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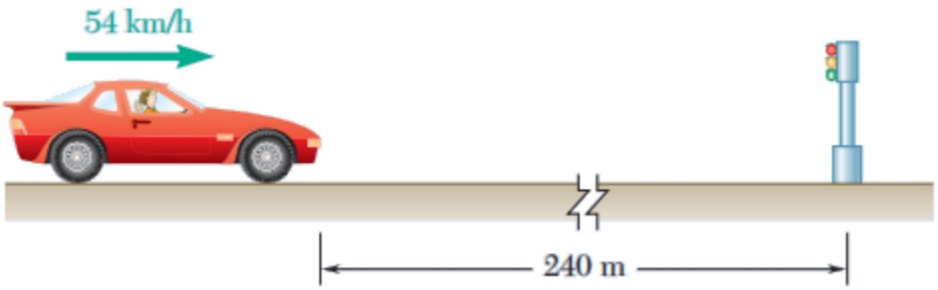
A motorist is traveling at 54 km/h when she observes that a traffic light 240 m ahead of her turns red. The traffic light is timed to stay red for 24 s. If the motorist wishes to pass the light without stopping just as it turns green again, determine (*a*) the required uniform deceleration of the car, (*b*) the speed of the car as it passes the light. **[Ans. (a) -0.417 m/s^2. (b) 18.00 km/h]**



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If the acceleration of an object is given by 4t-30, when t=0 v = 3m/s and x = -5m

a) Find the velocity
b) Find the distance

$$a = \frac{dv}{dt}$$

$$4t - 30 = \frac{dv}{dt}$$

$$\int_0^t 4t - 30\,dt = \int_3^v dv$$

$$2t^2 - 30t \Big|_0^t = v \Big|_3^v$$

$$2t^2 - 30t = v - 3$$

$$v = 2t^2 - 30t + 3$$

$$a = \frac{dv}{dt}$$

$$a = \frac{d^2x}{dt^2}$$

$$a = v\frac{dv}{dx}$$ X

$$v = \frac{dx}{dt}$$

$$2t^2 - 30t + 3 = \frac{dx}{dt}$$

$$\int_0^t 2t^2 - 30t + 3\,dt = \int_{-5}^x dx$$

$$\frac{2}{3}t^3 - 15t^2 + 3t \Big|_0^t = x \Big|_{-5}^x$$

$$\frac{2}{3}t^3 - 15t^2 + 3t = x - (-5)$$

$$x = \frac{2}{3}t^3 - 15t^2 + 3t - 5$$

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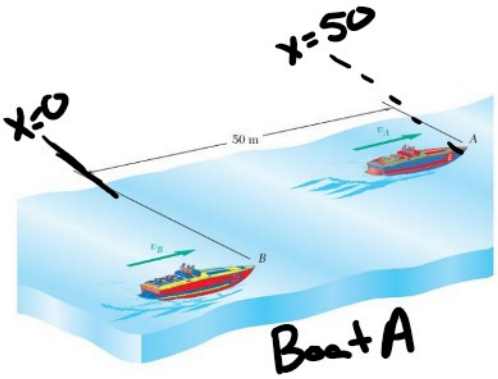
Example 2

In a boat race, boat A is leading boat B by 50m and both boats are traveling at a constant speed of 180km/h. At t = 0, the boats accelerate at constant rates. Knowing that when B passes A, t = 8s and v_a = 225 km/hr, determine

a) The acceleration of A
b) The acceleration of B



Boat A

$X_{0A} = 50$

$V_{0A} = 180 \frac{km}{hr}$

$= 50 \frac{m}{s}$

$V_{fA} = 225 \frac{km}{hr}$

$= 62.5 \frac{m}{s}$

Boat B

$X_{0B} = 0$

$V_{0B} = 50 \frac{m}{s}$

$V_f = V_0 + at$

a) $62.5 = 50 + a_A(8)$

$a_A = 1.56 \frac{m}{s^2}$

@ t = 8 seconds

$X_{A_f} = X_{B_f}$

$X_{A_f} = 50 + 50(8) + \frac{1}{2}(1.56)(8)^2$

$= 500\ m$

t = 8 seconds they pass

$X_{Bf} = X_{BG} + V_{0B}t + \frac{1}{2}a_0t^2$

$500 = 0 + 50(8) + \frac{1}{2}a_B(8)^2$

$a_B = 3.125 \frac{m}{s^2}$

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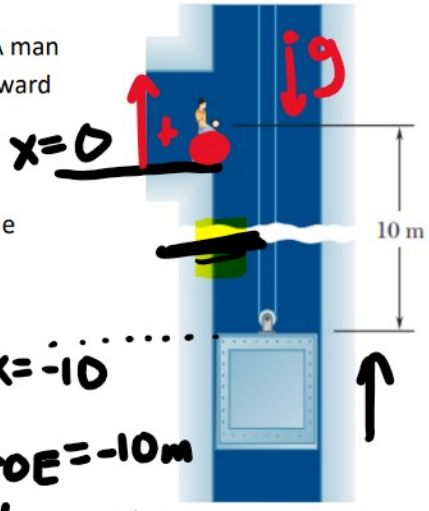
Example 3

An elevator is moving upward at a constant speed of 4 m/s. A man standing 10 m above the top of the elevator throws a ball upward with a speed of 3 m/s. Determine

a) When the ball will hit the elevator
b) Where the ball will hit the elevator with respect to the location of the man



$V_{oB} = 3\ m/s$
$a_B = -9.81\ m/s^2$
$X_{oB} = 0\ m$
$X_{fB} = ?$ (B)
$t = ?$ (A)

a) when they hit

$X_E = X_B$

$X_{oE} = -10\ m$
$V_{oE} = 4\ m/s$
$a_E = 0$
$V_{fE} = 4\ m/s$

0 constant v

$X_E = X_{oE} + V_{oE}t + \frac{1}{2}a_E t^2$ ←

=

$X_B = X_{oB} + V_{oB}t + \frac{1}{2}a_B t^2$

$X_{oE} + V_{oE}t = X_{oB} + V_{oB}t + \frac{1}{2}a_B t^2$

→ $-10 + 4t = 0 + 3t + \frac{1}{2}(-9.81)t^2$

$-4.905t^2 - t + 10 = 0$ ← solve this

solve w/ calc quadratic equation

$\frac{-b \pm \sqrt{b^2-4ac}}{2a}$

$t = -1.5$ or $t = 1.33s$

b) $X = -10 + 4(1.33) = -4.68\ m$