BLUE PRINT FOR MODEL QUESTION PAPER – 4

Class : I PUC **Subject : PHYSICS (33)**

BLUE PRINT

Unit	Chapter Number	TOPICS (CHAPTERS)	Number of teaching Hours	Weightage of marks	1Mark	2 Marks	3 Marks	5 Marks (Theory)	5 Marks (Numerical Problem)
I	1	Physical World	2	2		✓			
	2	Units and Measurements	4	3	✓	✓			
II	3	Motion in a Straight Line	8	7		✓		✓	
	4	Motion in a Plane	12	11	✓	✓	✓		✓
III	5	Laws of Motion	11	10		✓	✓	✓	
IV	6	Work, Energy and Power	11	9	✓		✓		✓
V	7	System of Particles and Rotational Motion	12	11	✓	✓	✓	✓	
VI	8	Gravitation	9	8	✓	✓			✓
VII	9	Mechanical Properties of Solids	5	5				✓	
	10	Mechanical Properties of Fluids	5	4	✓		✓		
	11	Thermal Properties of Matter	10	9	✓		✓	✓	
VIII	12	Thermodynamics	8	6	✓				✓
IX	13	Kinetic Theory	5	4	✓		✓		
X	14	Oscillations	8	6	✓			✓	
	15	Waves	10	10		✓	✓		✓
		Number of Questions	--	--	10	8	8	6	5
		TOTAL	120	105	20	16	24	30	25

I P.U.C. MODEL QUESTION PAPER – 4

SUBJECT: PHYSICS (33)

Time: 3 hours 15 min. **Max. Marks: 70**

General instructions:

a) All parts are compulsory.

b) Answers without relevant diagram/ figure/circuit wherever necessary will not carry any marks.

c) Direct answers to the Numerical problems without detailed solutions will not carry any marks.

PART – A

I. Answer ALL the following questions **10 × 1 = 10**

1. How many metres make one parsec?
2. What is a unit vector?
3. When does the work done by a force is zero?
4. Define torque.
5. Mention the value of escape speed of an earth satellite?
6. State Pascal's law.
7. Give Principle of calorimetry.
8. What is equation of state for adiabatic process?
9. Name a factor on which internal energy of the gas depends.
10. What happens to the time period of a simple pendulum when it is taken from equator to the pole?

PART – B

II. Answer FIVE of the following questions. **5 × 2 = 10**

11. Mention any two basic forces in nature.
12. The resistance R = V/I, where V = (100±5) volt and I = (10±0.2) A, Find the percentage error in R.
13. Distinguish between distance and displacement.
14. Write the expression for range of the projectile? For what angle of projection it is maximum?
15. Mention two methods of reducing friction.
16. Give two general conditions of equilibrium of a rigid body.
17. Define Gravitational potential energy: Give expression for it.
18. What is Doppler effect? Mention one of its applications.

PART – C

III. Answer FIVE of the following questions. **5 × 3 = 15**

19. Derive the expression for centripetal acceleration.
20. State Newton's first law of motion? Hence define force and inertia.
21. Prove work-energy theorem for a constant force.
22. Compare equations of linear and rotational motion.

23. Derivation of pressure at a point inside a liquid.

24. State Stefan's law and Draw the intensity distribution graph of black body radiation.

25. Mention three postulates of Kinetic theory of gases.

26. Explain Laplace's correction to Newton's formula for the Speed of a sound wave.

PART – D

IV. Answer TWO of the following questions. **2 × 5 = 10**

27. Derive $x = v_0 t + \frac{1}{2} a t^2$ by graphical method.

28. Derive the expression for maximum safe speed of a vehicle on a banked road in circular motion

29. State and explain the parallel axis and perpendicular axis theorem.

V. Answer TWO of the following questions. **2 × 5 = 10**

30. State and explain Hooke's law. Draw Stress – strain curve with labeling the parts.

31. Graphically represent the variation of coefficient of volume expansion of copper as a function of temperature. Derive $\alpha_V = 1/T$ for an ideal gas.

32. Derive the expression for time period of a simple pendulum.

VI. Answer THREE of the following questions. **3 × 5 = 15**

33. A particle starts from origin at t = 0 with a velocity $5\hat{i}$ ms^{-1} and moves in x-y plane under the action of a force which produces a constant acceleration of $(4\hat{i} + 2\hat{j})$ ms^{-2}.
    (a) What is the y-coordinate of the particle at an instant when its x-coordinate is 84 m?
    (b) What is the speed of the particle at this time?

34. A pump on the ground floor of a building can pump up water to fill a tank of volume $40m^3$ in 20minutes if the tank is 30m above the ground and the efficiency of the pump is 60%. How much electric power is consumed by the pump? Given density of water = 1000 kg/m^3 and acceleration due to gravity = $9.8m/s^2$

35. The planet Mars take 1.88 years to complete on revolution around the sun. The mean distance of the earth from the Sun is 1.5×10^8 km. Calculate that of planet Mars?

36. A steam engine delivers 7.5×10^8J of work per minute and services 3.6×10^9J of heat per minute from its boiler. What is the efficiency of the engine? How much heat is wasted per minute? Also find the ratio of temperature of sink to the source.

37. A particle executes SHM along the x-axis, its displacement varies with the time according to the equation: $x(t) = 5.4 \cos(6\pi t + \pi/4)$, where x(t) in metre and t is in second.
    Determine the amplitude, frequency, period and initial phase of the motion.

SCHEME OF VALUATION FOR I PU PHYSICS – 4

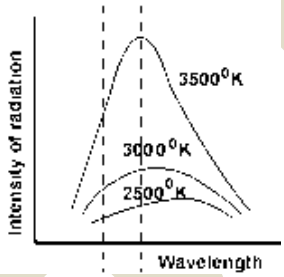
Q.No	Key Answers	Marks
1	How many metres make one parsec? 3.08×10^{16}m	1
2	What is a unit vector? *A vector whose magnitude is equal to one.*	1
3	When does the work done by a force is zero? *If the force acts at angle of 90^0 or if the displacement is zero*	1
4	Define torque. The rotating effect of the applied force is called torque.	1
5	*Mention the value of escape speed of an earth satellite?* *11.2 km/s*	1
6	State Pascal's law. It states that if change in pressure is produced in any part of an enclosed fluid (liquid or gas), the same is transmitted equally to all points of the fluid in all directions.	1
7	Give Principle of calorimetry. If there is no loss of heat energy by radiation, heat lost by hot body is equal to heat gained by cold body.	1
8	What is equation of state for adiabatic process? $PV^{\gamma} = constant$	1
9	Name a factor on which internal energy of the gas depends. Temperature/pressure	1
10	What is the time period of a seconds pendulum? 2 seconds	1
II main	**Two marks questions/ any Five**	
11	Mention any two basic forces in nature. Gravitational force, Electrostatic force and nuclear force Any two forces	1 each
12	The resistance R = V/I, where V = (100±5) volt and I = (10±0.2) A, Find the percentage error in R. The percentage error in V is 5% and that in current is 2% therefore error in R is 5% + 2% = 7%	2 marks

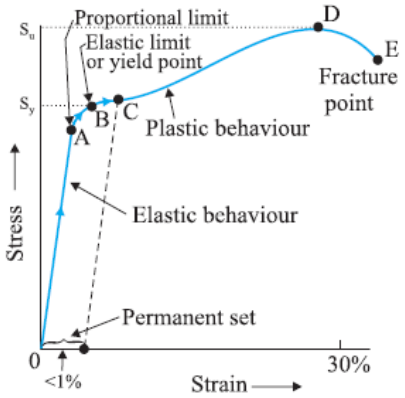
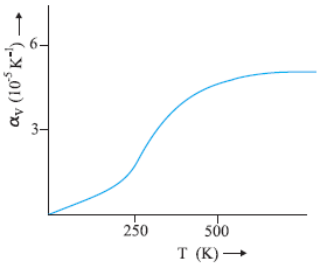
<table>
<tr><td>13</td><td>Distinguish between distance and displacement.
<table><tr><td>It is the actual path length between the initial and final positions of the body during motion.</td><td>It is the shortest distance between the initial and final positions of the body during motion.</td></tr><tr><td>It is a scalar quantity</td><td>It is a vector quantity</td></tr><tr><td>It is never zero or negative, but is always positive</td><td>It may be zero or positive or negative</td></tr></table>Any two differences</td><td>1+1</td></tr>
<tr><td>14</td><td>Write the expression for range of the projectile? For what angle of projection it is maximum?
$R=\frac{u^2 \sin 2\theta}{g}$
if $\theta = 45^0$</td><td>1

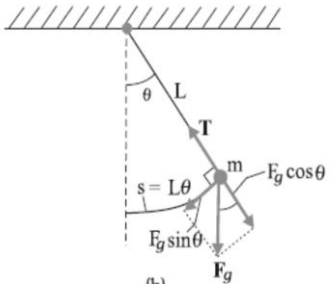
1</td></tr>
<tr><td>15</td><td>Mention two methods of reducing friction.
1) Friction can be reduced by polishing.
2) Friction can be reduced by using ball bearings.
3) Friction can be reduced by lubrication .
Any two</td><td>1+1</td></tr>
<tr><td>16</td><td>Give two general conditions of equilibrium of a rigid body.
Vector sum of external forces acting on the body is zero.
Vector sum of external torques acting on a body is zero.</td><td>1+1</td></tr>
<tr><td>17</td><td>Define Gravitational potential energy: Give expression for it.
Energy possessed by the body by virtue of its position or configuration.
P.E = mgh.</td><td>1+1</td></tr>
<tr><td>18</td><td>What is Doppler effect? Mention one of its applications.
Apparent change in the frequency of source of sound due to relative motion between source and the observer.
It is used in SONAR, over speeding of the vehicles RADAR etc.</td><td>1+1</td></tr>
<tr><td>III main</td><td>THREE marks questions/ any Five</td><td></td></tr>
<tr><td>19</td><td>Derive the expression for centripetal acceleration.
Vector Diagram
$\frac{dv}{v} = \frac{dl}{r}$
Final equation $a = v^2/r$</td><td>1

1
1</td></tr>
<tr><td>20</td><td>State Newton’s first law of motion? Hence define force and inertia.
Statement of the law
Definition of force</td><td>1

1</td></tr>
</table>

	Definition of inertia	1
21	Prove work-energy theorem for a constant force. Taking the equation $v^2 - u^2 = 2 a x$ Multiplying both sides of above equation by $\frac{m}{2}$ Arriving the final equation, Final KE – Initial KE = F x	1 1 1
22	Compare equations of linear and rotational motion. Any three differences	1 mark each
23	Derivation of pressure at a point inside a liquid. Diagram $P = \frac{F}{A}$ $P = \rho g h$	1 1 1
24	State Stefan's law and briefly explain black body radiation. It states that the total amount of heat energy radiated per second per unit area of a perfect black body is directly proportional to the fourth power of the absolute temperature of the surface of the body. Graph  	1 2
25	Mention three postulates of Kinetic theory of gases. Any three postulates	1 mark each
26	Explain Laplace's correction to Newton's formula for the Speed of a sound wave. Newtons formula Considering adiabatic changes and final answer	1 1+1
IV main	**FIVE marks questions/ any TWO**	
27	Derive $x = v_0 t + ½ a t^2$ by graphical method. v-t graph Calculating area under v-t graph Intermediate steps with final answer	1 1+1 1+1

28	Derive the expression for maximum safe speed of a vehicle on a banked road in circular motion. Diagram Taking resolved components Calculation of N and arriving at the final expression $v_{max} = \sqrt{\frac{rg(\tan\theta + \mu_s)}{(1 - \mu_s \tan\theta)}}$	 1 2 2
29	State and explain the parallel axis and perpendicular axis theorem. Statements Explanations Both the diagrams	 1+1 1+1 1
V main	**FIVE marks questions/ any TWO**	
30	State and explain Hooke's law. Draw Stress – strain curve with labeling the parts.  Statement and explanation Drawing of graph Labeling	1+1 2 1
31	Graphically represent the variation of coefficient of volume expansion of copper as a function of temperature. Derive $\alpha_V = 1/T$ for an ideal gas.  Graph PV=nRT PΔV=nRΔT Arriving at the final equation	 2 1 2

32	Derive the expression for time period of a simple pendulum.  Figure $I\alpha = mgL\sin\theta$ $\alpha = \omega^2\theta$ $\omega = \sqrt{\frac{g}{L}}$ $T = 2\pi\sqrt{\frac{L}{g}}$	 1 1 1 1 1
VI main	**FIVE marks questions/ any THREE**	
33	**A particle starts from origin at t = 0 with a velocity 5 $\hat{i}$ ms^{-1} and moves in x-y plane under the action of a force which produces a constant acceleration of ($4\hat{i} + 2\hat{j}$) ms^{-2}.** **(a) What is the y-coordinate of the particle at an instant when its x-coordinate is 84 m?** **(b) What is the speed of the particle at this time?** $\vec{r}=\vec{v_0}+\frac{1}{2}\vec{a}t^2$ $X(t) = 5t + 2t^2$ $Y(t) = 1.0t^2$ $t = 5.26s$ **Y(t)=27.7m** **V=28.08m/s**	 1 2 1 1
34	**A pump on the ground floor of a building can pump up water to fill a tank of volume 40m^3 in 20minutes if the tank is 30m above the ground and the efficiency of the pump is 60%. How much electric power is consumed by the pump? Given density of water = 1000 kg/m^3 and acceleration due to gravity = 9.8m/s^2** P_0=W/t=mgh/t=$\rho Vmgh/t$	

	Substitution P_0 =9.8x10^{+3} W P=9.8kw/0.6=16.33kW	1 1 2 1
35	**The planet Mars take 1.88 years to complete on revolution around the sun. The mean distance of the earth from the Sun is 1.5×10^8 km. Calculate that of planet Mars?** $\frac{T^2}{a^3}$ **= constant** $\frac{T_2^2}{T_1^2} = \frac{a_2^3}{a_1^3}$ Substitution a_2 =22.8x10^{10}m	 1 1 1 2
36	**A steam engine delivers 7.5×10^{8}J of work per minute and services 3.6 × 10^{9}J of heat per minute from its boiler. What is the efficiency of the engine? How much heat is wasted per minute? Also find the ratio of temperature of sink to the source.** $\eta = \frac{P_0}{P_i}$ $\eta = 0.21$ **$P_0 - P_i$=47.5MW** **$\eta = 1 - \frac{T_1}{T_2}$** $\frac{T_1}{T_2}$ **= 0.79**	 1 1 1 1 1
37	**A particle executes SHM along the x-axis, its displacement varies with the time according to the equation: *x*(t) = 5.4 cos(6πt + π/4), where x(t) in metre and t is in second.**	

	Determine the amplitude, frequency, period and initial phase of the motion. **$x(t) = 5.4\cos(6\pi t + \pi/4)$,** **A= 5.4m** **n = 3 Hz** **T = 0.333 s** **Initial Phase = $\varphi = \pi/4$**	1 1 1 1 1