Physics 20

Unit A: Motion in one and two dimensions

Kinematics in technology and free fall

A Bow pathway commute

- A rider covers 5.40 km along the Bow River pathway from Sunnyside to East Village in 20.0 min.
- Average speed is 5.40 km divided by 20.0 min. People who time a pathway or a bus route use that same division.

Speed and free fall

- Average speed uses total distance over elapsed time and stays a scalar.
- In a vacuum tube, a heavy object and a light object both speed up at 9.81 m/s squared downward.
- Builders test a runway length, a merge lane, or a traffic light time on paper before they pour concrete.

Key terms

average speed

Average speed is the total distance travelled divided by the elapsed time, reported as a magnitude with a unit. (speed = distance / time)

free fall

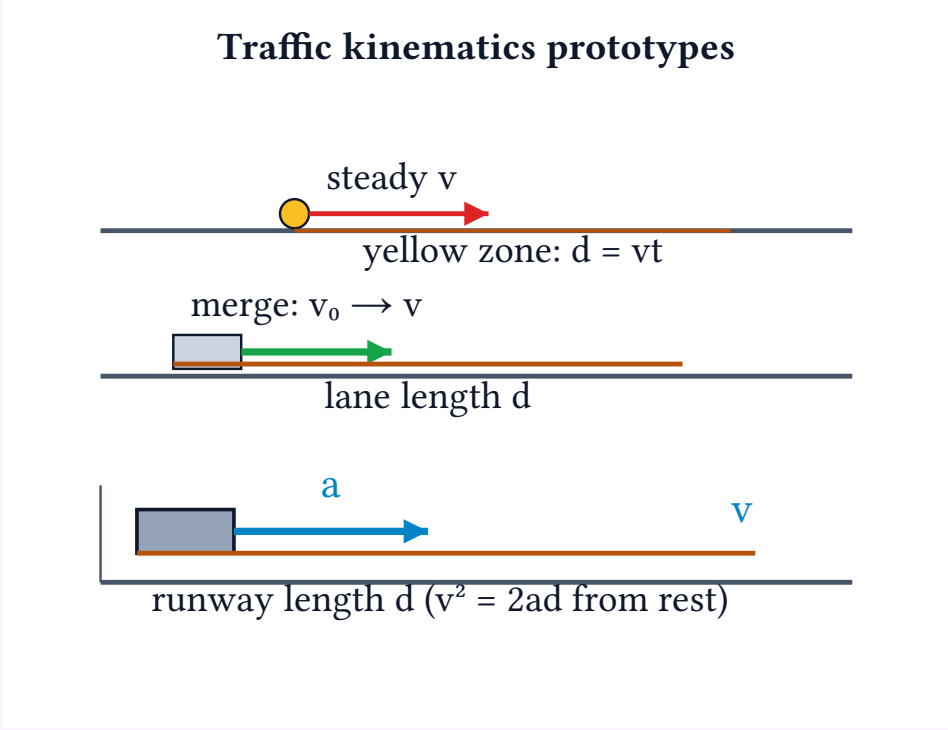
Free fall is motion under gravity alone in the vacuum model, with acceleration 9.81 m/s² downward near Earth.

prototype

A prototype is an early working version of a design, used to test whether the kinematics meet the plan.

Motion in traffic

- During the takeoff roll, the speed up connects the liftoff speed to how long that roll lasts.
- From rest, the runway length comes from v squared = 2 a d.
- Merging lane length and yellow light timing use the same kinematics with different knowns.



A 540 m prototype runway

- The trainer reaches 54.0 m/s from rest at 2.70 m/s².
- Runway length: (54.0 m/s)² / (2 × 2.70 m/s²) = 540 m.
- Roll time: 54.0 m/s / 2.70 m/s² = 20.0 s.

A shared lunar landing

- In vacuum a hammer and a feather share one free fall acceleration.
- The shared landing revised the older idea that a heavier object falls faster.
- People who design roads and runways use these same motion rules, and cart work stays inside a marked zone.



A vacuum tube in the classroom

- A steel nut and a feather drop from rest through 1.23 m in a vacuum tube.
- Free fall near Earth uses $g = 9.81\ \mathrm{m/s^2}$ downward for both objects.
- Both objects reach the bottom together.

A yellow light and a marked zone

- A prototype signal on Gateway Boulevard serves cars in uniform motion at 14.0 m/s.
- The intersection distance is 42.0 m.
- Find the yellow light time. If the cart setup differs from the approved procedure, stop and call the teacher.

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