2022-Ph-H2-Q2

Section: Our Dynamic Universe
Topic: Forces, Energy and Power

Summary:
A puck of mass $m = 0.350\,\text{kg}$ is pushed on a table with initial speed $u = 0.78\,\text{m s}^{-1}$ and stops after a distance $d = 2.160\,\text{m}$.
Tasks:
(a)(i) Find the average acceleration.
(a)(ii) Calculate the frictional force.
(b) Explain why reducing the mass uncertainty will not significantly improve force uncertainty.

Solution:

(a)(i) Average acceleration:
Use $v^2 = u^2 + 2as$.
$0 = (0.78)^2 + 2a(2.160),$

$$a = -\frac{0.78^2}{2 \times 2.160} = -0.141\,\text{m s}^{-2}.$$

Answer: $a = 0.14\,\text{m s}^{-2}$ **(opposite to motion).**

(a)(ii) Average frictional force:
$F = ma = 0.350 \times 0.141 = 0.049\,\text{N}.$

Answer: $F \approx 0.049\,\text{N}$**.**

(b) Explanation:

- The percentage uncertainty of mass is very small (0.3%).
- The largest percentage uncertainty is from speed (1.3%).
- Improving mass measurement won't significantly reduce total uncertainty.

Guidance for Students:

- Use $v^2 = u^2 + 2as$ for motion with constant acceleration.
- Always check which measurement dominates uncertainty.

Revision Tips:

- $F = ma$ connects acceleration and force.
- Reducing small uncertainties doesn't help much; focus on largest sources.
- Keep units consistent (m/s², N).