**Q1.** At room temperature $(27^{\circ}\mathrm{C})$, the resistance of a heating element is $50\Omega$. The temperature coefficient of the material is $2.4 \times 10^{-4}{}^{\circ}\mathrm{C}^{-1}$. The temperature of the element, when its resistance is $62\Omega$, is _____ $^{\circ}\mathrm{C}$.

***09 Apr 2024 (E)***

**Q2.** On celcius scale the temperature of body increases by $40^{\circ}\mathrm{C}$. The increase in temperature on Fahrenheit scale is :

***04 Apr 2024 (M)***

(1) $68^{\circ}\mathrm{F}$ (2) $75^{\circ}\mathrm{F}$

(3) $72^{\circ}\mathrm{F}$ (4) $70^{\circ}\mathrm{F}$

**Q3.** The resistances of the platinum wire of a platinum resistance thermometer at the ice point and steam point are $8\Omega$ and $10\Omega$ respectively. After inserting in a hot bath of temperature $400^{\circ}\mathrm{C}$, the resistance of platinum wire is :

***04 Apr 2024 (M)***

(1) $10\Omega$ (2) $8\Omega$

(3) $16\Omega$ (4) $2\Omega$

**Q4.** Two conductors have the same resistances at $0\ ^{\circ}\mathrm{C}$ but their temperature coefficients of resistance are $\alpha_1$ and $\alpha_2$. The respective temperature coefficients for their series and parallel combinations are :

***31 Jan 2024 (M)***

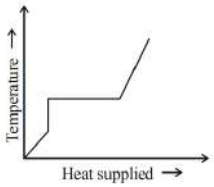
(1) $\alpha_1 + \alpha_2,\ \frac{\alpha_1+\alpha_2}{2}$ (2) $\frac{\alpha_1+\alpha_2}{2},\ \frac{\alpha_1+\alpha_2}{2}$

(3) $\alpha_1 + \alpha_2,\ \frac{\alpha_1\,\alpha_2}{\alpha_1+\alpha_2}$ (4) $\frac{\alpha_1+\alpha_2}{2},\ \alpha_1 + \alpha_2$

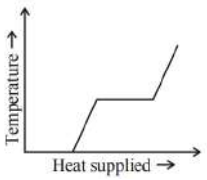
**Q5.** A block of ice at $-10\ ^{\circ}\mathrm{C}$ is slowly heated and converted to steam at $100\ ^{\circ}\mathrm{C}$. Which of the following curves represent the phenomenon qualitatively:

***30 Jan 2024 (E)***

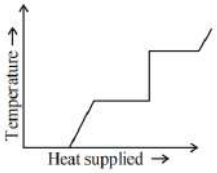
(1)



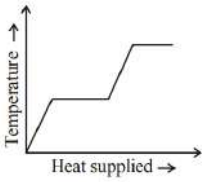

(2)




(3)




(4)




**Q6.** Two plates A and B have thermal conductivities 84 W $\mathrm{m}^{-1}$ $\mathrm{K}^{-1}$ and 126 W $\mathrm{m}^{-1}$ $\mathrm{K}^{-1}$ respectively. They have same surface area and same thickness. They are placed in contact along their surfaces. If the temperatures of the outer surfaces of A and B are kept at $100^{\circ}\mathrm{C}$ and $0^{\circ}\mathrm{C}$ respectively, then the temperature of the surface of contact in steady state is_____ $^{\circ}\mathrm{C}$.

***13 Apr 2023 (E)***

**Q7*.** A body cools from $80^{\circ}\mathrm{C}$ to $60^{\circ}$ in 5 minutes. The temperature for the surrounding is $20^{\circ}\mathrm{C}$. The time it takes to cool from $60^{\circ}\mathrm{C}$ to $40^{\circ}\mathrm{C}$ is

***12 Apr 2023 (M)***

(1) 450 s (2) 420 s

(3) 500 s (4) $\frac{25}{3}$ s

**Q8.** On a temperature scale '$X$', the boiling point of water is $65^{\circ}\mathrm{X}$ and the freezing point is $-15^{\circ}\mathrm{X}$. Assuming that the $X$ scale is linear. The equivalent temperature corresponding to $-95^{\circ}\mathrm{X}$ on the Fahrenheit scale would be

***11 Apr 2023 (M)***

(1) $-112^{\circ}\mathrm{F}$ (2) $-48^{\circ}\mathrm{F}$

(3) $-148^{\circ}\mathrm{F}$ (4) $-63^{\circ}\mathrm{F}$

**Q9.** $1\ \mathrm{kg}$ of water at $100^{\circ}\mathrm{C}$ is converted into steam at $100^{\circ}\mathrm{C}$ by boiling at atmospheric pressure. The volume of water changes from $1.00 \times 10^{-3}\ \mathrm{m}^3$ as a liquid to $1.671\ \mathrm{m}^3$ as steam. The change in internal energy of the system during the process will be (Given latent heat of vaporisation $= 2257\ \mathrm{kJ/kg}$, Atmospheric pressure $= 1 \times 10^5\ \mathrm{Pa}$)

***11 Apr 2023 (M)***

(1) $-2426\ \mathrm{kJ}$ (2) $+2090\ \mathrm{kJ}$

(3) $-2090\ \mathrm{kJ}$ (4) $+2476\ \mathrm{kJ}$

**Q10.** A steel rod of length $1\ \mathrm{m}$ and cross-sectional area $10^{-4}\ \mathrm{m}^2$ is heated from $0^{\circ}\mathrm{C}$ to $200^{\circ}\mathrm{C}$ without being allowed to extend or bend. The compressive tension produced in the rod is _____$\times 10^4$ N. (Given Young's modulus of steel $= 2 \times 10^{11}\ \mathrm{N\ m^{-2}}$, coefficient of linear expansion $= 10^{-5}\ \mathrm{K^{-1}}$)

***08 Apr 2023 (E)***

**Q11*.** A body cools in 7 minutes from 60°C to 40°C. The temperature of the surrounding is 10°C. The temperature of the body after the next 7 minutes will be

***06 Apr 2023 (E)***

(1) 30°C (2) 32°C

(3) 34°C (4) 28°C

**Q12.** A water heater of power 2000 W is used to heat water. The specific heat capacity of water is 4200 J $\mathrm{kg^{-1}\ K^{-1}}$. The efficiency of heater is 70%. Time required to heat $2\ \mathrm{kg}$ of water from $10^{\circ}\mathrm{C}$ to $60^{\circ}\mathrm{C}$ is _____ s. (Assume that the specific heat capacity of water remains constant over the temperature range of the water).

***31 Jan 2023 (E)***

**Q13.** A thin rod having a length of $1\ \mathrm{m}$ and area of cross-section $3 \times 10^{-6}\ \mathrm{m}^2$ is suspended vertically from one end. The rod is cooled from $210^{\circ}\mathrm{C}$ to $160^{\circ}\mathrm{C}$. After cooling, a mass $M$ is attached at the lower end of the rod such that the length of rod again becomes $1\ \mathrm{m}$. Young's modulus and coefficient of linear expansion of the rod are $2 \times 10^{11}\ \mathrm{N\ m^{-2}}$ and $2 \times 10^{-5}\ \mathrm{K^{-1}}$, respectively. The value of $M$ is _____ kg. (Take $g = 10\ \mathrm{m\ s^{-2}}$)

***31 Jan 2023 (M)***

**Q14.** A faulty thermometer reads $5^{\circ}\mathrm{C}$ in melting ice and $95^{\circ}\mathrm{C}$ in steam. The correct temperature on absolute scale will be _____ K when the faulty thermometer reads $41^{\circ}\mathrm{C}$.

***30 Jan 2023 (E)***

**Q15*.** A body cools from $60^{\circ}\mathrm{C}$ to $40^{\circ}\mathrm{C}$ in 6 minutes. If, temperature of surroundings is $10^{\circ}\mathrm{C}$. Then, after the next 6 minutes, its temperature will be _____ $^{\circ}\mathrm{C}$.

***29 Jan 2023 (M)***

**Q16.** Heat energy of $184\ \mathrm{kJ}$ is given to ice of mass 600 g at $-12\ ^{\circ}\mathrm{C}$, Specific heat of ice is $2222.3\ \mathrm{J\ kg^{-1}\ ^{\circ}C^{-1}}$ and latent heat of ice is $336\ \mathrm{kJ\ kg^{-1}}$.

(A) Final temperature of system will be $0\ ^{\circ}\mathrm{C}$ (B) Final temperature of the system will be greater than $0\ ^{\circ}\mathrm{C}$

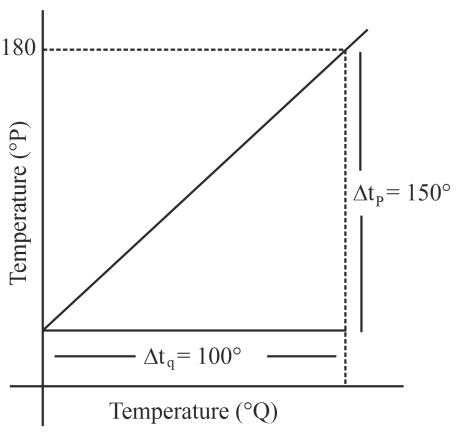
(C) The final system will have a mixture of ice and water in the ratio of $5:1$ (D) The final system will

have a mixture of ice and water in the ratio of $1:5$ (E) The final system will have water only. Choose the correct answer from the options given below :

***29 Jan 2023 (E)***

(1) A and D only
(2) B and D only
(3) A and E only
(4) A and C only

**Q17.** The graph between two temperature scales $P$ and $Q$ is shown in the figure. Between upper fixed point and lower fixed point there are 150 equal divisions of scale $P$ and 100 divisions on scale $Q$. The relationship for conversion between the two scales is given by :




***25 Jan 2023 (E)***

(1) $\frac{t_Q}{150}=\frac{t_P-180}{100}$
(2) $\frac{t_Q}{100}=\frac{t_P-30}{150}$
(3) $\frac{t_P}{180}=\frac{t_Q-40}{100}$
(4) $\frac{t_Q}{100}=\frac{t_P-180}{150}$

**Q18.** According to law of equipartition of energy the molar specific heat of a diatomic gas at constant volume where the molecule has one additional vibrational mode is :- ***25 Jan 2023 (E)***

(1) $\frac{9}{2}R$
(2) $\frac{5}{2}R$
(3) $\frac{3}{2}R$
(4) $\frac{7}{2}R$

**Q19*.** A bowl filled with very hot soup cools from 98°C to 86°C in 2 minutes when the room temperature is 22°C. How long it will take to cool from 75°C to 69°C ? ***25 Jan 2023 (M)***

(1) 2 minute
(2) 1.4 minute
(3) 0.5 minute
(4) 1 minute

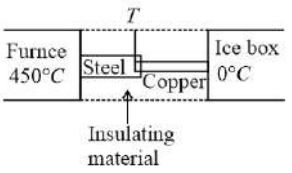
**Q20.** A hole is drilled in a metal sheet. At 27 °C, the diameter of hole is 5 cm. When the sheet is heated to 177 °C, the change in the diameter of hole is $d\times10^{-3}$ cm . The value of $d$ will be _____, if coefficient of linear expansion of the metal is $1.6\times10^{-5}/°C$ ***24 Jan 2023 (M)***

**Q21.** Two metallic wires of identical dimensions are connected is series. If $\sigma_1$ and $\sigma_2$ are the conductivities of the these wires respectively, the effective conductivity of the combination is : ***29 Jul 2022 (M)***

(1) $\frac{\sigma_1\sigma_2}{\sigma_1+\sigma_2}$
(2) $\frac{2\sigma_1\sigma_2}{\sigma_1+\sigma_2}$
(3) $\frac{\sigma_1+\sigma_2}{2\sigma_1\sigma_2}$
(4) $\frac{\sigma_1+\sigma_2}{\sigma_1\sigma_2}$

**Q22.** Nearly 10% of the power of a 110 W light bulb is converted to visible radiation. The change in average intensities of visible radiation, at a distance of 1 m from the bulb to a distance of 5 m is $a\times10^{-2}$ W $m^{-2}$. The value of '$a$' will be ***29 Jul 2022 (E)***

**Q23.** If $K_1$ and $K_2$ are the thermal conductivities $L_1$ and $L_2$ are the lengths and $A_1$ and $A_2$ are the cross sectional areas of steel and copper rods respectively such that $\frac{K_2}{K_1} = 9, \frac{A_1}{A_2} = 2, \frac{L_1}{L_2} = 2$. Then, for the arrangement as shown in the figure. The value of temperature $T$ of the steel - copper junction in the steady state will be




***27 Jul 2022 (M)***

(1) $18^\circ\text{C}$ (2) $14^\circ\text{C}$

(3) $45^\circ\text{C}$ (4) $150^\circ\text{C}$

**Q24.** An ice cube of dimensions $60\text{ cm} \times 50\text{ cm} \times 20\text{ cm}$ is placed in an insulation box of wall thickness $1\text{ cm}$. The box keeping the ice cube at $0^\circ\text{C}$ of temperature is brought to a room of temperature $40^\circ\text{C}$. The rate of melting of ice is approximately: (Latent heat of fusion of ice is $3.4 \times 10^5\text{ J kg}^{-1}$ and thermal conducting of insulation wall is $0.05\text{ W m}^{-1}\,^\circ\text{C}^{-1}$) ***26 Jul 2022 (E)***

(1) $61 \times 10^{-1}\text{ kg s}^{-1}$ (2) $61 \times 10^{-5}\text{ kg s}^{-1}$

(3) $208\text{ kg s}^{-1}$ (4) $30 \times 10^{-5}\text{ kg s}^{-1}$

**Q25.** A unit scale is to be prepared whose length does not change with temperature and remains $20\text{ cm}$, using a bimetallic strip made of brass and iron each of different length. The length of both components would change in such a way that difference between their lengths remains constant. If length of brass is $40\text{ cm}$ and length of iron will be _____ cm.
$\left(\alpha_{\text{iron}} = 1.2 \times 10^{-5}\,\text{K}^{-1}\text{ and }\alpha_{\text{brass}} = 1.8 \times 10^{-5}\,\text{K}^{-1}\right)$.

***25 Jul 2022 (M)***

**Q26.** A block of ice of mass 120 g at temperature $0^\circ\text{C}$ is put in 300 g of water at $25^\circ\text{C}$. The $x$ g of ice melts as the temperature of the water reaches $0^\circ\text{C}$. The value of $x$ is
[Use: Specific heat capacity of water $= 4200\text{ J kg}^{-1}\text{ K}^{-1}$, Latent heat of ice $= 3.5 \times 10^5\text{ J kg}^{-1}$]

***25 Jul 2022 (E)***

**Q27.** At what temperature a gold ring of diameter $6.230\text{ cm}$ be heated so that it can be fitted on a wooden bangle of diameter $6.241\text{ cm}$? Both the diameters have been measured at room temperature $(27^\circ\text{C})$. (Given: coefficient of linear thermal expansion of gold $\alpha_L = 1.4 \times 10^{-5}\,\text{K}^{-1}$) ***29 Jun 2022 (E)***

(1) $125.7^\circ\text{C}$ (2) $91.7^\circ\text{C}$

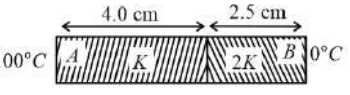
(3) $425.7^\circ\text{C}$ (4) $152.7^\circ\text{C}$

**Q28.** A cylinder of fixed capacity of $44.8$ litres contains helium gas at standard temperature and pressure. The amount of heat needed to raise the temperature of gas in the cylinder by $20.0^\circ\text{C}$ will be (Given gas constant $R = 8.3\text{ J K}^{-1}\text{ mol}^{-1}$) ***29 Jun 2022 (M)***

(1) 249 J (2) 415 J

(3) 498 J (4) 830 J

**Q29.** As per the given figure, two plates $A$ and $B$ of thermal conductivity $K$ and $2K$ are joined together to form a compound plate. The thickness of plates are $4.0\text{ cm}$ and $2.5\text{ cm}$ respectively and the area of cross-section is $120\text{ cm}^2$ for each plate. The equivalent thermal conductivity of the compound plate is $\left(1 + \frac{5}{\alpha}\right)K$, then the value of $\alpha$ will be _____ .



***29 Jun 2022 (M)***

**Q30.** Resistance of the wire is measured as $2\ \Omega$ and $3\ \Omega$ at $10^{\circ}\mathrm{C}$ and $30^{\circ}\mathrm{C}$ respectively. Temperature coefficient of resistance of the material of the wire is ***28 Jun 2022 (E)***

(1) $0.033^{\circ}\mathrm{C}^{-1}$ (2) $-0.033^{\circ}\mathrm{C}^{-1}$

(3) $0.011^{\circ}\mathrm{C}^{-1}$ (4) $0.055^{\circ}\mathrm{C}^{-1}$

**Q31.** A lead bullet penetrates into a solid object and melts. Assuming that $40\%$ of its kinetic energy is used to heat it, the initial speed of bullet is

(Given, initial temperature of the bullet $= 127^{\circ}\mathrm{C}$, Melting point of the bullet $= 327^{\circ}\mathrm{C}$,
Latent heat of fusion of lead $= 2.5 \times 10^4\ \mathrm{J\ kg^{-1}}$, Specific heat capacity of lead $= 125\ \mathrm{J\ kg\ K^{-1}}$)

***27 Jun 2022 (E)***

(1) $125\ \mathrm{m\ s^{-1}}$ (2) $500\ \mathrm{m\ s^{-1}}$

(3) $250\ \mathrm{m\ s^{-1}}$ (4) $600\ \mathrm{m\ s^{-1}}$

**Q32.** A geyser heats water flowing at a rate of $2.0$ kg per minute from $30^{\circ}\mathrm{C}$ to $70^{\circ}\mathrm{C}$. If geyser operates on a gas burner, the rate of combustion of fuel will be _____ $\mathrm{g\ min^{-1}}$.

[Heat of combustion $= 8 \times 10^3\ \mathrm{Jg^{-1}}$, Specific heat of water $= 4.2\ \mathrm{Jg^{-1}\,^{\circ}C^{-1}}$]

***26 Jun 2022 (E)***

**Q33.** A solid metallic cube having total surface area $24\ \mathrm{m^2}$ is uniformly heated. If its temperature is increased by $10^{\circ}\mathrm{C}$, calculate the increase in volume of the cube. (Given $\alpha = 5.0 \times 10^{-4}{}^{\circ}\mathrm{C^{-1}}$). ***25 Jun 2022 (E)***

(1) $2.4 \times 10^6\ \mathrm{cm^3}$ (2) $1.2 \times 10^5\ \mathrm{cm^3}$

(3) $6 \times 10^4\ \mathrm{cm^3}$ (4) $4.8 \times 10^5\ \mathrm{cm^3}$

**Q34.** A steam engine intakes $50\ \mathrm{g}$ of steam at $100^{\circ}\mathrm{C}$ per minute and cools it down to $20^{\circ}\mathrm{C}$. If latent heat of vaporization of steam is $540\ \mathrm{cal\ g^{-1}}$, then the heat rejected by the steam engine per minute is _____ $\times 10^3$ cal

(Given : specific heat capacity of water: $1\ \mathrm{cal\ g^{-1}{}^{\circ}C^{-1}}$)

***25 Jun 2022 (M)***

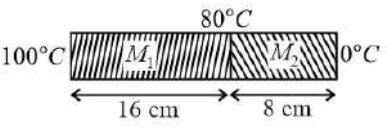
**Q35.** A copper block of mass $5.0\ \mathrm{kg}$ is heated to a temperature of $500^{\circ}\mathrm{C}$ and is placed on a large ice block. What is the maximum amount of ice that can melt?

[Specific heat of copper : $0.39\ \mathrm{Jg^{-1}\,^{\circ}C^{-1}}$ and latent heat of fusion of water : $335\ \mathrm{Jg^{-1}}$] ***25 Jun 2022 (E)***

(1) $1.5\ \mathrm{kg}$ (2) $5.8\ \mathrm{kg}$

(3) $2.9\ \mathrm{kg}$ (4) $3.8\ \mathrm{kg}$

**Q36.** Two metallic blocks $M_1$ and $M_2$ of same area of cross-section are connected to each other (as shown in figure). If the thermal conductivity of $M_2$ is $K$ then the thermal conductivity of $M_1$ will be : [Assume steady state heat conduction]




***24 Jun 2022 (M)***

(1) $10K$ (2) $8K$

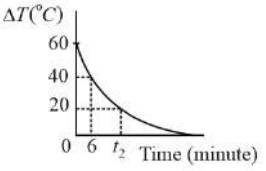
(3) $12.5K$ (4) $2K$

**Q37.** A 100 g of iron nail is hit by a $1.5$ kg hammer striking at a velocity of $60\ \text{ms}^{-1}$. What will be the rise in the temperature of the nail if one fourth of energy of the hammer goes into heating the nail ? [Specific heat capacity of iron $= 0.42\ \text{Jg}^{-1}\,^{\circ}\text{C}^{-1}$] ***24 Jun 2022 (E)***

(1) $16.07^{\circ}\text{C}$ (2) $6.75^{\circ}\text{C}$

(3) $1600^{\circ}\text{C}$ (4) $675^{\circ}\text{C}$

**Q38*.** In an experiment to verify Newton's law of cooling. a graph is plotted between. the temperature difference $(\Delta T)$ of the water and surroundings and time as shown in figure. The initial temperature of water is taken as $80^{\circ}\text{C}$. The value of $t_2$ as mentioned in the graph will be




***24 Jun 2022 (E)***

**Q39.** Due to cold weather, a 1 m water pipe of cross-sectional area 1 $\text{cm}^2$ is filled with ice at $-10\ ^{\circ}\text{C}$. Resistive heating is used to melt the ice. Current of $0.5$ A is passed through 4 $\text{k}\Omega$ resistance. Assuming that all the heat produced is used for melting, what is the minimum time required? (Given latent heat of fusion for water/ice $= 3.33 \times 10^5\ \text{J kg}^{-1}$, specific heat of ice $= 2 \times 10^3\ \text{J kg}^{-1}\ ^{\circ}\text{C}^{-1}$ and density of ice $= 10^3\ \text{kg m}^{-3}$) ***01 Sep 2021 (E)***

(1) $3.53$ s (2) $0.353$ s

(3) $35.3$ s (4) $70.6$ s

**Q40.** Two thin metallic spherical shells of radii $r_1$ and $r_2 (r_1 < r_2)$ are placed with their centres coinciding. A material of thermal conductivity $K$ is filled in the space between the shells. The inner shell is maintained at temperature $\theta_1$ and the outer shell at temperature $\theta_2 (\theta_1 < \theta_2)$. The rate at which heat flows radially through the material is : ***31 Aug 2021 (E)***

(1) $\frac{K(\theta_2-\theta_1)}{r_2-r_1}$ (2) $\frac{K(\theta_2-\theta_1)(r_2-r_1)}{4\pi r_1 r_2}$

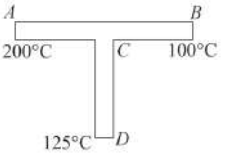
(3) $\frac{\pi K r_1 r_2(\theta_2-\theta_1)}{r_2-r_1}$ (4) $\frac{4\pi K r_1 r_2(\theta_2-\theta_1)}{r_2-r_1}$

**Q41.** An ideal gas is expanding such that $PT^3 =$ constant. The coefficient of volume expansion of the gas is: ***27 Aug 2021 (M)***

(1) $\frac{2}{T}$ (2) $\frac{3}{T}$

(3) $\frac{1}{T}$ (4) $\frac{4}{T}$

**Q42.** A rod $CD$ of thermal resistance $10.0\,\text{KW}^{-1}$ is joined at the middle of an identical rod $AB$ as shown in figure. The ends $A$, $B$ and $D$ are maintained at $200^{\circ}\text{C}, 100^{\circ}\text{C}$ and $125^{\circ}\text{C}$ respectively. The heat current in $CD$ is $P$ W. The value of $P$ is




***27 Aug 2021 (M)***

**Q43.** The temperature of equal masses of three different liquids $x$, $y$ and $z$ are $10^{\circ}\text{C}$, $20^{\circ}\text{C}$ and $30^{\circ}\text{C}$ respectively. The temperature of mixture when $x$ is mixed with $y$ is $16^{\circ}\text{C}$ and that when $y$ is mixed with $z$ is $26^{\circ}\text{C}$. The temperature of mixture when $x$ and $z$ are mixed will be : ***26 Aug 2021 (E)***

(1) $25.62^{\circ}\text{C}$ (2) $20.28^{\circ}\text{C}$

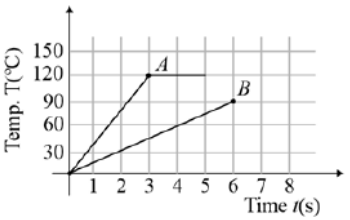
(3) $28.32^{\circ}\text{C}$ (4) $23.84^{\circ}\text{C}$

**Q44*.** A body takes 4 min to cool from 61°C to 59°C. If the temperature of the surroundings is 30°C, the time taken by the body to cool from 51°C to 49°C is: ***27 Jul 2021 (M)***

(1) 4 min. (2) 3 min.

(3) 8 min. (4) 6 min.

**Q45.** Two different metal bodies $A$ and $B$ of equal mass are heated at a uniform rate under similar conditions. The variation of temperature of the bodies is graphically represented as shown in the figure. The ratio of specific heat capacities is:




***25 Jul 2021 (M)***

(1) $\frac{8}{3}$ (2) $\frac{3}{8}$

(3) $\frac{3}{4}$ (4) $\frac{4}{3}$

**Q46*.** In 5 minutes, a body cools from 75 °C to 65 °C at room temperature of 25 °C. The temperature of body at the end of next 5 minutes is _____ °C.

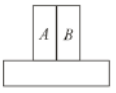
***22 Jul 2021 (M)***

**Q47.** Two identical metal wires of thermal conductivities $K_1$ and $K_2$ respectively are connected in series. The effective thermal conductivity of the combination is: ***17 Mar 2021 (M)***

(1) $\frac{2K_1K_2}{K_1+K_2}$ (2) $\frac{K_1+K_2}{2K_1K_2}$

(3) $\frac{K_1+K_2}{K_1K_2}$ (4) $\frac{K_1K_2}{K_1+K_2}$

**Q48.** A bimetallic strip consists of metals $A$ and $B$. It is mounted rigidly as shown. The metal $A$ has higher coefficient of expansion compared to that of metal $B$. When the bimetallic strip is placed in a cold both, it will :



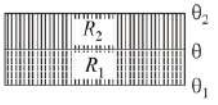

***16 Mar 2021 (E)***

(1) Bend towards the right (2) Not bend but shrink

(3) Neither bend nor shrink (4) Bend towards the left

**Q49.** A container is divided into two chambers by a partition. The volume of first chamber is 4.5 litre and second chamber is 5.5 litre. The first chamber contain 3.0 moles of gas at pressure 2.0 atm and second chamber contain 4.0 moles of gas at pressure 3.0 atm. After the partition is removed and the mixture attains equilibrium, then, the common equilibrium pressure existing in the mixture is $x \times 10^{-1}$ atm. Value of $x$ (nearest integer) is _____ ***26 Feb 2021 (M)***

**Q50.** The temperature $\theta$ at the junction of two insulating sheets, having thermal resistances $R_1$ and $R_2$ as well as top and bottom temperatures $\theta_1$ and $\theta_2$ (as shown in figure) is given by :




***26 Feb 2021 (M)***

(1) $\frac{\theta_1R_2-\theta_2R_1}{R_2-R_1}$ (2) $\frac{\theta_2R_2-\theta_1R_1}{R_2-R_1}$

(3) $\frac{\theta_1R_2+\theta_2R_1}{R_1+R_2}$ (4) $\frac{\theta_1R_1+\theta_2R_2}{R_1+R_2}$

**Q51.** Given below are two statements: one is labelled as Assertion $A$ and the other is labelled as Reason $R$.

Assertion $A$ : When a rod lying freely is heated, no thermal stress is developed in it.

Reason $R$ : On heating, the length of the rod increases.

In the light of the above statements, choose the correct answer from the options given below:

***25 Feb 2021 (M)***

(1) Both $A$ and $R$ are true and $R$ is the correct explanation of $A$

(2) $A$ is false but $R$ is true

(3) Both $A$ and $R$ are true but $R$ is NOT the correct explanation of $A$

(4) $A$ is true but $R$ is false

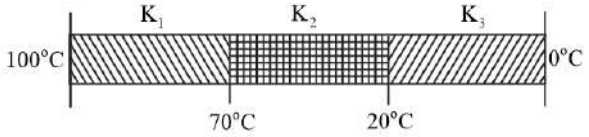
**Q52.** Each side of a box made of metal sheet in cubic shape is $a$ at room temperature $T$, the coefficient of linear expansion of the metal sheet is $\alpha$. The metal sheet is heated uniformly, by a small temperature $\Delta T$, so that its new temperature is $T + \Delta T$. Calculate the increase in the volume of the metal box. ***24 Feb 2021 (M)***

(1) $4a^3\alpha\Delta T$ (2) $3a^3\alpha\Delta T$

(3) $4\pi a^3\alpha\Delta T$ (4) $\frac{4}{3}\pi a^3\alpha\Delta T$

**Q53.** Three rods of identical cross-section and length are made of three different materials of thermal conductivity $K_1,\ K_2$ and $K_3$, respectively. They are joined together at their ends to make a long rod (see figure). One end of the long rod is maintained at $100^\circ\text{C}$ and the other at $0^\circ\text{C}$ (see figure). If the joints of the rod are at $70^\circ\text{C}$ and $20^\circ\text{C}$ in steady and there is no loss of energy from the surface of the rod, the correct relationship between $K_1,\ K_2$ and $K_3$ is :

***06 Sep 2020 (E)***




(1) $K_1 : K_3 = 2 : 3,$
$K_2 : K_3 = 2 : 5$

(2) $K_1 < K_2 < K_3$

(3) $K_1 : K_2 = 5 : 2,$
$K_1 : K_3 = 3 : 5$

(4) $K_1 > K_2 > K_3$

**Q54.** Two different wires having lengths $L_1$ and $L_2$ and respective temperature coefficient of linear expansion $\alpha_1$ and $\alpha_2$, are joined end-to-end. Then the effective temperature coefficient of linear expansion is :

***05 Sep 2020 (E)***

(1) $\frac{\alpha_1 L_1 + \alpha_2 L_2}{L_1 + L_2}$ (2) $2\sqrt{\alpha_1\alpha_2}$

(3) $\frac{\alpha_1 + \alpha_2}{2}$ (4) $4\frac{\alpha_1\alpha_2}{\alpha_1+\alpha_2}\frac{L_2 L_1}{(L_2+L_1)^2}$

**Q55.** The specific heat of water $= 4200$ J kg$^{-1}$ K$^{-1}$ and the latent heat of ice $= 3.4 \times 10^5$ J kg$^{-1}$. 100 grams of ice at 0 °C is placed in 200 g of water at 25 °C. The amount of ice that will melt as the temperature of water reaches 0 °C is close to (in grams) ***04 Sep 2020 (M)***

(1) $61.7$ (2) $63.8$

(3) $69.3$ (4) $64.6$

**Q56.** A calorimeter of water equivalent 20 g contains 180 g of water at $25^\circ\text{C}$. $'\text{m}''$ grams of steam at $100^\circ\text{C}$ is mixed in it till the temperature of the mixture is $31^\circ\text{C}$. The value of $'\text{m}'$ is close to (Latent heat of water $= 540$ cal g$^{-1}$, specific heat of water$= 1$ cal g$^{-1}{}^\circ\text{C}^{-1}$) ***03 Sep 2020 (E)***

(1) 2 (2) 4
(3) 3.2 (4) 2.6

**Q57.** A bakelite beaker has volume capacity of 500 cc at 30°C. When it is partially filled with $V_m$ volume (at 30°C ) of mercury, it is found that the unfilled volume of the beaker remains constant as temperature is varied. If $\gamma_{bester} = 6 \times 10^{-6} 0^{\circ}C^{-1}$, where $\gamma$ is the coefficient of volume expansion, then $V_m$ (in cc ) is close to ...

***03 Sep 2020 (M)***

**Q58*.** A metallic sphere cools from 50 °C to 40 °C in 300 s. If atmospheric temperature around is 20 °C, then the sphere's temperature after the nest 5 minutes will be close to: ***03 Sep 2020 (E)***

(1) 31 °C (2) 33 °C
(3) 28 °C (4) 35 °C

**Q59.** When the temperature of a metal wire is increased from 0ºC to 10ºC, its length increases by 0.02%.The percentage change in its mass density will be closed to:

***02 Sep 2020 (E)***

(1) 0.06 (2) 2.3
(3) 0.008 (4) 0.8

**Q60.** Three containers $C_1, C_2$ and $C_3$ have water at different temperatures. The table below shows the final temperature $T$ when different amounts of water (given in liters) are taken from each container and mixed (assume no loss of heat during the process)

| $C_1$ | $C_2$ | $C_3$ | $T$ |
|---|---|---|---|
| $1l$ | $2l$ | $--$ | $60^{\circ}C$ |
| $--$ | $1l$ | $2l$ | $30^{\circ}C$ |
| $2l$ | $--$ | $1l$ | $60^{\circ}C$ |
| $1l$ | $1l$ | $1l$ | $\theta$ |

The value of $\theta$ (in ºC to the nearest integer) is_____

***08 Jan 2020 (E)***

**Q61.** A non-isotropic solid metal cube has coefficients of linear expansion as: $5 \times 10^{-5}/^{o}C$ along the x-axis and $5 \times 10^{-6}/^{o}C$ along the y and the z-axis. If the coefficient of volume expansion of the solid is $C \times 10^{-6}/^{o}C$ then the value of C is _____ ***07 Jan 2020 (M)***

**Q62.** M grams of steam at 100ºC is mixed with 200g of ice at its melting point in a thermally insulated container. If it produces liquid water at 40ºC [heat of vaporization of water is 540cal/g and heat of fusion of ice is 80cal/g ], the value of M is _____ ***07 Jan 2020 (E)***

**Q63.** At 40°C, a brass wire of 1 mm radius is hung from the ceiling. A small mass, M is hung from the free end of the wire. When the wire is cooled down from 40°C to 20°C it regains its original length of 0.2 m. The value of M is close to: (Coefficient of linear expansion and Young's modulus of brass are $10^{-5}/^{\circ}C$ and $10^{11}\ N/m^2$, respectively; $g = 10\ m\ s^{-2}$ ) ***12 Apr 2019 (M)***

(1) 0.9 kg (2) 0.5 kg
(3) 1.5 kg (4) 9 kg

**Q64.** A uniform cylindrical rod of length $L$ and radius r, is made from a material whose Young's modulus of Elasticity equals $Y$. When this rod is heated by temperature T and simultaneously subjected to a net longutudinal compressional force F, its length remains unchanged. The coefficient of volume expansion, of the material of the rod, is (nearly) equal to: ***12 Apr 2019 (E)***

(1) $F/\left(3\pi r^2 YT\right)$ (2) $9F/\left(\pi r^2 YT\right)$

(3) $6F/\left(\pi r^2 YT\right)$ (4) $3F/\left(\pi r^2 YT\right)$

**Q65.** When $M_1$ gram of ice at $-10^{o}$C (specific heat $= 0.5$ cal g$^{-1}$ °C$^{-1}$ ) is added to $M_2$ gram of water at 50 °C, finally no ice is left and the water is at 0 °C . The value of latent heat of ice, in cal g$^{-1}$ is: ***12 Apr 2019 (M)***

(1) $\frac{50M_2}{M_1}$ (2) $\frac{5M_1}{M_2} - 50$

(3) $\frac{5M_2}{M_1} - 5$ (4) $\frac{50M_2}{M_1} - 5$

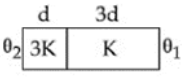
**Q66.** 1 kg of water, at 20 $^\circ$C is heated in an electric kettle whose heating element has a mean (temperature averaged) resistance of 20 $\Omega$. The rms voltage in the mains is 200 V. Ignoring heat loss from the kettle, time taken for water to evaporate fully is close to

[ Specific heat of water $= 4200$ J kg$^{-1}$ $^\circ$C$^{-1}$ Latent heat of water $= 2260$ kJ kg$^{-1}$ ] ***12 Apr 2019 (E)***

(1) 3 min (2) 16 min

(3) 22 min (4) 10 min

**Q67.** Two materials having coefficients of thermal conductivity 3K and K and thickness d and 3d respectively, are joined to form a slab as shown in the figure. The temperatures of the outer surfaces are $\theta_2$ and $\theta_1$ respectively, $(\theta_2 > \theta_1)$. The temperature at the interface is




***09 Apr 2019 (E)***

(1) $\frac{\theta_2+\theta_1}{2}$ (2) $\frac{\theta_1}{6} + \frac{5\theta_2}{6}$

(3) $\frac{\theta_1}{3} + \frac{2\theta_2}{3}$ (4) $\frac{\theta_1}{10} + \frac{9\theta_2}{10}$

**Q68.** A massless spring $(k = 800\,\mathrm{N/m})$, attached with a mass $(500\,\mathrm{g})$ is completely immersed in 1 kg of water. The spring is stretched by 2 cm and released so that it starts vibrating. What would be the order of magnitude of the change in the temperature of water when the vibrations stop completely? (Assume that the water container and spring receive negligible heat and specific heat of mass $= 400$ J/kg K, specific heat of water $= 4184\,\mathrm{J/kg\,K}$ ) ***09 Apr 2019 (E)***

(1) $10^{-5}$ K (2) $10^{-1}$ K

(3) $10^{-3}$ K (4) $10^{-4}$ K

**Q69.** A thermally insulated vessel contains 150 g of water at $0^\circ$C . Then the air from the vessel is pumped out adiabatically. A fraction of water turns into ice and the rest evaporates at $0^\circ$C itself. The mass of evaporated water will be closest to: (Latent heat of vaporization of water $= 2.10 \times 10^6$ J kg$^{-1}$ and Latent heat of Fusion of water $= 3.36 \times 10^5$ J kg$^{-1}$ ) ***08 Apr 2019 (M)***

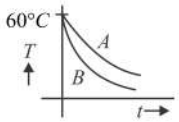
(1) 35 g (2) 20 g

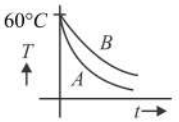
(3) 130 g (4) 150 g

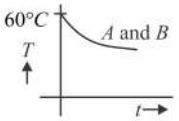
**Q70.** Two identical beakers A and B contain equal volumes of two different liquids at $60^\circ$C each and left to cool down. Liquid in A has density of $8 \times 10^2$ kg m$^{-3}$ and specific heat of 2000 J kg$^{-1}$K$^{-1}$ while the liquid in B

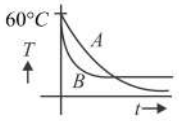
has density $10^3$ kg m$^{-3}$ and specific heat of 4000 J kg$^{-1}$K$^{-1}$. Which of the following best describes their temperature versus time graph schematically? (assume the emissivity of both the beakers to be the same)

***08 Apr 2019 (M)***

(1) 


(2) 


(3) 


(4) 


**Q71.** A cylinder of radius $R$ is surrounded by a cylindrical shell of inner radius $R$ and outer radius $2R$. The thermal conductivity of the material of the inner cylinder is $K_1$ and that of the outer cylinder is $K_2$. Assuming no loss of heat, the effective thermal conductivity of the system for heat flowing along the length of the cylinder is:

***12 Jan 2019 (M)***

(1) $\frac{2K_1+3K_2}{5}$ (2) $\frac{K_1+K_2}{2}$

(3) $K_1+K_2$ (4) $\frac{K_1+3K_2}{4}$

**Q72.** A thermometer graduated according to a linear scale reads a value $x_0$ when in contact with boiling water, and $x_0/3$ when in contact with ice. What is the temperature of an object in °C, if this thermometer in the contact with the object reads $x_0/2$?

***11 Jan 2019 (E)***

(1) 25 (2) 60

(3) 40 (4) 35

**Q73.** Two rods $A$ and $B$ of identical dimensions are at temperature 30°C. If A is heated upto 180°C and B upto T°C, then the new lengths are the same. If the ratio of the coefficients of linear expansion of A and B is 4 : 3, then the value of $T$ is

***11 Jan 2019 (E)***

(1) 230°C (2) 270°C

(3) 200°C (4) 250°C

**Q74.** 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 of 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)

***11 Jan 2019 (M)***

(1) 50 g (2) 100 g

(3) 60 g (4) 40 g

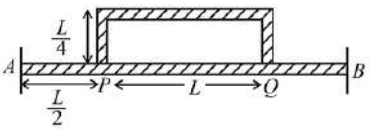
**Q75.** A heat source at $T = 10^3$ K is connected to another heat reservoir at $T = 10^2$ K by a copper slab which is 1 m thick. Given that the thermal conductivity of copper is $0.1$ W K$^{-1}$ m$^{-1}$, the energy flux through it in the steady-state is:

***10 Jan 2019 (M)***

(1) 65 W m$^{-2}$ (2) 120 W m$^{-2}$

(3) 90 W m$^{-2}$ (4) 200 W m$^{-2}$

**Q76.** Temperature difference of $120^oC$ is maintained between two ends of a uniform rod $AB$ of length $2L$. Another bent rod $PQ$, of same cross-section as $AB$ and length $\frac{3L}{2}$, is connected across $AB$ (See figure). In steady state, temperature difference between $P$ and $Q$ will be close to:




***09 Jan 2019 (M)***

(1) $45^oC$
(2) $35^oC$
(3) $60^oC$
(4) $75^oC$

## ANSWER KEYS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1.** (1027) | **2.** (3) | **3.** (3) | **4.** (2) | **5.** (4) | **6.** (40) | **7.** (3) | **8.** (3) |
| **9.** (2) | **10.** (4) | **11.** (4) | **12.** (300) | **13.** (60) | **14.** (313) | **15.** (28) | **16.** (1) |
| **17.** (2) | **18.** (4) | **19.** (2) | **20.** (12) | **21.** (2) | **22.** (84) | **23.** (3) | **24.** (2) |
| **25.** (60) | **26.** (90) | **27.** (4) | **28.** (3) | **29.** (21) | **30.** (1) | **31.** (2) | **32.** (42) |
| **33.** (2) | **34.** (31) | **35.** (3) | **36.** (2) | **37.** (1) | **38.** (16) | **39.** (3) | **40.** (4) |
| **41.** (4) | **42.** (2) | **43.** (4) | **44.** (4) | **45.** (2) | **46.** (57) | **47.** (1) | **48.** (4) |
| **49.** (26) | **50.** (3) | **51.** (3) | **52.** (2) | **53.** (1) | **54.** (1) | **55.** (1) | **56.** (1) |
| **57.** (20) | **58.** (2) | **59.** (1) | **60.** (50) | **61.** (60) | **62.** (40) | **63.** (4) | **64.** (4) |
| **65.** (4) | **66.** (3) | **67.** (4) | **68.** (1) | **69.** (2) | **70.** (2) | **71.** (4) | **72.** (1) |
| **73.** (1) | **74.** (4) | **75.** (3) | **76.** (1) | | | | |