Phy cpt 3

2022年9月13日 星期二 上午7:15

Matriculation Physics: Momentum and Impulse (Q4)
Pek Explains Physics

Example 1

A 500 g squash ball is travelling on its right with a speed of 5 ms^{-1}. It then hits the wall and bounce back with the same speed in 0.3 s. Find the

a) momentum of the squash ball **(Answer: 2.5 kg ms^{-1})**
b) impulse of the ball **(Answer: - 5 kg ms^{-1})**
c) impulsive force on the ball **(Answer: -16.67 N)**

Example 2

A 0.20 kg tennis ball strikes the wall horizontally with a speed of 100 m s^{-1} and it bounces off with a speed of 70 m s^{-1} in the opposite direction.

a) Calculate the **magnitude** of impulse delivered to the ball by the wall, **(Answer: 34 Ns)**
b) If the ball is in contact with the wall for 10 ms, determine the **magnitude** of average force exerted by the wall on the ball. **(Answer: 3400 N)**

Example 3

A baseball with a mass of 0.2 kg is moving towards a player with a speed of 50 ms^{-1}. The player then hits the ball with his bat. The bat exerts an average force of 8.0 x 10^3 N on the ball for 1.6 ms. The average force is directed in the opposite direction to the initial velocity of the ball. Calculate the final speed of the ball. (Assume that *u* is to the left and *F* is to the right)

(Answer: 14.0 ms^{-1})

Chapter 03 Physics

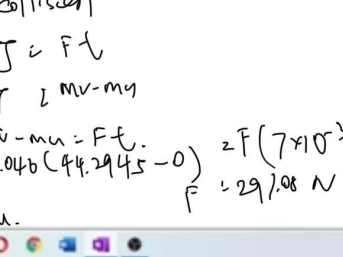
Exercise 3.1 :

1. A steel ball with mass 40.0 g is dropped from a height of 2.00 m onto a horizontal steel slab. The ball rebounds to a height of 1.60 m.
   a. Calculate the impulse delivered to the ball during impact.
   b. If the ball is in contact with the slab for 2.00 ms, determine the average force on the ball during impact.

ANS. : 0.47 N s; 237. 1 N

2. A golf ball (m = 46.0 g) is struck with a force that makes an angle of 45° with the horizontal. The ball lands 200 m away on a flat fairway. If the golf club and ball are in contact for 7.00 ms, calculate the average force of impact. (neglect the air resistance.)

ANS. : 293 N



Example 4

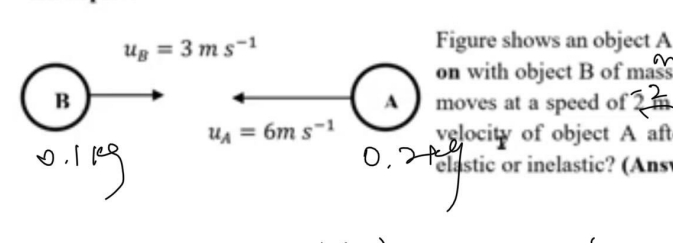


Figure shows an object A of mass 200 g collides **head-on** with object B of mass 100 g. After the collision, B moves at a speed of 2 m s^{-1} to the left. Determine the velocity of object A after collision. Is the collision elastic or inelastic? **(Answer: -3.5 ms^{-1})**

Example 5

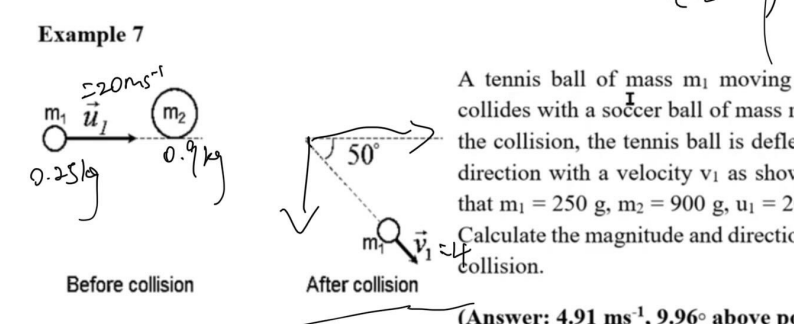
A car of mass 3000 kg travelling with a velocity of 90 km h^{-1} collides with a **stationary** car of mass 2000 kg. After collision, the two cars move with the **same velocity** *v*, what is the velocity *v*? Calculate the impulse of the first car. **(Answer: 15 ms^{-1}, -30 x 10^3 kg ms^{-1})**

Example 6

A **bullet fired from a pistol** has mass of 8.0 g and a muzzle speed of 352 m s^{-1}. If the mass of the gun is 0.9 kg, what is its **recoil** speed when fired horizontally? **(Answer: -3.13 ms^{-1})**

Matriculation Physics: Conservation of Linear Momentum (Q7)
Pek Explains Physics

Example 7



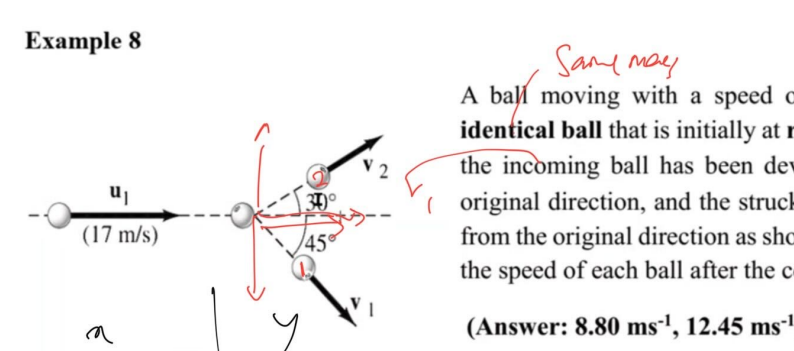
Before collision

After collision

A tennis ball of mass m_1 moving with initial velocity u_1 collides with a soccer ball of mass m_2 initially at **rest**. After the collision, the tennis ball is deflected 50° from its initial direction with a velocity v_1 as shown in figure. Suppose that m_1 = 250 g, m_2 = 900 g, u_1 = 20 m s^{-1} and v_1 = 4 m s^{-1}. Calculate the magnitude and direction of soccer ball after the collision.

(Answer: 4.91 ms^{-1}, 9.96° above positive x axis)

Example 8



A ball moving with a speed of 17 m s^{-1} strikes an **identical ball** that is initially at **rest**. After the collision, the incoming ball has been deviated by 45° from its original direction, and the struck ball moves off at 30° from the original direction as shown in figure. Calculate the speed of each ball after the collision.

(Answer: 8.80 ms^{-1}, 12.45 ms^{-1})

Example 9

A 1 kg ball moves to the right at 4 ms^{-1} and collides **head-on** with a **stationary** 2 kg ball. Calculate the final velocity of each ball after the **elastic collision**. (Answer: 2.67 ms^{-1}, -1.34 ms^{-1})

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6 a) State the principle of conservation of linear momentum.

(b)

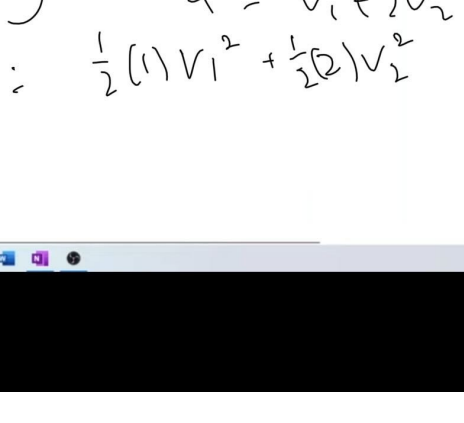

FIGURE 3.1

FIGURE 3.1 shows a 12 g bullet shot vertically into a 5 kg block and lifting it upwards to a maximum height of 4 mm. The bullet travelled for 1 ms in the block before stopping completely. Calculate the

i) speed of the block and bullet just after the collision.
ii) impulse on the block.

7.

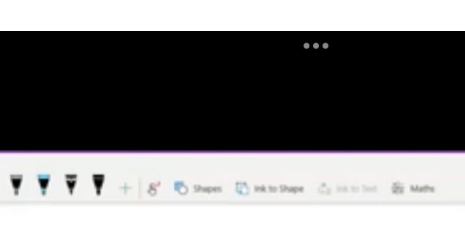

FIGURE 3.3

Object A and B, of masses 1.5 kg and 2.0 kg respectively, are on a horizontal smooth plane as shown in **FIGURE 3.3.** B is at rest but A moves at constant speed 4.0 m s^{-1} towards B. After collision, A moves in the opposite direction at constant speed 2.0 m s^{-1} while B moves at constant speed towards a vertical wall. When B strikes the wall, the wall exerts an impulse of magnitude 15 Ns on B. Determine the speed of B after B has collided with the wall.

[Answer: -3.0 ms^{-1}]

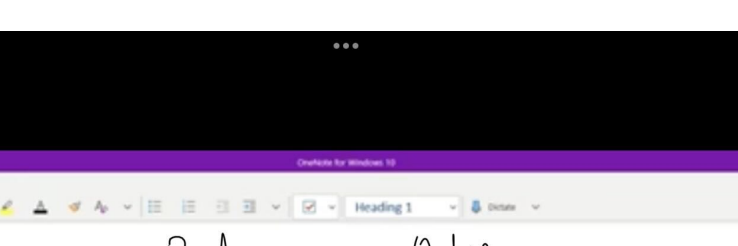

FIGURE 3.4

9. A car moves with the velocity of 2 m s^{-1} collides with another car which has the same mass as shown in FIGURE 3.4. The second car is initially at rest. After the collision, both cars move at 60° and 40° from horizontal. Calculate the final velocity of each car after the collision. Assume the collision is elastic.

[Answer: v_1=1.305 ms^{-1}, v_2=1.758 ms^{-1}]

Types of Collisions

ELASTIC COLLISION

The total kinetic energy of a ... conserved.

$\sum KE_{initial} = \sum K$

Note : KE is NOT a vector

6 A 20-kg object sitting at rest is struck elastically in head-on collision with a 10-kg object initially moving at 3.0 m s^{-1}. Find the final velocity of 20-kg object after collision.

A -1.0 m s^{-1}
B -2.0 m s^{-1}
C +1.5 m s^{-1}
D +2.0 m s^{-1}