King Saud University
College of Engineering
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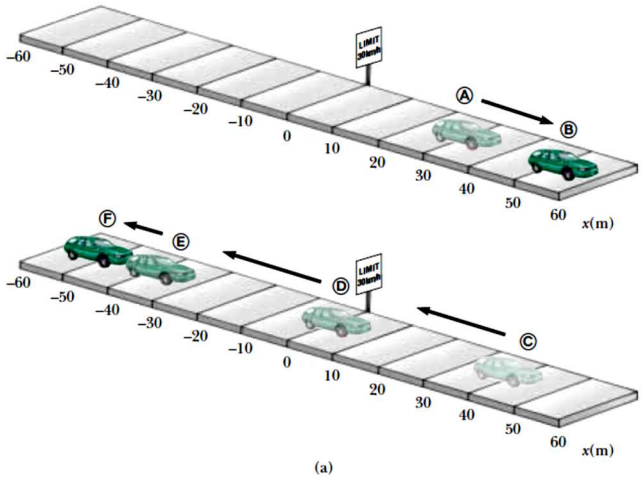
Physics I (PHYS1210)

Sheet (2)
Motion in One Dimension

1. Find the displacement, average velocity, and average speed of the car in the Figure between positions A and F.



(a)

Position of the Car at Various Times

Position	t(s)	x(m)
Ⓐ	0	30
Ⓑ	10	52
Ⓒ	20	38
Ⓓ	30	0
Ⓔ	40	−37
Ⓕ	50	−53

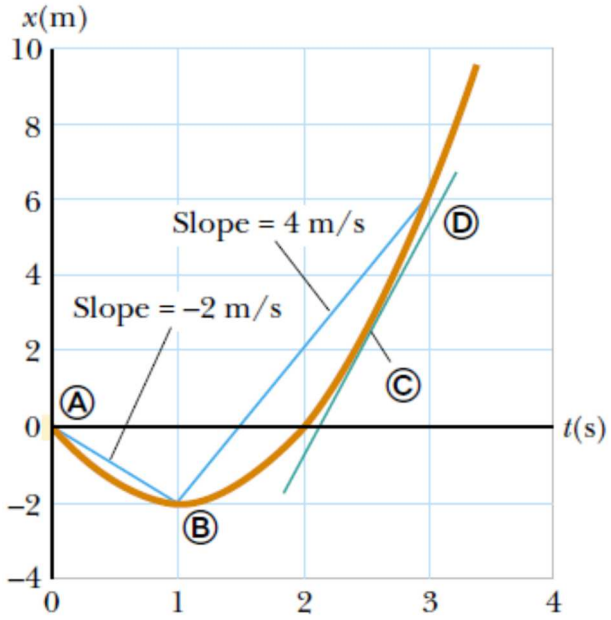
2. Consider the following one-dimensional motions: (A) A ball thrown directly upward rises to a highest point and falls back into the thrower's hand. (B) A race car starts from rest and speeds up to 100 m/s. (C) A spacecraft drifts through space at constant velocity. Are there any points in the motion of these objects at which the instantaneous velocity has the same value as the average velocity over the entire motion? If so, identify the point(s).

3. A particle moves along the x axis. Its position varies with time according to the expression $x = -4t + 2t^2$ where x is in meters and t is in seconds. The position–time graph for this motion is shown in Figure 2. Note that the particle moves in the negative x direction for the first second of motion, is momentarily at rest at the moment t = 1 s, and moves in the positive x direction at times t > 1 s.

(A) Determine the displacement of the particle in the time intervals t = 0 to t = 1 s and t = 1 s to t = 3 s.

(B) Calculate the average velocity during these two time intervals.

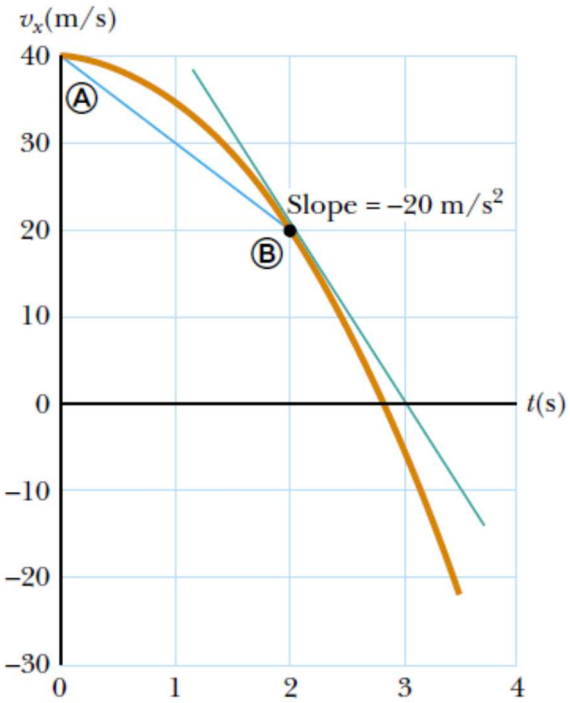
(C) Find the instantaneous velocity of the particle at t = 2.5 s.



4. The velocity of a particle moving along the x axis varies in time according to the expression $v_x = (40 - 5t^2)$ m/s, where t is in seconds.

   (A) Find the average acceleration in the time interval t = 0 to t = 2.0 s.

   (B) Determine the acceleration at t = 2.0 s.

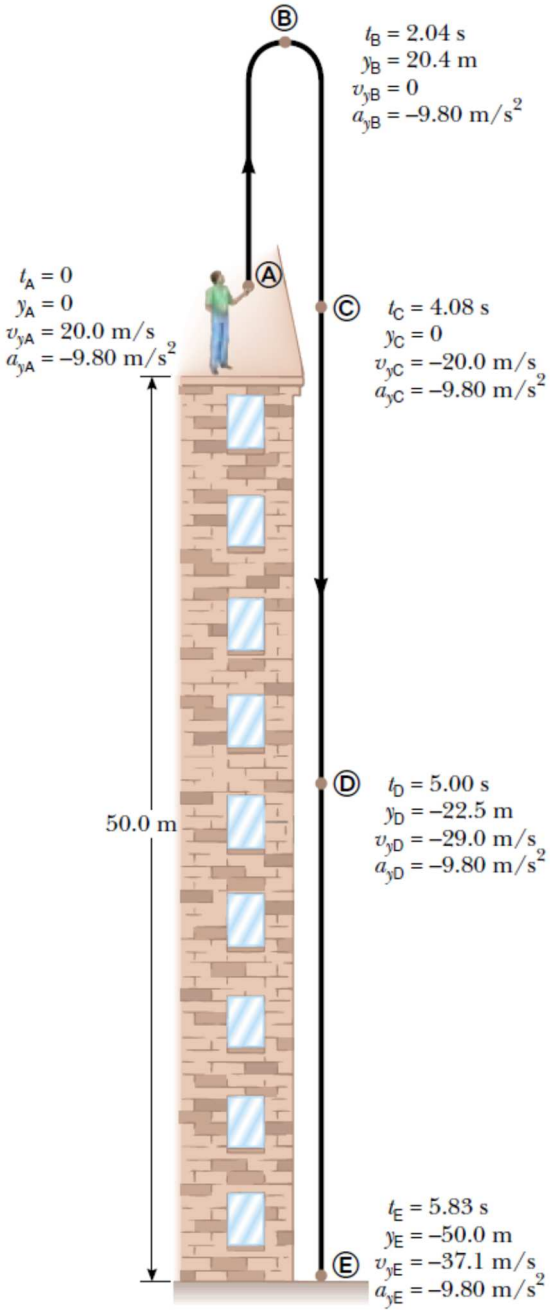


5. A jet lands on an aircraft carrier at 140 mi/h (≈ 63 m/s).
   (A) What is its acceleration (assumed constant) if it stops in 2.0 s due to an arresting cable that snags the airplane and brings it to a stop?
   (B) If the plane touches down at position $x_i=0$, what is the final position of the plane?
   (C) Suppose the plane lands on the deck of the aircraft carrier with a speed higher than 63 m/s but with the same acceleration as that calculated in part (A). How will that change the answer to part (B)?

6. A car traveling at a constant speed of 45.0 m/s passes a trooper hidden behind a billboard. One second after the speeding car passes the billboard, the trooper sets out from the billboard to catch it, accelerating at a constant rate of 3.00 m/s^2. How long does it take her to overtake the car?

7. A ball is tossed straight up at 25 m/s. Estimate its velocity at 1-s intervals.

8. A stone thrown from the top of a building is given an initial velocity of 20.0 m/s straight upward. The building is 50.0 m high, and the stone just misses the edge of the roof on its way down, as shown in Figure 2.14. Using $t_A = 0$ as the time the stone leaves the thrower's hand at position A, determine :
   (A) the time at which the stone reaches its maximum height,
   (B) the maximum height,
   (C) the time at which the stone returns to the height from which it was thrown,
   (D) the velocity of the stone at this instant, and (E) the velocity and position of the stone at t = 5.00 s.



9. The speed of a bullet as it travels down the barrel of a rifle toward the opening is given by $v = (-5 \times 10^7)\, t^2 + (3 \times 10^5)\, t$, where v is in meters per second and t is in seconds. The acceleration of the bullet just as it leaves the barrel is zero.
   a. Determine the acceleration and position of the bullet as a function of time when the bullet is in the barrel.
   b. Determine how long the bullet is accelerated.
   c. Find the speed at which the bullet leaves the barrel.
   d. What is the length of the barrel?