PHYSICS ACADEMY
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SUBJECT – CLASSICAL MECHANICS

CLASS ROOM TEST–01

"CSIR-NET/JRF JUNE-2021"

For –

- ☞ **CSIR-NET/JRF**
- ☞ **GATE / JEST**
- ☞ **TIFR / BARC**
- ☞ **All Ph.D. Entrance Exams**

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CLASSICAL MECHANICS

CLASS ROOM TEST-01

1. A circular orbit of radius 'r' under a central force f(r) is stable if.

(a) $f(r) > +\frac{r}{3}\frac{\partial f}{\partial r}$ (b) $f(r) > -\frac{r}{3}\frac{\partial f}{\partial r}$

(c) $f(r) < -\frac{r}{3}\frac{\partial f}{\partial r}$ (d) $f(r) < +\frac{r}{3}\frac{\partial f}{\partial r}$

2. Equation of orbit of a particle under a central force is rv = constant. f(r) varies with r as.

(a) $\frac{1}{r^2}$ (b) $\frac{1}{r}$ (c) $\frac{1}{r^3}$ (d) $\frac{1}{r^4}$

3. A solid sphere of mass M, radius R, rolls on a horizontal surface without slidin. If k and L be its total K.E. and angular momentum about point of contact with surface then value of $\frac{MkR^2}{L^2}$ is.

(a) $\frac{5}{14}$ (b) $\frac{5}{7}$ (c) $\frac{3}{5}$ (d) $\frac{3}{10}$

4. Lagrangian of a system is.

$$L = \frac{1}{2}m\left(\dot{s} - \frac{1}{2}\delta s\right)^2 - \frac{1}{2}ks^2$$

Which of the following is NOT correct?

(a)Equation of motion is $\ddot{s} + \left(\frac{k}{m} - \frac{\delta}{4}\right)s^2$ is constant.

(b) $\dot{s}^2 + \left(\frac{k}{m} - \frac{\delta}{4}\right)s^2$ is constant

(c) for $\delta = 0$ dynamics is simple harmonic in nature.

(d) $\dot{s}^2 - \left(\frac{k}{m} + \frac{\delta}{4}\right)s^2$ is another constant of motion.

5. Poisson Bracket $\left[r^2, \vec{L}.\vec{p}\right]$ is equal to.

(a) $2\vec{r}.\vec{p}$ (b) $2\vec{r}.\vec{L}$ (c) $2\vec{p}.\vec{L}$ (d) 0

6. A planet revolves around the sun in elliptical orbit. If semimajor, semiminior axes and mass of planet all gets doubled then.

(a)Energy becomes double (b) Energy gets halved

(c) Angular momentum remains uncharged

(d) Angular momentum becomes $2\sqrt{2}$ times.

7. A change particle moves in electromagnetic potential $\left(\vec{A}, \phi\right)$ if we do guage transformation of electromagnetic potential then.

(a)Lagrangian remains unchanged

(b)Hamiltonian remain unchanged

(c)Equation of motion remains unchanged

(d)Angular momentum becomes $2\sqrt{2}$ times.

8. Consider three frame of reference s_1, s_2, s_3, s_2 has velocity $\frac{4c}{5}\hat{\imath}$ w.r.t. s_1 and s_2 has velocity $\frac{3c}{5}$ w.r.t. s_1 two events take place at separation Δx in s_1, these events are simultaneously is s_2. Time interval between the two events in frame s_3 is.

(a)$\frac{\Delta x}{2c}$ (b) $\frac{\Delta x}{3c}$ (c) $\frac{2\Delta x}{3c}$ (d) $\frac{\Delta x}{4c}$

9. Lagrangian of a particle is L = $-m_0c^2\sqrt{1-\frac{v^2}{c^2}}+\vec{A}.\vec{v}$. If generalized momentum of the particle is $\vec{p}$ then.

(a)$\vec{v}=\frac{\vec{p}}{m_0}$ (b) $\vec{v}=\frac{\vec{p}-\vec{A}}{m_0}$ (c) $\vec{v}=\frac{c}{\sqrt{1+\left(\frac{m_0c}{\vec{p}-\vec{A}}\right)}}$

(d) $\vec{v}=\frac{c}{\sqrt{1+\left(\frac{m_0c}{\vec{p}+\vec{A}}\right)}}$

10. A particle is moving in a 3-dimensional space. For which of the following potentials, z-component of angular momentum of particle is not conserved $[a \neq b]$

(a)$V(x,y,z)=a(x^2+y^2+z^2)$
(b) $V(x,y,z)=a(x^2+y^2)+bz^2$
(c) $V(x,y,z)=ax^2+by^2+az^2$
(d) $V(x,y,z)=a(x^2+y^2)$

11. With positive z-axis chosen upward, the Lagrangian of a particle of mass 'm' falling under gravity is.

(a)$\frac{1}{2}m\dot{z}^2-mgz$ (b) $-\frac{1}{2}m\dot{z}^2-mgz$
(c) $\frac{1}{2}m\dot{z}^2+mgz$ (d) $-\frac{1}{2}m\dot{z}^2+mgz$

12. A particle describes the curve $r^2 = a^2\cos^2\theta$ under a force towards the pole, then the force varies as.

(a)$\frac{1}{r^2}$ (b) $\frac{1}{r^3}$ (c) $\frac{1}{r^5}$ (d) $\frac{1}{r^7}$

13. A particle of mass 'm' moves in a central force field defined by $F=-\frac{kr}{r^4}$, If E is the total energy supplied to the particle, then its speed is given by.

(a)$\frac{k}{mr^2}+\frac{2E}{m}$ (b) $\frac{k}{mr^2}-\frac{2E}{m}$ (c) $\sqrt{\frac{k}{mr^2}+\frac{2E}{m}}$ (d) $\sqrt{\frac{k}{mr^2}-\frac{2E}{m}}$

14. For the Lagrangian L = $\frac{1}{2}q^2\dot{q}^2 - q^3$ with one degree of freedom, the Lagrange equation is obtained as L + nq^3 = constant.
The value of the integer n is
(a)1 (b) 2 (c) -1 (d) -2

15. The Lagrangian for a three particle system is given by.
$L = \frac{1}{2}(\dot{\eta}_1^2 + \dot{\eta}_2^2 + \dot{\eta}_3^2) - a^2(\eta_1^2 + \eta_2^2 + \eta_3^2 - \eta_1\eta_3)$
where 'a' is real, then one of the normal co-ordinates has frequency ω given by,
(a)$\omega^2 = a^2$ (b) $\omega^2 = \frac{a^2}{2}$ (c) $\omega^2 = 2a^2$ (d) $\omega^2 = \sqrt{2}a^2$

ANS-KEY

1.	B	**2.**	C	**3.**	A	**4.**	D	**5.**	B
6.	D	**7.**	C	**8.**	D	**9.**	C	**10.**	C
11.	A	**12.**	D	**13.**	C	**14.**	B	**15.**	C