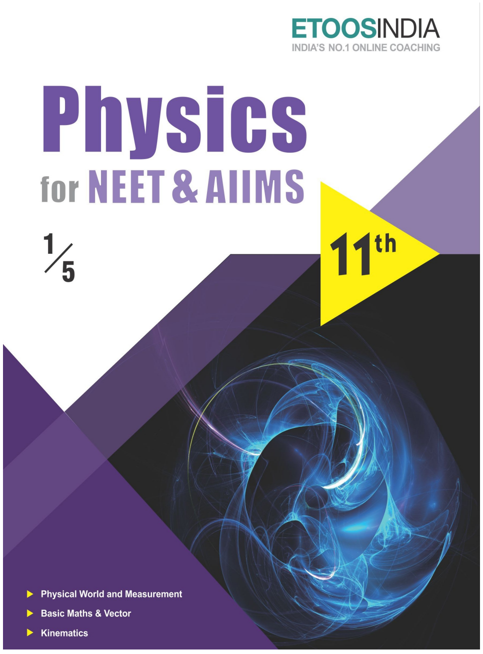
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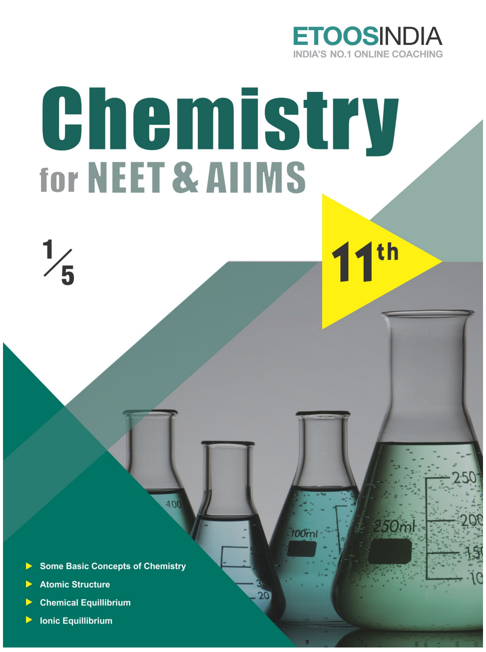
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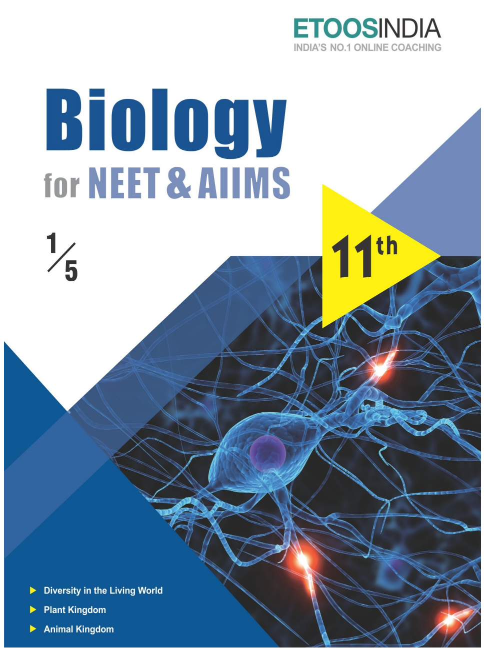
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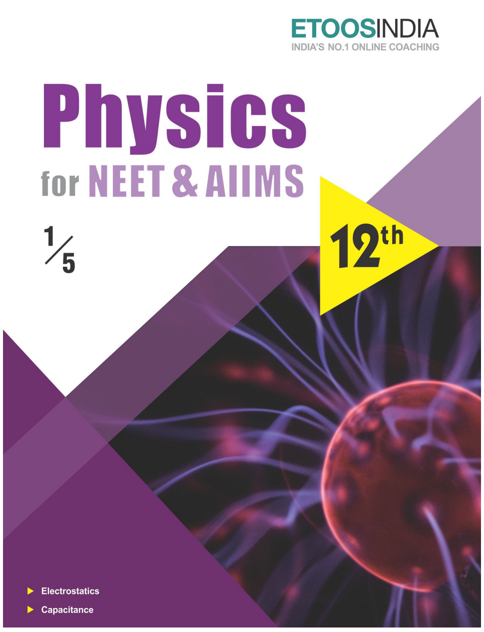
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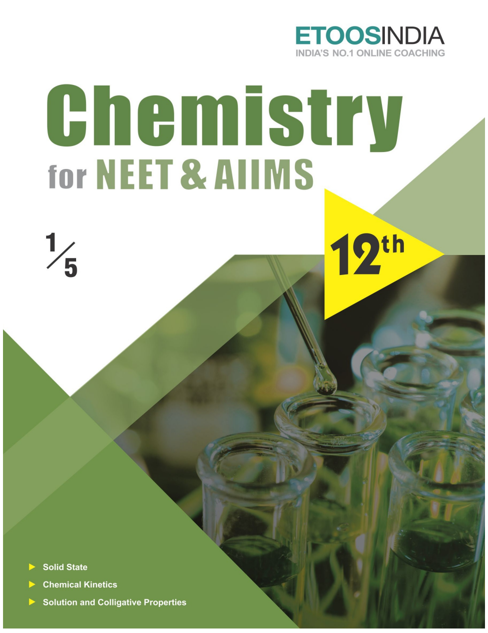
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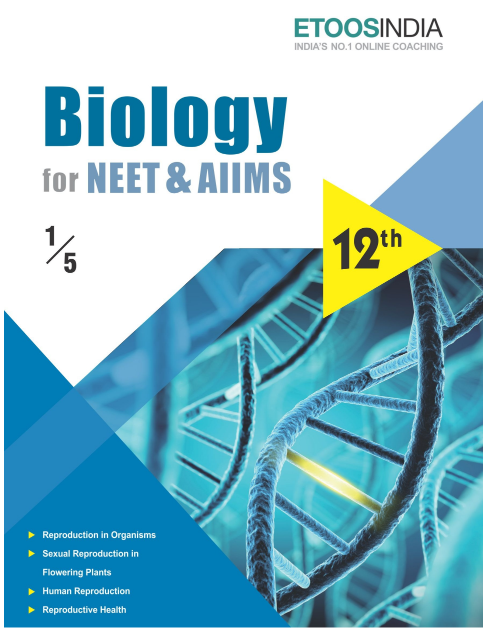
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Reproductive Health

CHAPTER 09

THERMAL PROPERTIES OF MATTER

A perfect thermo-dynamic engine is such that, whatever amount of mechanical effect it can derive from a certain thermal agency; if an equal amount be spent in working it backwards, an equal reverse thermal effect will be produced.

"BARON WILLIAM THOMSON KELVIN"

INTRODUCTION

When a body is heated, various changes take place. The temperature of the body may rise, accompanied by an expansion or contraction of the body; or the body may liquefy or vaporise with no change in temperature. In this chapter we will examine some of the thermal propoerties of matter and some of the important processes involving thermal energy. We will first consider thermal expansion which plays an important role in everyday life and then discuss changes of phase and latent heat. At the end, we will discuss the phenomenon of heat transfer.

(f) Some other application

(i) When rails are laid down on the ground, space is left between the ends of two rails

(ii) The transmission cable are not tightly fixed to the poles

(iii) Test tubes, beakers and cubicles are made of pyrex–glass or silica because they have very low value of coefficient of linear expansion

(iv) The iron rim to be put on a cart wheel is always of slightly smaller diameter than that of wheel

(v) A glass stopper jammed in the neck of a glass bottle can be taken out by warming the neck of the bottle.

Ex. A steel ruler exactly 20 cm long is graduated to give correct measurements at 20^0C. ($\alpha_{steel} = 1.2 \times 10^{-5}\ °C^{-1}$)

(a) Will it give readings that are too long or too short at lower temperatures?

(b) What will be the actual length of the ruler be when it is used in the desert at a temperature of 40^0C?

Sol. (a) If the temperature decreases, the length of the ruler also decreases through thermal contraction. Below 20^0C, each centimeter division is actually somewhat shorter than 1.0 cm, so the steel ruler gives readings that are too long.

(b) At 40^0C, the increases in length of the ruler is

$\Delta\ell = \ell\alpha\Delta T = (20)(1.2 \times 10^{-5})(40^0 - 20^0) = 0.48 \times 10^{-2}$ cm

$\therefore$ The actual length of the ruler is, $\ell' = \ell + \Delta\ell = 20.0048$ cm

Ex. A second's pendulum clock has a steel wire. The clock is calibrated at 20^0C. How much time does the clock lose or gain in one week when the temperature is increased to 30^0C? ($\alpha_{steel} = 1.2 \times 10^{-5}\ °C^{-1}$)

Sol. The time period of second's pendulum is 2 second. As the temperature increases length time period increases. Clock becomes slow and it loses the time. The change in time period is

$$\Delta T = \frac{1}{2} T\alpha\Delta\theta = \left(\frac{1}{2}\right)(2)(1.2 \times 10^{-5})(30^0 - 20^0) = 1.2 \times 10^{-4}\ s$$

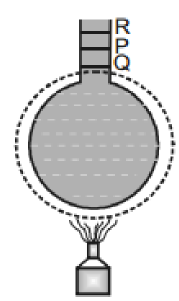
$\therefore$ New Time period is $T' = T + \Delta T = (2 + 1.2 \times 10^{-4}) = 2.00012$ s

$\therefore$ Time lost in one week $\Delta t = \left(\frac{\Delta T}{T'}\right) t = \frac{(1.2 \times 10^{-4})}{(2.00012)}(7 \times 24 \times 3600) = 36.28$ s

Thermal Expansion in Liquids

(i) Liquids do not have linear and superficial expansion but these only have volume expansion.

(ii) Since liquids are always to be heated along with a vessel which contains them so initially on heating the system (liquid + vessel), the level of liquid in vessel falls (as vessel expands more since it absorbs heat and liquid expands less) but later on, it starts rising due to faster expansion of the liquid.



PQ $\rightarrow$ represents expansion of vessel

QR $\rightarrow$ represents the real expansion of liquid.

(iii) The actual increase in the volume of the liquid

= The apparent increase in the volume of liquid + the increase in the volume of the vessel.

ETOOS KEY POINTS

(i) Natural convection takes place from bottom to top while forced convection in any direction.

(ii) In case of natural convection, convection currents move warm air upwards and cool air downwards. This is why heating is done from base, while cooling from the top.

(iii) Natural convection is not possible in a gravity free region such as a freely falling lift or an orbiting satellite.

(iv) Natural convection plays an important role in ventilation, in changing climate and weather and in forming land and sea breezes and trade winds.

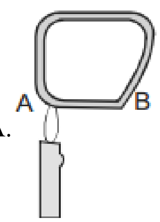
(v) The forced convection of blood in our body by a pump (heart) helps in keeping the temperature of body constant.

(vi) For heat propagation via convection, temperature gradient exists in vertical direction and not in horizontal direction.

(vii) Most of heat transfer that is taking place on Earth is by convection, the contribution due to conduction and radiation is very small.

Ex. Water in a closed tube is heated with one arm vertically placed above the lamp. In what direction water will begin the circulate along the tube ?

Sol. On heating the liquid at A will become lighter and will rise up. This will push the liquid in the tube upwards and so the liquid in the tube will move clockwise i.e. form B to A.



THERMAL RADIATION

The process of the transfer of heat from one place to another place without heating the intervening medium is called radiation. When a body is heated and placed in vacuum, it loses heat even when there is no medium surrounding it. The heat can not go out from the body by the process of conduction or convection since both of these process require the presence of a material medium between source and surrounding objects. The process by which heat is lost in this case is called radiation. This does not require the presence of any material medium.

It is by radiation that the heat from the Sun reaches the Earth. Radiation has the following properties:

(a) Radiant energy travels in straight lines and when some object is placed in the path, it's shadow is formed at the detector.

(b) It is reflected and refracted or can be made to interfere. The reflection or refraction are exactly as in case of light.

(c) It can travel through vacuum.

(d) Intensity of radiation follows the law of inverse square.

(e) Thermal radiation can be polarised in the same way as light by transmission through a nicol prism.

All these and many other properties establish that heat radiation has nearly all the properties possessed by light and these are also electromagnetic waves with the only difference of wavelength or frequency. The wavelength of heat radiation is larger than that of visible light.

Etoos Tips & Formulas

THERMAL SCALE & THERMAL EXPENSION

1. TEMPERATURE SCALES

Name of the scale	Symbol for each degree	Lower fixed point (LFP)	Upper fixed point (UFP)	Number of divisions on the scale
Celsius	°C	0°C	100°C	100
Fahrenheit	°F	32°F	212°F	180
Kelvin	K	273.15 K	373.15 K	100

$$\frac{C-0°}{100°-0°} = \frac{F-32°}{212°-32°} = \frac{K-273.15}{373.15-273.15} = \frac{X\text{–}LFP}{UFP\text{–}LFP}$$

$$\Rightarrow \frac{\Delta C}{100} = \frac{\Delta F}{180} = \frac{\Delta K}{100} = \frac{\Delta X}{UFP-LFP}$$

(i) Old thermometry

$$\frac{\theta-0}{100-0} = \frac{X-X_0}{X_{100}-X_0}$$ [two fixed points – ice & steam points]

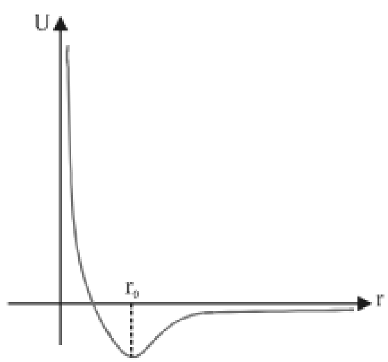
where X is the thermometric property i.e. length, resistance etc.

(ii) Modern thermometry $\frac{T-0}{273.16-0} = \frac{X}{X_{tr}}$

[Only one reflection point – triple point of water is chosen]

2. THERMAL EXPANSION

It is due to asymmetry in potential energy curve



In solids $\rightarrow$ Linear expansion $\ell = \ell_0(1+\alpha\Delta T)$

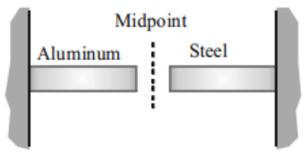
In solids $\rightarrow$ Areal Expansion $A = A_0(1+\beta\Delta T)$

In solids, liquids and gases $\rightarrow$ volume expansion $V = V_0(1+\gamma\Delta T)$

[For isotropic solids : $\alpha : \beta : \gamma = 1 : 2 : 3$]

SOLVED EXAMPLE

Ex.1 The figure shows two thin rods, one made of aluminum [$\alpha = 23 \times 10^{-6}\ (C°)^{-1}$] and the other of steel [$\alpha = 12 \times 10^{-6}\ (C°)^{-1}$]. Each rod has the same length and the same initial temperature. They are attached at one end to two separate immovable walls. Temperature of both the rods is increased by the same amount, until the gap between the rods vanishes. Where do the rods meet when the gap vanishes?



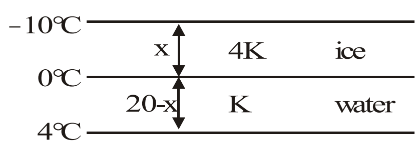
(A) The rods meet exactly at the midpoint.
(B) The rods meet to the right of the midpoint .
(C) The rods meet to the left of the midpoint.
(D) Information insufficient

Sol. As $\alpha_{A\ell} > \alpha_{steel}$ so expansion in aluminum rod is greater.

Ex.2 In a 20m deep lake, the bottom is at a constant temperature of 4°C. The air temperature is constant at –10°C. The thermal conductivity of ice is 4 times that water. Neglecting the expansion of water on freezing, the maximum thickness of ice will be

(A) $\frac{20}{11}$ m **(B)** $\frac{200}{11}$ m
(C) 20 m **(D)** 10 m

Sol. The rate of heat flow is the same through water and ice in the steady state so



$$\frac{KA(4-0)}{20-x} = \frac{4KA[0-(-10)]}{x} \Rightarrow x = \frac{200}{11}\text{m}$$

Ex.3 Certain perfect gas is found to obey PV^n = constant during adiabatic process. The volume expansion coefficient at temperature T is

(A) $\frac{1-n}{T}$ **(B)** $\frac{1}{(1-n)T}$
(C) $\frac{n}{T}$ **(D)** $\frac{1}{nT}$

Sol. PV^n = constant & PV = μRT $V \propto T^{\left(\frac{1}{1-n}\right)}$

$$\Rightarrow \frac{\Delta V}{V} = \left(\frac{1}{1-n}\right)\frac{\Delta T}{T}$$

⇒ volume expansion coefficient

$$= \frac{\Delta V}{V\Delta T} = \frac{1}{(1-n)T}$$

Ex.4 The temperature of a body rises by 44°C when a certain amount of heat is given to it. The same heat when supplied to 22 g of ice at – 8°C, raises its temperature by 16°C. The water eqivalent of the body is
[Given : s_{water} = 1 cal/g°C & L_f = 80 cal/g, s_{ice} = 0.5 cal/g°C]

(A) 25g **(B)** 50 g
(C) 80 g **(D)** 100 g

Sol. Supplied heat = (22) (0.5) (8) + (22) (80) + (22) (1) (16)
= 88 + 1760 + 352 = 2200 cal

Heat capacityof the body = $\frac{2200\ \text{cal}}{44°C}$ = 50 cal/°C

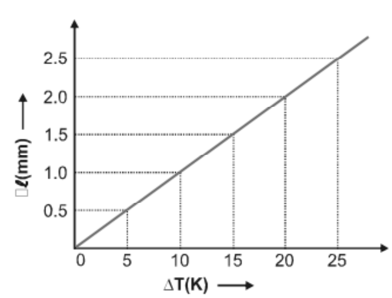
Water equavalent of the body

$$= \frac{\text{Heat capacity of the body}}{\text{spcific heat capacity of water}}$$

$$= \frac{50\ \text{cal/°C}}{1\ \text{cal/g°C}} = 50\text{g}$$

Ex.5 Figures shows the expansion of a 2m long metal rod with temperature. The volume expansion coefficient of the

metal is :–



(A) 3×10^{-4} K^{-1} **(B)** 1.5×10^{-4} K^{-1}
(C) 3×10^{-5} K^{-1} **(D)** 1.5×10^{-5} K^{-1}

Exercise # 1

SINGLE OBJECTIVE — NEET LEVEL

1. Mercury boils at 367°C. However, mercury thermometers are made such that they can measure temperature up to 500°C. This is done by
(A) Maintaining vacuum above mercury column in the stem of the thermometer.
(B) Filling nitrogen gas at high pressure above the mercury column.
(C) Filling nitrogen gas at low pressure above the mercury level.
(D) Filling oxygen gas at high pressure above the mercury column.

2. In a mercury thermometer the ice point (lower fixed point) is marked as 10° and the steam point (upper fixed point) is marked as 130°. At 40°C temperature, what will this thermometer read
(A) 78° (B) 66°
(C) 62° (D) 58°

3. The ratio of coefficient of thermal conductivity of two different materials is 5 : 3. If the thermal resistance of the two rods of these materials of same thickness is same, then the ratio of the length of these rods will be
(A) 5 : 3 (B) 3 : 5
(C) 9 : 25 (D) 25 : 9

4. When the room temperature becomes equal to the dew point, the relative humidity of the room is
(A) 100% (B) 0%
(C) 70% (D) 85%

5. The correct value of 0°C on Kelvin scale will be
(A) 273.15 K (B) 273.00 K
(C) 273.05 K (D) 273.63 K

6. On centigrade scale the temperature of a body increases by 30 degrees. The increase in temperature on Fahrenheit scale is
(A) 50° (B) 40°
(C) 30° (D) 54°

7. A constant volume gas thermometer shows pressure reading of 50cm and 90cm of mercury at 0°C and 100°C respectively. When the pressure reading is 60cm of mercury, the temperature is
(A) 25°C (B) 40°C
(C) 15° (D) 12.5°C

8. If temperature of an object is 140°F, then its temperature in centigrade is
(A) 105°C (B) 32°C
(C) 140°C (D) 60°C

9. What is rise in temperature of a collective drop when initially 1 gm and 2 gm drops travel with velocities 10cm/sec and 15cm/sec
(A) 6.6×10^{-3} °C (B) 66×10^{-3} °C
(C) 660×10^{-3} °C (D) 6.6 °C

10. At what temperature the centigrade (Celsius) ane Fahrenheit, readings are the same
(A) –40° (B) +40°
(C) 36.6° (D) –37°

11. A clock with a metal pendulum beating seconds keeps correct time at 0°C. If it loses 12.5 s a day at 25°C, the coefficient of linear expansion of metal pendulum is
(A) $\frac{1}{86400}$ / °C (B) $\frac{1}{43200}$ / °C
(C) $\frac{1}{14400}$ / °C (D) $\frac{1}{28800}$ / °C

12. The coefficient of volume expansion of a liquid is 49×10^{-5} K^{-1}. Calculate the fractional change in its density when the temperature is raised by 30°C.
(A) 7.5×10^{-2} (B) 3.0×10^{-2}
(C) 1.5×10^{-2} (D) 1.1×10^{-2}

13. Two solid spheres of the same material have the same radius but one is hollow while the othre is solid. Both sphere are heated to samne temperature. Then
(A) The solid sphere expands more
(B) The hollow sphere expands more
(C) Expansion is same for both
(D) Nothing can be said about their brelative expansion if their masses are not given

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

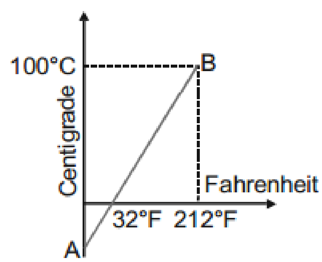
1. A centigrade and a Fahrenheit thermometer are dipped in boiling water. The water temperature is lowered until the Fahrenheit thermometer registers 140°F What is the temperature as registered by the centigrade thermometer :–

(A) 30° (B) 40°
(C) 60° (D) 80°

2. On an X temperature scale, water freezes at –125.0° X and boils at 375.0° X. On a Y temperature scale, water freezes at –70.0° Y and boils at –30.0° Y. The value of temperature on X–scale equal to the temperature of 50.0°Y on Y–scale is :–

(A) 455.0°X (B) –125.0°X
(C) 1375.0°X (D) 1500.0°X

3. The graph AB shown in figure is a plot of temperature of a body in degree Celsius and degree Fahrenheit. Then :–



(A) Slope of line AB is 9/5
(B) Slope of line AB is 5/9
(C) Slope of line AB is 1/9
(D) slope of line AB is 3/9

4. A faulty thermometer reads freezing point and boiling point of water as –5°C and 95°C respectively.

What is the correct value of temperature as it reads 60°C on faulty thermometer?

(A) 60°C (B) 65°C
(C) 64°C (D) 62°C

5. Two absolute scales X and Y assigned numerical values 200 and 450 to the triple point of water. What is the relation between T_X and T_Y ?

(A) $9T_X = 4T_Y$ (B) $4T_X = 9T_Y$
(C) $T_X = 3T_Y$ (D) None of these

6. At 4°C, 0.98 of the volume of a body is immersed in water. The temperature at which the entire body gets immersed in water is (neglect the expansion of the body) $(\gamma_w = 3.3 \times 10^{-4} K^{-1})$:–

(A) 40.8°C (B) 64.6°C
(C) 60.6°C (D) 58.8°C

7. A meter washer has a hole of diameter d_1 and external diameter d_2, where $d_2=3d_1$. On heating, d_2 increases by 0.3%. Then d_1 will :–

(A) decrease by 0.1% (B) decrease by 0.3%
(C) increase by 0.1% (D) increase by 0.3%.

8. 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 during the ruling of the millimeter marks is ($\alpha=12\times10^{-6}C^{-1}$):–

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

9. Two metal rods of the same length and area of cross–section are fixed ends to end between rigid supports. The materials of the rods have Young moduli Y_1 and Y_2, and coefficients of linear expansion α_1 and α_2. When rods are cooled the junction between the rods does not shift if:–

(A) $Y_1\alpha_1 = Y_2\alpha_2$ (B) $Y_1\alpha_2 = Y_2\alpha_1$
(C) $Y_1\alpha^2_1 = Y_2\alpha^2_2$ (D) $Y^2_1\alpha_1 = Y^2_2\alpha_2$

10. A brass disc fits simply in a hole of a steel plate. The disc from the hole can be loosened if the system ($\alpha_{brass} > \alpha_{steel}$)

(A) First heated then cooled
(B) First cooled then heated
(C) Is heated
(D) Is cooled

11. In a vertical U–tube containing a liquid, the two arms are maintained at different temperatures, t_1 and t_2. The liquid columns in the two arms have heights ℓ_1 and ℓ_2 respectively. The coefficient of volume expansion of the liquid is equal to:–

Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1.

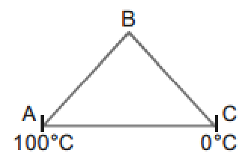
	Column–I		Column–II
(A)	Isobaric process	(P)	No heat exchange
(B)	Isothermal process	(Q)	Constant pressure
(C)	Isoentropy process	(R)	Constant internal energy
(D)	Isochoric process	(S)	Work done is zero

2. Three liquids A, B and C having same specific heat and mass m, 2m and 3m have temperature 20°C, 40°C and 60°C respectively. Temperature of the mixture when :

	Column I		Column II
(A)	A and B are mixed	(P)	35°C
(B)	A and C are mixed	(Q)	52°C
(C)	B and C are mixed	(R)	50°C
(D)	A, B and C all three are mixed	(S)	45°C
		(T)	None

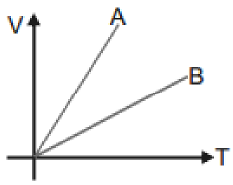
3. Three rods of equal length of same material are joined to form an equilateral triangle ABC as shown in figure. Area of cross–section of rod AB is S, of rod BC is 2S and that of AC is S, then

	Column I		Column II
(A)	Temperature of junction B	(P)	Greater than 50°C
(B)	Heat current in AB	(Q)	Less than 50°C
(C)	Heat current in BC	(R)	Is equal to heat current in BC
		(S)	Is $\frac{2}{3}$ times heat current in AC
		(T)	None



4. In the V–T graph shown in figure:

	Column I		Column II
(A)	Gas A is ... and gas B is ...	(P)	monoatomic, diatomic
(B)	P_A / P_B is	(Q)	diatomic, monoatomic
(C)	n_A / n_B is	(R)	> 1
		(S)	< 1
		(T)	cannot say any thing



5.

	Column I		Column II
(A)	In $P = \frac{2}{3}E$, E is	(P)	Change in internal energy is only in isochoric process
(B)	In U=3RT for an monoatomic gas U is	(Q)	Translational kinetic energy of unit volume
(C)	In $W = P(V_f - V_i)$, W is	(R)	Internal energy of one mole
(D)	In $\Delta U = nC_v\Delta T$, ΔU is	(S)	Work done in isobaric process
		(T)	None

Exercise # 4 PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. An engine takes heat from a reservoir and converts its 1/6 part into work. By decreasing temperature of sink by 62°C, its efficiency becomes double. The temperatures of source and sink must be **[CBSE AIPMT 2000]**

(A) 90°C, 37°C (B) 99°C, 37°C
(C) 372°C, 37°C (D) 206°C, 37°C

2. The gases carbon-monoxide (CO) and nitrogen at the same temperature have kinetic energies E_1 and E_2 respectively. Then **[CBSE AIPMT 2000]**

(A) $E_1 = E_2$
(B) $E_1 > E_2$
(C) $E_1 < E_2$
(D) E_1 and E_2 cannot be compared

3. Which one of the following processes depends on gravity? **[CBSE AIPMT 2000]**

(A) Conduction (B) Convection
(C) Radiation (D) None of these

4. The wavelength corresponding to maximum intensity of radiation emitted by a source at temperature 2000 K is λ, then what is the wavelength corresponding to maximum intensity of radiation at temperature 3000 K? **[CBSE AIPMT 2001]**

(A) $\frac{2}{3}\lambda$ (B) $\frac{16}{81}\lambda$
(C) $\frac{81}{16}\lambda$ (D) $\frac{4}{3}\lambda$

5. The temperatures of source and sink of a heat engine are 127°C and 27°C respectively. An inventor claims its efficiency to be 26%, then, **[CBSE AIPMT 2001]**

(A) it is impossible
(B) it is possible with high probability
(C) it is possible with low probability
(D) Data is insufficient

6. Rate of heat flow through a cylindrical rod is H_1. Temperatures of ends of rod are T_1 and T_2. If all the dimensions of rod become double and temperature difference remains same and rate of heat flow becomes H_2. Then, **[CBSE AIPMT 2001]**

(A) $H_2 = 2H_1$ (B) $H_2 = \frac{H_1}{2}$
(C) $H_2 = \frac{H_1}{4}$ (D) $H_2 = 4H_1$

7. Which of the following is close to an ideal black body? **[CBSE AIPMT 2002]**

(A) Black lamp
(B) Cavity maintained at constant temperature
(C) Platinum black
(D) A lamp of charcoal heated to high temperature

8. Wien's displacement law expresses relation between **[CBSE AIPMT 2002]**

(A) wavelength corresponding to maximum energy and absolute temperature
(B) radiated energy and wavelength
(C) emissive power and temperature
(D) colour of light and temperature

9. The unit of Stefan's constant is **[CBSE AIPMT 2002]**

(A) $W\text{-}m^2\text{-}K^4$ (B) $W\text{-}m^2/K^4$
(C) $W/m^2\text{-}K$ (D) $W/m^2\text{-}K^4$

10. Consider two rods of same length and different specific heats (s_1, s_2), thermal conductivities (K_1, K_2) and area of cross-section (A_1, A_2) and both having temperatures (T_1, T_2) at their ends. If their rate of loss of heat due to conduction are equal, then **[CBSE AIPMT 2002]**

(A) $K_1A_1 = K_2A_2$ (B) $\frac{K_1A_1}{s_1} = \frac{K_2A_2}{s_2}$
(C) $K_2A_1 = K_1A_2$ (D) $\frac{K_2A_1}{s_2} = \frac{K_1A_2}{s_1}$

MOCK TEST

STRAIGHT OBJECTIVE TYPE

1. A diatomic ideal gas is heated at constant volume until the pressure is doubled and again heated at constant pressure until volume is doubled. The average molar heat capacity for whole process is:

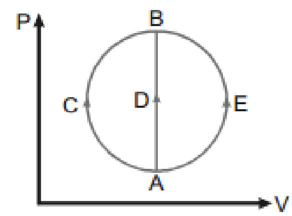
(A) $\frac{13R}{6}$ (B) $\frac{19R}{6}$ (C) $\frac{23R}{6}$ (D) $\frac{17R}{6}$

2. A gas mixture consists of 2 moles of Oxygen and 4 moles of Argon at temperature T. Neglecting all vibrational modes, the total internal energy of the system is :

(A) 4 RT (B) 5 RT (C) 15 RT (D) 11 RT

3. One mole of an ideal gas is taken from state A to state B by three different processes, (a) ACB (b) ADB (c) AEB as shown in the P – V diagram. The heat absorbed by the gas is :

(A) greater in process (B) then in (A)

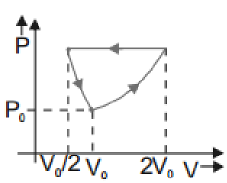


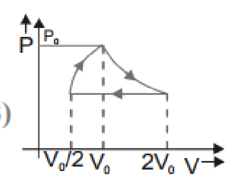
(B) the least in process (B)
(C) the same in (A) and (C)
(D) less in (C) then in (B)

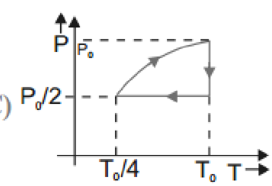
4. In an adiabatic expansion the product of pressure and volume :

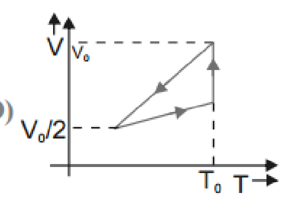
(A) decreases (B) increases
(C) remains constant (D) first increases then decreases.

5. One mole of an ideal gas at pressure P_0 and temperature T_0 is expanded isothermally to twice its volume and then compressed at constant pressure to $(V_0/2)$ and the gas is brought back to original state by a process in which P α V (Pressure is directly proportional to volume). The correct representation of process is

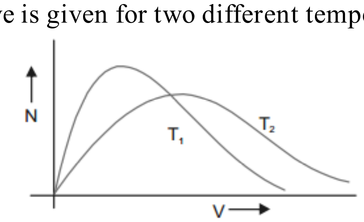
(A) 

(B) 

(C) 

(D) 

6. Maxwell's speed distribution curve is given for two different temperatures. For the given curves.



(A) $T_1 > T_2$ (B) $T_1 < T_2$ (C) $T_1 \le T_2$ (D) $T_1 = T_2$

11th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1

1. Physical World & Measurements
2. Basic Maths & Vector
3. Kinematics

Module-2

1. Law of Motion & Friction
2. Work, Energy & Power

Module-3

1. Motion of system of particles & Rigid Body
2. Gravitation

Module-4

1. Mechanical Properties of Matter
2. Thermal Properties of Matter

Module-5

1. Oscillations
2. Waves

CHEMISTRY

Module-1(PC)

1. Some Basic Conceps of Chemistry
2. Atomic Structure
3. Chemical Equilibrium
4. Ionic Equilibrium

Module-2(PC)

1. Thermodynamics & Thermochemistry
2. Redox Reaction
3. States Of Matter (Gaseous & Liquid)

Module-3(IC)

1. Periodic Table
2. Chemical Bonding
3. Hydrogen & Its Compounds
4. S-Block

Module-4(OC)

1. Nomenclature of Organic Compounds
2. Isomerism
3. General Organic Chemistry

Module-5(OC)

1. Reaction Mechanism
2. Hydrocarbon
3. Aromatic Hydrocarbon
4. Environmental Chemistry & Analysis Of Organic Compounds

BIOLOGY

Module-1

1. Diversity in the Living World
2. Plant Kingdom
3. Animal Kingdom

Module-2

1. Morphology in Flowering Plants
2. Anatomy of Flowering Plants
3. Structural Organization in Animals

Module-3

1. Cell: The Unit of Life
2. Biomolecules
3. Cell Cycle & Cell Division
4. Transport in Plants
5. Mineral Nutrition

Module-4

1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

Module-5

1. Body Fluids & Its Circulation
2. Excretory Products & Their Elimination
3. Locomotion & Its Movement
4. Neural Control & Coordination
5. Chemical Coordination and Integration

12th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1

1. Electrostatics
2. Capacitance

Module-2

1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3

1. Electromagnetic Induction
2. Alternating Current

Module-4

1. Geometrical Optics
2. Wave Optics

Module-5

1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)

1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)

1. Electrochemistry
2. Surface Chemistry

Module-3(IC)

1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)

1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)

1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1

1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2

1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3

1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4

1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5

1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues