

EXAM 1

Name: _____ Student ID #: _____

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A high performance sports car is proceeding south along a straight stretch of I-15 at 48.0 m/s when the driver notices the flashing lights of a police car behind her. The sports car driver begins braking uniformly at 2.00 m/s^2 until the speed of the sports car is 34.0 m/s, just inside the legal limit for that stretch of road. The police car is traveling at 55.0 m/s towards the sports car and is 600. m behind it when the sports car starts braking.

A. [20 pts.] How far has the sports car traveled during the braking period and how long did it take the sports car driver to slow from 48.0 m/s to 34.0 m/s?

DIST. SPORTS CAR TRAVELED

$$v^2 = v_0^2 + 2a(x - x_0)$$

$$\text{DIST.} = x - x_0 = \frac{v^2 - v_0^2}{2a}$$

$$\text{DIST.} = \frac{(34 \text{ m/s})^2 - (48 \text{ m/s})^2}{(2)(-2 \text{ m/s}^2)} = \boxed{287 \text{ m}}$$

$$x - x_0 = \left(\frac{v + v_0}{2}\right) t$$

$$t = \frac{2(x - x_0)}{v + v_0} = \frac{(2)(287 \text{ m})}{82 \text{ m/s}}$$

$$t = 7.05 \text{ s}$$

B. [10 pts.] After the braking period, how far behind the sports car is the police car?

DIST POLICE CAR TRAVELED $(x - x_0) = v_{pc} t = (55 \text{ m/s})(7 \text{ s})$
DIST = 385 m

DIST POLICE CAR IS BEHIND SPORTS CAR.

$$600 \text{ m} - (385 - 287) \text{ m}$$

$$= \boxed{502 \text{ m}}$$

C. [10 pts.] When the sports car gets to 34.0 m/s, it stops braking and proceeds at a constant 34.0 m/s. After how many additional seconds does the police car catch up to the sports car?

LET $t_0 = 0$ AT END OF BRAKING PERIOD

LET $x_{opc} = 0$ AND $x_{osc} = 502 \text{ m}$. THEN AT TIME t

$$x_{pc} = x_{sc}$$

$$x_{opc} + v_{pc} t = x_{osc} + v_{sc} t$$

$$(v_{pc} - v_{sc}) t = x_{osc} - x_{opc}$$

$$t = \frac{x_{osc}}{v_{pc} - v_{sc}} = \frac{502 \text{ m}}{55 \text{ m/s} - 34 \text{ m/s}}$$

$$\boxed{t = 23.95}$$