

# K.S ACADEMY, SALEM

## PG TRB, UG-TRB, POLYTECHNIC TRB, ENG TRB, BEO TRB, TNPSC SCIENTIFIC ASST & TNSET COACHING CENTRE FOR PHYSICS

### UNIT TEST : CLASSICAL MECHANICS

**Time: 2 Hours**

**Marks: 90**

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- **PG TRB (BATCH-2) admission going on.**
- To know our institute effectiveness **JUST attend one class.**
- Our institute is **not** a NOTES GIVING INSTITUTE; We teach and coach the student properly with good understanding NO NEED FOR MEMORIZATION OF CONCEPT.
- This question is prepared by **own** not copied from other state / institute question paper.

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**ANSWER ALL THE QUESTION:**  
**EACH QUESTION CARRIES ONE MARK**

1. A pendulum with an extensible cord is
 

a) Rheonomic	b) Scleronomic
c) Independent of constraints	d) None of these
  
2. The transformation matrix for first rotation about the space set of z – axis, is  $A_\phi = \begin{bmatrix} \frac{\sqrt{3}}{2} & \frac{1}{2} & 0 \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} & 0 \\ 0 & 0 & 1 \end{bmatrix}$ . The angle of precession is
 

a) 30°	b) 90°	c) 45°	d) 60°
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3. The frequency of oscillations of a system with two degrees of freedom whose Lagrangian  $L = \frac{1}{2}m(\dot{x}^2 + \dot{y}^2) - \frac{1}{2}\omega_0^2(x^2 + y^2) + axy$  is

a)  $\omega_1^2 = \frac{\omega_1^2}{\sqrt{2m}}, \omega_2^2 = \frac{\omega_0^2}{\sqrt{m}}$

b)  $\omega_1^2 = \frac{\alpha + \omega_0^2}{m}, \omega_2^2 = \frac{\omega_0^2 - \alpha}{m}$

c)  $\omega_1^2 = \sqrt{\frac{\alpha + \omega_0^2}{2m}}, \omega_2^2 = \sqrt{\frac{\omega_0^2 - \alpha}{2m}}$

d)  $\omega_1^2 = \sqrt{3m \omega_0^2 + \alpha}, \omega_2^2 = \sqrt{m \omega_0^2 + \alpha}$

4. The dimension of  $p_k \dot{q}_k$  is

- a) Amplitude
- b) Twice kinetic energy
- c) Linear momentum
- d) Energy

5. Match the following: Part-I represent invariance of the system and Part-II represent Conserved quantity

Part-I

- A) Under time translation
- B) Under space rotation
- C) Under space translation
- D) Under cyclic variable

Part-II

- i) canonical momentum
- ii) momentum
- iii) Hamiltonian function
- iv) angular momentum

	A	B	C	D
a)	iii	iv	i	ii
b)	ii	iv	i	iii
c)	iii	iv	ii	i
d)	ii	iii	iv	i

6. A Particle constrained to move under gravity on the smooth inner surface of the paraboloid. The Lagrangian of the system is  $L = \frac{1}{2} m (\dot{\rho} + \rho^2 \dot{\phi}^2 + \dot{z}^2) - mgz$  then which of the following is correct.

- a) The angular momentum  $m\rho^2 \dot{\phi}$  of the particle about the axis of symmetry is conserved
- b) The linear momentum  $m\dot{\phi}$  of the particle about the axis of symmetry is conserved
- c) The kinetic energy  $\frac{1}{2} m (\dot{\rho} + \rho^2 \dot{\phi}^2 + \dot{z}^2)$  is conserved
- d) both a and b



12. A coordinate  $q_k$  is called cyclic, if the Lagrangian function  $L$  is

- a) dependent of that coordinate                      b) independent of this coordinate  
 c) a function of that coordinate                      d) None of these

13. The equation of motion for a simple pendulum is

- a)  $\dot{\theta} + g \sin \theta = 0$                                       b)  $\ddot{\theta} + \frac{g}{l} \sin \theta = 0$   
 c)  $\ddot{\theta} + l \sin \theta = 0$                                       d)  $\ddot{\theta} + \frac{l}{g} \sin \theta = 0$

14. Generation of body set of axes from space set of axes through three successive rotations is given by

- a) Lorentz transformation                                      b) Euler angles  
 c) A non-orthogonal transformation                      d) None of these

15. Lorentz transformation matrix  $L$  is a

- a)  $3 \times 3$  matrix    b)  $4 \times 4$  matrix  
 c)  $2 \times 2$  matrix    d)  $3 \times 4$  matrix

16. If the kinetic energy of the particle is  $\frac{8}{5} m_0 C^2$  then the velocity of the particle is

- a)  $\frac{12}{13} C$                       b)  $\frac{\sqrt{2}}{3} C$                       c)  $\frac{13}{12} C$                       d)  $\frac{\sqrt{3}}{2} C$

17. A coordinate is called cyclic

- a) it is absent from the Lagrangian  
 b) it is absent from the Hamiltonian  
 c) its conjugate momentum is constant  
 d) all the above are correct

18. The force of constraints follows

- a) Newton's gravitational law                                      b) Einstein's relativity  
 c) Newton's third law of motion                                      d) Friction

19. The Hamiltonian for the inverse square orbit problem is  $H = \frac{1}{2}m(\dot{r}^2 + r^2\dot{\theta}^2) - \frac{mMG}{r}$  the value of  $P_{\theta}$  is

- a)  $\frac{P_{\theta}^2}{mr^3} - \frac{mMG}{r^2}$                       b)  $P_r/m$   
 c) 0    d)  $P_{\theta}/mr^2$

20. The constraints involved when a body glides on an inclined plane are

- a) holonomic , rheonomic, and conservative constraints  
 b) holonomic , rheonomic, and dissipative constraints  
 c) non- holonomic , rheonomic, and conservative constraints  
 d) non- holonomic , scleronomic, and conservative constraints

21. Consider the following statements about Generalized Coordinates and choose the incorrect statements

- 1) They need not be lengths or angles in particular  
 2) They are in number just equal to the number of degrees of freedom of the system.  
 3) They are independent of one another

- a) 1 Only                                      b) 1 & 2  
 c) 1,2 and 3                                d) none of the above

22. If the conditions of the constraint imposed on the motion of the system can be expressed in the following form  $f_j(q_1, q_2, \dots, q_n, t) = 0, j = 1, 2, \dots, k$  then the constraints imposed on the system is are said to be

- a) Holonomic                                b) Non holonomic  
 c) Holonomic & rheonomic              d) Non holonomic & rheonomic

23. The advantage of Hamilton's Principle over Lagrangian is

- a) It produces first order differential equations instead of second order.  
 b) It introduces a class of generalized momentum corresponding to the various generalized coordinates.





c)  $L = T - q\phi + q(V.A)$

d)  $L = T + q\phi + - (V.A)$

35. 'P' is momentum of a particle 'C' is velocity of light and T is kinetic energy then PC=

a)  $\sqrt{T[T + 2m_0c^2]}$

b)  $\sqrt{[T + 2m_0c^2]}$

c)  $\sqrt{T[T - 2m_0c^2]}$

d)  $\sqrt{T[T - m_0c^2]}$

36. Choose the correct statement about relativity

1. Relativistic momentum expression is  $P = \gamma mv$

2. Conservation of momentum, applies in Special Relativity, which implies that each component of momentum is conserved.

3. Lorentz Invariance equation is used to compute the energy and momentum, for given the kinetic energy of the object.

4. Massless particles must travel at the speed of light

a) 1 and 2 only

b) 2 and 3 only

c) 1,2 and 4 only

d) 1,2,3 and 4

37. Equation of motion for the bead sliding on a uniformly rotating wire in force free space is

a)  $\ddot{r} = r\omega^2$

b)  $\ddot{\theta} + \frac{mgl\theta}{l} = 0$

c)  $2m\dot{r}\dot{\theta} + mr^2\ddot{\theta} = 0$

d)  $\ddot{\theta} + \frac{g}{l}\theta = 0$

38.  $L = I\vec{\omega}$  implies that L is the angular momentum  $\vec{\omega}$  the angular velocity vector and I represents

a) Tensor of rank 3

b) A vector

c) The moment of inertia tensor

d) None of these

39. At rest muons has a mass of  $207m_e$  and mean life-time of  $2.1 \times 10^{-6}$  s. The observed mean lifetime of muons as measured in the laboratory is  $6.3 \times 10^{-6}$  s. The effective mass of a muon at this speed is

a)  $207m_e$

b)  $621m_e$

c)  $107m_e$

d)  $304.6m_e$







	P	Q	R	S
a)	ii	iii	iv	i
b)	ii	iv	i	iii
c)	iii	iv	i	ii
d)	iii	iv	ii	i

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**ANSWER KEY AT THE LAST PAGE**

➤ **OUR INSTITUTE IS AT SALEM (NOTE: NO BRANCH AT NAMAKKAL DISTRICT)**

**Welcome to K.S Academy, Salem**

- **Our vision** is to provide positive learning experience so student becomes competent.
- **Our mission** is to maximize student career opportunities.

OUR SPECIALTIES	OUR SPECIALTIES
<ul style="list-style-type: none"> <li>• Time Saving <b>Short Tricks</b> For problem questions &amp; Reasoning</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Best question paper for complete preparation. ( no repeated questions)</b></li> </ul>
<ul style="list-style-type: none"> <li>• <b>High quality lecturer</b></li> </ul>	<ul style="list-style-type: none"> <li>• Experienced and <b>expert faculty</b> ( 1<sup>st</sup> rank holder in 3 different TRB exams)</li> </ul>
<ul style="list-style-type: none"> <li>• <b>Slip test, unit test, two unit combined test, one third test, half test, and full test</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Mock tests and accuracy test for every unit</b></li> </ul>
<ul style="list-style-type: none"> <li>• <b>Quality of questions has the TRB Level and also higher level than TRB level</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>KS Academy is committed to the development of our students</b></li> </ul>
<ul style="list-style-type: none"> <li>• <b>2 Trial Classes Before Admission</b></li> </ul>	<ul style="list-style-type: none"> <li>• 9 years of TRB coaching experience and <b>many success stories.</b></li> </ul>

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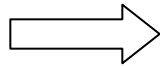
STC பில்டிங்,

Lவுன் ரயில்வே ஸ்டேஷன் அருகில்

சேலம்-1

**PG TRB - 2019 (BATCH-2) CLASSICAL MECHANICS & RELATIVITY  
ANSWER KEY**

1	A	31	A	61	D	91	121
2	A	32	B	62	D	92	122
3	B	33	A	63	C	93	123
4	B	34	C	64	C	94	124
5	C	35	A	65	D	95	125
6	A	36	C	66	C	96	126
7	D	37	A	67	B	97	127
8	C	38	C	68	C	98	128
9	A	39	B	69	A	99	129
10	C	40	C	70	D	100	130
11	C	41	B	71	C	101	131
12	B	42	C	72	A	102	132
13	B	43	B	73	C	103	133
14	B	44	C	74	C	104	134
15	B	45	B	75	A	105	135
16	A	46	B	76	C	106	136
17	D	47	C	77	A	107	137
18	C	48	D	78	B	108	138
19	C	49	B	79	A	109	139
20	B	50	D	80	C	110	140
21	D	51	C	81	A	111	141
22	C	52	B	82	B	112	142
23	D	53	B	83	B	113	143
24	C	54	B	84	A	114	144
25	B	55	A	85	B	115	145
26	A	56	B	86	B	116	146
27	D	57	C	87	C	117	147
28	C	58	A	88	A	118	148
29	D	59	C	89	D	119	149
30	C	60	B	90	D	120	150

**(NOTE: QUESTION NO 51 TO 90 NOT GIVEN IN THE ABOVE QUESTION PAPER)****FOR 100% SUCCESS****KS ACADEMY, SALEM**

- **PG TRB (BATCH-2) admission going on.**
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