MAX. MARKS - **70**   TIME ALLOTTED - **3 Hrs**.
GENERAL INSTRUCTIONS:
(1) There are 35 questions in all. All questions are compulsory
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.
(3) Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.
(4) There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
(5) Use of calculators is not allowed.

	SECTION - A	
Q.1.	Length cannot be measured by: (a) Fermi (b) Debye (c) Micron (d) Light year	(1)
Q.2	If we choose velocity V, acceleration A and force F as the fundamental quantities then angular momentum in terms of V, A and F would be: (a) $[FA^{-1}V]$ (b)$[FA^{-2}V^3]$ (c)$[FA^{-1}V^2]$ (d)$[ML^2T^{-1}]$	(1)
Q.3	The displacement of a body along x axis depends on time as $\sqrt{x} = t + 1$, then the velocity of the body (a) Increases with time b. Decreases with time c. Independent of time d. None of these	(1)
Q.4	A passenger is at a distance x of from a bus when the bus begins to move with constant acceleration a. What is the minimum velocity with which the passenger should run towards the bus so as to reach it? a. $\sqrt{2ax}$ b. $2ax$ c. $\sqrt{ax}$ d. ax	(1)
Q.5	Two forces P and Q have a resultant perpendicular to P. The angle between the forces is (a) $tan^{-1}\left(\frac{-P}{Q}\right)$ b. $tan^{-1}\left(\frac{P}{Q}\right)$ c. $Sin^{-1}\left(\frac{P}{Q}\right)$ d. $cos^{-1}\left(\frac{-P}{Q}\right)$	(1)
Q.6	A motorcar is travelling at 60 m/s on a circular road of radius 1200 m. It is increasing its speed at the rate of 4m/s². The acceleration of the car is (a) $3\,ms^{-2}$ b. $4\,ms^{-2}$ c. $5\,ms^{-2}$ d. $7\,ms^{-2}$	(1)
Q.7	The potential energy of a spring when stretched through a distance **s** is 10J. The amount of work (in joule) that must be done on this spring to stretch it through additional distance **s** will be: (a) 30 b. 40 c. 10 d.20	(1)
Q.8	The kinetic energy acquired by a mass **m** in travelling a certain distance **d** starting from rest under the action of a constant force is directly proportional to: (a) $\sqrt{m}$ (b)Independent of m (c) $\frac{1}{\sqrt{m}}$ (d) m	(1)
Q.9	The escape velocity on the earth's surface is 11.2 kms⁻¹. If the mass and radius of a planet is 4 and 2 times respectively than that of the earth, then what is the escape velocity of the planet? (a) 11.2 kms⁻¹ 1.112 kms⁻¹ 15.8 kms⁻¹ 22.4 kms⁻¹	(1)
Q.10	The orbital velocity of a satellite very near to the surface of earth is v. What will be its orbital velocity at an altitude 7 times the radius of the earth? (a) $\frac{v}{\sqrt{2}}$ b. $\frac{v}{2}$ c. $\frac{v}{2\sqrt{2}}$ d. $\frac{v}{4}$	(1)
Q.11	If S is stress and Y is young's modulus of material of wire, the energy stored in the wire per unit volume is (a) 2Y/S (b) S/2Y (c) 2S²Y (d) S²/2Y	(1)
Q.12	Sea animals are safe in winter in cold countries because of (a) their body conditions (b) high specific heat of water (c) low conductivity of water (d) anomalous expansion of water	(1)
Q.13	Pressure of an ideal gas is increased by keeping temperature constant. What is the effect on kinetic energy of molecules? (a) Increases (b) Decreases (c) No change (d) cannot be determined	(1)
Q.14	A simple harmonic motion has an amplitude A and time period T. The time required by it to travel from x=A to x=A/2 is (a)$\frac{T}{6}$ b.$\frac{T}{4}$ c.$\frac{T}{3}$ d.$\frac{T}{2}$	

		(1)

Q.15	A scientist says that the efficiency of his heat engine, which works at source temperature 127°C and sink temperature is 27°C is 36%. Then
	    (a) It is impossible b. It is possible but less probable
	    c. It is quite probable d. Data is incomplete
		(1)

For Q.16 - Q.18 Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below. (a) Both A and R are true and R is the correct explanation of A (b) Both A and R are true and R is NOT the correct explanation of A (c) A is true but R is false (d) A is false and R is also false		
Q.16	**ASSERTION**: Use of ball bearings between two moving parts of a machine is a common practice. **REASON**: Ball bearings reduce vibrations and provide good stability.	(1)
Q.17	**ASSERTION**: For an ideal gas at constant temperature, the product of the pressure and volume is constant. **REASON**: The mean square velocity of the molecules is inversely proportional to mass.	(1)
Q.18	**ASSERTION**: In simple harmonic motion, the velocity is maximum, when the acceleration is minimum. **REASON**: Velocity and acceleration in simple harmonic motion differ in phase by $\frac{\pi}{2}$.	(1)
	SECTION – B	
Q.19	Find the dimension of (a x b) in the relation $P = \frac{b-x^2}{at}$; where P is power, x is distance and t is time.	(2)
Q.20	A light string passing over a smooth pulley connects two blocks of masses m_1 and m_2 (vertically). If the acceleration of the system is **g/8,** find m_1/m_2.	(2)
Q.21	Show that moment of couple does not depend on the point about which you take the moments. **OR** Show that the angular momentum about any point of a single particle moving with constant velocity remains constant throughout the motion.	(2)
Q.22	Give reason: (a) It is difficult to revolve a stone tied to a longer string than a stone tied to smaller string. (b) It is difficult to open the door by pushing it near the hinge.	(2)
Q.23	The edge of aluminium cube is 10 cm long. One face of the cube is firmly fixed to a vertical wall. A mass of 100 kg is then attached to the opposite face of the cube. The shear modulus of aluminium is 25 G Pa. What is the vertical deflection of this face.	(2)
Q.24	A refrigerator converts 50 gram of water at 15° C into ice at 0°C in one hour. Calculate the quantity of heat removed per minute. Given: specific heat of water = 1 cal g $^{-1}$°C $^{-1}$ and Latent heat of water = 80 cal g $^{-1}$	(2)
Q.25	Using the law of equipartition of energy, calculate the value of C_v and C_p for diatomic gas at high temperature. **OR** Discuss the kinetic interpretation of temperature. Hence define absolute temperature.	(2)
	SECTION-C	
Q.26	Draw velocity time graph for uniformly accelerated motion and derive the following equation from this graph. (1) $v = u + at$ 2. (2) $v^2 - u^2 = 2as$	(3)
Q.27	What are conservative forces? Show that gravitational force is a conservative force. **OR** Define Elastic collision. Show that in case of one dimensional elastic collision of two bodies the relative velocity of separation after collision is equal to the relative velocity of approach before collision.	(3)
Q.28	Define escape velocity. Derive an expression for the escape velocity of an object from the surface of the earth.	(3)
Q.29	(a) State the principle of conservation of angular momentum. (b) What will be the duration of day, if earth suddenly shrinks to (1/64) of its original volume, mass remaining the same.	(3)
Q.30	Show that for small oscillation the motion of a simple pendulum is simple harmonic. Derive an expression for its time period. **OR**	(3)

	Derive an expression for the velocity of a particle executing S.H.M. When is this velocity (i)maximum and (ii)minimum?	
	SECTION - D	
Q.31	(a) State any two assumptions used in projectile motion. (b) A projectile is fired with a velocity u at an angle θ with the horizontal. Show that its trajectory is parabolic. (c) Prove that the horizontal range is same when angle of projection is (i) greater than 45º by certain value and (ii) less than 45º by same value. **OR** (a) Derive an expression for the centripetal acceleration of a particle undergoing uniform circular motion. Explain how it acts along the radius towards the centre of circular path. (b) A circular wheel of radius 0.5 m is moving with a speed of $20\ ms^{-1}$. What is its angular speed?	(5)
Q.32	(a) State stokes law and using this law derive an expression for terminal velocity in case of small spherical body falling through viscous fluid. (b) Why do air bubble in water moves in upward direction? **OR** (a) How do the insects run on the surface of water ? (b) Derive an expression for excess pressure inside a soap bubble. (c) Two soap bubbles of unequal sizes are blown at the ends of a capillary tube. Which one will grow at the expense of the other?	(5)
Q.33	(a) What is meant by plane progressive harmonic wave? (b)What do you mean by phase of the wave? (c)A wave is represented by $$y = 0.25 \times 10^{-3} \sin(500t - 0.025x)$$ Where y,t and x are in cm, sec and metres respectively. Deduce –(i) Amplitude (ii) Time period (iii) Angular frequency (iv) Wavelength (v) Velocity amplitude **OR** (a)What are stationary waves? (b)What is the necessary conditions for the formation of stationary waves? (c)Describe the first and second mode of vibration in case of closed end organ pipe with the help of suitable diagram.	(5)
	SECTION-E	

Q.34	**CASE STUDY:**
	Read the following paragraph and answer the questions.
	It is a common observation that when a body (A) exerts some force on another body(B), then the body 'B' also exerts a force on body 'A'. Newton concluded that whenever two bodies interact with each other, they exert equal and opposite force on each other. Out of these two forces one is known as action and other is known as reaction. For example, when a person walks on the ground, he pushes the ground with his feet in backward direction (action), as a result ground exerts equal and opposite reaction on his foot. The horizontal component of reaction helps the person to move forward.
	(1) Action & reaction are equal & opposite but they do not cancel each other. Why?
	(2) Why does a heavy gun recoil not so strongly as a light gun firing the same bullet?
	(3) A woman stands on a weighing machine on an elevator. In which of the following cases the machine records the minimum or maximum reading:
	    (i) elevator is stationary (ii) elevator is accelerating upward
	    (iii) elevator accelerating downward
	 OR
	(3) Explain:(a) A rocket can operate in free space
	           (b) Horse cannot pull a cart and run in empty space.
		1
		
		1
		
		2

Q.35	CASE STUDY: Read the following paragraph and answer the questions. A change in pressure and volume of gas without any change in its temperature is called an isothermal change. In such a change, there is free exchange of heat between the gas and its surroundings. These changes are governed by Boyle's Law i.e. PV=constant A change in pressure and volume of a gas in which temperature also changes is called an adiabatic change. In such a change, no heat is allowed to enter into or escape from the gas. The equation of adiabatic change is $PV^\gamma = constant$ where $\gamma = \dfrac{C_P}{C_V}$ (1) Can we increase the temperature of a gas without supplying heat to the gas? (2) During adiabatic change $V \propto \dfrac{1}{T^2}$. How will pressure of the gas vary with temperature. (3) Write two essential conditions for adiabatic process to take place. **OR**	1 1

| | (3) Show that the slope of an adiabatic curve is γ times the slope of an isothermal curve at the corresponding point. | 2 |