DPP No. 45		**PHYSICS**
Maximum Time 50 Min		TARGET JEE-MAINS

SYLLABUS : CALORIMETRY AND THERMAL EXPANSION

1. The volume thermal expansion coefficient of an ideal gas at constant pressure is

(A) T (B) T^2 (C) $\frac{1}{T}$ (D) $\frac{1}{T^2}$

(Here T = absolute temperature of gas)

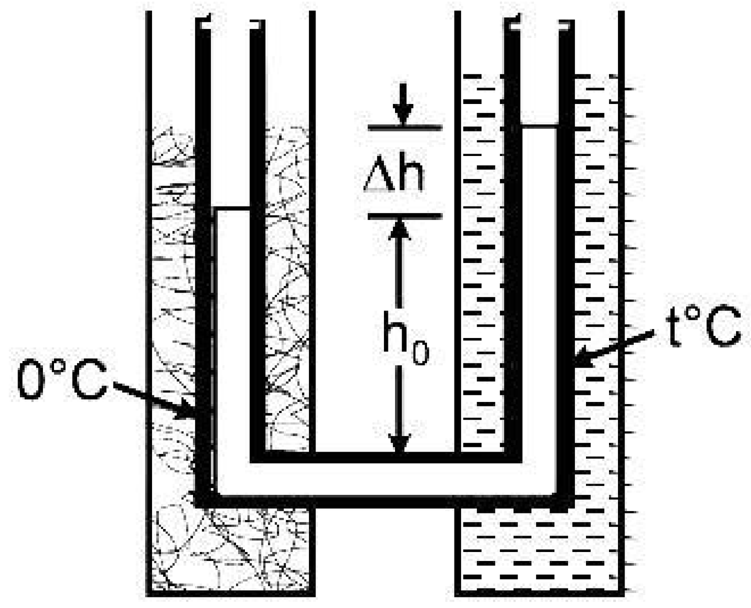
2. A metal ball immersed in water weighs w_1 at 5ºC and w_2 at 50ºC. The coefficient of cubical expansion of metal is less than that of water. Then

(A) $w_1 > w_2$ (B) $w_1 < w_2$ (C) $w_1 = w_2$ (D) data is insufficient

3. A piece of metal floats on mercury. The coefficient of volume expansion of the metal and mercury are γ_1 & γ_2 respectively. If the temperatures of both mercury and the metal are increased by an amount ΔT, the fraction of the volume of the metal submerged in mercury changes by the factor of. (Ratio of final fraction to the initial fraction)

(A) $\frac{1+\gamma_2\Delta T}{1+\gamma_1\Delta T}$ (B) $\frac{1+\gamma_1\Delta T}{1+\gamma_2\Delta T}$ (C) $1 + (\gamma_1 + \gamma_2)\Delta T$ (D) None of these

4. Two vertical glass tubes filled with a liquid are connected at their lower ends by a horizontal capillary tube. One tube is surrounded by a bath containing ice and water at 0°C and the other by hot water at t°C. The difference in the height of the liquid in the two columns is Δh, and the height of the column at 0°C is h_0. Coefficient of volume expansion of the liquid is.



(A) $\frac{\Delta h}{h_0 t}$ (B) $\frac{2\Delta h}{h_0 t}$ (C) $\frac{2h_0}{\Delta h t}$ (D) $\frac{h_0}{\Delta h t}$

5. **STATEMENT-1 :** Gas thermometers are more sensitive than liquid thermometers.

STATEMENT-2 : Coefficient of thermal expansion of gases is more than liquid.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True.

6. The specific heat capacity of a metal at low temperature (T) is given as:

$$C_p\,(kjK^{-1}\,kg^{-1}) = 32\left(\frac{T}{400}\right)^3$$

A 100 gram vessel of this metal is to be cooled from 20K to 4K by a special refrigerator operating at room temperature (27ºC). The amount of work required to cool the vessel is :

(A) greater than 0.148 kJ
(B) between 0.148 kJ and 0.028 kJ
(C) less than 0.028 kJ
(D) equal to 0.002 kJ

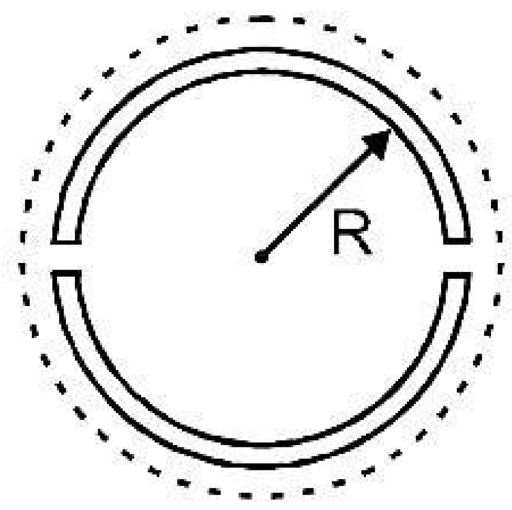
7. A metal rod of Young's modulus Y and coefficient of thermal expansion α is held at its two ends such that its length remains invariant. If its temperature is raised by tºC, the linear stress developed in its is :

(A) $\frac{Y}{\alpha t}$
(B) $Y\alpha t$
(C) $\frac{1}{(Y\alpha t)}$
(D) $\frac{\alpha t}{Y}$

8. An aluminium sphere of 20 cm diameter is heated from 0ºC to 100ºC. Its volume changes by (given that coefficient of linear expansion for aluminium $\alpha_{Al} = 23 \times 10^{-6}$/ºC)

(A) 2.89 cc
(B) 9.28 cc
(C) 49.8 cc
(D) 28.9 cc

9. A wooden wheel of radius R is made of two semicircular parts (see figure). The two parts are held together by a ring made of a metal strip of cross sectional area S and length L. L is slightly less than $2\pi R$. To fit the ring on the wheel, it is heated so that its temperature rises by ΔT and it just steps over the wheel. As it cools down to surrounding temperature, it presses the semicircular parts together. If the coefficient of linear expansion of the metal is α, and its Young's modulus is Y, the force that one part of the wheel applies on the other part is :



(A) $2\pi SY\alpha\Delta T$
(B) $SY\alpha\Delta T$
(C) $\pi SY\alpha\Delta T$
(D) $2SY\alpha\Delta T$

10. A pendulum clock lose 12 s a day if the temperature is 40°C and gains 4 s a day if the temperature is 20°C. The temperature at which the clock will show correct time, and the co-efficient of linear expansion (α) of the metal of the pendulum shaft are respectively :

(A) 60°C ; $\alpha = 1.85 \times 10^{-4}$/°C
(B) 30°C ; $\alpha = 1.85 \times 10^{-3}$/°C
(C) 55°C ; $\alpha = 1.85 \times 10^{-2}$/°C
(D) 25°C ; $\alpha = 1.85 \times 10^{-5}$/°C

11. A metal ball of mass 0.1 kg is heated upto 500°C and dropped into a vessel of heat capacity 800 JK^{-1} and containing 0.5 kg water. The initial temperature of water and vessel is 30°C. What is the approximate percentage increment in the temperature of the water? [Specific Heat Capacities of water and metal are, respectively, 4200 $J\,kg^{-1}K^{-1}$ and 400 $J\,kg^{-1}K^{-1}$]

(A) 25%
(B) 20%
(C) 30%
(D) 15%

12. When 100 g of a liquid A at 100°C is added to 50 g of a liquid B at temperature 75°C, the temperature of the mixture becomes 90°C. The temperature of the mixture, if 100 g of liquid A at 100°C is added to 50 g of liquid B at 50°C, will be

(A) 85°C (B) 80°C (C) 70°C (D) 60°C

13. Ice at –20°C is added to 50 g of water at 40°C. When the temperature of the mixture reaches 0°C, it is found that 20 g of ice is still unmelted. The amount off ice added to the water was close to (Specific heat of water = 4.2 J/g/°C Specific heat of Ice = 2.1 J/g/°C Heat of fusion of water at 0°C = 334 J/g)

(A) 100 g (B) 40 g (C) 50 g (D) 60 g

14. A calorimeter of water equivalent 20 g contains 180 g of water at 25°C. 'm' grams of steam at 100°C is mixed in it till the temperature of the mixture is 31°C. The value of 'm' is close to (Latent heat of water = 540 cal g^{-1}, specific heat of water = 1 cal g–1 $°C^{-1}$)

(A) 2 (B) 3.2 (C) 2.6 (D) 4

15. A 750 Hz, 20 V (rms) source is connected to a resistance of 100 Ω, an inductance of 0.1803 H and a capacitance of 10 μF all in series. The time in which the resistance (heat capacity 2 J/°C) will get heated by 10°C. (assume no loss of heat to the surroudings) is close to

(A) 348 s (B) 418 s (C) 245 s (D) 365 s

16. A bullet of mass 5 g, travelling with a speed of 210 m/s, strikes a fixed wooden target. One half of its kinetic energy is converted into heat in the bullet while the other half is converted into heat in the wood. The rise of temperature of the bullet if the specific heat of its material is 0.030 cal/(g – °C) (1 cal = 4.2×10^7 ergs) close to

(A) 83.3°C (B) 87.5°C (C) 38.4°C (D) 119.2°C

ANSWER KEY

1.	(C)	**2.**	(B)	**3.**	(A)	**4.**	(A)	**5.**	(A)
6.	(B)	**7.**	(B)	**8.**	(D)	**9.**	(D)	**10.**	(D)
11.	(B)	**12.**	(B)	**13.**	(B)	**14.**	(A)	**15.**	(A)
16.	(B)								