QB365

# Important Questions - Thermal Properties of Matter

11th Standard CBSE

**Physics**

Reg.No. : | | | | | | |

Time : 01:00:00 Hrs

Total Marks : 50

## Section-A

1) If all the objects radiate electromagnetic energy, why do not the objects around us in everyday life become colder and colder? **1**

2) Can we boil water inside in the earth satellite? **1**

3) Stainless steel cooking pans are preferred with extra copper bottom. Why? **1**

4) Give the relation between celsis, fahrenheit and reaumur scale temperature. **1**

5) Van temperature on celsius scale and kelvin scale related? **1**

6) Why an ice box is constructed with a double wall? **1**

7) Usually a good conductor of heat is a good conductor of electricity also. Give reason. **1**

8) Two absolute scales A and B have triple points of water defined to be 200 A and 350 B. What is relation between $T_A$ and $T_B$ ? **1**

9) Why the temperature above $1200^0$C cannot be measured accurately by a platinum resistance thermometer? **1**

10) Each side of a cube increases by 0.01% on heating. How much is the area of its faces and volume increased? **1**

## Section-B

11) By how much the temperature of a copper rod to be raised so as to increase its length by 1% ? Given that coefficient of linear expansion of copper = $1.7 \times 10^{-5}\ K^{-1}$ . **2**

12) The length of a steel pan of a river bridge is 50 m and the bridge has to withstand temperature ranging from $4^o$ C to $52^o$ C.
What allowance should be kept for its change in length with temperature? Given that for a steel, $\alpha = 1.1 \times 10^{-5} C$. **2**

13) What should be the length of steel and copper rods at $0^o$ C so that the length of the steel rod is 5 cm longer than the copper rod at any temperature? **2**

14) An aluminum cube 10 cm on side at $0^o$C is heated to 30 $^o$ C. Find the change in its density. Given that coefficient of volume expansion of aluminium = $7.2 \times 10^{-5}/^0$C and density of aluminium at $0^o$ C = 2700 kg/m$^3$ **2**

15) What kind of thermal conductivity and specific heat requirement would you specify for cooking utensils? **2**

16) Two thermos flasks are of the same height and same capacity. One has a circular cross-section while the other has a square cross-section. Which of the two is better? **2**

17) The coolant used in a nuclear reactor should have high specific heat. Why? **2**

18) Two identical rectangular strip-one of copper and the other of steel are riveted to form a bimetallic strip. What will happen on heating? **2**

19) At what temperature, if any, do the following pairs of scales gives the same reading? **2**

Fahrenheit and Kelvin.

20) A pan filled by hot food cools from 94°c to 86° C in 120 s when the room temperature is 293 K. How long will it take to cool from 71°C to 69°C? **2**

## Section-C

21) **A Hardworking Blacksmith** **5**

A blacksmith fixes iron ring on the rim of the wooden wheel of a bullock cart. The diameter of the rim and the iron ring are 5.243 m and 5.231 m, respectively at $27^{\circ}C$. To what temperature should the ring be heated so as to fit the rim of the wheel?

22) A circular disc made by iron is rotating about its axis of rotation with a uniform angular speed $\omega$ **5**

Determine the change in the linear speed of particle at the rim in percentage. The disc of rim is slowly heated from 20° C to 50° C keeping the angular speed uniform. Give that coefficient of linear expansion for the material of iron is $1.2 \times 10^{-5}$ $^{0}C^{-1}$

23) A hole is drilled in a copper sheet. The diameter of the hole is 4.24 cm at temperature 27° C . What is the change in the diameter of the hole when the sheet is heated upto temperature 227° C . Given that coefficient of linear expansion for the copper is 1.7 x $10^{-5}$ $^{o}C^{-1}$ **5**

24) Explain why **5**

an optical pyrometer (for measuring high temperature) calibrated for an ideal black body radiation gives too low a value for the temperature of a red hot iron piece in the open, but gives a correct value for the temperature when the same piece is in the furnace.

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## Section-A

1) **1**

According to the principal of heat exchanges, all the objects (above 0 K) not only radiate electromagnetic energy but also absorb at the same rate from their surroundings. Thus they do not become colder.

2) **1**

No, the process of transfer of heat by convection is based on the fact that a liquid becomes lighter .on becoming hot and rise up. In condition of weightlessness, this is not possible. So, transfer of heat by convection is not possible in the earth satellite.

3) **1**

The thermal conductivity of copper is much larger than that of steel. The copper bottom allows more heat to flow into the pan and hence helps in cooking the food faster.

4) $\frac{C-0}{100-0} = \frac{F-32}{212-32} = \frac{R-0}{80-0}$ **1**

5) t($^{0}$C)=T(k)-273.15 or T(k)=t($^{0}$C)+273.15 **1**

6) **1**

An ice box is made of double wall and the space in between the walls is filled with some non-conducting material to provide heat insulation, so that the loss of heat can be minimized.

7) 1

Electrons contribute largely both towards the flow of electricity and the flow of heat. A good conductor contains a large number of free electrons. So, it is both a good conductor of heat and electricity.

8) $\frac{T_A}{T_B} = \frac{200}{350} = \frac{4}{7} \quad or \quad T_A = \frac{4}{7}T_B$ 1

9) This is because platinum begins evaporate above $1200^0$C 1

10) The area of the faces will increased by 0.02% and the volume by 0.03% 1

## Section-B

11) 588.2° C 2

12) 2.6 cm 2

13) Given that linear expansion coefficient of steel = 12 x $10^{-5}$ / ° C and for copper = 1.6 x $10^{-5}$/ ° C 2

14) -5.8 kg/ $m^3$ 2

15) A cooking utensil should have 2

(i) high conductivity so that it can conduct heat through itself and transfer it to the contents quickly.

(ii) low specific heat so that it immediately attains the temperature of the source.

16) 2

As both flasks have same height and capacity, the area of the cylindrical wall will be less than that of the square wall. Hence, the thermos flask of circular cross section will transmit less heat as compared to the thermos flask of square cross section and will be better.

17) 2

The purpose of a coolant is to absorb maximum heat with least rise in its own temperature. This is possible only if specific heat is high because Q = mc $\Delta$T. For a given value of m and Q, the rise in temperature $\Delta$T will be small if c is large. This will prevent different parts of the nuclear reactor from getting too hot.

18) 2

The coefficient of linear expansion of copper is more than steel. On heating, the expansion in copper strip is more than the steel strip. The bimetallic strip will bend with steel strip on inner (concave) side.

19) 574.6° 2

20) 42 s 2

## Section-C

21) Given, initial temperature $T_1 = 27^\circ C$ 5

Initial length, $l_1 = 5.231m$

Final length, $l_2 = 5.243m$

$Now, \quad \alpha_1 = \frac{\triangle l}{l_1 \triangle t} = \frac{l_2 - l_1}{l_1 \triangle t}$

$\Rightarrow \quad l_2 = l_1[(1 + \alpha_1(T_2 - T_1)]$

$5.243m = 5.231m[1 + 1.20 \times 10^{-5}k^{-1}(T_2 - 27^\circ C)]$

$This \quad gives \quad T_2 = 218^\circ C$

22) 3.6 x $10^{-2}$ 5

23) 0.0144 cm 5

24)

Let T be the temperature of the hot iron in the furnace. Heat radiated per second per unit area, $E = \sigma T^4$ . When the body is placed in the open at temperature $T_0$ , the heat radiated/Second/unit area,

$E' = \sigma(T_4 - T_0 4)$

Clearly, E' < E. So, the optical pyrometer gives too low a value for the temperature in the open.