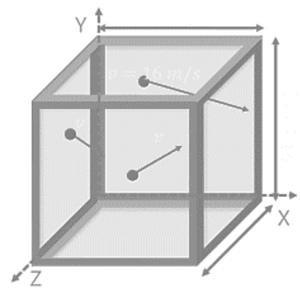
Q.1 The speed of a molecule of gas in a cubical vessel of side 4 m is 16 m/s. This molecule is constantly colliding with the wall of the container. The collision frequency will be

(A) $2\ s^{-1}$ **(B)** $4\ s^{-1}$ **(C)** $6\ s^{-1}$ **(D)** $1\ s^{-1}$



Q.2 If mean square of x– component of the velocity of molecules is denoted by ω^2, then R.M.S velocity of molecules will be

(A) ω **(B)** $\frac{\omega^2}{3}$ **(C)** $3\omega^2$ **(D)** $\frac{\omega}{3}$

Q.3 R.M.S velocity of an ideal gas molecules is 300 m/s at 1 atm pressure. If pressure is increased to four times, then R.M.S velocity becomes

(A) 150 m/s **(B)** 300 m/s **(C)** 600 m/s **(D)** 100 m/s

Q.4 The density of an ideal gas is $6 \times 10^{-2}\ kg/m^3$ and the root mean square velocity of the gas molecules is 500 m/s. The pressure exerted by the gas on the walls of the vessel is

(A) $5 \times 10^3\ N/m^2$ **(B)** $1.2 \times 10^{-4}\ N/m^2$
(C) $0.75 \times 10^{-4}\ N/m^2$ **(D)** $40\ N/m^2$

Q.5 The translational kinetic energy of all the molecules of Helium having a volume V exerting a pressure P is 1000 J. The total kinetic energy (in Joule) of all the molecules of N_2 having the

(A) 4000 J **(B)** 3000 J **(C)** 2000 J **(D)** 1000 J

Q.6 The translational kinetic energy of 1 *mole* of an ideal gas at standard temperature is close to

(A) 3403 J **(B)** 3000 J **(C)** 2342 J **(D)** 1564 J

Q.7 Degree of freedom of unknown gas is 3. The gas can be

(A) H_2 **(B)** O_2 **(C)** CO_2 **(D)** He

Q.8 The average kinetic energy of one mole of gas per degree of freedom (on the basis of kinetic theory of gases)

(A) $\frac{1}{4}kT$ **(B)** $\frac{3}{2}kT$ **(C)** $\frac{3}{2}RT$ **(D)** $\frac{1}{2}RT$

Q.9 Degree of freedom of ideal gas depends upon

(A) Atomicity of gas **(B)** temperature
(C) Structure of gas molecules **(D)** all of the above

Q.10 What is the average translational kinetic energy of a gas molecule at 500 K ?

(A) 1035×10^{-23} J **(B)** 750×10^{-23} J
(C) 1725×10^{-23} J **(D)** 1150×10^{-23} J

WORKSHEET

DERIVATIVE

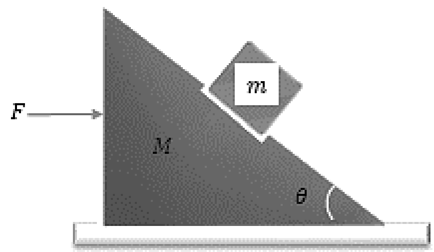
Q.1 If $S = e^x \sin x$, find $\frac{d^2S}{dx^2}$

(A) $2e^x \sin x$ **(B)** $\frac{e^x \cos x}{2}$ **(C)** $2e^x \cos x$ **(D)** $\frac{e^x \sin x}{2}$

EQUILIBRIUM

Q.2 Magnitude of F such that block remains stationary with respect to the wedge. All surfaces are smooth.

(A) $2g(M + m)\tan\theta$ **(B)** $g(m - M)\tan\theta$
(C) $g(M - m)\tan\theta$ **(D)** $g(M + m)\tan\theta$



CONSERVATION OF MOMENTUM

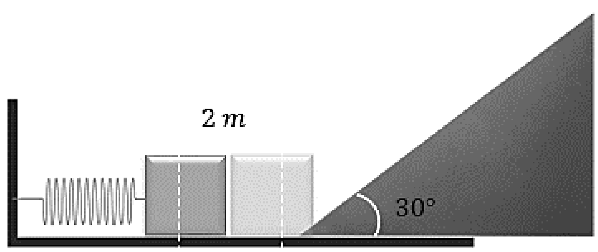
Q.3 A bomb of mass 2 kg at rest explodes into two chunks of masses 0.5 kg and 1.5 kg. Velocity of 0.5 kg chunk is $(2\hat{i} + 4\hat{j} + 8\hat{k})$ m/s Velocity of 1.5 kg chunk is -

(A) $\left(\frac{2}{3}\hat{i} + \frac{4}{3}\hat{j} + \frac{8}{3}\hat{k}\right)$ m/s **(B)** $-\left(\frac{2}{3}\hat{i} + \frac{4}{3}\hat{j} + \frac{8}{3}\hat{k}\right)$ m/s
(C) $\left(\frac{2}{3}\hat{i} - \frac{4}{3}\hat{j} + \frac{8}{3}\hat{k}\right)$ m/s **(D)** $\left(\frac{2}{3}\hat{i} - \frac{4}{3}\hat{j} - \frac{8}{3}\hat{k}\right)$ m/s

Conservation of energy

Q.4 In given figure, all surfaces are smooth and frictionless. Spring is compressed by 2 m and then released. Maximum distance travelled by the block over the inclined plane is (Take $g = 10\ m/s^2$)

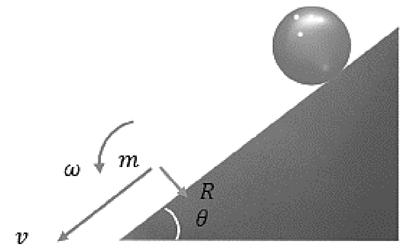
(A) 2m **(B)** 3m **(C)** 5m **(D)** 4m



Rotational motion

Q.5 A spherical ball rolls on an inclined plane without slipping. Ratio of total kinetic energy to rotational kinetic energy is

(A) $\frac{2}{7}$ **(B)** $\frac{2}{5}$ **(C)** $\frac{2}{5}$ **(D)** $\frac{2}{5}$



BULK MODULUS

Q.6 The bulk modulus for an incompressible liquid is

(A) Zero **(B)** Unity **(C)** Infinity **(D)** Between 0 and 1

ATMOSPHERIC PRESSURE

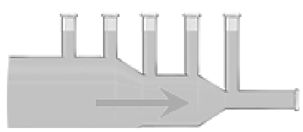
Q.7 If height of mercury in a barometer is 760 mm at any location. If mercury is replaced by water, then height of water will be

(A) 6.883 m **(B)** 10.336 m **(C)** 5.251 m **(D)** 8.521 m

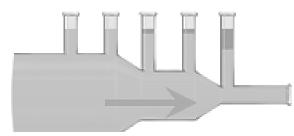
Fluid dynamics

Q.8 A non-viscous liquid flows through a horizontal pipe of varying cross-sectional area. Identify the option which correctly represents the variation of height of rise of liquid in each vertical tube.

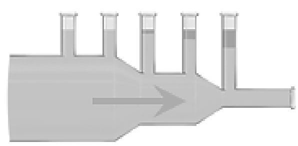
(A)



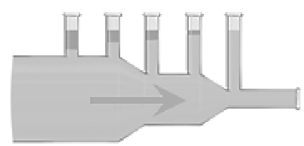
(B)



(C)



(D)



SURFACETENSION

Q.9 The lower end of a capillary tube touches a liquid whose angle of contact is 120°, the liquid

(A) Rises into the tube
(B) Falls in the tube
(C) May rise or fall inside
(D) Neither rises nor falls inside the tube

STRESS

Q.10 Diameter of steel rod fixed between two rigid supports is 20 mm. Find the stress in the rod when the temperature increases by 80°C. (Take Young's modulus $Y = 2 \times 10^{11}$ N/m2 and thermal expansion coefficient $\alpha = 12 \times 10^{-6}/°C$)

(A) 150 MPa **(B)** 192 MPa **(C)** 250 MPa **(D)** 100 MPa

Pressure exerted by gas

Q.11 The mass of hydrogen molecule is 3.32×10^{-27} kg. If 1023 hydrogen molecules strike per second at 2 cm2 area of rigid wall of a close container normally and rebound back with the speed of 1000 m/s, then the pressure exerted on the wall (according to kinetic theory of gas) is

(A) 3000 N/m^2 **(B)** 6640 N/m^2 **(C)** 8320 N/m^2 **(D)** 3320 N/m^2

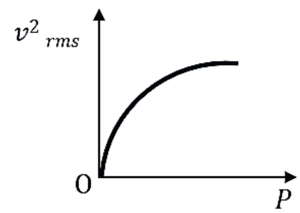
IDEAL GAS EQUATION

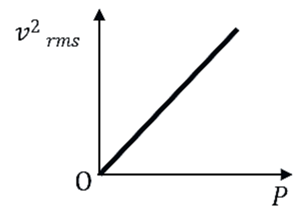
Q.12 The molecules of a given mass of gas has r.m.s speed 400 m/s at 27°C and 105 N/m2 pressure. When the absolute temperature is doubled and the pressure is halved, the R.M.S. speed of the molecules of the same gas is

(A) 400 m/s **(B)** $200\sqrt{2}$ m/s **(C)** $400\sqrt{2}$ m/s **(D)** 1200 m/s

IDEAL GAS EQUATION

Q.13 The curve between v2rms and pressure P for constant volume is

(A)


(B)


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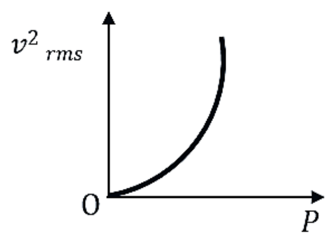

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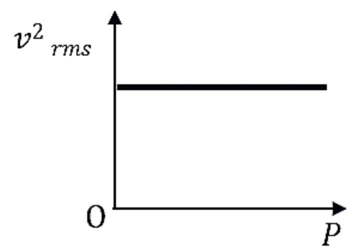


Root mean square velocity

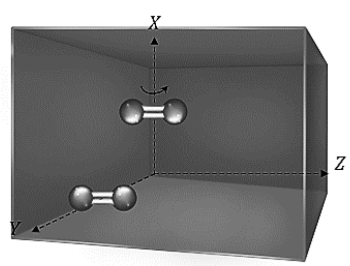
Q.14 If at same pressure, the densities of two gases are ρ1 and ρ2 respectively, then the ratio of R.M.S. velocity of their molecules respectively are

(A) $\rho_1 : \rho_2$ **(B)** $\sqrt{\rho_2} : \sqrt{\rho_1}$ **(C)** $\rho_2 : \rho_1$ **(D)** $\sqrt{\rho_1} : \sqrt{\rho_2}$

Degree of freedom

Q.15 The number of rotational degree of freedom for a diatomic gas is

(A) 2 **(B)** 3 **(C)** 5 **(D)** 7



Degree of freedom

Q.16 The degree of freedom of a gas is 6. Gas can be

(A) H_2 **(B)** He **(C)** N_2 **(D)** O_3

Rotational kinetic energy

Q.17 Ratio of rotational kinetic energy to the total energy for diatomic gas molecule at room temperature is

(A) 2: 5 **(B)** 5: 2 **(C)** 3: 2 **(D)** 2: 3

Degree of freedom

Q.18 A vessel contains a mixture of one mole of oxygen and two moles of nitrogen at 300 K. The ratio of the average rotational kinetic energy of O2 molecules to that of N2 molecules per degree of freedom is

(A) 1: 1 **(B)** 1: 2

(C) 2: 1 **(D)** depends on moment of inertia

Degree of freedom

Q.19 Each molecule of mass m of a monoatomic gas has got three degrees of freedom. The R.M.S. velocity of these atoms is v at temperatureT. For a diatomic molecule of mass m and temperature T which has got five degrees of freedom, R.M.S. velocity of molecule is

(A) $\sqrt{\frac{5}{3}}$ v **(B)** $\sqrt{\frac{3}{5}}$ v **(C)** v **(D)** None of these

ANSWER KEY

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(A)	(C)	(C)	(A)	(C)	(A)	(D)	(D)	(D)	(A)

WORK SHEET

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(D)	(D)	(D)	(A)	(C)	(C)	(B)	(B)	(B)	(B)
Q.	11	12	13	14	15	16	17	18	19	
Sol.	(D)	(C)	(B)	(B)	(A)	(D)	(A)	(A)	(C)	