$v = 2.5$ m/s

Momentum and Impulse:

① A. $\vec{x}_0 = \frac{m_1\vec{x}_{10} + m_2\vec{x}_{20}}{m_1 + m_2} = \frac{4.0kg(-12.0m) + 2.0kg(18m)}{6.0kg} = -2.0m$ $(-2m)$

B. $\vec{x}_1 = \frac{m_1\vec{x}_{11} + m_2\vec{x}_{21}}{m_1 + m_2} = \frac{4.0kg(-11.5m) + 2.0kg(16m)}{6.0kg} = -2.3\ m$ $(-2\frac{1}{3}m)$

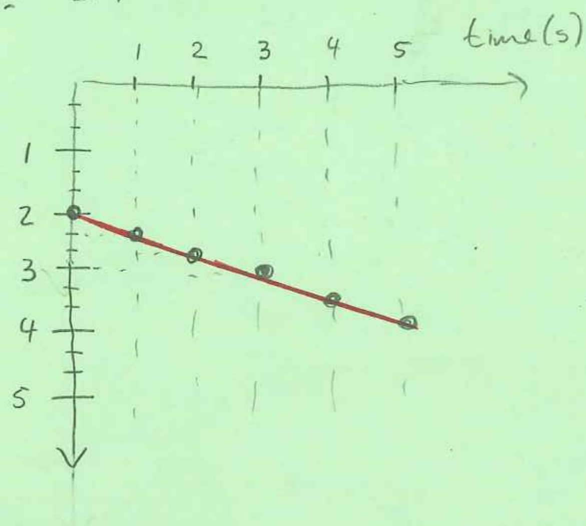
C. $\vec{x}_2 = \frac{m_1\vec{x}_{12} + m_2\vec{x}_{22}}{m_1 + m_2} = \frac{4.0kg(-11m) + 2.0kg(14m)}{6.0kg} = -2.7\ m$ $(-2\frac{2}{3}m)$

D. $\vec{x}_3 = -3.0^m$ (-3)

E. $\vec{x}_4 = -3.3m$ $(-3\frac{1}{3})$

F. $\vec{x}_5 = -3.7m$ $(-3\frac{2}{3})$

G.



H. slope $= \frac{-3\frac{2}{3}m - (-2m)}{5s - 0s} = -0.33\ m/s$ $(-\frac{1}{3}\ m/s)$

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② A. i moves to the left

B. Static friction between car's tires and surface of train cart.

C. Remains constant ($\vec{v} = 12\ m/s\ \hat{x}$)

D. i speed up

E. 14 m/s. * This turns out to be a much more difficult problem than I imagined it to be!! you can skip it!

F. 12 m/s

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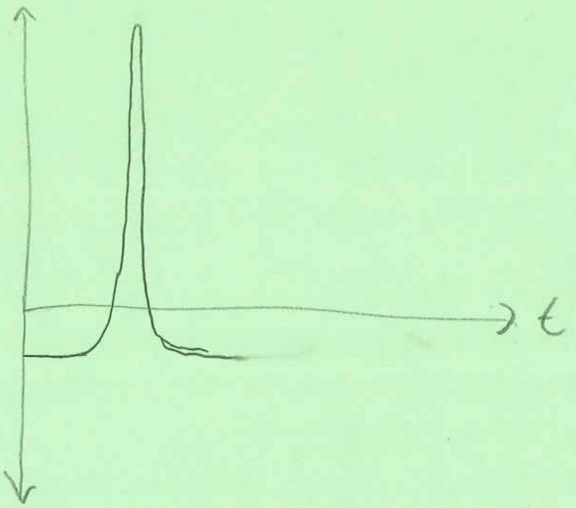
③ A. $\Delta\vec{v} = \vec{v} - \vec{v}_0 = 3.2\ m/s\ \hat{y} - (-4.0\ m/s\ \hat{y}) = 7.2\ m/s\ \hat{y}$

B. $\Delta\vec{p} = m\Delta\vec{v} = 1.584\ kgm/s\ \hat{y} \simeq 1.6\ kgm/s\ \hat{y}$

C. $\Sigma\vec{J} = \Delta\vec{p} = 1.584\ kgm/s\ \hat{y} \simeq 1.6Ns\ \hat{y}$

D. $\Sigma\vec{J} = \Sigma\vec{F}t \Rightarrow \Sigma\vec{F} = \frac{\Sigma\vec{J}}{t} = 26.4N\ \hat{y} \simeq 26N\ \hat{y}$

E.



F.

$$\Sigma \vec{F} = \vec{F}_N + \vec{F}_g$$
$$26.4N = \vec{F}_N - 2.156N$$
$$\vec{F}_N = 28.556N$$
$$\vec{F}_N = 29N\ \hat{y}$$

G. No.
- Initial momentum is down, Final momentum is up.
- Initial speed > Final speed
- The ball is acted upon by a NET EXTERNAL FORCE

H. Yes. The other object is Earth, it would experience exact opposite changes to its momentum, however since it is so massive the changes to its velocity are miniscule.

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4. In a collision the car strikes some object and comes to a stop. Assuming the same mass and initial speed, the change in momentum is the same whether the car crumples or not. However the car that crumples will come to rest more gradually, ⇒ in a longer time.

$$\Sigma \vec{F} t = \Delta \vec{p}$$
$$\Sigma \vec{F} = \frac{\Delta \vec{p}}{t} \Rightarrow \text{more time} \Rightarrow \text{LESS FORCE.}$$

LESS FORCE ⇒ SAFER!