area of plate 1 increases the most

D. the vertical dimension of plate 4 increases the most and the area of plate 3 increases the most

E. the vertical dimension of plate 4 increases the most and the area of plate 4 increases the most

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

A: The temperature of 3 g of substance A increases by 10 K

B: The temperature of 4 g of substance B increases by 4 K

C: The temperature of 6 g of substance C increases by 15 K

D: The temperature of 8 g of substance D increases by 6 K

E: The temperature of 10 g of substance E increases by 10 K Which substance has the greatest specific heat?

8- A calorie is about:

A. 0.24 J B. 8.3 J

C. 250 J D. 4.2 J E. 4200 J

9- 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

10- 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

11. A 10-kg piece of aluminum (which has a specific heat of 900 J/kg C) is warmed so that its temperature increases by 5.0 C. How much heat was transferred into it?

A) 4.5 × 104 *J*

B) 9.0 × 104 *J*

C) 1.4 × 105 *J*

D) 2.0 × 105

12. Marc attaches a falling 500-kg object with a rope through a pulley to a paddle wheel shaft. He places the system in a well-insulated tank holding 25 kg of water. When the object falls, it causes the paddle wheel to rotate and churn the water. If the object falls a vertical distance of 100 m at constant speed, what is the temperature change of the water? (1 kcal = 4 186 J, the specific heat of water is 4 186 J/kg C, and g = 9.8 m/s2).

A) 19600°C

B) 4700°C

C) 4.7°C

D) 0.8°C

13. A 3.00-g lead bullet is traveling at a speed of 240 m/s when it embeds in a wood post. If we assume that half of the resultant heat energy generated remains with the bullet, what is the increase in temperature of the embedded bullet? (specific heat of lead = 0.030 5 kcal/kg C, 1 kcal = 4 186 J).

A) 113 C

B) 137 C

C) 226 C

D) 259 C

14. A hot (70 C) lump of metal has a mass of 250 g and a specific heat of 0.25 cal/g C. John drops the metal into a 500-g calorimeter containing 75 g of water at 20 C. The calorimeter is constructed of a material that has a specific heat of 0.10 cal/ g C. When equilibrium is reached, what will be the final temperature? C water = 1.00 cal/g C.

A) 114°C
B) 72°C
C) 64°C
D) 37°C

15. A 0.003 0-kg lead bullet is traveling at a speed of 240 m/s when it embeds in a block of ice at 0 C. If all the heat generated goes into melting ice, what quantity of ice is melted? (Lf = 80 kcal/kg, the specific heat of lead = 0.03 kcal/kg C, and 1 kcal = 4 186 J).

A) $1.47 \times 10{-}2kg$
B) $5.8 \times 10{-}4kg$
C) $3.2 \times 10{-}3kg$
D) $2.6 \times 10{-}4kg$

16. When a wool blanket is used to keep warm, what is the primary insulating material?

A) Wool
B) Air
C) The trim around the edge of the blanket.
D) A thin layer of Aluminum foil (usually not apparent) inside the blanket.

17. If cooking is done using an aluminum pan over an electric burner, which of the following will not promote the rate of heat flow from burner to food?

A) Increase the pan bottom thickness.
B)Increase the pan bottom area.
C) Increase burner temperature.
D) Decrease the height of pan sides.

18. The emissivity of an ideal reflector has which of the following values?

A) 0

B) 1

C) 100

D) Infinity

.

19. The filament temperature of a light bulb is 2 000 K when the bulb delivers 40 W of power. If its emissivity remains constant, what power is delivered when the filament temperature is 2 500 K?

A) 105W

B) 62W

C) 98W

D) 50W

20. Arrange from smallest to largest: the BTU, the joule, and the calorie.

A) BTU, J, cal

B) J, cal, BTU

C) cal, BTU, J

D) J, BTU, cal

21. 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

E. none of the above

22. 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 (273.16K) the pressure in the thermometer is 8.500×104 Pa. When it is in contact with the object the pressure is 9.650× 104 Pa. The temperature of the object is:

A. 37.0K B. 241K

C. 310K D .314K

E. 2020K

23. Object A, with heat capacity CA and initially at temperature TA, is placed in thermal contact with object B, with heat capacity CB and initially at temperature TB. 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. (CATA −CBTB)/(CA + CB)

B. (CATA + CBTB)/(CA + CB)

C. (CATA −CBTB)/(CA −CB)

D. (CA −CB)|TA −TB|

E. (CA + CB)|TA −TB|

24. The heat capacity of object B is twice that of object A. Initially A is at 300K and B is at 450K. They are placed in thermal contact and the combination is isolated. The final temperature of both objects is:

A. 200K B. 300K

C. 400K D. 450K

E. 600K

25.Possible units for the coefficient of volume expansion are:

A. mm/C◦ B. mm3/C◦

C. (C◦)3 D. 1/(C◦)3

E. 1/C◦

26. 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

27. An annular ring of aluminum is cut from an aluminum sheet as shown. When this ring is heated:

A. the aluminum expands outward and the hole remains the same in size

B. the hole decreases in diameter

C. the area of the hole expands the same percent as any area of the aluminum

D. the area of the hole expands a greater percent than any area of the aluminum

E. linear expansion forces the shape of the hole to be slightly elliptic

28 . 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

29. The coefficient of linear expansion of a certain steel is 0.000012per C◦ . The coefficient of volume expansion, in (C◦)−1, is:

A. (0.000012)3

B. (4π/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

30. The specific heat of lead is 0.030cal/g·C◦. 300g of lead shot at 100◦ C is mixed with 100g 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

31- The heat transfers from the hot cup of water to the cold one because ....

A- Has more heat energy .

B- Hs more latent heat

C- Has less specific heat energy

D- Has more specific heat of energy

32- Two liters of water at 20 C is mixed with four liters of water at 70C .Suppose no heat is lost outside the system ,the final tempreture of the mixture equals ....

a) 53.33C
b) 70C
c) 30C
d) 20C

33 - Which o the following values of temperature is equal ?

A) -17.78C=0F

B) -32C=0F

C) -6.67C=-40F

d) 100C=132F

34- Which one of the following statements describe the correct state on heating a piece of ice from -10C to 0C?

A- Its latent heat of fusion increases

B- Its latent heat of fusion decreases

C- Its internal energy increases

D- Its internal energy remains constant

35- When is an iron stove used for heating a room by radiation more efficient ?

A- If its inner surface is highly polished

B- If its inner surface is rough and black

C- If its outer surface is highly polished

D- If its outer surface is rough and black

36- Heat has the same unit as:

A- Temperature

B- Work

C- Energy/time

D- Heat capacity

37- Most of the radiation emitted by a human body is in the form of ......

A- Ultraviolet radiation and invisible

B- Infrared radiation and is invisible

C- Visible radiation but is too weak to be visible

D- Humans do not emit electromagnetic radiation

38- if the temperature changes by 5 K that means that it changes by ......

a) 287 C
b) 5C
c) 5F
d) 41F

39- Which of the following is equivalent to 212F ?

a) 100K
b) 273K
c) 373K
d) 473K

40- What is the amount of heat is required to raise the temperature of 500 g of liquid water from 25C to 75 C ?

Knowing that the specific heat capacity of water is 4200 J/Kg.K

a) 105 KJ
b) 345 KJ
c) 678 KJ
d) 786 KJ

41-

Which of the following is not one of the laws of thermodynamics?

Possible Answers:

At a temperature of absolute zero, all motion within a system ceases

Energy and mass are interconvertible

If two systems are in each in thermal equilibrium, respectively, with a third system, then they must be in thermal equilibrium with each other

Energy can only be converted from one form to another; it cannot be created

All spontaneous processes must lead to an increase of entropy in the universe

42-

$2\ \mathrm{mol}$ **of an ideal gas expands at a constant temperature of** $0\ ^{\circ}C0\ ^{\circ}C$**. If** $1\ \mathrm{kJ}$ **of energy is inputted into the system and the net change of internal energy** $\Delta U = 0\Delta U = 0$**, by what factor does the volume of the gas change?**

Possible Answers:

0.67

0.8

1.25

1.5

0.5

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43-

In an isothermal process, you are told that heat is being added to the system. Which of the following is not true?

Possible Answers:

The gas is expanding.

The pressure of the gas is decreasing.

Work is being done on the system.

The average kinetic energy of the particles is remaining constant.

Work is being done by the system.

44-

The heat capacity for any given material is defined as the amount of heat that must be added to that material in order to increase its temperature by 1^oC. However, the heat capacity for any given material can be measured under different conditions, such as constant pressure or constant volume.

How would the heat capacity for a material at constant volume differ from the heat capacity for that same material at constant pressure?

Possible Answers:

There is no way to tell; the relative values of the constant volume and constant pressure heat capacities depends on the material under consideration

The heat capacity at constant pressure is greater than the heat capacity at constant volume

The heat capacity at constant volume is greater than the heat capacity at constant pressure

The heat capacity at constant volume is equal to the heat capacity at constant pressure

45-

$3\ \text{mol}$ **of ethanol is at a temperature of** $-10\ ^\circ C$ $-10\ ^\circ C$ **and** $2\ \text{mol}$ **of methanol is at a temperature of** $30\ ^\circ C$ $30\ ^\circ C$**. If the two gases are in an isolated system together and allowed to transfer heat between each other, at which temperature will they reach thermal equilibrium?**

Possible Answers:

$310\ ^\circ C$

$254\ ^\circ C$

$276\ ^\circ C$

$268\ ^\circ C$

$294\ ^\circ C$

46-

Ana is holding onto an ice cube. Why does it melt in her hand?

Possible Answers:

All of these

The cold leaves the ice cube

The ice cube gave off energy to her hand

The heat from her hand warms it

Her hand took energy from the ice cube

47-

What is the average molecular kinetic energy of a gas at a temperature of $27\ ^{\circ}C$?

$k = 1.38 * 10^{-23}\ \frac{\text{J}}{\text{K}}$

Possible Answers:

$9.8 * 10^{-21}\ \text{J}$

$4.6 * 10^{-23}\ \text{J}$

$3.5 * 10^{-22}\ \text{J}$

$6.21 * 10^{-21}\ \text{J}$

$7.2 * 10^{-22}\ \text{J}$

48-

You have $50g$ of water in a container above a burner. If $14kJ$ of energy is put into the container (assume all of it goes into the water), and the specific heat of water is $4.17\frac{J}{g^{o}C}$, how much did the water's temperature rise?

Possible Answers:

67^{o}

83^{o}

43^{o}

There's not enough information to determine the temperature change

100^{o}

Answers

1- Ans: D

- $\Delta L = l_0 + (1 + \propto\ \Delta T)$
- $80 = l_0(1 - 2\ x\ 10^{-3})$
- $l_0 = 79.84\ mm$

2- Ans: D

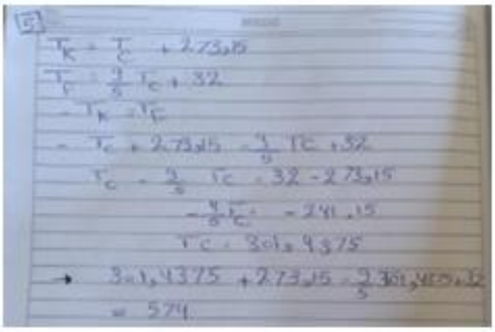
- Surface area expansion (length and width of the rectangular hole)

3- Ans: E

4- Ans: C

- Temperature is discovered from the Zeroth law of thermodynamics

5- Ans: E



6- Ans: D

-The most area and length will expand most

7- Ans: B

- The relation between mΔT is invers relation with C with constant Q
- So, the specific heat is the greatest with the least mΔT which is 4*4= 16 kg /c

8- Ans: D

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9- Ans: E

-because the liquid takes the shape of container. the container expands with its liquid, so it is difficult to calculate the coefficient of any liquid

10- Ans: E

-every substant has different coefficient for linear expansion.

11- ANS: **(A)**

Givens:

Mass=10kg. $\Delta T = 5°C$. $C_s = 900 \frac{J}{Kg.°C}$

We want to find the heat transferred which is symbolized by (Q).

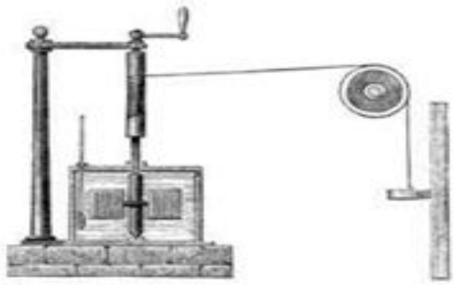
We will use the law of specific heat capacity in this question.

$$C_s = \frac{Q}{m \times \Delta T}$$

$$Q = C_s \times m \times \Delta T = 900 \times 10 \times 5 = 45000 = 4.5 \times 10^4 J.$$

12- ANS: **(C)**

This system is called "Mechanical equivalent of heat system".



It could be represented by this system.
This system indicates that the loosed potential energy in the right side of the system is equal to the energy that will be gained to the water in the form of heat energy.

Givens:

Mass of the block = 500Kg. Gravity = 9.8 m/s^2. Height = 100m.
Mass of the water = 25kg. specific heat capacity of water = 4186 kg/J C.
ΔT *wanted*.

We could say that:

$P.E = Q_{water}$
$m_{Block}gh = mc\Delta T$
$500 \times 9.8 \times 100 = 25 \times 4186 \times \Delta T$
$\Delta T \cong 4.7°C$

13- ANS: **(A)**

We deal in this question with motion which mean's (Kinetic energy). We have to make an equation to relate the kinetic energy in the bullet to the heat energy that was gained by this bullet. So:

$$K.E = Q_{Bullet}$$

$$1/_2 \times m \times v^2 = m \times c \times \Delta T$$

We must make sure of the units.

Mass of the bullet = 0.003kg. V= 240m/s^2. C= $\frac{0.0305\ Kcal}{1\ kg} = \frac{4186\ J}{1 Kcal} = 127.673 \frac{J}{kg.°C}$

(We will remove the masses with each other because both of them represents the mass of the bullet).

$$1/_2 \times v^2 = c \times \Delta T$$

$$1/_2 \times (240)^2 = 127.673 \times \Delta T$$

$$\Delta T \cong 225.57°C$$

$In\ the\ question\ he\ said\ tha\ half\ of\ the\ resultant\ heat\ transfered.\quad then\ \frac{225.57}{2} \cong$ 113°C.

14- ANS: **(D)**

Firstly, we must determine the systems in the questions that tend to gain or lose the heat.

The hot metal tends to lose heat, while the calorimetry and the water tend to gain the heat that is lost by the metal. So, we can say:

$$Q_{Metal} = Q_{Water} + Q_{calirometry}$$

We should gather the givens:

1) Metal: Mass→250g Initial temperature→70°C specific heat capacity→0.25cal/g.C
2) Water: Mass→75g Initial temperature→20°C specific heat capacity→ 1.00cal/g.C
3) Calorimetry: Mass→ 500g Initial temperature→20°C (because the water is in the calorimetry so they have the same temperature). Specific heat capacity→0.10cal/g.C

Now let's substitute in the equation:

$$Q_{Metal} = Q_{Water} + Q_{calirometry}$$

$$M_{metal}C\Delta T = M_{water}C\Delta T + M_{calorimetry}C\Delta T$$

$$250 \times 0.25 \times (T_f - 70) = 75 \times 1 \times (20 - T_f) + 500 \times 0.10 \times (20 - T_f)$$

$$62.5T_f - 4375 = 1500 - 75T_f + 1000 - 50T_f$$

$$62.5T_f - 4375 = 2500 - 125T_f$$

$$187.5T_f = 6875$$

Final temperature ≅ 37°C

15- ANS: **(D)**

We are dealing with the latent heat of water. The amount of kinetic energy that will be lost with the bullet will equal to the amount of heat energy that will be gained with the ice cube. We can say that:

$$K.E = Q_{Water}$$

We should first make sure of the givens and the units:

1) Lead: Mass→0.003kg velocity→240m/s^2 specific heat capacity→ 0.03Kcal/g.C = 125.58J/g.C (we will multiply with 4186 to convert to joules).
2) Ice cup: Temperature→0°C L_f→80Kcal/kg = 334880J/kg (we will multiply with 4186 to convert to Joules).

$$K.E = Q_{Water}$$

16- $Q_{Water} = {}^{1}/_{2} \times (240)^2 \times 0.003 = \frac{432}{5} J$

We are dealing with a phase changing state so we will use the equation :

$$Q_{Water} = m \times L_f$$

$$\frac{432}{5} = 334880 \times m$$

Mass $\cong 2.6 \times 10^{-4}$

16- ANS: **(B)**

Because the blanket insulates the outer air from the inside air. So, the primary insulating is the air.

17- ANS: **(A)**

We will use the equation of the heat flow rate to know the relation between the heat flow rate with different variables.

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

This shows us that the heat flow rate will decreases by increasing the thickness of the bottom of the pan.

18- ANS: **(A)**

Ideal reflector means that it reflects most of the light that's on it and these objects have the emissivity of **zero**, while the objects that absorbs most of the light on it as black body objects their emissivity is about **one**.

19- ANS: **(C)**

We will use **Stefan Boltzmann law of radiations** to determine the relation between the power and the temperature of the filament.

$\frac{Q}{\Delta T} = e\theta AT^4$ e is the emissivity, θ is Stefan Boltzmann constant (5.67×10^{-8}), A is the cross section area of the object, T is the temperature in Kelvin.

We could deduce that (e, θ, and A) is the same in both situations for the same light bulb, So:

$$\frac{W_1}{T_1^4} = \frac{W_2}{T_2^4}$$

$$\frac{40}{(2000)^4} = \frac{W_2}{(2500)^4}$$

$$W_2 \cong 98 watt.$$

20- ANS: **(B)**

Because that "1cal" = 4.186J …… and "1BTU" =1054J.

So, the smallest measuring unit is the **joule** then the **cal** (lower case calory) then the **BTU** (British Thermal Unit).

21- Ans: C

When the temperature inside and outside the balloon becomes same that is the air inside and outside the balloon are in thermal equilibrium then **the balloon stops expanding**.

22- Ans: C

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} = \frac{8.500 \times 10^4 \, Pa}{273.16 \, K} \times \frac{9.650 \times 10^4}{T_2}$$

$$T_2 = \frac{9.650 \times 10^4 \times 273.16}{8.500 \times 10^4 \, Pa} = 310 \, K$$

23- Ans: B

we can say that

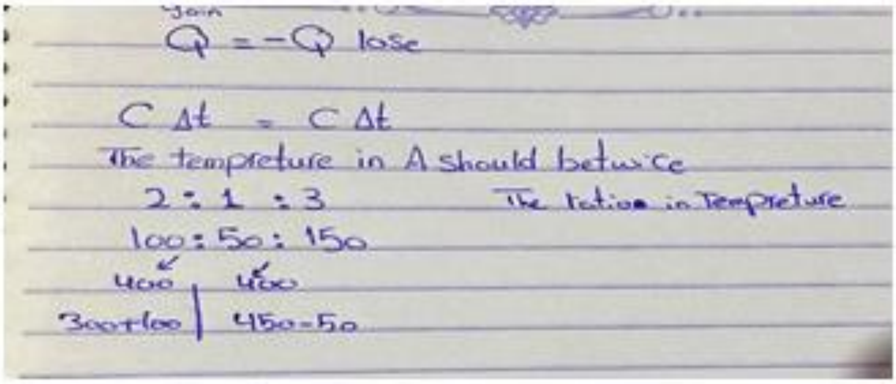
Q gain = Q lose

CATA – CA T = CB T – CBTB

(CA + CB) T = CATA + CBTB

T = (CA TA + CBTB) ÷ (CA + CB)

24- Ans: C



$Q = -Q$ lose

$C \Delta t = C \Delta t$

The temprature in A should betwice

2 : 1 : 3 The ratio in Temprature

100 : 50 : 150

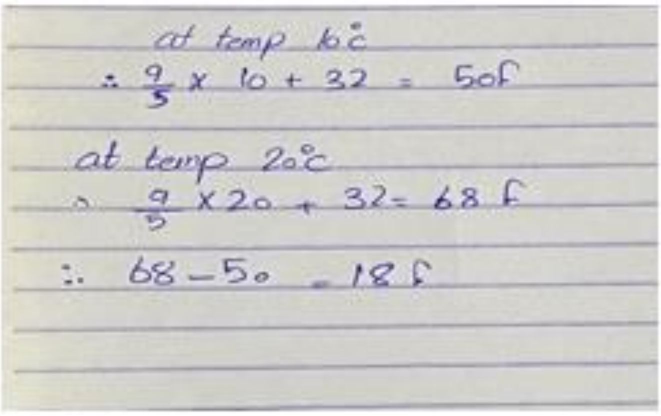
400 | 450

300+100 | 450-50

25- Ans: E

SI unit of coefficient of volume expansion is **°C^{-1}**.

26- Ans: C



at temp 10°c

$\therefore \frac{9}{5} \times 10 + 32 = 50f$

at temp 20°c

$\therefore \frac{9}{5} \times 20 + 32 = 68 f$

$\therefore 68 - 50 = 18 f$

27- Ans: C

28- Ans: E

29- Ans: c ,,, $B = 3\alpha$

30- Ans: E

heat gained = heat lost

$m_1 c_1 \Delta t = m_2 c_2 \Delta t$

$300 \times 0.030\ (100 - t) = 100 \times 1 \times (T - 70)$

$0.09\ (100 - t) = t - 70$

$9 - 0.09t = t - 70$

$\rightarrow 1.09\, t = 79$

$T = \frac{79}{1.09} \approx 72.47\ C^\circ$

31- Ans: D

32- Ans: A

$Q_{lost} = Q_{gain}$

$(mcT)_{lost} = (mcT)_{gain}$

$4 \times 10^3 * (70 - T_f) = 2 \times 10^3 * (T_f - 20)$

$2\ (70 - T_f) = (T_f - 20)$

$140 - 2\ T_f = T_f - 20$

$3\ T_f = 160$

$T_f = 53.33\ °C$

33- Ans: A

$0 = 9/5C + 32$

$C = -32 * 5/9$

$C = -17.78$

34- Ans: C

As the temperature increases the internal energy increases

35- Ans: D

36- Ans: B

37- Ans: B

38- Ans: B

39- Ans: C

(212-32)*5/9 =100C

100+273 =373K

40- Ans: A

Q = mcT

=0.5 *4200*(75-25)

=105000J

=105 KJ

41) .

Correct answer:

Energy and mass are interconvertible

Explanation:

In order to find out which of the answer choices is not one of the laws of thermodynamics, we'll need to consider each one.

The zeroth law of thermodynamics says that if two systems are in each in thermal equilibrium, respectively, with a third system, then they must be in thermal equilibrium with each other.

The first law of thermodynamics says that energy can only be converted from one form to another and cannot be created.

The second law of thermodynamics says that all spontaneous processes must lead to an increase of entropy in the universe.

The third law of thermodynamics says that at a temperature of absolute zero, all motion within a system ceases.

The only other answer choice left states that energy and mass are interconvertible. Although this is a true statement, as is stated by Einstein's famous equation $E = mc^2$, this is not a thermodynamic law.

42) .

Correct answer:

1.25

Explanation:

We will begin with the 1st law of thermodynamics:

$$\Delta U = Q - W$$

We know that there is no change in internal energy, so we can say:

$$Q = W$$

Also, the problem statement tells us that this is isothermal expansion, we can use the following expression for work:

$$W = nRT\ln\left(\frac{V_2}{V_1}\right)$$

Plugging this into our expression, we get:

$$Q = nRT\ln\left(\frac{V_2}{V_1}\right)$$

Rearranging for the change in volume, we get:

$$\frac{V_2}{V_1} = e^{\frac{Q}{nRT}}$$

43) .

Correct answer:

Work is being done on the system.

Explanation:

In an isothermal process, there are two possibilities: the gas is expanding or the gas is being compressed. If the gas is expanding, the gas is doing work and therefore needs heat in order to remain at constant temperature (which is the definition of an isothermal process). If the gas is compressed, then work is being done on the gas and heat must be emitted in order for the temperature to remain constant. We're told heat is added, so the gas must be expanding. This means the volume is increasing and work is being done by the gas. Therefore, those two choices are not the answer. The pressure must decrease, which can be seen using the formula $PV = nRT$. Since temperature is constant, if volume goes up, pressure must go down. The average kinetic energy (A.K.A. temperature) will remain constant. Work is not being done on the gas, so that is the correct answer.

Both of these conceptual methods of figuring out if heat must be added or released can be mathematically computed using the formula $Q = W_{by} + \Delta U$. Q is the heat added to the gas, W_{by} denotes the work done by the gas, and ΔU denotes the change in internal energy, which is directly related to temperature.

44) .

Correct answer:

The heat capacity at constant pressure is greater than the heat capacity at constant volume

Explanation:

In this question, we're presented with the definition of heat capacity. We're also told that the heat capacity for any given material can be measured at 1) constant volume, or 2) constant pressure. We're being asked to determine whether the constant volume heat capacity is greater than, less than, or equal to the constant pressure heat capacity for the same material.

First, let's revisit the definition of heat capacity. It is the amount of heat that must be added to a material to raise the temperature of that material by $1^{o}C$.

Next, let's consider what is happening as we add heat to a material at constant volume. When the volume of a material is held constant, that means that it is prevented from expanding as heat is added. Thus, all of the heat being added is resulting directly in an increase in the average kinetic energy of the particles that make up that material. In other words, all of the heat being added results in a temperature increase.

Let's now consider what happens when heat is added to a material at constant pressure. In this situation, the material is allowed to expand as heat is added to it (because volume is not being held constant). Therefore, when heat is added to the material, some of the heat will result in an increased temperature, but some of the heat will also result in an expansion of the material. The consequence of this is that in order to increase the temperature of the material by a given amount at constant pressure, it will require more heat energy than at constant volume.

Again, the main point of this is as follows:

Constant volume - all of the added heat results in increased temperature
Constant pressure - some of the added heat results in increased temperature and some of the added heat results in expansion

Since only a fraction of the heat being added at constant pressure will actually result in a temperature increase, we'll have to add more heat in order to increase its temperature by a given amount, when compared to constant volume conditions.

45) .

Correct answer:

$276\,^{\circ}C$

Explanation:

Since the two gases are in an isolated system, we know that the heat lost by one is equal to the heat gained by the other. Furthermore, we know that the two gases will be in thermal equilibrium when they have the same temperature, which will be some value in between their two initial values. Since methanol is at a higher temperature, we can say that it will loose heat and ethanol will gain that same amount of heat:

$$Q_{ethanol} = -Q_{methanol}$$

Substituting in expressions for each of these, we get:

$$n_{ethanol}c_{p_{ethanol}}\Delta T = -n_{methanol}c_{p_{methanol}}\Delta T$$

$$n_{ethanol}c_{p_{ethanol}}(T_f - T_{i_{ethanol}}) = -n_{methanol}c_{p_{methanol}}(T_f - T_{i_{methanol}})$$

Where the final temperature is equal for both gases:

$$n_e c_{p_e}(T - T_{i_e}) = n_m c_{p_m}(T_{i_m} - T)$$

Now we simply need to rearrange for the final temperature:

$$T(n_e c_{p_e} + n_m c_{p_m}) = n_e c_{p_e} T_{i_e} + n_m c_{p_m} T_{i_m}$$

$$T = \frac{n_e c_{p_e} T_{i_e} + n_m c_{p_m} T_{i_m}}{n_e c_{p_e} + n_m c_{p_m}}$$

We have all of these values, so time to plug and chug:

$$T = \frac{(3mol)\left(112.4\frac{J}{k\,mol}\right)(263K) + (2mol)\left(79.5\frac{J}{k\,mol}\right)(303K)}{(3mol)\left(112.4\frac{J}{k\,mol}\right) + (2mol)\left(79.5\frac{J}{k\,mol}\right)}$$

$$T = 276^{\circ}C$$

46)

46) .

Correct answer:

The heat from her hand warms it

Explanation:

According to the second law of thermodynamics, heat flows from hot to cold. Thus, the heat from her hand flows into the ice cube, causing it to melt.

47) .

Correct answer:

$6.21 * 10^{-21}$ J

Explanation:

We know that the expression for average kinetic energy is:

$$K_{avg} = \frac{1}{2}mv_{avg}^2$$

Where average velocity of a gas is:

$$v_{avg} = \sqrt{\frac{3kT}{m}}$$

Plugging this into our expression for kinetic energy, we get:

$$K_{avg} = \frac{1}{2}m\left(\frac{3kT}{m}\right) = \frac{3}{2}kT$$

Plugging in our values, we get:

$$K_{avg} = \frac{3}{2}(1.38x10^{-23})(300K)$$

$$K_{avg} = 6.21 * 10^{-21}J$$

48) .

Correct answer:

67^o

Explanation:

The equation for temperature change given applied heat is

$Q = mc\Delta T.$

Q is the amount of heat energy, m is the mass, c is the specific heat, and ΔT is the change in temperature. In this problem, we're given the energy, the mass, and the specific heat, so we need to solve the equation for ΔT.

$Q = mc\Delta T$

Rearranging to find the change in temperature:

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

Now, we can plug in our numbers.

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

$$\Delta T = \frac{14 \cdot 10^3}{50 \cdot 4.17}$$

$$\Delta T = 67.15^\circ$$

Therefore, the water changed by about 67 degrees celsius given that amount of energy applied.

Good job