

First Name: _____

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ADDBA

U08 - Summative Quiz #2

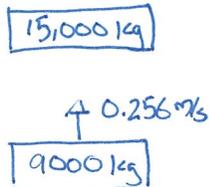
Momentum Collisions in 1-Dimension and 2-Dimensions

8 marks

PART 1 - MULTIPLE CHOICE (1 mark each; Possible half marks for work)

Q1: A 9000 kg rail flatcar moving at 0.256 m/s [N] encounters a stationary 15 000 kg boxcar on the same track. Based on the information in the above narrative, if the cars couple upon impact, what will be their combined velocity?

- a. 0.0960 m/s [N]
- b. 0.154 m/s [N]
- c. 0.192 m/s [N]
- d. 0.128 m/s [N]



$$P_i = P_f$$

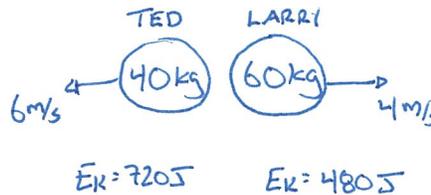
$$(9000\text{kg})(0.256\text{m/s}) + (15000\text{kg})(0\text{m/s}) = P_f$$

$$2304 = 24,000 v_f$$

$$v_f = 0.096\text{ m/s [N]}$$

Q2: Two boys, Ted and Larry, initially at rest, push each other apart on a frictionless surface. Ted has a mass of 40kg and Larry has a mass of 60kg. After the boys push each other apart, Ted has a speed of 6m/s. As the boys move apart, Larry has

- ~~a.~~ More momentum than Ted
- ~~b.~~ Less momentum than Ted
- c. More kinetic energy than Ted
- d. Less kinetic energy than Ted



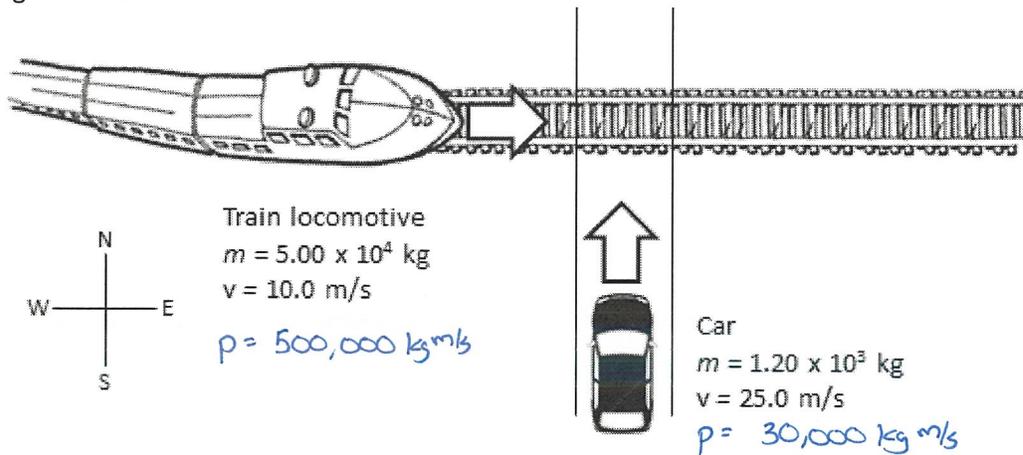
Q3: An empty freight car of mass m coasts along a track at 2.00 m/s until it couples to a stationary freight car of mass $2m$. The final speed of the two freight cars immediately after collision is

- a. 1.50 m/s
- b. 1.33 m/s
- c. 1.15 m/s
- d. 0.667 m/s

$$P_i = mv$$

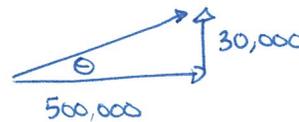
$$P_f = (3m)(\frac{1}{3}v)$$

Q4: In a movie stunt, a car and a train locomotive intentionally crash. The collision is illustrated in the diagram below.



Immediately before the collision, the momentum of the locomotive-car system is

- a. $5.01 \times 10^5 \text{ kg} \cdot \text{m/s}$, 68.2° north of east
- b. $5.01 \times 10^5 \text{ kg} \cdot \text{m/s}$, 3.43° north of east
- c. $5.30 \times 10^5 \text{ kg} \cdot \text{m/s}$, 68.2° north of east
- d. $5.30 \times 10^5 \text{ kg} \cdot \text{m/s}$, 3.43° north of east



$$a^2 + b^2 = c^2$$

$$c = 500,899 \text{ kg m/s}$$

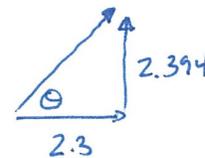
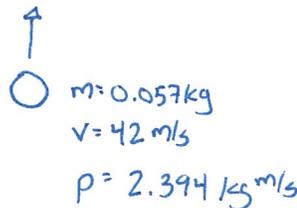
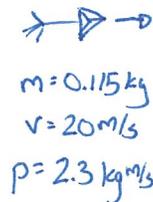
$$= 5.01 \times 10^5 \text{ kg m/s}$$

$$\tan \theta = \frac{a}{b}$$

$$\theta = 3.43^\circ \text{ N of E}$$

Q5: A 0.115 kg arrow travelling east at 20 m/s imbeds itself in a 0.057 kg tennis ball moving north at 42 m/s . The direction of the ball-and-arrow combination after impact is

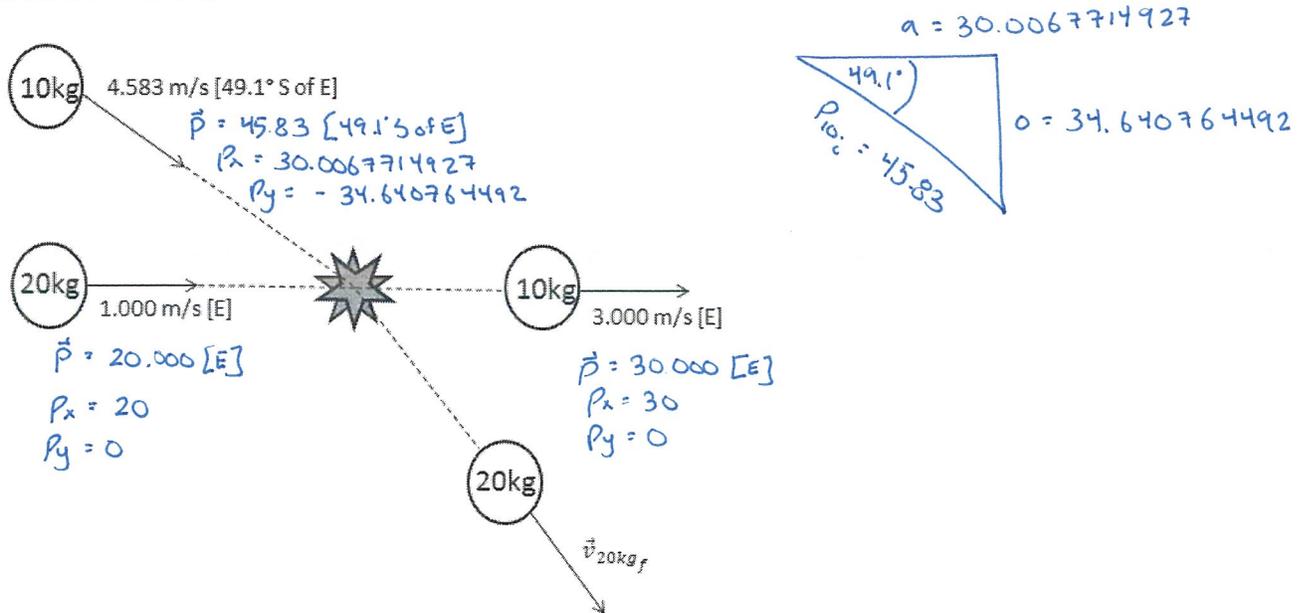
- a. 46° N of E
- b. 46° E of N
- c. 25° E of N
- d. 25° N of E



$$\tan \theta = \frac{a}{b}$$

$$\theta = 46.14^\circ \text{ N of E}$$

Q6: A 10kg ball travelling at 4.583 m/s [49.1° S of E] strikes a 20kg ball travelling 1.000 m/s [E], as depicted below. The 10kg ball rebounds at 3.000 m/s [E]. What is the speed of the 20kg ball immediately after the collision?



x-comp

$$P_i = P_f$$

$$30.0067714927 + 20 = 30 + P_{20fx}$$

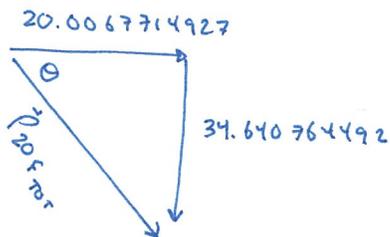
$$P_{20fx} = 20.0067714927$$

y-comp

$$P_i = P_f$$

$$-34.640764492 + 0 = 0 + P_{20fy}$$

$$P_{20fy} = -34.640764492$$



$$a^2 + b^2 = c^2$$

$$|\vec{P}_{20f_{TOT}}| = 40.0031682514 \text{ kg m/s}$$

$$|\vec{V}_{20f}| = 2.00015841257 \text{ m/s}$$

Unnecessary

$$\tan \theta = \frac{b}{a}$$

$$\theta = 59.9914204727^\circ \text{ S of E}$$

Unnecessary

$$\left. \begin{array}{l} E_{ki} = 115.019445 \text{ J} \\ E_{kf} = 85.0 \text{ J} \end{array} \right\} \text{Inelastic}$$

Answer:

2 . 0 0