Name: _____ **Reg. No.:** _____

PHY101: Quiz – 1

Date: 26/09/2025 Time: 30 minutes

Write answers inside the boxes provided. Use symbols, expressions, or one word.

Q1. A block of mass 2 kg is pulled on a frictionless surface with a force of 10 N.

(a) Acceleration a =? (1)

$$a = \frac{F}{m} = \frac{10}{2} = 5 \text{ m/s}^2$$

(b) If the mass is doubled, a =? (1)

$$a = \frac{10}{4} = 2.5 \text{ m/s}^2$$

(c) If instead the force is doubled, a =? (1)

$$a = \frac{20}{2} = 10 \text{ m/s}^2$$

Q2. A stationary bomb of mass M explodes into two pieces of masses $M/3$ and $2M/3$.

(a) If the smaller piece has velocity $+v\hat{x}$, the larger piece moves with velocity = ? (1)

$$\mathbf{v}_2 = -\frac{v}{2}\,\hat{x}$$

(b) Total momentum before explosion = ? (1)

0

(c) Total momentum after explosion = ? (1)

0

Q3. A block of mass m rests on the floor of a bus accelerating forward with a.

(a) Pseudo force *on the block* in the bus frame = ? (1)

$$\mathbf{F}_{\text{pseudo}} = -ma\,\hat{x}$$

(b) Direction of pseudo force? (1)

backward

(c) Minimum μ_s (coeff. of static friction) so that the block does not slide = ? (1)

$$\mu_s \geq \frac{a}{g}$$

Q4. A uniform rod of length l and mass m lies along the x-axis with one end at $x = 0$.

(a) Coordinate of center of mass, x_{cm} =? (2)

$$x_{\text{cm}} = \frac{l}{2}$$

(b) If the rod is cut into two equal halves, does the *center of mass of each piece* coincide with the x_{cm} of the original rod? (yes / no) (1)

no

Q5. A particle of mass m is at $\mathbf{r} = x\hat{x} + y\hat{y}$ with momentum $\mathbf{p} = p_x\hat{x} + p_y\hat{y}$.

(a) Angular momentum about the origin, L_z =? (2)

$$L_z = (\mathbf{r} \times \mathbf{p})_z = xp_y - yp_x$$

(b) A constant force $\mathbf{F} = F\hat{x}$ acts. Torque $\boldsymbol{\tau}$ =? (1)

$$\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F} = -yF\,\hat{z}$$

(c) From (b), is L_z conserved? (yes / no) (1)

no

Q6. A particle moves under an attractive force proportional to $1/r^2$, with $L \neq 0$.

(a) As $r \to 0$, the effective potential $V_{\text{eff}}(r)$ tends to which value? ($+\infty$ / 0 / $-\infty$). (1)

$+\infty$

(b) Condition for r to remain constant in time: Energy E =? (2)

$$r_0 = \frac{L^2}{mk}, \qquad E = V_{\text{eff}}(r_0) = -\frac{mk^2}{2L^2}$$

(c) For $E = 0$, what is the trajectory? (1)

parabola