A-Level Further Mathematics Name: _____ Score: _____

1. A ball is thrown at u = 20 m/s at 30°. Using 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 × perpendicular distance

   ☐ force × time

   ☐ force ÷ distance

☐ mass × 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

A-Level Further Mathematics

1. **5**

   $400 \times \sin^2 30° / 20 = 400 \times 0.25 / 20 = 5$ m.

2. **50**

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

3. **6**

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

4. **12.5**

   $T = 50 \times 0.5 / 2 = 12.5$ 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 $v = 2$ m/s.

7. **stays constant**

   There is no horizontal force, so u cos α is constant throughout.

8. **force × perpendicular distance**

   Moment = force × 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).