Detailed Solutions to Problems #25, #33, & #109 of 505 Final EXAM ... for which original KEY was in error.

25. Two objects have different masses but the same kinetic energies. If you stop them with the same retarding force, which one will stop in the shorter distance?

a. the heavier one, because it has a larger inertia.
b. the lighter one, because it has less momentum.
c. the lighter one, because it requires less impulse to stop
(d.) both stop in the same distance, because of the work energy theorem.
e. both stop in the same distance because of the impulse/momentum theorem.
f. None of the above is completely true.

} NO. Both stop in same distance.

$\vec{F}\cdot\Delta\vec{X} = \Delta(KE)$: YES:

If $\vec{F}$ is same & $\Delta(KE)$ is same, then ΔX is same.

↳ False, because (d) is true.

↳ Relates $\Delta\vec{P}$ & Δt NOT $\Delta(KE)$ & ΔX, as required here.

{ Note: Although (d) is at worst a better answer than (e), (e) might also be arguably correct: Both theorems follow from NII, and either can provide this answer .... but WORK/ENERGY does so more directly here. }

33. You have a mass of 70 kg. How fast (in mph) would you have to run to have the same momentum as an 18-wheeler (m = 20,000 kg) rolling along at 1 mph? (1 mi = 1609 m.)

a. 8.9×10^5 m/s
b. 4.6×10^5 m/s
c. 7.8×10^3 m/s
d. 2.9×10^2 m/s
(e.) 1.3×10^2 m/s
f. None of the above answers is within 10 % of the correct result.

$mv = MV \Rightarrow v = \frac{M}{m}\cdot V = \frac{2\times10^4}{7\times10}\cdot\frac{1\,\text{mi}}{\text{hr}}\times\frac{1609\times10^3\,\text{m}}{\text{mi}}\times\frac{1\,\text{hr}}{3.6\times10^3\,\text{sec}}$

$v = \frac{(2)(1.609)\times10^{4+3-3-1}}{(7)(3.6)} = 0.13\times10^3\,\frac{\text{m}}{\text{sec}} = 130\,\text{m/sec}$

(e) IS CORRECT

109. A 30-kg crate is being pushed across a horizontal floor by a horizontal applied force of 270 N. If the coefficient of sliding friction is 0.4, and the speed is 7 m/s at time t = 0, how far does the crate move in the next nine seconds, most nearly ?

a) 27 m; b) 100 m; c) 200 m; (d) 250 m; e) 400 m;
f) None of these answers is within 10% of the correct answer.

$\vec{F}_{NET} = \vec{F}_{APP} + \vec{F}_{fr} = 270 - 120 = 150\,N = ma \Rightarrow a = \frac{150}{30} = 5\,\text{m/sec}^2$

$|\vec{F}_{fr}| = \mu|\vec{N}| = \mu|mg| = (0.4)(30)(10) = 120\,N$ (... directed opposite to motion: − sign)

$X(t=9) - X_0 = v_0 t + \frac{a}{2}t^2 = 7\cdot9 + \frac{5}{2}\cdot81 = 63 + 202.5 = 265.5\,\text{m}$

(d) is correct