

3. Further Mechanics

Starter Quiz · 课前小测

A-Level Further Mathematics

Name: _____ Score: _____

1. A ball is thrown at $u = 20 \text{ m/s}$ at 30° . Using $\text{height} = u^2 \sin^2 \alpha / (2g)$ with $g = 10$, find the greatest height (m).

2. A uniform 4 m beam of weight 100 N is pivoted at A; a force F at B (4 m away) balances it. Taking moments about A (weight acts at the 2 m centre), find F (N).

3. A particle moves in a circle of radius 2 m with angular speed 3 rad/s. What is its speed $v = r\omega$ (m/s)?

4. An elastic string of natural length 2 m and modulus 50 N is stretched by 0.5 m. Find the tension $T = \lambda x / L$ (N).

5. When a force depends on position x , acceleration is best written as:
☐ $v \, dv/dx$
☐ dv/dt
☐ $x \, dx/dv$
☐ dx/dt
6. A 2 kg body at 3 m/s hits a stationary 1 kg body and they stick together. By momentum conservation $2(3) = (2+1)v$, find v (m/s).

7. During the flight, the horizontal velocity of a projectile (ignoring air resistance):
☐ stays constant
☐ increases
☐ decreases to zero
☐ reverses
8. The moment of a force about a point is:
☐ force $\times$ perpendicular distance
☐ force $\times$ time
☐ force $\div$ distance

☐ mass $\times$ acceleration

9. Substituting $a = v \, dv/dx$ into $F = ma$ gives a separable differential equation in v and x .

☐ True ☐ False

10. The coefficient of restitution e always lies in which range?

☐ $0 \leq e \leq 1$

☐ $e \geq 1$

☐ $-1 \leq e \leq 0$

☐ any real number

1. **5**

$400 \times \sin^2 30^\circ / 20 = 400 \times 0.25 / 20 = 5 \text{ m.}$

2. **50**

$F \times 4 = 100 \times 2$, so $F = 200/4 = 50 \text{ N.}$

3. **6**

$v = r\omega = 2 \times 3 = 6 \text{ m/s.}$

4. **12.5**

$T = 50 \times 0.5 / 2 = 12.5 \text{ N.}$

5. **$v \, dv/dx$**

$a = dv/dt = (dv/dx)(dx/dt) = v \, dv/dx$ — convenient when force depends on x .

6. **2**

$6 = 3v$, so $v = 2 \text{ m/s.}$

7. **stays constant**

There is no horizontal force, so $u \cos \alpha$ is constant throughout.

8. **force $\times$ perpendicular distance**

Moment = force $\times$ perpendicular distance — the turning effect.

9. **True**

$F(x) = mv \, dv/dx$ separates into $v \, dv$ and an x -expression, then integrate.

10. **$0 \leq e \leq 1$**

e runs from 0 (perfectly inelastic) to 1 (perfectly elastic).