PHYSICS

BOOKS - MTG-WBJEE PHYSICS (HINGLISH)

HEAT AND THERMAL PHYSICS

Wb Jee Workout Category 1 Single Option Correct Type

1. When water is heated from $0^{\circ}C$ to $10^{\circ}C$, its volume

A. increases

B. decreases

C. does not change

D. first decreases and then increases.

Answer: D

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2. Solids expand on heating because

A. kinetic energy of the atoms increase

B. potential energy of the atoms increases

C. total energy of the atoms increases

D. the potential energy curve is asymmetric about the equilibrium distance between neighbouring atoms.

Answer: D

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3. Two rods of length l_1 and l_2 are made of material whose coefficient of linear expansion are α_1 and α_2 , respectively. The difference between their lengths will be independent of temperatiure if l_1 / l_2 is to

A. $\frac{l_1}{l_2} = \frac{\alpha_1}{\alpha_2}$

B. $\frac{l_1}{l_2} = \frac{\alpha_2}{\alpha_1}$

C. $l_1^2 \alpha_1 = l_2^2 \alpha_2$

D. $\alpha_1^2 l_1 = \alpha_2^2 l_2$

Answer: B

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4. The ratio of densities of two substances is 2 : 3 and their specific heats are in the ratio 3:4. The ratio of their thermal capacities for unit volume is

A. $1:1$

B. $1:2$

C. $2:1$

D. $8:9$

Answer: B

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5. One gram of ice at $0^\circ C$ is added to 5 gram of water at $10^\circ C$. If the latent heat of ice be 80 cal/g, then the final temperature of the mixture is -

A. $-5^\circ C$

B. $0^\circ C$

C. $+5^\circ C$

D. none of these

Answer: B

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6. A body with heat capacity not depending on the temperature and equal to C = 20.0 J/K is cooled from $t_1 = 100^\circ C$ to $t_2 = 20^\circ C$. The heat received by the body is

A. $+160J$

B. $-1.6J$

C. $-16J$

D. $+1.6J$

Answer: B

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7. During melting process, the heat given to a body is utilised in

A. increasing the temperature

B. increasing the density of the material

C. increasing the average distance between the molecules

D. decreasing the mass of the body.

Answer: C

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8. Boiling water is changing into steam. Under this condition the specific heat of water is

A. zero

B. one

C. infinite

D. less than one

Answer: C

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9. A fan produces a feeling of comfort during hot weather, because

A. a fan supplies cool air

B. our perspiration evaporates rapidly

C. fan cools the air

D. conductivity of air increases.

Answer: B

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10. A cold coke bottle is left open on the pan of a balance and its weight observed from time to time, the weight

A. increases

B. decreases

C. increases, reaches a maximum and then starts decreasing

D. remains stationary.

Answer: C

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11. Two layers of cloth of equal thickness provide warmer covering than a single layer of cloth of double the thickness, because they .

A. behave like a thermos

B. have lesser thickness

C. allow heat of atmosphere to come to body

D. enclose between them a layer of air

Answer: D

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12. The amount of radiation emitted by a perfectly black body is proportional to .

A. Fourth power of temperature on ideal gas scale.

B. Fourth root of temperature on ideal gas scale

C. Square of temperature on ideal gas scale

D. Square root of temperature on ideal gas scale.

Answer: A

13. For a perfectly black body, its abosrpitve power is

A. 1

B. 0.5

C. zero

D. infinity

Answer: A

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14. The thermal resistances of two slabs are 3 and 2 units. When connected in series, the equivalent thermal resistance will be

A. 5/6 units

B. 5 units

C. 6/5 units

D. 3/2 units

Answer: B

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15. Four slabs of iron heated to different temperatures show different colours listed below. The temperature is highest for

A. Yellow slab

B. Red slab

C. White slab

D. Green slab

Answer: C

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16. If Wien's constant b = 0.3 cm K, then the temperature of the Sun having a maximum intensity of radiation at 5000Å wavelength is

A. 3000k

B. 4000k

C. 5000k

D. 6000k

Answer: D

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17. Newton's law of cooling is a special case of .

A. Planck's law

B. Wien's law

C. Rayleigh Jean's law

D. Stefan's law

Answer: D

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18. Relation between emissivity e and absorptive power a is (for black body)

A. $e = a^2$

B. $e = a$

C. $e = a^{-1}$

D. $e = a^{-2}$

Answer: B

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19. The ratio of absolute temperatures of two black bodies is 2 : 1. The ratio of their maximum radiation intensities will be

A. $1:32$

B. $32:1$

C. $8:1$

D. $16:1$

Answer: B

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20. Which of the following is the least black body?

A. Coal

B. Sun

C. Ferry's black body

D. Wien's black body

Answer: A

21. The reflectance and emittance of a perfectly black body are respectively

A. Unity and zero

B. Unity and infinity

C. Zero and unity

D. Zero and infinity

Answer: C

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22. Wien's displacement law fails at .

A. Low temperature

B. High temperature

C. Long wavelengths

D. Short wavelengths

Answer: C

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23. A rectangular body has maximum wavelength λ_m at $2000K$. Its corresponding wavelength at $3000K$ will be

A. $\frac{16}{81}\lambda_{ml}$

B. $\frac{81}{16}\lambda_{m}$

C. $\frac{3}{2}\lambda_{m}$

D. $\frac{2}{3}\lambda_{m}$

Answer: D

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24. In which of the following heat loss is primarily not due to convection?

A. boiling of water

B. land and sea breeze

C. heating of glass surface of a bulb due to current in filament

D. circulation of air around blast furnace.

Answer: C

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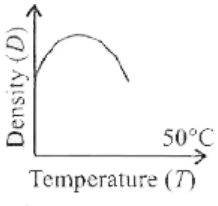
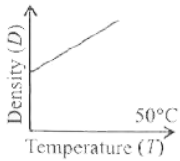
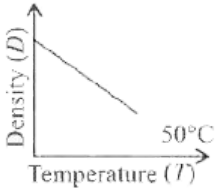
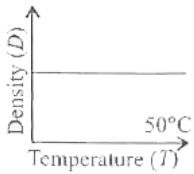
25. Which one of the figures gives the temperature dependance of density of water correctly?

A. 

B. 

C. 

D. 

Answer: A

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26. It is difficult to cook rice in an open vessel by boiling it at high altitudes because of

A. low boiling point and high pressure

B. high boiling point and low pressure

C. low boiling point and low pressure

D. high boiling point and high pressure

Answer: C

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27. The height of a waterfall is 50 m. Ifg=9.8 m s^{-2} the difference between the temperature at the top and the bottom of the waterfall is

A. $1.17^{\circ}C$

B. $2.17^{\circ}C$

C. $0.117^{\circ}C$

D. $1.43^{\circ}C$

Answer: C

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28. Experimental investigations show that the intensity of solar radiation is maximum for a wavelength $480nm$ in the visible ragion. Estimate the surface temperature of sun. (Given Wien's constant $b = 2.88 \times 10^{-3} mK$).

A. 4000 K

B. 6000 K

C. 8000 K

D. 106K

Answer: B

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29. Two temperature scales A and B are related by :

$$\frac{A-42}{110}=\frac{B-72}{220}$$

At which temperature two scales have the same reading ?

A. -42°

B. -72°

C. $+12^{\circ}$

D. -40°

Answer: C

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30. In a mercury thermometer the ice point (lower fixed point) is marked as 10o and the steam point (upper fixed point) is marked as

130°. At $40^\circ C$ temperature, what will this thermometer read?

A. 78°

B. 66°

C. 62°

D. 58°

Answer: D

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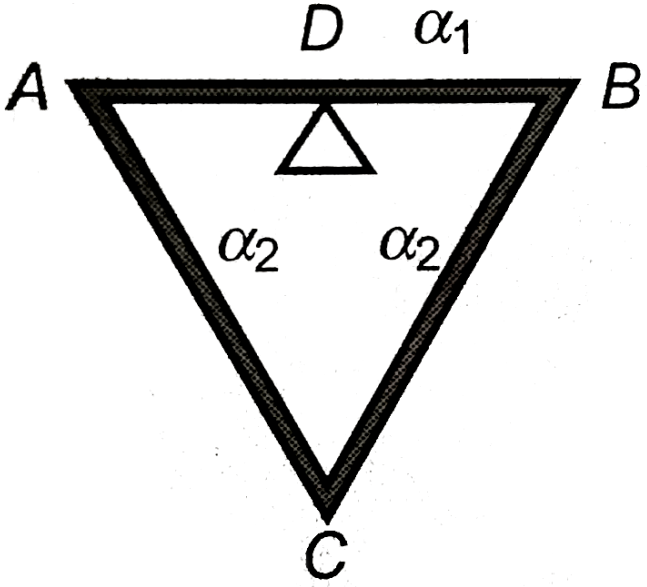
Wb Jee Workout Category 2 Single Option Correct Type

1. Three rods of equal of length are joined to from an equilateral triangle ABC. D is the midpoint of AB. The coefficient of linear expansion is α_1 for AB and α_2 for AC and BC . If the distance DC remains constant for

small changes in temperature,



A. $\alpha_1 = \alpha_2$

B. $\alpha_1 = 2\alpha_2$

C. $\alpha_1 = 4\alpha_2$

D. $\alpha_1 = \frac{1}{2}\alpha_2$

Answer: C

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2. One kilogram of steam at 100°C can melt how much ice at 0°C?

A. 8.0 kg

B. $\frac{8}{54} kg$

C. $\frac{54}{8}$ kg

D. 540 kg

Answer: A

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3. When two blocks of ice are pressed against each other then they stick together (coalesce) because

A. of heat produced during pressing

B. of cold produced during pressing

C. melting point of ice decreases with increase in pressure

D. melting point of ice increases with increase in pressure.

Answer: C

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4. A slab consists of two parallel layers of two different materials of same thickness having thermal conductivities K_1 and K_2. The equivalent conductivity of the combination is

A. $K_1 - K_2$

B. $\frac{k_1}{K_2}$

C. $\frac{2k_1K_2}{K_1 + K_2}$

D. $\frac{K_1 + K_2}{2K_1K_2}$

Answer: C

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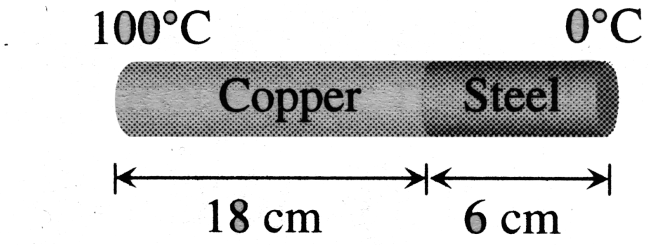

5.

The coefficient of thermal conductivity of copper is nine times that of steel. In the composite cylindrical bar shown in Fig. what will be the temperature at the junction of copper and steel ?

A. $75^{\circ} C$

B. $67^{\circ} C$

C. $33^\circ C$

D. $20^\circ C$

Answer: A

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6. Three rods made of same material and having same cross-section have been joined as shown in the figure given below. Each rod is of same length. The left and right ends are kept at $0^\circ C$ and 90°C respectively. The

temperature of the junction of the three rods will be

A. $45^\circ C$

B. $60^\circ C$

C. $20^\circ C$

D. $25^\circ C$

Answer: B

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7. Hot water cools from $60^\circ C$ to $50^\circ C$ in the first 10 min and to $42^\circ C$ in the next 10 min. The temperature of the surrounding is

A. $10^\circ C$

B. $15^\circ C$

C. $20^\circ C$

D. $25^\circ C$

Answer: A

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8. The temperature of a body is increased by 50%. The amount of radiation emitted by it would be nearly

A. increase by 400%

B. decrease by 400%

C. increase by 50%

D. decrease by 50%

Answer: A

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9. The maximum spectral emissive power at black body temperature 5000 K is obtained at $\lambda_m = 6000Å$. If the temperature is increased by 10%, then decrease in λ_m will be

A. 0.15

B. 0.1

C. 0.05

D. 0.03

Answer: B

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10. If the temperature of the sun were to increase form T to 2T and its radius from R to 2R, then the ratio of the radiant energy received on earth to what it was previously will be

A. 4

B. 16

C. 32

D. 64

Answer: D

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11. An experiment takes 10 minutes to raise the temperature of water in a container from $0^\circ C \text{to} 100^\circ C$ and another 55 minutes to convert it totally into steam by a heater supplying heat at a uniform rate. Neglecting the specific heat of the container and taking specific heat of water to be $1 cal/g^\circ C$, the

heat of vapourization according to this experiment will come out to be:-

A. 530 cal/g

B. 540 cal/g

C. 550 cal/g

D. 560 cal/g

Answer: C

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12. Two rods of equal length and diameter have thermal conductivite 3 and 4 units respectively. If they are joined in series, the thermal conductivity of the combination in the given units would be

A. 3.43

B. 7

C. 7.34

D. 6.25

Answer: A

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13. 19 g of water at $30^\circ C$ and 5 g of ice at $-20^\circ C$ are mixed together in a calorimeter. What is the final temperature of the mixture? Given specific heat of ice $= 0.5 cal g^{-1}(.^\circ C)^{-1}$ and latent heat of fusion of ice $= 80 cal g^{-1}$

A. $0^\circ C$

B. -5° C

C. $5^\circ C$

D. $10^\circ C$

Answer: C

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14. Two black bodies at temperatures $327^\circ C$ and $427^\circ C$ are kept in an evacuated chamber at $27^\circ C$. The ratio of their rates of loss of heat are

A. $\left(\frac{6}{7}\right)$

B. $\left(\frac{6}{7}\right)^2$

C. $\left(\frac{6}{7}\right)^3$

D. $\frac{243}{464}$

Answer: D

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Wb Jee Workout Category 2 One Or More Than One Option Correct Type

1. $1.56 \times 10^5 J$ of heat is conducted through is $2m^2$ wall of 12 cm thick in one hour. Temperature difference between the two sides of the wall is $20^\circ C$. The thermal conductivity of the material of the wall is (in $Wm^{-1}K^{-1}$)

A. 0.11

B. 0.13

C. 0.15

D. 1.2

Answer: B

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2. A block of ice at temperature $-20^{\circ}C$ is slowly heated and converted to steam at 100° C. Which of the following diagram is most appropriate?

A. 

B. 

C. 

D. 

Answer: A

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3. A black body of temperature T is inside a chamber of temperature T_0 Now the closed chamber is slightly opened to Sun that temeperature of black body (T) and chamber (T_0) remain constant .

A. The rate of emission of energy from the black body remains the same.

B. The rate of emission of energy from the black body increases

C. The rate of absorption of energy by the black boby increases.

D. The energy radiated by the black body equals the energy absorbed by it.

Answer: A::D

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4. The graph shown represents the variation of temperature (T) of two bodies, x and y, having same surface area, with time (t) due to the emission of radiation. Then ,

A. $a_x < a_y$

B. $a_x > a_y$

C. $e_x > e_y$

D. $e_x < e_y$

Answer: B::C

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5. When the temperature of a copper coin is raised by $80^{\circ}C$, its diameter increases by $0.2\,\%$.

A. percentage rise in the area of a face is 0.4%

B. percentage rise in the thickness is 0.4%

C. percentage rise in the volume is 0.6%

D. coefficient of linear expansion of copper is $0.25 \times 10^{-4} / ^{\circ} C$

Answer: A::C::D

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6. Two bodies A and B have thermal emissivities of 0.01 and 0.81 respectively. The outer surface areas of the two bodies are same. The two bodies emit total radiant power at the same rate. The wavelength λ_B

corresponding to maximum spectral radiancy from B is shifted from the wavelength corresponding to maximum spectral radiancy in the radiation from A by 1.0 μm. If the temperature of A is 5802 K, calculate (a) the temperature of B, (b) wavelength λ_B.

A. the temperature of B is 1934 K

B. $\lambda_b = 1.5 \mu m$

C. the temperature of B is 11604 K

D. the temperature of B is 2901 K

Answer: A::B

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7. In an industrial process 10 kg of water per hour is to be heated from $20^\circ C$ to $80^\circ C$. To do this steam at $150^\circ C$ is passed from a boiler into a copper coil immersed in water. The steam condenses in the coil and is returned to the boiler as water at $90^\circ C$. How many kilograms of steam is required per hour (specific heat of steam $= 1 cal/g^\circ C$, Latent heat of vapourization $= 540 cal/g$)?

A. Heat gained by water in one hour is 6×10^5 cal.

B. Mass of steam required per hour is 1 kg.

C. Mass of steam required per hour is 1000 kg.

D. Heat gained by water on boiling in one hour is 540×10^2 cal

Answer: A::B

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8. Heat is supplied to a certain homogeneous sample of matter, at a uniform rate. Its temperature is plotted against time, as shown. Which of the following conclusion can be drawn? Slope of OA is greater than slope of BC

A. Its specific heat capacity is greater in the solid state than in the liquid state

B. Its specific heat capacity is greater in the liquid state than in the solid state

C. Its latent heat of vaporisation is greater than its latent heat of fusion

D. Its latent heat of vaporisation is smaller than its latent heat of fusion

Answer: B::C

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9. A bimetallic strip is formed out of two identical strips one of copper and the other of brass. The co-efficients of linear expansion of

the two metals are α_C and α_B. On heating, the the strip bends to form an are of radius of curvature R. Then R is

A. proportional to ΔT

B. inversely proportional to $Detla$T

C. proportional to $|\alpha_B - \alpha_C|$

D. inversely proportional to$|\alpha_B - \alpha_C|$

Answer: B::D

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10. A piece of metal weighs 46 g in air and 30 g in lipuid of density $1.24 \times 10^3 kgm^{-3}$ kept at 27^0C. When the temperature of the liquid is raised to 42^0C the metal piece weights 30.5 g . The density of the liqued at 42^0C is $1.20 \times 10^3 kgm^{-3}$. Calculate the coefficient of linear expandsion of the metal.

A. $1.15 \times 10^{-5}/^\circ C$

B. $2.31 \times 10^{-5}/^\circ C$

C. $3.46 \times 10^{-5}/^\circ C$

D. $0.96 \times 10^{-5}/^\circ C$

Answer: B

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11. Assuming the sun to have a spherical outer surface of radius r radiating like a black body at temperature $t^{\circ}C$. The power received by a unit surface (normal to the incident rays) at a distance R from the centre of the sun is where σ is the Stefan's constant.

A. $\frac{r^2\sigma(t+273)^4}{4\pi R^2}$

B. $\frac{16\pi^2 r^2 \sigma t^4}{R^2}$

C. $\frac{r^2 \sigma (t+273)^4}{R^2}$

D. $\frac{4\pi r^2 \sigma t^4}{R^2}$

Answer: C

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Wb Jee Previous Years Questions

1. In which mode of tranmission , the heat waves travel along straight line with the speed

of light?

A. Thermal conduction

B. Forced convection

C. Natural convection

D. Thermal radiation

Answer: D

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2. Consider a black body radiation in a cubical box at absolute temperature T. If the lengh of each side of the box is doubled and the temperature of the walls of the box and that of the radiation is halved then the total energy

A. halves

B. doubles

C. quadruples

D. remains the same

Answer: D

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3. A small quantity mass m, of water at a temperature $\theta(\text{in } {}^{\circ}C)$ is poured on to a larger mass M of ice which is at its melting point. If c is the specific heat capacity of water and L the specific heat capacity of water and L the specific latent heat of fusion of ice, then the mass of ice melted is give by

A. 4.2×10^3

B. 3.0×10^3

C. 1.2×10^3

D. 1.5×10^3

Answer: D

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4. Same quantity of ice is filled in each of the two metal containers P and having the same size, shape and wall thickness but made of

different materials. The containers are kept in identical surroundings. The ice in P melts completely in time t_1, whereas that in Q takes a time t_2. The ratio of thermal conductivities of the materials of P and Q is

A. $t_2 : t_1$

B. $t_1 : t_2$

C. $t_1 : t_2^2$

D. $t_2^2 : t_1^2$

Answer: A

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5. A metal rod if fixed rigidly at two ends so as to prevent its hermalexpension. If L,α Y respectively denote the length of the rod , coefficeent of linear thermal expension and Young's modulus of its material, then for an increase in temperature of the rod by $De < s$ T, the longitudinal stress developed in the rod is

A. inversely proportional to α

B. inversely proportional to Y

C. directly proportional to $\frac{\Delta T}{Y}$

D. independent of L

Answer: D

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6. A solid at temperature T_1 is kept in an evacuated chamber at temperature $T_2 > T_1$. The rate of increase of temperature of the body is proportional to

A. $t_2^4 - t_1^4$

B. $\left(t_2^4 + 273\right) - \left(t_1^4 + 273\right)$

C. $t_2 - t_1$

D. $t_2^2 : t_1^2$

Answer: A

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7. Three bodies of the same material and having masses m,m and 3m are at temperature $40^\circ C, 50^\circ$ C and $60^\circ C$

respectively . If the bodies are brought in thermal contact the final temperature will be

A. 45° C

B. $54^\circ C$

C. $52^\circ C$

D. $48^\circ C$

Answer: B

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8. If the temperature of the sun (black body) is doubled, the rate of energy received on earth will be increase by a factor of

A. 2

B. 4

C. 8

D. 16

Answer: D

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9. The temperature of the water of pond is $0^\circ C$ while that of the surrounding atmosphere is $-20^\circ C$. If the density of ice is p, coefficient of thermal conductivity is k and latent heat of melting is L then the thickness Z of ice layer formed increases as function of time t as

A. $Z^2 = \frac{60k}{\rho L}t$

B. $Z = \sqrt{\frac{40k}{\rho L}}l$

C. $Z^2 = \frac{40K}{\rho L}\sqrt{t}$

D. $z^2 = \frac{400k}{\rho L}t$

Answer: D

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10. A solid rectangular sheet has two different coefficients of linear expansion α_1 and α_2 along its length and breadth respectively. The coefficient of surface expansion is (for $\alpha_1 t << 1, \alpha_2 << 1$)

A. $\frac{\alpha_1 + \alpha_2}{2}$

B. $2(\alpha_1 + \alpha_2)$

C. $\frac{4\alpha_1\alpha_2}{\alpha_1 + \alpha_2}$

D. $\alpha_1 + \alpha_2$

Answer: D

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11. The water equivalent of a calorimeter is 10 g and it contains 50 g of water at 15°C. Some amount of ice, initially at -10°C is dropped in it and half of the ice melts till equilibrium is

reached. What was the initial amount of ice that was dropped (when specific heat of ice = $0.5calg^{-1\circ}C^{-1}$, specific heat of water $= 1.0calg^{-1\circ}C^{-1}$ and latent heat of melting of ice = 80 cal g'^{-1})?

A. 10 g

B. 18 g

C. 20 g

D. 30 g

Answer: C

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12. Two black bodies A and B have equal surface areas and are maintained at temperatures $27^\circ C$ and $177^\circ C$ respectively. What will be the ratio of the thermal energy radiated per second by A to that by B?

A. $4:9$

B. $2:3$

C. $16:81$

D. $27:177$

Answer: C

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13. A 10 watt electric heater is used to heat a container filled with 0.5 kg of water. It is found that the temperature of water and the container rises by $3^{\circ}K$ in 15 minutes. The container is then emptied, dried and filled with 2 kg of oil. The same heater now raises the temperature of container-oil system by $2^{\circ}K$ in 20 minutes. Assuming that there is no heat

loss in the process and the specific heat of water as $4200 Jkg^{-1}K^{-1}$ the specific heat of oil in the same unit is equal to

A. 1.50×10^3

B. 2.55×10^3

C. 3.00×10^3

D. 5.10×10^3

Answer: B

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14. A steam of water flowing horizontally with a speed of $25m^{s-1}$ gushes out of a tube of cross-sectional area $10^{-3}m^2$, and hits at a vertical wall nearby. What is the force exerted on the wall by the impact of water

A. $1^\circ C$

B. $0.1^\circ C$

C. $10^\circ C$

D. $0.01^\circ C$

Answer: A

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15. Two identical blocks of ice move in opposite directions with equal speed and collide with each other. What will be minimum speed required to make both the blocks melt completely, if the initial temperatures of the blocks were $-8^{\circ}C$ each? Specific heat of ice is $2100Jkg^{-1}$ K and latent heat of fusion of ice is $3.36 \times 10^{5}Jkg^{-1}$

A. $840ms^{-1}$

B. $420ms^{-1}$

C. $8.4ms^{-1}$

D. $84ms^{-1}$

Answer: A

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