## Quiz 08: Chapter 15

Due: Tuesday 20 Feb 24
Examine the solved problem below. There are four errors in the solution below. Your task is to locate and identify those errors, then correct them and calculate the proper result. If the same error occurs more than once, only count it as a single error, even if you have to correct it in more than one instance.

Each correctly identified error is worth 4 points, and the re-calculated results are worth 4 points as well. You must save your work in pdf format and submit via the Quiz 08 Assignment in the Chapter 15 folder of the in the Quizzes folder in the Online Classroom in Blackboard. Please do not use any other file format than pdf.

Two smooth billiard balls $A$ and $B$ have equal masses ( $m=200 \mathrm{~g}$ ). If $A$ strikes $B$ with a velocity $v_{1}=2 \frac{\mathrm{~m}}{\mathrm{~s}}$ as shown, determine the final velocity of each ball just after the collision. Ball $B$ is initially at rest and the coefficient of restitution $e=0.75$.
A) Write the velocity vector $\overrightarrow{v_{1}}$ in terms of its Cartesian components:

$$
\begin{aligned}
& v_{1 x}=-v_{1} \cos 40^{\circ}=\left(2 \frac{\mathrm{~m}}{\mathrm{~s}}\right) \cos 40^{\circ}=1.53 \frac{\mathrm{~m}}{\mathrm{~s}} \\
& v_{1 y}=-v_{1} \sin 40^{\circ}=\left(2 \frac{\mathrm{~m}}{\mathrm{~s}}\right) \sin 40^{\circ}=1.29 \frac{\mathrm{~m}}{\mathrm{~s}}
\end{aligned}
$$

B) Conserve momentum and apply the coefficient of restitution in the $x$-direction:

$$
\begin{array}{ll}
m v_{1 x}=m v_{A x}+m v_{B x} \\
1.53=v_{A x}+v_{B x} & e=\frac{v_{B x}-v_{A x}}{v_{1 x}} \\
0.75 v_{1 x}=v_{B x}-v_{A x}
\end{array}
$$


C) Solve the system for $v_{A x}$ and $v_{B x}$ :

$$
\begin{array}{ll}
v_{A x}+v_{B x}=1.53 \frac{\mathrm{~m}}{\mathrm{~s}} & 2 v_{B x}=2.28 \frac{\mathrm{~m}}{\mathrm{~s}} \\
-v_{A x}+v_{B x}=0.75 \frac{\mathrm{~m}}{\mathrm{~s}} & v_{B x}=1.14 \frac{\mathrm{~m}}{\mathrm{~s}}
\end{array}
$$

$$
\begin{aligned}
& v_{A x}=1.53 \frac{\mathrm{~m}}{\mathrm{~s}}-v_{B x} \\
& v_{A x}=1.53-1.14=0.39 \frac{\mathrm{~m}}{\mathrm{~s}}
\end{aligned}
$$

D) Conserve momentum and apply the coefficient of restitution in the $y$-direction:

$$
\begin{array}{lll} 
& e=\frac{v_{B y}-v_{A y}}{v_{1 y}} & 0.75 v_{1 y}=v_{B y}-v_{A y} \\
1.29=v_{A y}+v_{B y} & & \\
\text { E) Solve the system for } v_{A y} \text { and } v_{B y}: & 2 v_{B y}=2.26 \frac{\mathrm{~m}}{\mathrm{~s}} & v_{A y}=1.29 \frac{\mathrm{~m}}{\mathrm{~s}}-v_{B y} \\
v_{A y}+v_{B y}=1.29 \frac{\mathrm{~m}}{\mathrm{~s}} & v_{B y}=1.13 \frac{\mathrm{~m}}{\mathrm{~s}} & v_{A y}=1.29-1.13=0.16 \frac{\mathrm{~m}}{\mathrm{~s}}
\end{array}
$$

F) Express the velocities $\overrightarrow{v_{A}}$ and $\overrightarrow{v_{B}}$ in terms of their Cartesian components:

$$
\begin{aligned}
& \overrightarrow{v_{A}}=[0.39 \hat{\mathbf{1}}+0.16 \hat{\mathbf{j}}] \frac{\mathrm{m}}{\mathrm{~s}} \\
& \overrightarrow{v_{B}}=[1.13 \hat{\mathbf{1}}+1.14 \hat{\mathbf{\jmath}}] \frac{\mathrm{m}}{\mathrm{~s}}
\end{aligned}
$$

