**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ PDG: \_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Experiment 1**

Glider A is launched towards and collides ***inelastically*** with a stationary glider B on a smooth plane. After the collision, glider A reverses direction. The mass of glider A, m is one fifth the mass of glider B.

Given the conditions above, attempt the Java simulation with different values of initial velocities.

B

BA

AA

AA

1. In the space provided, draw separate free-body diagrams for each glider and for the system S of the two gliders at an instant during the collision.

R

R

R

Free-body diagram for glider B

Free-body diagram for glider A

Free-body diagram for system S

A

FB

FA

S

B

MSg

MBg

MAg

1. How does the net force on glider A, FA, compare to the net force on glider B, FB, at this instant? Discuss both the magnitude and direction of the net force.

The magnitude of FA is ~~greater than~~ / equal to / ~~smaller than~~ the magnitude of FB.

The direction of FA is ~~same as~~ / opposite to the direction of FB.

1. The F-t graph (Figure 1) below shows the net force FA acting on glider A during the collision. On Figure 1, sketch the variation with time t of net force FB acting on glider B.

F/N

t/s

Figure 1

1. What can you say about the net force acting on glider B
2. before collision zero
3. during collision FB (equal to FA)

(iii) after collision zero

1. Now, consider the time interval while the gliders are still in contact during the collision to be Δt. How does the product FA Δt compare to the product FB Δt? Discuss this in terms of the magnitude and direction.

Since FA equal to FB in magnitude and opposite in direction, FA Δt and FB Δt are equal in magnitude and opposite in direction.

1. Apply Newton’s second law (for constant mass) to each of the gliders to compare the change in momentum (Δp=mΔv) of gliders A and B during the collision. Discuss both the magnitude and direction of the change in momentum.

The magnitude of the change in momentum of glider A is ~~greater than~~ / equal to / ~~smaller than~~ the magnitude of the change in momentum of glider B.

The direction of the change in momentum of glider Ais ~~same as~~ / opposite to the direction of the change in momentum of glider B.

1. The area under an F-t graph represents the change in momentum of a body. Hence, on Figure 2, sketch corresponding momentum-time graphs for
2. glider A
3. glider B

momentum/N s

time/s

Figure 2

B

A

1. Describe the momentum-time graph for glider B after the collision.

The momentum-time graph for glider B after collision is a straight horizontal line.

1. Using your answers to D (iii) and H, what can you say about the velocity of glider B during this period?

The velocity of glider B during this period is constant. (No net force, no change in momentum)

**Experiment 2**

AA

C

C

AA

Glider A is now launched with a momentum of 200 kg m s-1 towards glider C which is moving in the opposite direction with a momentum of 50 kg m s­-1. After the inelastic collision, glider A reverses direction. The mass of glider A is 25 kg and the mass of glider C is 40 kg. The coefficient of restitution e for this collision is 0.897.

1. In the space provided, draw separate free-body diagrams for each glider and for the system S of the two gliders at an instant during the collision.

R

Free-body diagram for system S

Free-body diagram for glider C

Free-body diagram for glider A

R

R

FC

FA

S

C

A

MSg

MCg

MAg

(B) How does the net force on glider A, FA, compare to the net force on glider C, FC, at this instant? Discuss both the magnitude and direction of the net force.

The magnitude of FA is ~~greater than~~ / equal to / ~~smaller than~~ the magnitude of FC.

The direction of FA is ~~same as~~ / opposite to the direction of FC.

1. Discuss the magnitude and direction of the change in momentum.

The magnitude of change in momentum of glider A is ~~greater than~~ / equal to / ~~smaller than~~ the magnitude of change in momentum of glider C.

The direction of change in momentum of glider Ais ~~same as~~ / opposite to the direction of change in momentum of glider C.

1. Using values obtained from the Java simulation, fill in the final momentum of glider A and complete the momentum-time graph of glider C with an appropriate value.

time/ms

momentum/kg m s-1

glider C

glider A

0

5

-5

0

100

200

-100

final momentum of A = \_-70\_ kg m s-1\_

 -1 0 1 time/ms

200

100

0

-100

200

100

0

-100

100

0

-100

-70

Momentum/kg m s-1

glider C

glider A

220

**200**

**100**

**0**

**-100**

**Thinking Questions**

Comment on the velocities of the bodies after they collide elastically for the following situations:

1. 2 identical masses colliding.

2. A tennis ball incident on a wall

3. A bowling ball incident on a stationary table tennis ball.

Use the Java simulation to confirm your results.

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