Quiz Average **8.1** **Quiz High Score** **10**

PH 220 **Quiz # 09 (10 pts)** **Name** **Solution**

A method of testing if spaghetti is cooked involves throwing it against a wall and seeing if it sticks. Consider doing this with a pierogi. The mass of a pierogi is 0.033 kg. Assume the pierogi is thrown against the wall with an initial velocity of $5.70\ {}^{\mathrm{m}}/_{\mathrm{s}}\ \widehat{(+\imath)}$. Assume the time for the pierogi to come to rest and stick on the wall is 2.33×10^{-2} s. What is the magnitude and direction of the average force the wall exerts on the pierogi?

A. $\mathbf{8.07\ N\ \widehat{(-\imath)}}$ **C.** $0.19\ \mathrm{N}\ \widehat{(+\imath)}$

B. $8.07\ \mathrm{N}\ \widehat{(+\imath)}$ **D.** $0.19\ \mathrm{N}\ \widehat{(-\imath)}$

$$\overrightarrow{Impulse} = \overrightarrow{F_{ave}}\Delta t = \Delta\vec{p} = m(\overrightarrow{v_f} - \overrightarrow{v_0}) = -m\overrightarrow{v_0}$$

$$\overrightarrow{F_{ave}} = \frac{-m\overrightarrow{v_0}}{\Delta t} = -\frac{(0.033\ kg)(5.70\ {}^{m}/_{s}\ \widehat{(+\imath)})}{2.33\ x\ 10^{-2}\ s} = -\frac{0.188\ kg\ {}^{m}/_{s}\ \widehat{(+\imath)}}{2.33\ x\ 10^{-2}\ s}$$

$$\overrightarrow{F_{ave}} = -8.07\ N\ \widehat{(+\imath)} = 8.07\ N\ \widehat{(-\imath)}$$

So, the correct answer is A !

Sue has a mass ($m = 53.2$ kg) and is wearing roller skates (assume frictionless). She is at rest with her hands on a solid wall. She pushes on the wall with a force of 97.3 N. Her fingers remain in contact with the wall for a time 0.560 s. After she loses contact with the wall, assuming she is on a flat level horizontal surface, what is her speed moving away from the wall?

A. $0.960\ {}^{\mathrm{m}}/_{\mathrm{s}}$ **B.** $0.306\ {}^{\mathrm{m}}/_{\mathrm{s}}$ **C.** $\mathbf{1.02\ {}^{m}/_{s}}$ **D.** $16.3\ {}^{\mathrm{m}}/_{\mathrm{s}}$

$$Impulse = F_{ave}\Delta t = \Delta p = m(v_f - v_0) = mv_f$$

$$v_f = \frac{F_{ave}\Delta t}{m} = \frac{(97.3\ N)(0.560\ s)}{53.2\ kg} = 1.02\ {}^{m}/_{s}$$

So, the correct answer is C !

A rubber ball has a mass ($\mathrm{m} = 1.40\ \mathrm{kg}$). It is moving with a speed of $7.65\ ^{\mathrm{m}}/_{\mathrm{s}}$ downward. It impacts the floor and rebounds with a speed of $4.66\ ^{\mathrm{m}}/_{\mathrm{s}}$ upward. It made contact with the floor for a time of $0.098\ \mathrm{s}$. What is the average force the floor imparted on the ball during its contact with the floor?

A.	42.3 N	**C.**	58.9 N
B.	**176. N**	**D.**	105. N

$$F_{Ave}\Delta t = m(v_f - v_0)$$

$$F_{Ave} = \frac{m}{\Delta t}(v_f - v_0) = \frac{1.40\ kg}{0.098\ s}\left(4.66\ ^{m}/_{s} - \left(-7.65\ ^{m}/_{s}\right)\right) = \left(14.29\ ^{kg}/_{s}\right)\left(12.31\ ^{m}/_{s}\right)$$

$$F_{Ave} = 175.9\ N$$

So, the correct answer is B !

A sports car ($\mathrm{ms}_{\mathrm{Car\ \&\ Driver}} = 1350.\ \mathrm{kg}$) is traveling with a velocity $\overrightarrow{v_{S0}} = 38.7\ ^{\mathrm{m}}/_{\mathrm{s}}\ (\widehat{\mathrm{North}})$ when it collides with a truck ($\mathrm{mT}_{\mathrm{Truck\ \&\ Driver}} = 1740.\ \mathrm{kg}$) which is traveling with a velocity $\overrightarrow{v_{T0}} = 32.4\ ^{\mathrm{m}}/_{\mathrm{s}}\ (\widehat{\mathrm{South}})$. After the collision the two vehicles are stuck together. What is their final velocity?

A.	$35.2\ ^{\mathrm{m}}/_{\mathrm{s}}\ (\widehat{\mathrm{North}})$	**C.**	$35.2\ ^{\mathrm{m}}/_{\mathrm{s}}\ (\widehat{\mathrm{South}})$
B.	$1.34\ ^{\mathrm{m}}/_{\mathrm{s}}\ (\widehat{\mathrm{North}})$	**D.**	$\mathbf{1.34\ ^{m}/_{s}\ (\widehat{South})}$

$$\overrightarrow{p_{Before}} = mS_{Car}\overrightarrow{v_{S0}} + mT_{Truck}\overrightarrow{v_{T0}} = \overrightarrow{P_{After}} = (mS_{Car} + mT_{Truck})\overrightarrow{v_f}$$

$$\overrightarrow{v_f} = \frac{mS_{Car}\overrightarrow{v_{S0}} + mT_{Truck}\overrightarrow{v_{T0}}}{mS_{Car} + mT_{Truck}}$$

$$\overrightarrow{v_f} = \frac{(1350.\ kg)38.7\ ^{m}/_{s}\ (\widehat{North}) + (1740.\ kg)32.4\ ^{m}/_{s}\ (\widehat{South})}{1350.\ kg + 1740.\ kg}$$

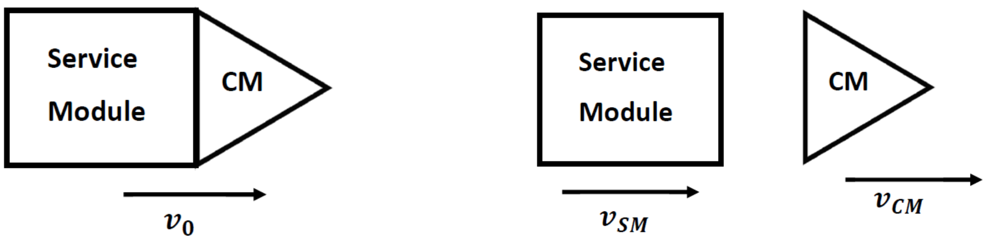
$$\overrightarrow{v_f} = \frac{(1350.\ kg)38.7\ ^{m}/_{s}\ (\widehat{North}) - (1740.\ kg)32.4\ ^{m}/_{s}\ (\widehat{North})}{1350.\ kg + 1740.\ kg}$$

$$\overrightarrow{v_f} = \frac{52,245\ kg\ ^{m}/_{s} - 56,376\ kg\ ^{m}/_{s}}{3090.\ kg}(\widehat{North}) = \frac{-4,131\ kg\ ^{m}/_{s}}{3090.\ kg}(\widehat{North})$$

$$\overrightarrow{v_f} = -1.34\ ^{m}/_{s}\ (\widehat{North}) = 1.34\ ^{m}/_{s}\ (\widehat{South})$$

So, the correct answer is D !

For Apollo 11 the Command Module (where the crew travelled) had a mass(including the crew) of $5.56 \text{ x } 10^3$ kg. The Service Module (where air, water, power, and other essential resources were for the trip) had a mass of $2.32 \text{ x } 10^4$ kg. Before the crew could reenter the Earth's atmosphere they had to separate from the Service Module. Explosive devices between the two modules were used. While the two modules were connected their velocity was $7.59 \text{ x } 10^3 \ \mathrm{m}/_{\mathrm{s}}$. After they were separated the Service Module had a speed of $7.13 \text{ x } 10^3 \ \mathrm{m}/_{\mathrm{s}}$. What was the speed of the Command Module? The situation is shown below:



A. $\mathbf{9.51 \text{ x } 10^3 \ m/_{s}}$

B. $6.90 \text{ x } 10^4 \ \mathrm{m}/_{\mathrm{s}}$

C. $2.28 \text{ x } 10^3 \ \mathrm{m}/_{\mathrm{s}}$

D. $1.65 \text{ x } 10^4 \ \mathrm{m}/_{\mathrm{s}}$

$$p_{Before} = (m_{SM} + m_{CM})v_0 = p_{After} = m_{SM}v_{SM} + m_{CM}v_{CM}$$

$$m_{CM}v_{CM} = (m_{SM} + m_{CM})v_0 - m_{SM}v_{SM}$$

$$v_{CM} = \frac{(m_{SM} + m_{CM})v_0 - m_{SM}v_{SM}}{m_{CM}}$$

$$v_{CM} = \frac{(2.32 \ x \ 10^4 \ kg + 5.56 \ x \ 10^3 \ kg) \ 7.59 \ x \ 10^3 \ ^m/_s - (2.32 \ x \ 10^4 \ kg)(7.13 \ x \ 10^3 \ ^m/_s)}{5.56 \ x \ 10^3 \ kg}$$

$$v_{CM} = \frac{2.183 \ x \ 10^8 \ kg \ ^m/_s - 1.654 \ x \ 10^8 \ kg \ ^m/_s}{5.56 \ x \ 10^3 \ kg} = \frac{5.290 \ x \ 10^7 \ kg \ ^m/_s}{5.56 \ x \ 10^3 \ kg}$$

$$v_{CM} = 9.514 \ x \ 10^3 \ ^m/_s$$

So, the correct answer is A !

Please send any comments or questions about this page to ddonovan@nmu.edu

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