

University Mechanical Engineering

Name: _____ Score: _____

1. Dropped from 1.80 m from rest: landing speed (m/s, three decimals)?

_____ m/s

2. The 2.5 kg till on a 25 degree ramp: normal force (N, two decimals)?

_____ N

3. A 2.5 kg till dropped 1.80 m onto $k = 4900$ N/m: maximum deflection (m, four decimals)?

_____ m

4. A 2.5 kg till hits at 5.943 m/s with $e = 0.35$: impulse magnitude (N s, two decimals)?

_____ N · s

5. A 0.310 m wheel rolling at 2.00 m/s: angular velocity (rad/s, three decimals)?

_____ rad/s

6. That 5.0 kg disk after 1.50 m of rolling carries 19.04 J total. The split is:

- ☐ 9.52 J carried, 9.52 J spun
- ☐ 12.70 J carried, 6.35 J spun
- ☐ 19.04 J carried, nothing spun
- ☐ 6.35 J carried, 12.70 J spun

7. The horizontal and vertical components of the slide-off:

- ☐ run on independent clocks
- ☐ exchange energy
- ☐ are equal in magnitude at landing
- ☐ share one clock, set by the vertical fall

8. On the 25 degree ramp, the normal force equals:

- ☐ $mg \sin 25^\circ$
- ☐ $\mu_k mg$
- ☐ $mg \cos 25^\circ$
- ☐ mg

9. In $mg(h + x) = kx^2/2$, the $+x$ exists because:

- ☐ x is measured from the table

- ☐ the spring softens as it compresses
- ☐ gravity keeps working through the deflection
- ☐ energy is not conserved in impacts

10. The coefficient of restitution is the ratio of:

- ☐ final energy to initial energy
- ☐ impulse to momentum
- ☐ separation speed to approach speed
- ☐ rebound height to drop height

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1. **5.943 m/s**

$$v = \sqrt{2gh} = \sqrt{2 \times 9.81 \times 1.80}.$$

2. **22.23 N**

$$N = mg \cos 25^\circ.$$

3. **0.1393 m**

$$mg(h+x) = kx^2/2.$$

4. **20.06 N · s**

$$J = m(1+e)v.$$

5. **6.452 rad/s**

$$\omega = v/r.$$

6. **12.70 J carried, 6.35 J spun**

Two thirds translation, one third rotation - the disk geometry taxes every ramp.

7. **share one clock, set by the vertical fall**

One t governs both axes; the vertical equation sets it.

8. **$mg \cos 25^\circ$**

The perpendicular equation owns N .

9. **gravity keeps working through the deflection**

The weight descends h plus the whole compression.

10. **separation speed to approach speed**

Speeds at the contact, not energies.