PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Basic Mechanics - CSIR NET Physics PYQs

Classical Mechanics . All PYQs (2015-2025) with answer key

19 questions . Answer key included

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Q1. [Dec 2016] . 3.5 marks
Classical Mechanics > Basic Mechanics

CSIR NET	2016 Dec	3.5M

A ball of mass m is dropped from a tall building with zero initial velocity. In addition to gravity, the ball experiences a damping force of the form $-\gamma v$, where v is its instantaneous velocity and γ is a constant. Given the values $m = 10\ \mathrm{kg}, \gamma = 10\ \mathrm{kg}/s$, and $g \approx 10\ \mathrm{m}/s^2$, the distance travelled (in metres) in time t in seconds, is

1. $10(t + 1 - e^{-t})$

2. $10(t - 1 + e^{-t})$

3. $5t^2 - (1 - e^{t})$

4. $5t^2$

Q2. [Dec 2016] . 5.0 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2016 Dec	5M

After a perfectly elastic collision of two identical balls, one of which was initially at rest, the velocities of both the balls are nonzero. The angle θ between the final velocities (in the lab frame) is

1. $\theta = \frac{\pi}{2}$
2. $\theta = \pi$
3. $0 < \theta \leq \frac{\pi}{2}$
4. $\frac{\pi}{2} < \theta \leq \pi$

Q3. [June 2016] . 3.5 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2016 June	3.5M

A ball of mass m, initially at rest, is dropped from a height of 5 meters. If the coefficient of restitution is 0.9 , the speed of the ball just before it hits the floor the second time is approximately (take $\mathrm{g} = 9.8\ \mathrm{m/s^2}$)

1. $9.80\ \mathrm{m/s}$

2. $9.10\ \mathrm{m/s}$

3. $8.91\ \mathrm{m/s}$

4. $7.02\ \mathrm{m/s}$

Q4. [Dec 2017] . 3.5 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2017 Dec	3.5M

A cyclist, weighing a total of 80 kg with the bicycle, pedals at a speed of $10\ \mathrm{m/s}$. She stops pedalling at an instant which is taken to be $t = 0$. Due to the velocity dependent frictional force, her velocity is found to vary as $v(t) = \frac{10}{\left(1+\frac{t}{30}\right)} m.s$, where t is measured in seconds. When the velocity drops to $8\ \mathrm{m/s}$, she starts pedalling again to maintain a constant speed. The energy expended by her in 1 minute at this (new) speed, is

1. $4kJ$
2. 8 kJ
3. 16 kJ
4. 32 kJ

Q5. [June 2017] . 3.5 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2017 June	3.5M

A ball weighing 100 gm , released from a height of 5 m , bounces perfectly elastically off a plate. The collision time between the ball and the plate is $0.5s$. The average force on the plate is approximately

1. 3 N
2. 2 N
3. 5 N
4. 4 N

Q6. [Dec 2018] . 3.5 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2018 Dec	3.5M

A particle of mass m, moving along the x - direction, experiences a damping force $-\gamma v^2$, where γ is a constant and v is its instantaneous speed. If the speed at $t = 0$ is v_0, the speed at time t is

1. $v_0 e^{-\frac{\gamma v_0 t}{m}}$

2. $\frac{v_0}{1+\ln\left(1+\frac{\gamma v_0 t}{m}\right)}$

3. $\frac{m v_0}{m+\gamma v_0 t}$

4. $\frac{2v_0}{1+e^{\frac{\gamma v_0 t}{m}}}$

Q7. [Dec 2019] . 3.5 marks
Classical Mechanics > Basic Mechanics

CSIR NET	2019 Dec	3.5M

A ball, initially at rest, is dropped from a height h above the floor bounces again and again vertically. If the coefficient of restitution between the ball and the floor is 0.5 , the total distance travelled by the ball before it comes to rest is

1. $\frac{8h}{3}$
2. $\frac{5h}{3}$
3. 3 h
4. 2 h

Q8. [Dec 2019] . 5.0 marks
Classical Mechanics > Basic Mechanics

CSIR NET	2019 Dec	5M

The fixed points of the time evolution of a one-variable dynamical system described by $y_{t+1} = 1 - 2y_t^2$ are 0.5 and -1 . The fixed points 0.5 and -1 are

1. both stable
2. both unstable
3. unstable and stable, respectively
4. stable and unstable, respectively

Q9. [Dec 2019] . 5.0 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2019 Dec	5M

Following a nuclear explosion, a shock wave propagates radially outwards. Let E be the energy released in the explosion and ρ be the mass density of the ambient air. Ignoring the temperature of the ambient air, using dimensional analysis, the functional dependence of the radius R of the shock front on E, ρ and the time t is

1. $\left(\frac{Et^2}{\rho}\right)^{1/5}$
2. $\left(\frac{\rho}{Et^2}\right)^{1/5}$
3. $\frac{Et^2}{\rho}$
4. $E\rho t^2$

Q10. [June 2019] . 3.5 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2019 June	3.5M

An object is dropped on a cushion from a height $10m$ above it. On being hit, the cushion is depressed by 0.1 m . Assuming that the cushion provides a constant resistive force, the deceleration of the object after hitting the cushion, in terms of the acceleration due to gravity g is

1. 10 g
2. $50g$
3. 100 g
4. g

Q11. [June 2019] . 5.0 marks

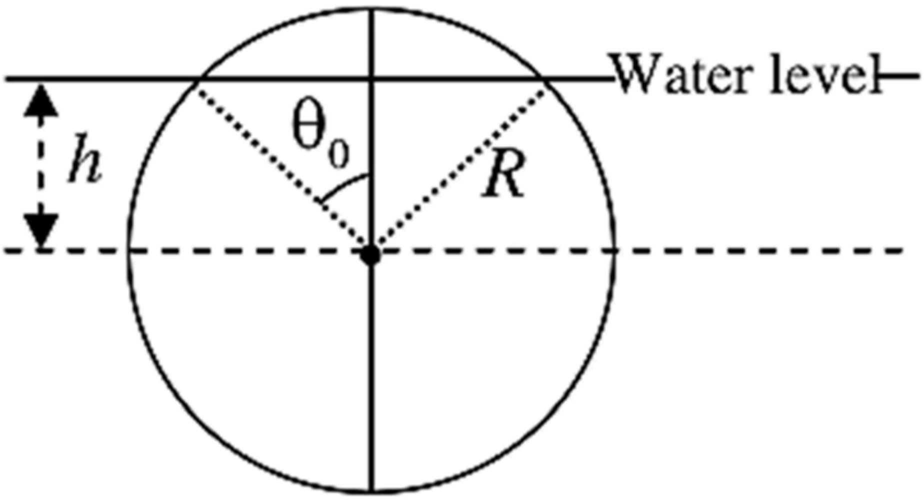
Classical Mechanics > Basic Mechanics

CSIR NET	2019 June	5M

A solid spherical Cork of radius R and specific gravity 0.5 floats on water. The cork is pushed down so that its centre of mass is at a distance h (where $0 < h < R$) below the surface of water, and Then released. The volume of the part of the cork above water level is $\pi R^3\left(\frac{2}{3} - \cos\theta_0 + \frac{1}{3}\cos^3\theta_0\right)$ where θ_0 is the angle as shown in the figure.

At the moment of release, the dependence of the upward force on the cork on h is

1. $\frac{h}{R} - \frac{1}{3}\left(\frac{h}{R}\right)^3$
2. $\frac{h}{R} + \frac{1}{3}\left(\frac{h}{R}\right)^3$
3. $\frac{h}{R} - \frac{2}{3}\left(\frac{h}{R}\right)^3$
4. $\frac{h}{R} + \frac{2}{3}\left(\frac{h}{R}\right)^3$



Q12. [June 2019] . 5.0 marks
Classical Mechanics > Basic Mechanics

CSIR NET	2019 June	5M

The time evolution of a coordinate x of a particle is described by the equation

$$\frac{d^2x}{dt^4} + 2\Omega^2 \frac{d^2x}{dt^2} + (\Omega^4 - A^4)x = 0$$

For $\Omega > A$, the particle will

1. eventually come to rest at the origin
2. eventually drift to infinity ($|x| \to \infty$)
3. oscillate about the origin
4. eventually come to rest at $\frac{\Omega}{A}$ or $-\frac{\Omega}{A}$

Q13. [June 2020] . 5.0 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2020 June	5M

Falling drops of rain break up and coalesce with each other and finally achieve an approximately spherical shape in the steady state. The radius of such a drop scales with the surface tension σ as

1. $1/\sqrt{\sigma}$
2. $\sqrt{\sigma}$
3. σ
4. σ^2

Q14. [June 2020] . 5.0 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2020 June	5M

The velocity $v(x)$ of a particle moving in one dimension is given by $v(x) = v_0 \sin\left(\frac{\pi x}{x_0}\right)$, where v_0 and x_0 are positive constants of appropriate dimensions. If the particle is initially at $x/x_0 = \in$, where $|\in| \ll 1$, then, in the long time, it

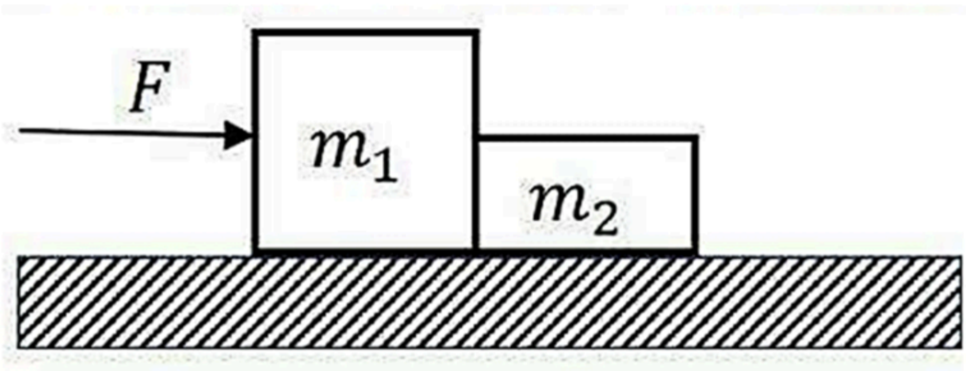
1. Executes an oscillatory motion around $x = 0$
2. Tends towards $x = 0$
3. Tends towards $x = x_0$
4. Executes an oscillatory motion around $x = x_0$

Q15. [Dec 2024] . 3.5 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2024 Dec	3.5M

Two blocks m_1 and m_2 are in contact on a frictionless horizontal table. A horizontal force is applied to one of the blocks, as shown in the figure.



If $m_1 = 2\text{ kg}, m_2 = 1\text{ kg}$, and $F = 3\text{ N}$, the force of contact between the blocks is

1. $1N$
2. $2N$
3. 1.5 N
4. $3N$

Q16. [Dec 2024] . 3.5 marks
Classical Mechanics > Basic Mechanics

CSIR NET	2024 Dec	3.5M

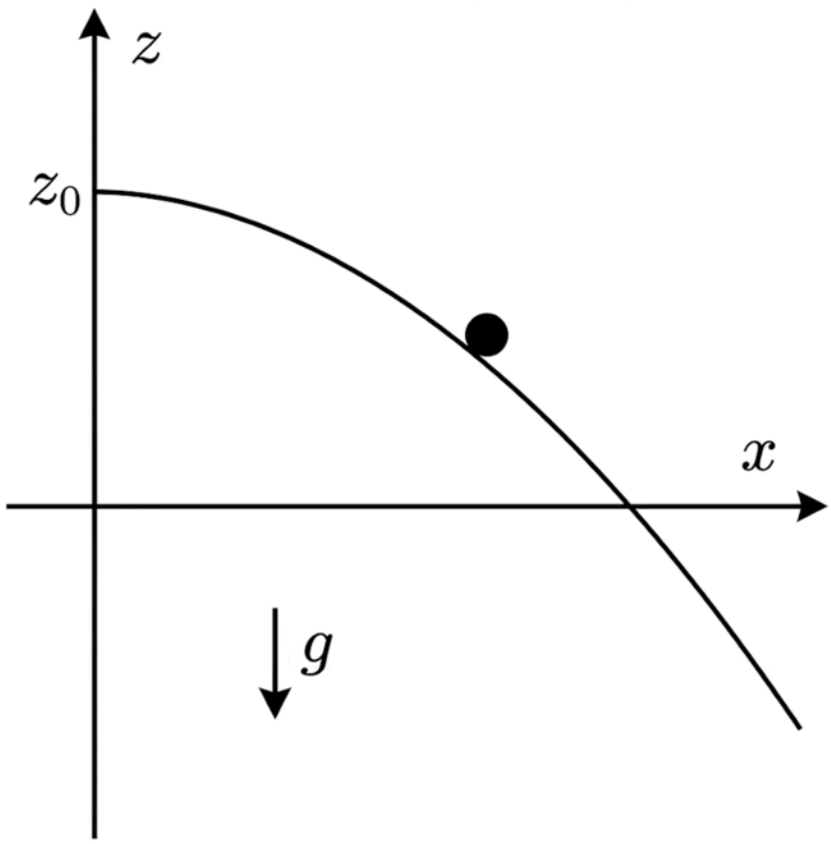
A frictionless track is defined by $z = z_0 - \frac{x^2}{4z_0}$, as shown in the figure. A particle is constrained to slide down the track under the action of gravity. The tangential acceleration at position (x, z) would be

1. $\frac{2gx}{\sqrt{x^2 + 4z_0^2}}$

2. $\frac{gx}{\sqrt{x^2 + 4z_0^2}}$

3. $\frac{gx}{2z_0}$

4. $g\sqrt{\frac{x(x + z_0)}{x^2 + 4z_0^2}}$

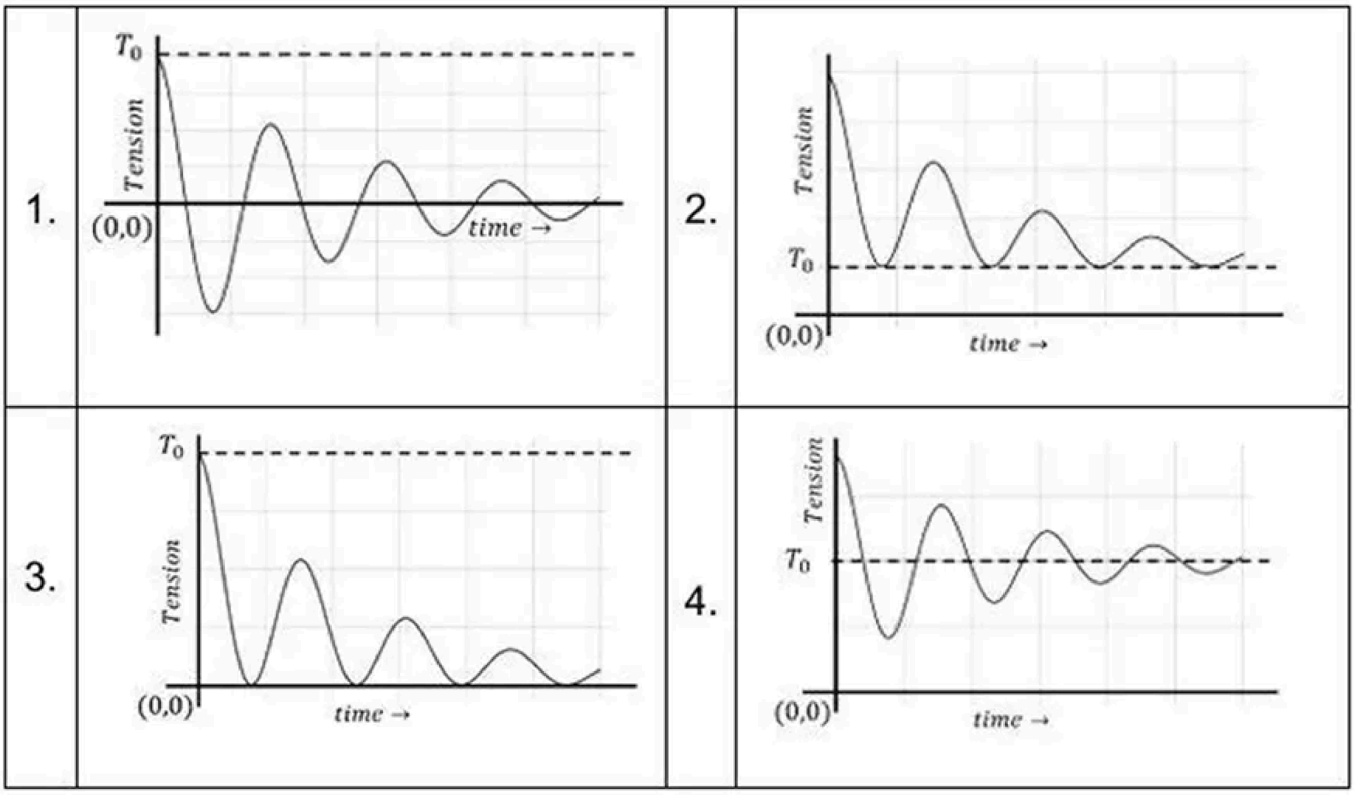


Q17. [Dec 2025] . 3.5 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2025 Dec	3.5M	Wave/Optic

A bow has a taut string of tension T_0 (when it is at rest). The string is pulled and released at time $t = 0$. Which plot best represents the tension in the bow string as a function of time?



Q18. [June 2025] . 3.5 marks

Classical Mechanics > Basic Mechanics

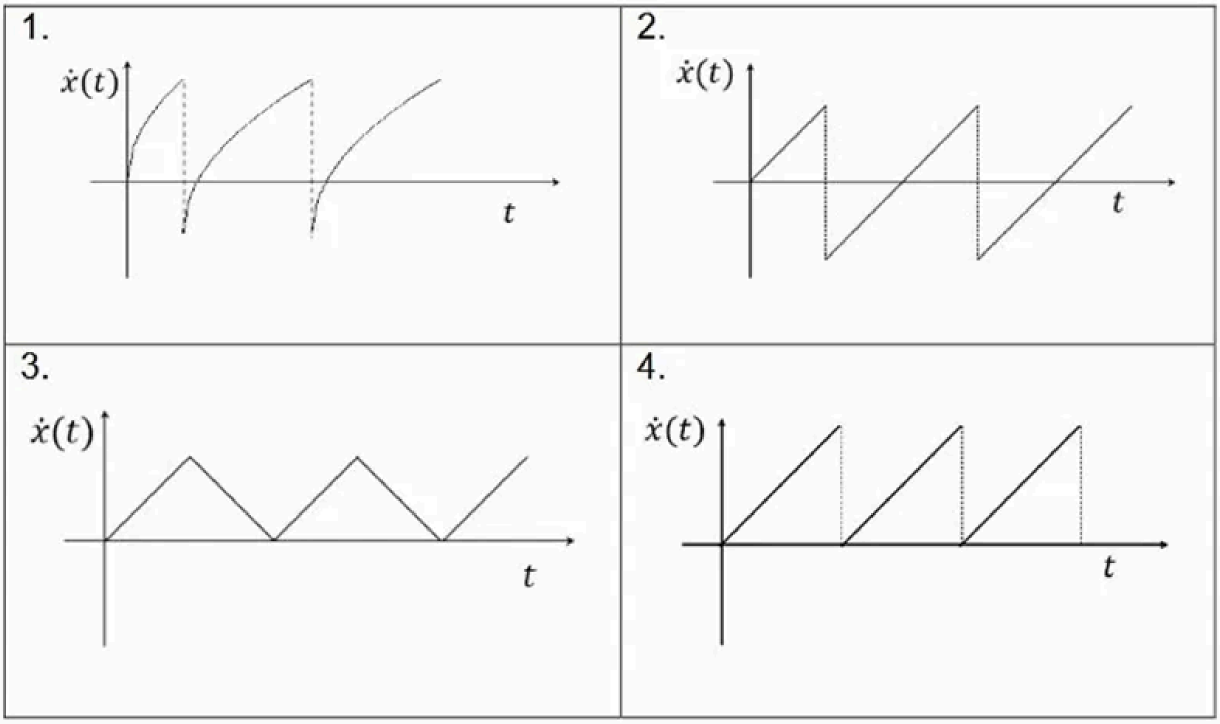
[image unavailable]

Q19. [June 2025] . 3.5 marks

Classical Mechanics > Basic Mechanics

CSIR NET	2025 June	3.5M	CM

A particle of mass m is subjected to a potential $V(x) = V_0\Theta(x) - kx$, where V_0 and k are positive constants and V_0 is much larger than the energy of the particle. The function $\Theta(x) = 1$ for $x \geq 0$ and equals 0 otherwise. The particle starts from rest at $t = 0$ and $x = -5$. In the limit $V_0 \to \infty$, the graph for $\dot{x}(t)$ is best represented by



Answer Key

19 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Classical Mechanics	Basic Mechanics	**2**
Q2	Classical Mechanics	Basic Mechanics	**1**
Q3	Classical Mechanics	Basic Mechanics	**3**
Q4	Classical Mechanics	Basic Mechanics	**2**
Q5	Classical Mechanics	Basic Mechanics	**3**
Q6	Classical Mechanics	Basic Mechanics	**3**
Q7	Classical Mechanics	Basic Mechanics	**2**
Q8	Classical Mechanics	Basic Mechanics	**2**
Q9	Classical Mechanics	Basic Mechanics	**1**
Q10	Classical Mechanics	Basic Mechanics	**3**
Q11	Classical Mechanics	Basic Mechanics	**1**
Q12	Classical Mechanics	Basic Mechanics	**3**
Q13	Classical Mechanics	Basic Mechanics	**1**
Q14	Classical Mechanics	Basic Mechanics	**3**
Q15	Classical Mechanics	Basic Mechanics	**1**
Q16	Classical Mechanics	Basic Mechanics	**2**
Q17	Classical Mechanics	Basic Mechanics	**2**
Q18	Classical Mechanics	Basic Mechanics	**1**
Q19	Classical Mechanics	Basic Mechanics	**2**

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