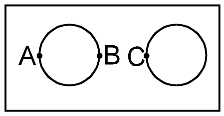
EXERCISE-I

THERMAL EXPANSION

1. Two large holes are cut in a metal sheet. If this is heated, distances AB and BC, (as shown)



(A) both will increase
(B) both will decrease
(C) AB increases, BC decreases
(D) AB decreases, BC increases

2. A steel scale is to be prepared such that the millimeter intervals are to be accurate within 6×10^{-5} mm. The maximum temperature variation from the temperature of calibration during the reading of the millimeter marks is
($\alpha = 12 \times 10^{-6}\ k^{-1}$)

(A) 4.0°C (B) 4.5°C
(C) 5.0°C (D) 5.5°C

3. Expansion during heating –
(A) occurs only in a solid
(B) increases the density of the material
(C) decreases the density of the material
(D) occurs at the same rate for all liquids and solids.

4. If a bimetallic strip is heated , it will .
(A) bend towards the metal with lower thermal expansion coefficient.
(B) bend towards the metal with higher thermal expansion coefficient.
(C) twist itself into helix.
(D) have no bending.

5. A motallic bar is heated from 0ºC to 100ºC. The coefficient of linear expansion is $10^{-5}K^{-1}$. What will be the percentage increase in length

(A) 0.01% (B) 0.1%
(C) 1% (D) 10%

6. A pendulum clock has an iron pendulum 1m long **($\alpha_{iron} = 10^{-5}$/ºC). If t**he temperature rises by 10ºC, the clock-
(A) Will lose 8 seconds per day
(B) Will lose 4.32 seconds per day
(C) Will gain 8 seconds per day
(D) Will gain 4.32 seconds per day

7. Two rods of lengths ℓ_1 and ℓ_2 are made of materials whose coefficient of linear expansions are α_1 are α_2. If the difference between two lengths is independent of temperature -

(A) $\frac{\ell_1}{\ell_2} = \frac{\alpha_1}{\alpha_2}$ (B) $\frac{\ell_1}{\ell_2} = \frac{\alpha_2}{\alpha_1}$

(C) $\ell_2^2\alpha_1 = \ell_1^2\alpha_2$ (D) $\frac{\alpha_1^2}{\ell_1} = \frac{\alpha_2^2}{\ell_2}$

8. The coefficient of linear expansion of steel and brass are 11×10^{-6}/ºC and 19×10^{-6}/ºC respectively. If their difference in lengths at all temperatures has to be kept constant at 30cm, their lengths at 0ºC should be -
(A) 71.25 cm and 41.25 cm
(B) 82 cm and 52 cm
(C) 92 cm and 62 cm
(D) 62.25 cm and 32.25 cm

9. A uniform metal rod is used as a bar pendulum. If the room temperature rises by 10ºC, and the coefficient of linear expansion of the metal of the rod is 2×10^{-6}perºC, the period of the pendulum will have percentage increase of -

(A) -2×10^{-3} (B) -1×10^{-3}
(C) 2×10^{-3} (D) 1×10^{-3}

10. The volume of a solid decreases by 0.6% when it is cooled through 50ºC. Its coefficient of linear expansion is -

(A) 4×10^{-6}K (B) 5×10^{-5}K
(C) 6×10^{4}K (D) 4×10^{-5}K

11. A rectangular block is heated from 0ºC to 100ºC. The percentage increase in its length is 0.10% What will be the percentage increase in it volume?

(A) 0.03 % (B) 0.10%
(C) 0.30% (D) none of these

12. A thin copper wire of length ℓ increases in lenth by 1% when heated from 0ºC to 100ºC. If a then cooper plate of area $2\ell \times \ell$ is heated from 0ºC to 100ºC, the percentage increase in its area will be

(A) 1% (B) 2%
(C) 3% (D) 4%

TEMPERATURE

13. A difference of temperature of 25º C is equivalent to a difference of :

(A) 45º F (B) 72º F
(C) 32º F (D) 25º F

14. What is the temperature at which we get the same reading on both the centigrade and Fahrenheit scales?

(A) – 40ºC or – 40ºF
(B) – 30ºC or – 30º F
(C) – 30ºC or – 40ºF
(D) – 10ºC or – 10ºF

Stefan's law

15. Two copper spheres A and B of the same surface finish are taken. Sphere B weight half as A. Both are heated to the same temperature and let in a room to cool by radiation only. What is the ratio of initial rate of loss of heat of A and B.

(A) 1.59 (B) 15.9
(C) 0.159 (D) 159

16. A black body emits 10 watts per cm^2 at 327ºC. The sun radiates 105 watt per cm^2. Then what is the temperature of the sun ?

(A) 5000K (B) 6000K
(C) 7000K (D) 8000K

17. A bulb made of tungsten filament of surface area $0.5cm^2$ is heated to a temperature 3000k when operated at 220V. The emissivity of the filament is $\in = 0.35$ and take $\sigma = 5.7 \times 10^8$ mks units. Then the wattage of the bulb is ..... (calculate)

(A) 81W (B) .81W
(C) 81.2W (D) 8.12 W

18. In the above example, if the temperature of the filament falls to 2000k due to a drop of mains voltage, then what will be the wattage of the bulb?

(A) 15W (B) 16W
(C) 17W (D) 18W

Newton's law

19. A metal ball cools from 62ºC to 50ºC in 10min and to 42ºC the next to minutes. What will be its temperature at the end of next ten minutes?

(A) 3.67ºC (B) 36.7ºC
(C) .376ºC (D) 367ºC

20. A liquid takes 30 seconds to cool from 95ºC to 90ºC and 70 seconds to cool from 55 to 50ºC. Find the room temperature and the time it will take to cool from 50ºC to 45ºC

(A) 81 sec (B) 82 sec
(C) 83 sec. (D) 84 sec.

Wien's law

21. A black body at 2000K emits radiation with λ_m = 1250nm. if for the radiation coming from the star SIRIUS λ_m is 71nm, then the temperature of this star is ....

(A) 3521.1K (B) 352.11K
(C) 35.21K (D) 35, 211K

22. When the temperature of the body is increased, the frequency corresponding to maximum emis sion, changes such that :

(A) $\frac{\Delta V_m}{V_m} = \frac{\Delta T}{T}$ (B) $V_m \Delta V_m = T\Delta T$

(C) $\Delta V_m = \frac{\Delta T}{T}$ (D) $\Delta V_m = T\Delta T$

23. At 1600K maximum radiation is emitted at a wavelength of 2μm. Then the corresponding wavelength at 2000K will be -

(A) 1.6μm (B) 16μm
(C) 160μm (D) .16μm

Solar Constant

24. Solar constant for earth is 2 cal/minute/cm^2 if the distance of the planet mercury from the sun is 0.40 times the distance of the earth from the sun, the Solar constant for the planet mercury in cal/minute/cm^2 will be –

(A) 12.5 (B) 25
(C) 0.32 (D) 2

25. Earth receive energy at the rate of 2cal/minute/cm^2 from sun. if angular diameter of sun is 32' and it is assumed as a black body, then the temperature of the surface of sun is

(A) 5723K (B) 5773K
(C) 5800K (D) 5925K

Heat conduction

26. Transmission of heat by molecular collisions is–

(A) Conduction (B) Convection
(C) Radiation (D) Scattering

27. Coefficient of thermal conductivity depends on–

(A) Nature of material
(B) Heat produced
(C) Difference in temperature
(D) Atmospheric pressure

28. The state when there is no more absorption of heat by the bar to raise the temperature of any part of it, is called the –

(A) Variable state
(B) Steady state
(C) Both the above
(D) None of the above

Miscellaneous Questions

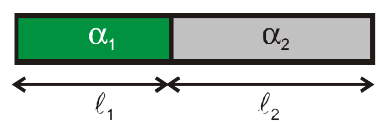
29. If I is the moment of inertia of a solid body having α -coefficient of linear expansion then the change in I corresponding to a small change in temperature ΔT is

(A) $\alpha I \Delta T$ (B) $\frac{1}{2}\alpha I \Delta T$
(C) $2\alpha I \Delta T$ (D) $3\alpha I \Delta T$

30. A liquid with coefficient of volume expansion γ is filled in a container of a material having the coefficient of linear expansion α .If the liquid overflows on heating, then.

(A) $\gamma > 3\alpha$ (B) $\gamma < 3\alpha$
(C) $\gamma = 3\alpha$ (D) none of these

31. Two rods having length ℓ_1 and ℓ_2, made of materials with the linear expansion coefficient α_1 and α_2, were soldered together. The equivalent coefficients of linear expansion for the obtained rod :-



(A) $\frac{\ell_1\alpha_2 + \ell_2\alpha_1}{\ell_1 + \ell_2}$ (B) $\frac{\ell_1\alpha_1 + \ell_2\alpha_2}{\alpha_1 + \alpha_2}$

(C) $\frac{\ell_1\alpha_1 + \ell_2\alpha_2}{\ell_1 + \ell_2}$ (D) $\frac{\ell_2\alpha_1 + \ell_1\alpha_2}{\alpha_1 + \alpha_2}$

32. 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)

33. Water is used to cool radiators of engines, because

(A) Of its lower density
(B) It is easily available
(C) It is cheap
(D) It has high specific heat

34. How much heat energy is gained when 5 kg of water at 20°C is brought to its boiling point

(Specific heat of water = 4.2 $kg^{-1}c^{-1}$)

(A) 1680 kJ (B) 1700 kJ

(C) 1720 kJ (D) 1740 kJ

35. A metallic ball and highly stretched spring are made of the same material and have the same mass. They are heated so that they melt, the latent heat required

(A) Are the same for both

(B) Is greater for the ball

(C) Is greater for the spring

(D) For the two may or may not be the same depending upon the metal

36. Two rigid boxes containing different ideal gases are placed on a table. Box A contains one mole of nitrogen at temperature T_0, While Box B contains one mole of helium at temperature (7/3) T_0. The boxes are then put into thermal contact with each other and heat flows between them until the gases reach a common final temperature (lgnore the heat capacity of boxes). Then, the final temperature of the gases, T_f, in term of T_0 is

(A) $T_f = \frac{7}{3}T_0$ (B) $T_f = \frac{3}{2}T_0$

(C) $T_f = \frac{5}{2}T_0$ (D) $T_f = \frac{3}{7}T_0$

37. The weight of person is 60 kg. If he gets 10^5 calories heat through food and the efficiency of his body is 28%, then upto how much height he can climb (approximately)

(A) 100 m (B) 200 m

(C) 400 m (D) 1000 m

38. The relative humidity on a day, when partial pressure of water vapour is 0.012×10^5 Pa at 12° C is (take vapour pressure of water at this temperature as 0.016×10^5 Pa)

(A) 70% (B) 40 %

(C) 75% (D) 25%

39. Compared to a burn due to water at 100°C, a burn due ot stem at 100°C is

(A) More dangerous

(B) Less dangerous

(C) Equally dangerous

(D) None of these

40. Absolute temperature can be calculated by

(A) Mean square velocity

(B) Motion of the molecule

(C) Both (a) and (b)

(D)None of the above

41. 50 gm ice at 0ºC in insulator vessel, 50 g water of 100ºC is mixed in it, then final temperature of the mixture is (neglect the heat loss) :

(A) 10ºC (B) $0^o << T_m < 20^oC$

(C) 20ºC (D) Above 20ºC

42. A bottle is filled with water at 30ºC. When it is taken on the moon then :

(A) water will freeze

(B) water will boil

(C) water will decompose in hydrogen and oxygen

(D) nothing will happen to water

43. The ratio of radii of two spheres of same material is 1 : 4, then the ratio of their heat capacities is

(A) $\frac{1}{4}$ (B) $\frac{1}{16}$

(C) $\frac{1}{32}$ (D) $\frac{1}{64}$

44. Heat given to a body which raises its temperature by 1°C is :

(A) water equivalent

(B) thermal capacity

(C) specific heat

(D) temperature gradient

45. Work done in converting one gram of ice at –10ºC into steam at 100ºC is -

(A) 3045 J (B) 6056 J

(C) 721 J (D) 616 J

46. Absolute zero (0K) is that temperature at which

(A) Matter ceases to exist

(B) Ice melts and water freezes

(C) Volume and pressure of a gas becomes zero

(D) None to these

47. The temperature on Celsius scale is 25°C. What is the corresponding temperature on the Fahrenheit scale

(A) 40°F (B) 77°F

(C) 50°F (D) 45°F

48. One quality of a thermometer is that its heat capacity should be small. If P is mercury thermometer, Qis resistance thermomerter and R thermocouple type then

(A) P is best, R worst

(B) R is best, P worst

(C) R is best, Q worst

(D) P is best, Q worst

49. Two thermometers are used to record the temperature of a room. If the bulb of one is wrapped in wet hanky

(A) The temperature recorded by both will be same

(B) The temperature recorded by wet-bulb thermometer will be greater than that recorded by the other

(C) The temperature recorded by dry-bulb thermometer will be greater than that recorded by the other

(D) None of the above

50. A centigrade and a Fahrenheit thermometer are dipped in boiling water. The water temperature is lowered until the Fahrenheit thermometer registers 140°F. What is the fall in temperature as registered by the Centigrade thermometer

(A) 30° (B) 40°

(C) 60° (D) 80°

51. A 5°C rise in temperature is observed in a conductor by passing a current. When the current is doubled the rise in temperature will be approximately:

(A) 16°C (B) 10°C

(C) 20°C (D) 12°C

52. If 1g of steam is mixed with 1 g of ice, then the resultant temperature of the mixture is :

(A) 270°C (B) 230°C

(C) 100°C (D) 50°C

53. The coefficients of linear expansions of brass and steel are α_1 and α_2 respectively. When we take a brass rod of length ℓ_1 and a steel rod of length ℓ_2 at 0°C, then the difference in their lengths $(\ell_2 - \ell_1)$ will remain the same at all temperatures if :

(A) $\alpha_1\ell_1 = \alpha_2\ell_2$ (B) $\alpha_1\ell_2 = \alpha_2\ell_1$

(C) $\alpha_1^2\ell_2 = \alpha_2^2\ell_1$ (D) $\alpha_1\ \ell_2^2 = \alpha_2\ \ell_1^2$

54. The amount of heat required to convert gram of ice at 0ºC into steam at 100ºC will be -

(A) 716 cal (B) 500 cal

(C) 180 cal (D) 100 cal

55. 10 grams of ice at 0ºC is mixed with 10 grams of water at 20ºC. The final temperature of mixture will be-

(A) 50ºC (B) 10ºC

(C) 0ºC (D) 15ºC

56. Value of – 40ºC in Fahrenheit scale is :

(A) –40º F (B) 32°F

(C) –32ºF (D) 40ºC

57. The amount of heat required to change 1 gm (0ºC) of ice into water of 100°C, is :

(A) 716 cal (B) 500 cal

(C) 180 cal (D) 100 cal

58. If temperature of an object is 140º F, then its temperature in centrigrade is :

(A) 105ºC (B) 32ºC

(C) 140°C (D) 60ºC

59. Latent heat of 1 gm of steam is 536 cal/gm , then its value in joule/kg is:

(A) 2.25×10^6 (B) 2.25×10^3

(C) 2.25 (D) none of these

60. Volume expansion coefficient of a gas at constant presure equal to :

(A) temperature

(B) proportional to square root of temperature

(C) inversely proportional to square root of temperature

(D) inversely proportional to temperature

61. If mass – energy equivalence is taken into account, when water is cooled to form ice, the mass of water should:

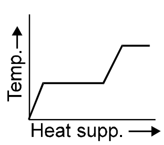
(A) increase

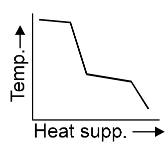
(B) remain unchanged

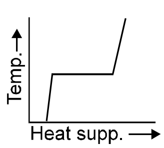
(C) decrease

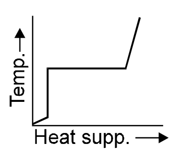
(D) first increase then decrease

62. A block of ice at -10ºC is slowly heated and converted to steam at 100ºC. Which of the following curves represents the phenomenon qualitatively:

(A) 

(B) 

(C) 

(D) 

63. When a block of iron floats in mercury at 0°C a fraction k_1 of its volume is submerged, while at the temperature 60ºC, a fraction k_2 is seen to be submerged. If the coefficient of volume expansion of iron is γ_{Fe} , then the ratio $\frac{k_1}{k_2}$ can be expressed as:

(A) $\frac{1+60\gamma_{Fe}}{1+60\gamma_{Hg}}$ (B) $\frac{1-60\gamma_{Fe}}{1+60\gamma_{Hg}}$

(C) $\frac{1+60\gamma_{Fe}}{1-60\gamma_{Hg}}$ (D) $\frac{1+60\gamma_{Hg}}{1+60\gamma_{Fe}}$

64. Two rods , one of aluminium of length ℓ_1 having coefficient of linear expansion α_a and other of steel is having coefficient of linear expansion α_s and length ℓ_2 are joined end to end . The expansion in both the rods is same for same variation of temperature . Then the value of $\frac{\ell_1}{\ell_1 + \ell_2}$ is

(A) $\frac{\alpha_s}{\alpha_a}$ (B) $\frac{\alpha_a}{\alpha_s}$

(C) $\frac{\alpha_s}{\alpha_a + \alpha_s}$ (D) $\frac{\alpha_a}{\alpha_a + \alpha_s}$

65. 2 kg ice at – 20 ºC is mixed with 5 kg water at 20 ºC . Then final amount of water in the mixture would be : Given : specific heat of ice = 0.5 cal/ g ºC, specific heat of water = 1 cal/g ºC, latent heat of fusion of ice = 80 cal/gm]

(A) 6 kg (B) 7 kg

(C) 3.5 kg (D) 5 kg

66. In a solar spectrum dark lines (fraunhofer lines) are obtained due to

(A) absorption (B) reflection

(C) emission (D) transmission

67. Fraunhofer lines are explained by

(A) Provosts theory of heat exchanges

(B) Newton's law of cooling

(C) Stefan's law

(D) Kirchoft's law

68. The nature of radiation emitted by a black body depends only on -

(A) the shape of a body

(B) the nature of a body

(C) the temperature of a body

(D) the medium

69. Two identical balls of wax are attached on the outer surface of two tin sheets. The inner surface of P is coated with lamp black and that of Q is polished. If a source of heat is placed between P and Q then which ball will melt first

(A) Q ball

(B) P ball

(C) both simultaneously

(D) nothing can be predated

70. Energy spectrum of radiations emitted by a black body is

(A) line spectrum

(B) continuous spectrum

(C) bond spectrum

(D) line and continuous spectrum

71. If the rate of emission of radiation from a body is equal to the rate of absorbing, then the temperature of the body will be -

(A) less than the temperature of the surrounding

(B) greater than the temperature of the surrounding

(C) equal to the temperature of the surrounding

(D) nothing can be said

72. For the analysis of spectral energy of thermal radiations emitted by a body the prism used made of

(A) quartz (B) crown glass

(C) flint glass (D) rock salt

73. If the temperature of a body is increased by 50%, then the increase in the amount of radiation emitted by it will be :

(A) 500% (B) 400%

(C) 200% (D) 100%

74. A blackened platinum wire of length 5cm and perimeter 0.02cm is maintained at atemperature of 300K. Then at what rate the wire is losing its energy?

(Take $\sigma = 5.7 \times 10^{-8}$ units)

(A) 4.62 W (B) 0.462W

(C) 46.2W (D) 4620W

75. A blackened sphere of radius 10cm at a temperature 227ºC is placed in a chamber with blackened wall, maintained at 27ºC. Calculate the rate of loss of heat?

(A) 9.224 cal/s (B) .9224 cal/s

(C) 922.4 cal/s (D) 92.24 cal/s

76. A blackened metal disc is held normal to the sun's rays, Both of its surfaces are exposed to atmosphere if the distance of earth from sun is 216 times the radius of sun and the temperature of sun is 6000K, the temperature of the disc in steady state will be-

(A) 80ºC (B) 70ºC

(C) 60ºC (D) 50ºC

77. In the above problem, if the heat capacity (thermal capacity) of the sphere is 1000 cal/ºC then what is the rate of cooling of the sphere ?

(A) 55ºC/min (B) 55ºC/min

(C) 550ºC/min (D) 5.5ºC/min

78. A slab of stone of area 3600 sq cm. and thickens 10cm is exposed on the lower surface to steam at 100ºC, block of ice is melted in one hour. The thermal conductivity of stone is (in cal/cm–ºC) given (latent heat of ice = 80 cal/gm)

(A) 0.003 (B) 0.03

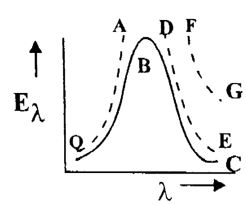
(C) 0.3 (D) none of these

79. Behaving like a black body sun emits maximum radiation at wavelength 0.48μm. The mean radius of the sun is 6.96 x 10^8m. Stefan's constant is 5.67×10^{-8} $wm^{-2}k^{-4}$ and Wien's constant is 0.293 cm-k. The loss of mass per second by the emission of radiation from sun is -

(A) 5.32×10^9kg/s (B) 6.24×10^{10}kg/s

(C) 8.65×10^{12} kg/s (D) 2.46×10^{14}kg/s

80. Which part of E_λ-λ graph represents wien's –



(A) OA part (B) BC part

(C) DE part (D) FG part