Unit 4 · Dynamics

HARDER PRACTICE QUESTIONS

Full marks 35

Write your answers on separate paper. Show your working. Take $g = 9.8\ m/s^2$.

1 Spot the error [3]

Find the mistake and correct it.

Nima, 60 kg, stands on a bathroom scale in a lift that is going up at a steady 2 m/s. His friend writes:
"The lift is moving up, so the floor must push harder than his weight: $R = m(g + a) = 60 \times (9.8 + 2) =$ **708 N**."

2 What if? [4]

A microbus moving at 54 km/h on a level road brakes hard and skids to a stop. The coefficient of kinetic friction between its tires and the dry road is 0.6.

i. Find its retardation and stopping distance.
ii. On a wet road the coefficient is 0.3. What happens to the stopping distance?
iii. Does a fully loaded microbus need a longer distance to stop on the same road? Explain.

3 Check the claim [5]

Answer from the data.

In a laboratory, trolley A (mass m_A) runs into trolley B (1.0 kg, at rest) on a level track, and they stick together. Their speeds were measured with a timer:

Run	m_A (kg)	Speed of A before (m/s)	Speed together after (m/s)
1	1.0	0.80	0.40
2	2.0	0.60	0.40
3	3.0	0.40	0.24

i. Find the total momentum before and after in each run.
ii. In which run is momentum clearly not conserved? Suggest a reason.
iii. Diksha says: "In run 1 the speed halves, so half the momentum is lost." Correct her.

4 Predict, then explain [4]

Write your prediction first, then explain it.

A 3.0 kg rifle fires a 10 g bullet at 600 m/s.

i. Find the rifle's recoil velocity.
ii. If the shooter's shoulder stops the rifle in 0.05 s, find the average force on her shoulder.
iii. Predict what happens to the recoil if she holds the rifle loosely, and if she presses it tightly into her shoulder. Explain.

5 Balance it [4]

A uniform plank 4.0 m long and of mass 20 kg rests on two supports, one at each end. Mingma (50 kg) stands 1.0 m from the left end. Find the force each support gives.

6 Design a fair test [4]

Isha wants to find out whether friction depends on the area of contact. She has a brick, a spring balance, a string and a long table.

i. What will she change, and what will she measure?
ii. Name two things she must keep the same.
iii. How should she pull, and when should she read the balance?
iv. What result would show that friction doesn't depend on the area?

7 Which explanation fits? [3]

When a bus brakes suddenly, the passengers lurch forward. Two students explain it:
Swapnil: "The braking makes a force that throws the passengers forward."
Alina: "Their bodies keep moving forward while the bus under their feet slows down."
Which explanation is right? Explain why the other is wrong.

8 Correct the misconceptions [3]

The paragraph has three mistakes. Write each mistake and correct it.

Rabina wrote: "Wide tires grip better because friction grows with the area of contact. Friction always acts backward, against the way we want to go. And static friction is always equal to $\mu_s R$."

9 Think [3]

Sneha stands on a bathroom scale in a lift. What does the scale read if the lift's cable breaks and it falls freely? Could a lift ever be made to accelerate downward faster than g with the scale still reading her weight? What would she feel?

10 Make your own [2]

Choose two masses to hang over a smooth pulley so that they accelerate at exactly g/5. Show that your choice works.