Keeping Track of Momentum 2
Hit and Bounce Collisions

Apprentice Difficulty Level
Question Group 1
Question 1

A red cart is moving rightward with a momentum of 60 kg•cm/s when it collides with a blue cart that is initially at rest. The collision causes the red cart to slow down and the blue cart to be set in motion with a momentum of 40 kg•cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 2

A red cart is moving rightward with a momentum of 80 kg•cm/s when it collides with a blue cart that is initially at rest. The collision causes the red cart to slow down and the blue cart to be set in motion with a momentum of 20 kg•cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 2
Question 3
A red cart is moving rightward with a momentum of 60 kg•cm/s when it collides with a blue cart that is also moving rightward with a momentum of 30 kg•cm/s. The collision causes the red cart to slow down and the blue cart to increase its momentum to 50 kg•cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 4
A red cart is moving rightward with a momentum of 80 kg•cm/s when it collides with a blue cart that is also moving rightward with a momentum of 40 kg•cm/s. The collision causes the red cart to slow down and the blue cart to increase its momentum to 70 kg•cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 3
Question 5
A red cart is moving rightward with a momentum of 40 kg•cm/s when it collides with a blue cart that is also moving rightward with a momentum of 60 kg•cm/s. The collision causes the red cart to lose 15 kg•cm/s of momentum.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 6
A red cart is moving rightward with a momentum of 60 kg•cm/s when it collides with a blue cart that is also moving rightward with a momentum of 80 kg•cm/s. The collision causes the red cart to lose 25 kg•cm/s of momentum.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 4
Question 7
A red cart is moving rightward with a momentum of 100 kg•cm/s when it collides with a blue cart that is also moving rightward with a momentum of 60 kg•cm/s. The collision causes the red cart to slow down and the blue cart to increase its momentum to 90 kg•cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 8
A red cart is moving rightward with a momentum of 100 kg•cm/s when it collides with a blue cart that is also moving rightward with a momentum of 80 kg•cm/s. The collision causes the red cart to slow down and the blue cart to increase its momentum to 140 kg•cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 5

Question 9

Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	80	60	-20
Blue Cart	0	20	+20
System	80	80	0

The momentum of the red cart and the blue cart does not change.
The momentum of the red cart equals the momentum of the blue cart.
The system momentum before the collision equals the system momentum after the collision.
The momentum of the red cart and the momentum of the blue cart equal the total momentum.
The momentum of the red cart is the same before and after the collision; the same is true of the blue cart.

Question 10

Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	60	45	-15
Blue Cart	0	15	+15
System	60	60	0

The momentum of the red cart and the blue cart does not change.
The momentum of the red cart equals the momentum of the blue cart.
The system momentum before the collision equals the system momentum after the collision.
The momentum of the red cart and the momentum of the blue cart equal the total momentum.
The momentum of the red cart is the same before and after the collision; the same is true of the blue cart.

Question Group 6
Question 11
Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	80	60	-20
Blue Cart	0	20	+20
System	80	80	0

Neither the red cart nor the blue cart have a momentum change.
The momentum of the red cart and the blue cart does not change.
The momentum of the red cart is equal to the momentum of the blue cart.
The momentum lost by the red cart is equal to the momentum gained by the blue cart.
The momentum of the red cart is equal and opposite to the momentum of the blue cart.

Question 12
Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	60	45	-15
Blue Cart	0	15	+15
System	60	60	0

Neither the red cart nor the blue cart have a momentum change.
The momentum of the red cart and the blue cart does not change.
The momentum of the red cart is equal to the momentum of the blue cart.
The momentum lost by the red cart is equal to the momentum gained by the blue cart.
The momentum of the red cart is equal and opposite to the momentum of the blue cart.

Master Difficulty Level
Question Group 7
Question 13
A 0.50-kg red cart is moving rightward with a speed of 50 cm/s when it collides with a 0.50-kg blue cart that is initially at rest. After the collision, the blue cart begins moving rightward with a speed of 40 cm/s. The red cart is still moving rightward but has slowed down to a speed of 10 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 14
A 0.50-kg red cart is moving rightward with a speed of 60 cm/s when it collides with a 0.50-kg blue cart that is initially at rest. After the collision, the blue cart begins moving rightward with a speed of 40 cm/s. The red cart is still moving rightward but has slowed down to a speed of 20 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 8
Question 15
A 1.00-kg red cart is moving rightward with a speed of 60 cm/s when it collides with a 0.50-kg blue cart that is initially at rest. After the collision, the blue cart begins moving rightward with a speed of 80 cm/s. The red cart is still moving rightward but has slowed down to a speed of 20 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 16
A 1.00-kg red cart is moving rightward with a speed of 40 cm/s when it collides with a 0.50-kg blue cart that is initially at rest. After the collision, the blue cart begins moving rightward with a speed of 50 cm/s. The red cart is still moving rightward but has slowed down to a speed of 15 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 9
Question 17
A 0.50-kg red cart is moving rightward with a speed of 60 cm/s when it collides with a 1.00-kg blue cart that is initially at rest. After the collision, the blue cart begins moving rightward with a speed of 24 cm/s. The red cart is still moving rightward but has slowed down to a speed of 12 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 18
A 0.50-kg red cart is moving rightward with a speed of 80 cm/s when it collides with a 1.00-kg blue cart that is initially at rest. After the collision, the blue cart begins moving rightward with a speed of 30 cm/s. The red cart is still moving rightward but has slowed down to a speed of 20 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 10
Question 19
A 1.00-kg red cart is moving rightward with a speed of 60 cm/s when it collides with a 2.00-kg blue cart that is initially at rest. After the collision, the blue cart begins moving rightward with a speed of 25 cm/s. The red cart is still moving rightward but has slowed down to a speed of 10 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 20
A 1.00-kg red cart is moving rightward with a speed of 40 cm/s when it collides with a 2.00-kg blue cart that is initially at rest. After the collision, the blue cart begins moving rightward with a speed of 15 cm/s. The red cart is still moving rightward but has slowed down to a speed of 10 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 11

Question 21

Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	80	60	-20
Blue Cart	0	20	+20
System	80	80	0

The momentum of the red cart and the blue cart does not change.
The momentum of the red cart equals the momentum of the blue cart.
The system momentum before the collision equals the system momentum after the collision.
The momentum of the red cart and the momentum of the blue cart equal the total momentum.
The momentum of the red cart is the same before and after the collision; the same is true of the blue cart.

Question 22

Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	60	45	-15
Blue Cart	0	15	+15
System	60	60	0

The momentum of the red cart and the blue cart does not change.
The momentum of the red cart equals the momentum of the blue cart.
The system momentum before the collision equals the system momentum after the collision.
The momentum of the red cart and the momentum of the blue cart equal the total momentum.
The momentum of the red cart is the same before and after the collision; the same is true of the blue cart.

Question Group 12

Question 23

Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	80	60	-20
Blue Cart	0	20	+20
System	80	80	0

Neither the red cart nor the blue cart have a momentum change.
The momentum of the red cart and the blue cart does not change.
The momentum of the red cart is equal to the momentum of the blue cart.
The momentum lost by the red cart is equal to the momentum gained by the blue cart.
The momentum of the red cart is equal and opposite to the momentum of the blue cart.

Question 24

Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	60	45	-15
Blue Cart	0	15	+15
System	60	60	0

Neither the red cart nor the blue cart have a momentum change.
The momentum of the red cart and the blue cart does not change.
The momentum of the red cart is equal to the momentum of the blue cart.
The momentum lost by the red cart is equal to the momentum gained by the blue cart.
The momentum of the red cart is equal and opposite to the momentum of the blue cart.

Wizard Difficulty Level
Question Group 13
Question 25
A 0.50-kg red cart is moving rightward with a speed of 40.0 cm/s when it collides with a 1.00-kg blue cart that is moving leftward with a speed of 20.0 cm/s. After the collision, the red cart moves leftward with a speed of 30.0 cm/s and the blue cart moves rightward with a speed of 15.0 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 26
A 0.50-kg red cart is moving rightward with a speed of 60.0 cm/s when it collides with a 1.00-kg blue cart that is moving leftward with a speed of 30.0 cm/s. After the collision, the red cart moves leftward with a speed of 40.0 cm/s and the blue cart moves rightward with a speed of 20.0 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 14
Question 27
A 0.50-kg red cart is moving rightward with a speed of 100.0 cm/s when it collides with a 1.00-kg blue cart that is moving leftward with a speed of 20.0 cm/s. After the collision, the red cart continues moving rightward with a speed of 10.0 cm/s and the blue cart moves rightward with a speed of 25.0 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 28
A 0.50-kg red cart is moving rightward with a speed of 100.0 cm/s when it collides with a 1.00-kg blue cart that is moving leftward with a speed of 30.0 cm/s. After the collision, the red cart continues moving rightward with a speed of 10.0 cm/s and the blue cart moves rightward with a speed of 15.0 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 15
Question 29
A 1.00-kg red cart is moving rightward with a speed of 40.0 cm/s when it collides with a 0.50-kg blue cart that is moving rightward with a speed of 20.0 cm/s. After the collision, the red cart moves rightward but slows down to a speed of 30.0 cm/s while the blue cart speeds up of to 40.0 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 30
A 1.00-kg red cart is moving rightward with a speed of 50.0 cm/s when it collides with a 0.50-kg blue cart that is moving rightward with a speed of 30.0 cm/s. After the collision, the red cart moves rightward but slows down to a speed of 40.0 cm/s while the blue cart speeds up of to 50.0 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 16
Question 31
A 1.50-kg red cart is moving rightward with a speed of 40.0 cm/s when it collides with a 0.50-kg blue cart that is moving rightward with a speed of 20.0 cm/s. After the collision, the red cart moves rightward but slows down to a speed of 30.0 cm/s while the blue cart speeds up of to 50.0 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question 32
A 1.50-kg red cart is moving rightward with a speed of 60.0 cm/s when it collides with a 0.50-kg blue cart that is moving rightward with a speed of 40.0 cm/s. After the collision, the red cart moves rightward but slows down to a speed of 50.0 cm/s while the blue cart speeds up of to 70.0 cm/s.

Enter the momentum values (in kg•cm/s) of each individual cart and of the system of two carts before and after the collision. Also indicate the change in momentum of each cart.

	Before Collision	After Collision	Momentum Change
Red Cart			
Blue Cart			
System			

Question Group 17
Question33
Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	90	70	-20
Blue Cart	30	50	+20
System	120	120	0

The momentum of the red cart and the blue cart does not change.
The momentum of the red cart equals the momentum of the blue cart.
The system momentum before the collision equals the system momentum after the collision.
The momentum of the red cart and the momentum of the blue cart equal the total momentum.
The momentum of the red cart is the same before and after the collision; the same is true of the blue cart.

Question 34
Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	150	80	-70
Blue Cart	-30	40	+70
System	120	120	0

The momentum of the red cart and the blue cart does not change.
The momentum of the red cart equals the momentum of the blue cart.
The system momentum before the collision equals the system momentum after the collision.
The momentum of the red cart and the momentum of the blue cart equal the total momentum.
The momentum of the red cart is the same before and after the collision; the same is true of the blue cart.

Question Group 18
Question 35

Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	90	70	-20
Blue Cart	30	50	+20
System	120	120	0

Neither the red cart nor the blue cart have a momentum change.
The momentum of the red cart and the blue cart does not change.
The momentum of the red cart is equal to the momentum of the blue cart.
The momentum of the red cart is equal and opposite to the momentum of the blue cart.
The momentum change of the red cart is equal and opposite to the momentum change of the blue cart.

Question 36

Consider the following completed table for the collision between a red cart and a blue cart. Two of the cells of the table have been highlighted. Identify the statement that best describes this data.

	Before Collision	After Collision	Momentum Change
Red Cart	150	80	-70
Blue Cart	-30	40	+70
System	120	120	0

Neither the red cart nor the blue cart have a momentum change.
The momentum of the red cart and the blue cart does not change.
The momentum of the red cart is equal to the momentum of the blue cart.
The momentum of the red cart is equal and opposite to the momentum of the blue cart.
The momentum change of the red cart is equal and opposite to the momentum change of the blue cart.