PHYSICS

BOOKS - DHANPAT RAI & CO PHYSICS (HINGLISH)

TRANSIENT CURRENT

Type A

1. A charged capacitor of capacitance $40\mu F$ is discharged through a 50Ω resistance.

Determine the time constant of the circuit.

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2. A circuit containing a 30 mH inductor in series with a 60Ω resistance is connected to a d.c. supply. Determine the time constant of the circuit.

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3. An inductor coil carries a steady state current of 2.0 A when connected across an ideal battery of emf 4.0 V. if its inductance is 1.0 H, find the time constant of the circuit.

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4. A 40 mH coil is joined to 2 eV battery through $1 M\Omega$ resistance. Find the time constant of the circuit. What is the maximum current that is established.

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5. An ideal inductor of self-inductance 2.5H is connected to a battery of 3V through a resistance of 50Ω. Calculate (i) time constant of the circuit (ii) the steady current in the circuit, (iii) the maximum rate of increase of current, (iv) The value of current after 0.5s and (v) the potential drop across the inductor at $t = 0.05s$.

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6. How many time constants one should wait for the current in an LR-circuit to grow within 0.1% of its steady state value.

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7. A3 H inductor is placed in series with 10Ω resistor and an emf of 10V is applied to the combination. Find

(i) the current at 0.3s,

(ii) the rate of increase of current at 0.3s,

(iii) the rate at which energy is dissipated as heat at $t = 0.3s$.

(iv) the rate at which energy is stored in the magnetic field at 0.3s.

(v) the rate at which energy is delivered by the battery, and

(vi) the energy stored when the current has attained steady value.

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8. A capacitor of $2.0\mu F$ is connected to a battery of 2V through a resistance of $10k\Omega$.

Calculate (i) the initial current in the circuit and (ii) the current after 0.02s.

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9. A capacitor is being charged from a battery through a $2M\Omega$ resistor. If it takes 0.5 s for charge to reach half its final value, what is the capacitance of the capacitor ?

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10. Find the time in which the charge on a capacitor of $1\mu F$ will be halved if it is connected across a resistor of $10^6 \Omega$.

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11. A capacitor of capacitance $0.1\mu F$ is charged to a certain potential through resistance of $10M\Omega$ and then discharged. Calculate the time in which the potential will fall to half its original value.

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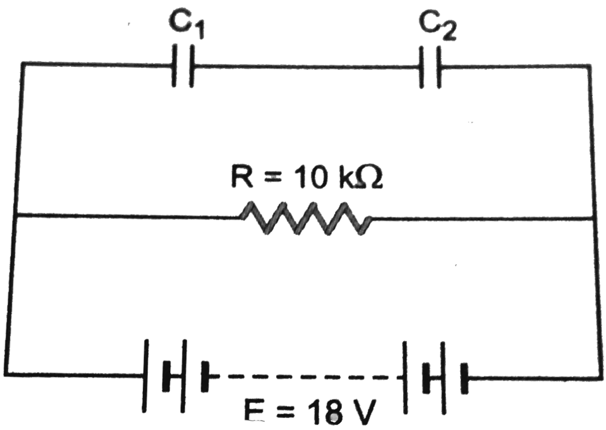
12. Two capacitors $4\mu F$ and $6\mu F$ in series are connected through a resistor of $10k\Omega$ to a 18 V battery of negligible internal resistance. Ater a time of about 10 s, the battery is disconneted and capacitors are allowed to discharge through the resistance. Determine the voltage across each capacitor after a time lapse of 48 millisecond.



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13. In a circuit, a resistor of $10 M\Omega$, a capacitance of $0.2 \mu F$ and a battery of 20V are connected in series. Calculated the rate of

(i) growth of charge.

(ii) energy stored by the capacitor,

(iii) heat dissipation in the resistor and

(iv) the energy delivered by the battery after 2s.

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14. A radio can tune over the frequency range of a portion of MW broadcast band (800 kHz to 1200 kHz). If its LC circuit has an effective inductance of $200\mu H$, what must be the range of its varialbe capacitor ?

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15. An LC circuit contains a 20 mH inductor and a $50\mu F$ capacitor with an initial charge of 10 mC. The resistance of the circuit is negligible. Let the instant the circuit is closed be t = 0.

(a) What is the total energy stored initially ? Is it conserved during the oscillalions?

(b) What is the natural frequency of the circuit?

(c) At what time is the energy stored? (i) Completely electrical ? (ii) Completely magnetic ?

(d) At what time is the total energy shared equally between the inductor and the capacitor ?

(e) If a resistor is inserted in the circuit, how much energy is eventually dissipated as heat ?

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16. What resistance must be connected in series with an inductor of 5mH so that the circuit has a time constant of $2 \times 10^{-3} S$?

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17. The pressure of a gas is changed at constant volume from $200 Nm^{-2}$ to $3000 Nm^{-2}$. If the initial temperature of the gas is $77^{\circ} C$, what will be its final temperature?

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18. Air is filled in a bottle and it is corked at $35^\circ C$. If the cork can come out at 3 atmospheric pressure, then upto what temperature should the bottle be heated to remove the cork ?

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19. A narrow uniform glass tube contains air enclosed by 15 cm long thread of mercury.

When the tube is vertical with open end uppermost, the air column is 30 cm long. When the tube is inverted, the length of air column becomes 45 cm. Calculate the atmospheric pressure.

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20. An open glass tube is immersed in mercury so that a length of $8cm$ of the tube projects above the mercury. The tube is then closed and raised through $44cm$. What length of the tube will be occupied by the air after it has been raised? Given 1 atm $= 76 cm$ of Hg.

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21. An empty barometric tube 1 m long is lowered vertically (mouth downwards) into a tank of water. What will be the depth above the water level in the tube, when the water has risen 20 cm inside the tube ? Take atmospheric pressure as 10.4 m column of water.

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22. When a gas filled in a closed vessel is heated through $1^\circ C$, its pressure increases by 0.4%. What is the initial temperature of gas ?

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Problems

1. Capacitor C_1 of the capacitance $1\mu F$ and another capacitor C_2 of capacitance $2\mu F$ are separately charged fully by a common battery.The two capacitors are then separately allowed to discharge through equal resistors at time $t = 0$.

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2. A solenoid has an inductance of 10 henty and a resistance of 2 ohm. It is connected to a 10 volt battery. How long will it take for the magnetic energy to reach $1/4$ of its maximum value?

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3. A solenoid of resistance 50Ω and inductance 80 H is connected to a 200 V battery, How long will it take for the current to reach 50% of its final equlibrium value ? Calculate the maximum enargy stored ?

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4. An inducatane L and a resistance R are connected in series with a battery of emf epsilon. Find the maximum rate at which the energy is stored in the magnetic field.

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5. A capacitor discharges through an inductance of 0.1 henry and a resistance of 100 ohm. If the frequency of discharge is 1000 Hz, calculate the capacitance.

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6. The temperature of an ideal gas is increased from 120 K to 480 K. If at 120 K the root mean square velocity of the gas molecules is v, at 480 K it becomes

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7. You are given the following group of particles n_1 represents the number of molecules with speed ve_1

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8. In a certain region of space there are only 5 molecules per cm^3 of gas on an average. The temperature is $3K$. What is the average pressure of this gas ? .

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9. Two glass bulbs of equal volume are connected by a narrow tube and are filled with a gas at $0^\circ C$ and a pressure of 76cm of mercury. One of the bulbs is then placed in

melting ice and the other is placed in a water bath maintained at $62^{\circ} C$. What is the new value of the pressure inside the bulbs? The volume of the connecting tube is negligible.

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10. A vessel of volume $2 \times 10^{-2} m^3$ contains a mixture of hydrogen and helium at $47^{\circ} C$ temperature and $4.15 \times 10^5 N/m^2$ Pressure. The mass of the mixture is $10^{-2} kg$. Calculate the masses of hydrogen and helium in the given mixture.

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11. A closed container of volume $0.02m^3$ contains a mixture of neon and argon gases, at a temperature of $27^\circ C$ and pressure of $1 \times 10^5 Nm^{-2}$. The total mass of the mixture is 28g. If the molar masses of neon and argon are 20 and $40gmol^{-1}$ respectively, find the masses of the individual gasses in the container assuming them to be ideal (Universal gas constant $R = 8.314 J / mol - K$).

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12. A thin tube, sealed at both ends, is $100cm$ long. If lies horizontally, the middle $10cm$ containing mercury and the two equal containing air at stan-dard atmospheric pressure. If the tube is now turned to a verical position, by what amount will the mercury be displaced ?

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13. A thin tube of uniform cross-section is sealed at both ends. It lies horizontally, the middle 5 cm containing mercury and the two equal end containing air at the same pressure P. When the tube is held at an angle of 60° with the vetical direction, the length of the air column above and below the mercury column are 46 cm and 44.5 cm respectively. Calculate the pressure P in centimeters of mercury. (The temperature of the system is kept at $30^{\circ} C$).

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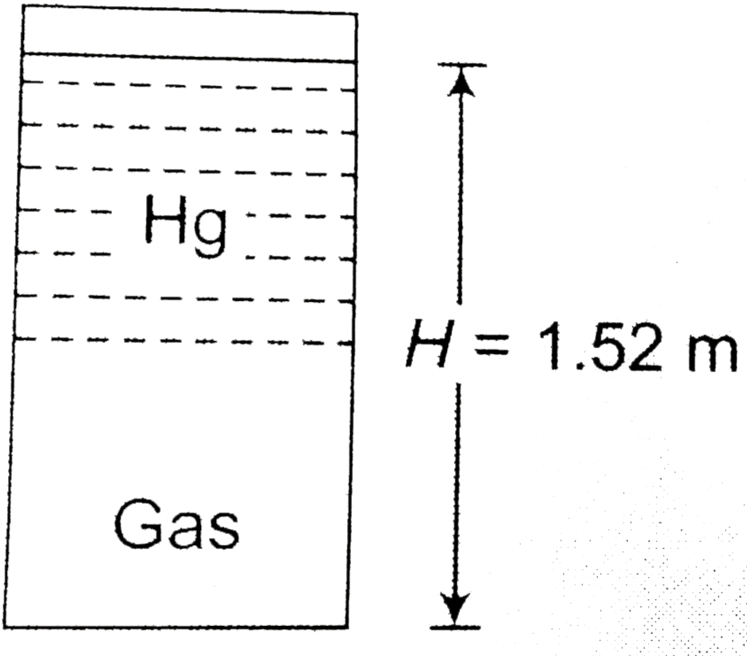
14. A vertical hollow cylinder of height $1.52m$ is fitted with a movable piston of negligible mass and thickness. The lower half portion of the cylinder contains an ideal gas and the upper half is filled with mercury. The cylinder is initially at $300K$. When the temperature is raised half of the mercury comes out of the cylinder. Find this temperature assuming the thermal expansion of the mercury to be negligible.



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15. Two perfect gases at absolute temperature T_1 and T_2 are mixed. There is no loss of energy. The masses of the molecules are m_1 and m_2. The number of molecules in the gases are n_1 and n_2. The temperature of the mixture is

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16. Calculate the rms speed of smoke particles of mass $5 \times 10^{-17} kg$ in their Brownian motion in air at NTP. Given $k_B = 1.38 \times 10^{-23} J/K$

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17. About 0.014 kg nitrogen is enclosed in a vessel at temperature of $27^\circ C$ How much heat has to be transferred to the gas to double the rms speed of its molecules ? $(R = 2cal/molK)$

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18. N molecules each of mass m of gas A and 2 N molecules each of mass 2m of gas B are contained in the same vessel which is maintined at a temperature T. The mean square of the velocity of the molecules of B type is denoted by v^2 and the mean square of the x-component of the velocity of a tye is denoted by ω^2. What is the ratio of $\omega^2 / v^2 = ?$

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19. Two vessels A and B, thermally insulated, contain an ideal monoatomic gas. A small tube fitted with a valve connects these vessels. Initially the vessel A has 2 litres of gas at $300K$ and $2 \times 10^5 Nm^{-2}$ pressure while vessel B has 4 litres of gas at $350K$ and $4 \times 10^5 Nm^{-2}$ pressure. The value is now opened and the system reaches equilibrium in pressure and temperature. Calculate the new pressure and temperature .

$$\left(R = \frac{25}{3} J / mol - K\right)$$

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Problems For Self Practice

1. Show that the time for attaining half the value of the final steady current in LR-series circuit is $0.693(L/R)$.

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2. A coil of inductance 10H and resistance 15Ω is connected to a supply of 90V. Determine the value of current after 0.67s. How long will it take for the current to attain 50% of its final value ?

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3. A potential difference of 4V is applied to a coil of resistance 8Ω and inductance 8H. How long does it take for the current to reach half of its final value ?

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4. A coil of resistance 11Ω and inductance $0.1H$ is connected to a 110V d.c. mains. Find

(i) the current finally established in the coil.

(ii) the voltage used in overcoming the resistance when the rising current is 3A, and

(iii) the rate at which the current is rising at that instant.

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5. An L-R combination is connected to an ideal battery. If $L = 20mH, R = 100\Omega$ and

$\varepsilon = 10V$, find (i) the time constant (ii) the maximum current and (iii) the time elapsed before the current reaches 90% of the maximum value.

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6. In an LR-circuit the current attains one-third of its final steady value in 5s. What is the time-constant of the circuit ? $(\log_2 = 0.405)$

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7. A inductor of 20mH inductance and a resistor of 100Ω resistance are connected in series to a battery of emf 10V. After a long time the circuit is short-circuited and the battery is disconnected. Find the current in the circuit 1 ms after short-circuiting.

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8. A solenoid having a resistance of 5Ω and self-inductance of 4H is connected to a battery of emf 10V and negligible resistance. After how long will the current in it rise to 1A ?

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9. A coil of reistance 5Ω and inductance 1H is connected to a battery of 10V. At $t = 0s$, calculate (i) the current in the circuit (ii) the rate of rise of current (iii) the rate at which energy is supplied by the battery, (iv) the rate at which energy is dissipated as heat and (v) the rate at which energy is stored in the magnetic field of the coil.

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10. A capacitor of $10\mu F$ is connected with a resistance of $2.2M\Omega$. What is the time constant of the circuit.

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11. A capacitor of $1.443\mu F$ capacitance after being charged is shunted by a high resistance. If half the charge leaks away in one minute, find the value of the resistance.

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12. A capacitor is being charged from dc source through a resistance of $5M\Omega$. If it takes 0.5s for charge to reach three-quarters of its final value, what is the capacitance of the capacitor ?

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13. A capacitr is charged from a dc source through a resistance of $3M\Omega$. If the potential difference across it reaches 75% of its final value in half a second, find its capacitance.

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14. A resistor R and $2\mu F$ capacitor in series are connected to a 220V dc supply. Across the capacitor is a neon bulb that strikes at 120V. Calculate the value of R to make the bulb strike 5s after the switch has been closed.

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15. A 0.18μ F capacitor is first charged and then discharged through a high resistance. If it takes 0.5 sec for the chage to reduce to one forth of its initial value, find the value of the resistance. Given $\log_e 4 = 1.386$

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16. A capacitor charged to 10 V is being discharged through a resistance R. At the end of 1 s, the voltage across the capacitor is $5V$. What will be the voltage after 2 s?

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17. A mass of gas exerts a pressure of $72cm$ of Hg at $27^\circ C$. It is heated at constant volume so that its pressure after some time is $90cm$ of Hg. Calculate the new temperature of the gas.

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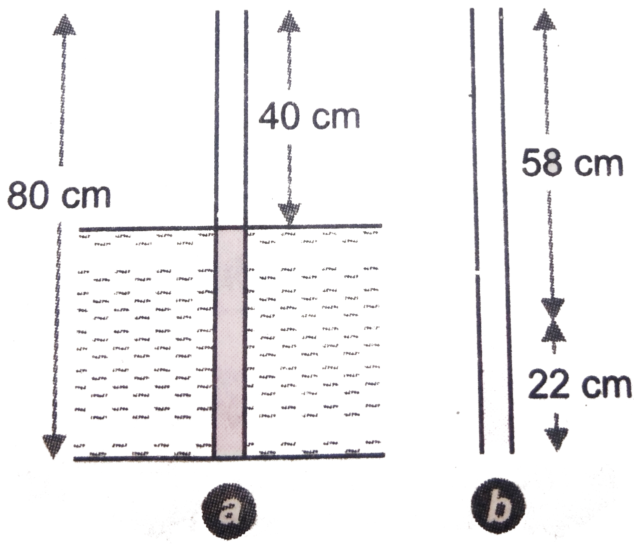
Example

1. A narrow uniform glass tube 80 cm long and open at both ends is half immersed in mercurry. Then the top of the tube is closed and it is taken out of mercury. A column of mercury 22 cm long then remains in the tube. What is the atmospheric pressure?



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2. A metre long narrow bore held horizontally (and close at one end) contains a 76 cm long mercury thread, which traps a 15 cm column of air. What happens if the tube is held vertically with the open end at the bottom?

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3. A given mass of a gas at $-73^{\circ}C$ exerts a pressure of 50 cm of mercury. What pressure will it exert at $27^{\circ}C$, if the volume remains constant?

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4. The rms velocity of hydrogen at S.T.P is u ms^{-1}. If the gas is heated at constant pressure till its volume is three fold, what will be its final temperature and rms velocity ?

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5. A gas at $27^\circ C$ in a cylinder has a volume of 4 litre and pressure $100Nm^{-2}$.

(i) Gas is first compressed at constant temperature so that the pressure is $150Nm^{-2}$. Calculate the change in volume.

(ii) It is then heated at constant volume so that temperature becomes $127^\circ C$. Calculate the new pressure.

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6. As an air bubble rises from the bottom of a lake to the surface, its volume is doubled. Find the depth of the lake. Take atmospheric pressure = 76 cm of Hg.

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7. Molar volume is the volume occupied by 1 mole of any (Ideal) gas at standard temperature and pressure (STP , $0^{\circ}C$, 1 atmospheric pressure). Show that it is 22.4 litres. Take $R = 8.31 J mol^{-1} K^{-1}$.

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8. Using the ideal gas equation, determine the value of gas constant R. Given that one gram mole of a gas at S.T.P occupies a volume of 22.4 litres

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9. Molecular weight of oxygen is 32. At S.T.P., volume of $1g$ of oxygen is $700cm^3$. Find the value of gas constant R.

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10. Estimate the total number of air molecules (inclusive of oxygen, nitrogen, water vapour and other constituents) in a room of capacity $25.0m^3$ at a temperature of $27^\circ C$ and 1 atm pressure. (Boltzmann constant $= 1.38 \times 10^{-23} JK^{-1}$).

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11. An air bubble of volume $1.0 cm^3$ rises from the bottom of a lake 40 m deep at a temperature of $12^\circ C$. To what volume does it grow when it reaches the surface, which is at a temperature of $35^\circ C$. ? Given $1 atm = 1.01 \times 10^5 Pa$.

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12. An oxygen cylinder of volume 30 litres has an initial gauge pressure of 15 atm. And a temperature of $27^{\circ} C$. After some oxygen is withdrawn from the cylinder, the gauge pressure drops to 11 atm. And its temperature drops to $17^{\circ} C$. Estimate the mass of oxygen taken out of the cylinder. $\left(R = 8.1 J \text{mole}^{-1} K^{-1}\right.$, molecular mass of $\left.O_2 = 32 u\right)$.

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13. A mixture of hydrogen and oxygen has volume $2000cm^3$, temperature $300K$, pressure $100KPa$ and mass $0.76g$.Calculate the masses of hydrogen and oxygen in the mixture.

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14. A vessel with open mouth contains air at $60^\circ C$. When the vessel is heated upto temperature T, one fourth of the air goes out. The value of T is

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15. The density of nitrotgen is $1.25kgm^{-3}$ at S.T.P. Find its density at $42^{\circ}C$ and $730mm$ of Hg.

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16. A vessel contains $14g$ of hydrogen and $96g$ of oxygen at STP.

(a) Find the volume of the vessel.

(b) Chemical reaction is induced by passing electric spark in the vessel till one of the gases is consumed, The temperature is brought back to its starting value $273K$. Find the pressure in the vessel.

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17. A vessel contains two non-reactive gases neon (monoatomic) and oxygen (diatomic). The ratio of their partial pressures is 3:2. Estimate the ratio of

(i) number of molecules, and

(ii) mass density of neon and oxygen in the vessel.

Atomic mass of neon = 20.2 u, and molecular mass of oxygen = 32.0 u.

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18. Four molecules of a gas have speeds $2, 4, 6$ and $8 kms^{-1}$ respectively. Calculate their average speed and root mean square speed.

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19. If three gas molecules have velocity 0.5, 1 and $2km / s$ respectively, find the ratio of their root mean square speed and average speed.

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20. Calculate the r.m.s. velocity of air molecules at $S.T.P.$ Given density of air at $S.T.P.$ is $1.296kgm^{-3}$.

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21. Calculate the rms velocity of oxygen molecules at S.T.P. The molecular weight of oxygen is 32.

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22. Calculate the temperature at which the rms speed of nitrogen molecules will be equal to $8km/s$. Given molecular weight of nitrogen = 28 and `R = 8.31 J/mole/K.

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23. The r.m.s speed of oxygen molecule (O_2) at a certain temperature T is V. If on increasing the temperature of the oxygen gas to 2T, the oxygen molecules dissociate into atomic oxygen, find the speed of the oxygen atom.

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24. Calculate the temperature at which r.m.s velocity of gas molecules is double its value at $27^\circ C$, pressure of the gas remaining the same.

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25. Calculate the temperature at which rms velocity of a gas is half its value at $0^\circ C$, pressure remaining constant

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26. At what temperature is the root mean square speed of an atom in an argon gas cylinder equal to the r.m.s. speed of a helium gas atom at $-20^{\circ}C$? (Atomic mass of Ar = 39.9 u, of He = 4.0 u).

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27. A vessel is filled with a gas at a pressure of 76 cm of mercury at a certain temperature. The mass of the gas is increased by 50% by introducing more gas in the vessel at the same temperature. Find the resultant pressure of the gas.

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28. Estimate the average energy of a helium atom at (i) room temperature $(27^{\circ} C)$ (ii) the temperature on the surface of the sun $(6000 K)$ and (iii) the temperature of $10^{7} K$. Given $k_{B}=1.38 \times 10^{-23} J \text{molecule}^{-1} K^{-1}$

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29. Calculate the kinetic energy of one mole of argon at $127^{\circ} C$. Given,Boltzmann's constant,

$k_B = 1.381 \times 10^{-23} J\text{molecular}^{-1} K^{-1}$.

Avogardro numbe, $N = 6.02 \times 10^{23} \text{mol}^{-1}$

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30. Calculate the kinetic energy of 1 gram of helium $(M = 4)$ at $127^\circ C$. Given $R = 8.31 J\text{mole}^{-1} K^{-1}$.

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31. The kinetic energy of a molecule of oxygen at $0^{\circ}C$ is $5.64 \times 10^{-21}J$. Calculate Avogadro's number. Given $R = 8.31 Jmol^{-1}K^{-1}$.

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32. Calculate the kinetic energy of one gram mole of gas at NTP. Density of gas $= 0.178 kgm^{-3}$ at NTP. Its molecular weight = 4. Density of mercury $= 13.6 \times 10^{3} kgm^{-3}$.

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33. Calculate the KE per molecule and also rms velocity of a gas at $127^{\circ}C$. Given $k = 1.38 \times 10^{-23} J\text{molecule}^{-1} K^{-1}$ and mass of each molecule $= 6.4 \times 10^{-27} kg$.

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34. (a) Calculate (i) root-mean-square speed and (ii) the mean energy of 1 mol of hyderogen at STP given that density of hydrogen is $0.09 kg/m^3$. (b) Given that the mass of a molecule of hydergen is 3.34×10^{-27} kg, calculate Avogadro's number. (c) Calculate Boltmann's constant.

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35. At what temperature will the average velocity of oxygen molecules be sufficient to escape from the earth. Given mass of oxygen molecule $= 5.34 \times 10^{-26} kg.$ Boltzmann constant, $k = 1.38 \times 10^{-23} J\text{molecule}^{-1} K^{-1}$. Escape velocity of earth $= 11.0 kms^{-1}$.

36. Calculate the temperature at which the average K.E. of a molecule of a gas will be the same as that of an electron accelerated through 1 volt. Boltzmann constant $= 1.4 \times 10^{-23} J \text{molecule}^{-1} K^{-1}$, charge of an electron $= 1.6 \times 10^{-19} C$.

37. A vessel A contains hydrogen and another vessel B whose volume is twice that of A contains same mass of oxygen at same temperature. Compare

(i) average KE of hydrogen and oxygen molecule.

(ii) root mean square speeds of molecules

(iii) pressure of gases in A and B.

Molecular weight of hydrogen and oxygen are 2 and 32 respectively.

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Type B

1. A bulb contains air at atmospheric pressure at $40^{\circ} C$. The maximum pressure bulb can with stand is 2 atmosphere. Calculate the temperature of air when the bulb is on the point of bursting.

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2. A $3000 cm^3$ tank contains oxygen at $20^{\circ} C$ and the gauge pressure is $2.5 \times 10^6 Pa$. Find the mass of the oxygen in the tank. Take 1 atm $= 10^5 Pa.$

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3. Calculate the number of molecules in each cubic metre of a gas at $1atm$ and $27^\circ C$.

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4. The volume of a gas at pressure $1.2 \times 10^7 Nm^{-2}$ and temperature $127^\circ C$ is

2.0 litre. Find the number of molecules in the gas.

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5. There are 4×10^{24} gas molecules in a vessle at $50K$ temperature. The pressure of the gas in the vessel is $0.03atm$. Calculate the volume of the vessel.

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6. A vessel of volume $8.0 \times 10^{-3} m^3$ contains an ideal gas at $300K$ and pressure $200kPa$. The gas is allowed to leak till the pressure falls to $125kPa$. Calculate the amount of the gas (in moles) leaked assuming that the temperature remains constants.

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7. A vessel of volume $2000cm^3$ contains $0.1mol$ of oxygen and $0.2mol$ of carbon dioxide. If the temperature if the mixture is $300K$, find its pressure.

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8. A balloon partially filled with helium has a volume of $30m^3$, at the earth's surface, where pressure is $76cm$ of (Hg) and temperature is $27^\circ C$ What will be the increase in volume of gas if balloon rises to a height, where pressure is $7.6cm$ of Hg and temperature is $-54^\circ C$?

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9. Find the volume of $1g$ of CO_2 at $107^\circ C$ and half the standard pressure when 1 ml of CO_2 weighs $0.0019g$ at S.T.P.

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10. A litre of dry air weighs 1.293 gram at S.T.P Find the temperature at which a litre of air will weigh one gram when the pressure is 72 cm. of mercury.

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11. A vessel of volume , $V = 5.0$ litre contains $1.4g$ of nitrogen at a temperature $T = 1800K$. Find the pressure of the gas if 30% of its molecules are dissociated into atoms at this temperature.

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12. 8g of oxygen, 14 g of nitrogen and 22 g carbon dioxide are mixed in an encloser of volume 10 litre and temperature $27^{\circ}C$. Calculate the pressure exerted by the mixture , $R = 8.3 J \text{mole}^{-1} K^{-1}$, Molecular weight of oxygen , nitrogen and carbon 32 , 28 and 44 respectively.

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Type C

1. The velocities of ten particles in ms^{-1} are $0, 2, 3, 4, 4, 4, 5, 5, 6, 9$. Calculate (i)average speed and

(ii)rms speed

(iii) most probable speed.

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2. The velocities of ten molecules of any gas are given $v, 0, 2v, 4v, 3v, 2v, v, 3v, 5v, v.$ Calculate their root mean square velocity.

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3. Calculate the rms velocity of molecules of a gas of density $1.5 glitre^{-1}$ at a pressure of $2 \times 10^6 N/m^2$.

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4. Calculate the rms velocity of the molecules of ammonia at S.T.P. Given molecular weight of ammonia $= 17$.

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5. The r.m.s. velocity of the molecules of a gas at S.T.P. is $485.6 m s^{-1}$. Calculate the density of the gas.

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6. Calculate the root mean square velocity of the molecules of hydrogen at $0^{\circ} C$ and pressure $76 cm$ of Hg when the density of hydrogen at S.T.P. is $0.00009 g cm^{-3}$.

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7. Show that the rms velocity of O_2 molecule is $\sqrt{2}$ times that of SO_2. Atomic weight of sulphur is 32 and atomic weight of oxygen is 16.

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8. Calculate the temperature at which the rms velocity of SO_2 is the same as that of oxygen at $27^\circ C$.

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9. Estimate the temperature at which the oxygen molecules will have the same rms velocity as hydrogen molecules at $150^{\circ}C$. Molecular weight of oxygen is 32 and that of hydrogen is 2.

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10. If root mean sqauare velocity of the molecules of hydrogen at NTP is $1.84kms^{-1}$, calculate the rms velocity of oxygen molecules at NTP. Molecular weights of hydrogen and oxygen are 2 and 32 respectively.

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11. At what temperature, pressure remaining unchanged, will the rms velocity of hydrogen be doubled its value at NTP ?

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12. Calculate the rms velocity of CO_2 molecules at N.T.P. Given $R = 8.31 K \text{mole}^{-1} K^{-1}$.

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13. Calculate the temperature at which root mean square velocity of N_2 molecules is 25% more than that of molecules of hydrogen at $-73^\circ C$. Molecular weight of nitro-gen is 28 while that of hydrogen at is 2.

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14. The root mean square velocity of helium atoms at normal temperature and pressure is $1300ms^{-1}$. Calculate (i) density of helium at $0^{\circ}C$ and (ii) mass of helium atom. Normal pressure $= 1.01 \times 10^5 Nm^{-2}$.

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15. The density of carbon dioxide gas at $0^{\circ}C$ and at pressure $1.0 \times 10^5 Nm^{-2}$ is

$1.98 kgm^{-3}$. Find the rms velocity of its molecules at $0^{\circ} C$ and also at $30^{\circ} C$, assuming pressure to be constant.

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16. What will be the root mean square speed of helium at $40^{\circ} C$, if root mean square speed of oxygen molecule at $0^{\circ} C$ is $460 m/s$? Molecular weight of oxygen is $32 g/\text{mole}$ and of helium is $4 g/\text{mole}$.

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17. A gas is filled in a vessel at a certain temperature and at a pressure of $80cm$ of Hg. At the same temperature, more gas is filled in the vessel so that its mean increases by 60%. Determine the resultant in the vessel.

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Type D

1. Calculate the value of Boltzmann constant k_B, Given $R = 8.3 \times 10^3 J / kg - mol - K$ and Avogadro number, $N = 6.03 \times 10^{26} / kg - mol.$

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2. The kinetic energy of a molecule of oxygen at $0^\circ C$ is $5.64 \times 10^{-21} J$. Calculate Avogadro's number. Given $R = 8.31 J mol^{-1} K^{-1}$.

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3. Calculate the total K.E. of 1g of nitrogen at $300K$. Molecule weight of nitrogen $= 28$.

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4. Find the molecular kinetic energy of 1 g of helium at S.T.P. Given $R = 8.3 \times 10^7 erg$.

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5. Consider hydrogen gas in a container at NTP. Calculate the average kinetic energy of each molecule.

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6. At what temperature the kinetic energy of a molecule will be equal to $2.8 \times 10^{-20} J$? Boltzmann constant $(k_B) = 1.4 \times 10^{-23} J \text{molecule}^{-1} K^{-1}$

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7. The mean kinetic energy of 1 kg-mol of nitrogen at $27^\circ C$ is $600J$. What will be its mean kinetic energy at $127^\circ C$?

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8. Calculate for hydrogen at 27°

(i) KE of one gram mole of the gas

(ii) KE of one gram of the gas

(iii) root mean square velocity of the molecule.

Given, molecule wt. Of hydrogen = 2.

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9. The average kinetic energy of a hydrogen molecule at $27^\circ C$ is $9.3 \times 10^{-21} J$. The mass of hydrogen molecule is $3.1 \times 10^{-27} kg$. (i) Determine the average kinetic en-ergy at $227^\circ C$. (ii) Determine the root mean square speed of hydrogen molecule at $27^\circ C$.

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10. At what temperature the average value of the kinetic energy of the molecule of a gas will be $1/3$ of the average value of kinetic energy at $27^{\circ}C$?

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11. If the temperature of air is increased from $27^{\circ} \rightarrow 227^{\circ}$, in what ratio will the average kinetic energy of its molecules be increased?

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12. The temperature of a gas is $-68^{\circ}C$. To what temperature should it be heated so that (i) the average kinetic energy of the molecules be doubled and (ii) the root-mean-square velocity of the molecules be doubled ?

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13. There are 6×10^{21} hydrogen molecules in a vessel of volume $200cm^{3}$. Its tempera-ture is $27^{\circ}C$ and the pressure is $10^{5}Nm^{-2}$. If the temperature be raised to $47^{\circ}C$, then in what ratio the following qunatities would change (i) number of molecules per unit volume (ii) pressure of the gas is the vessel and (iii) average kinetic energy of hydrogen ?

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