Physics WS Practice

Darren Nathaniel Khosma

5 November 2024

1 Introduction

Welcome back to LaTeX, I hate how I am doing this right now. Welcome this is english lesson yet I am doing this kill me frfr. Without any other yapping since I don't have a degree in yapping lah, welcome to another document to help your asses in physics.

2 The Actual Practice

2.1 1.

A ball of mass 250 gram strikes a vertical wall at left side with a speed of 30 m/s. The magnitude of the change of the momentum of the ball is 10 kg.m/s. Calculate the speed of the ball just after it rebounds!
The formula for I in this case is

$$I = \Delta P$$

I is the impulse, ΔP is the change in momentum. Since the initial speed (V_o) is 30 m/s (since it's asking after it rebounds, hence the V_t). Since the initial speed is from the left, hence it is negative.

$$\begin{aligned} I &= m(V_t - V_o) \\ 10 &= 0.25(V_t - (-30)) \\ 10 &= 0.25(V_t + 30) \\ \frac{10}{0.25} &= V_t + 30 \\ 40 &= V_t + 30 \\ V_t &= 10m/s \end{aligned}$$

2.2 2.

A first car of mass 750 kg moving to the right with speed 20 m/s and second car of mass 800 kg moving to the left with speed 15 m/s. Calculate total momentum of first car and second car.
The formula for momentum is,

$$P = m * v$$

Okay uh this is really simple, just put in the numbers into the formula, remember the SI units, that's it. Remember since the other car is moving from the left, the velocity is in negative.

$$P_1 = 750 * 20$$
$$P_1 = 15000kg.m/s$$

$$P_2 = 800 * -15$$
$$P_2 = -12000kg.m/s$$

$$P_total = 15000 - 12000$$
$$P_{total} = 3000kg.m/s$$

2.3 3.

Explain the boxing with gloves mechanism in relation to impulse and momentum!

In boxing, when a punch is thrown, the fist and glove have a certain momentum depending on their mass and speed. The faster and heavier the punch, the more momentum it carries.

2.4 4.

A steel ball of mass 0.5 kg is released freely from a height of 20 cm. We assume that the collision between the ball and the floor is perfect so that the ball bounces back to its original height

a. Calculate the impulse applied to the ball during the impact.

b. If the contact time between the ball and the floor is 0.004 seconds, calculate the average force exerted by the floor on the ball during the impact.

2.4.1 a.

We first have to find the original speed and the final speed. Since it is a perfect collision, once dropped it will go back to its original height, the gravity used is $10m/s^2$. Turn them all into SI units first because its so sigma

$$V_o = \sqrt{2gh}$$
$$V_o = \sqrt{2(10)(0.2)}$$
$$V_o = 2m/s$$

Since it is going down, its negative.

$$V_o = -2m/s$$

Same for the positive side, going up, but it is the V_t now

$$V_t = 2m/s$$

Okay shove this into the I formula, still remember right?

$$I = \Delta P$$
$$I = m(V_t - V_o)$$
$$I = 0.5(2 - (-2))$$
$$I = 2Ns$$

2.4.2 b.

YAY! Another formula, now to find average force use this formula, easy enough.

$$F_{average} = \frac{I}{\Delta t}$$

$$F_{average} = \frac{2}{0,004}$$
$$F_{average} = 500N$$

2.5 5.

The rocket is launched from the launch site. The initial speed of the rocket is 8 km/s and then in order to speed up to 10 km/s, a part of the rocket with a weight of 5 tons is detached. Calculate the speed of the detached part if the rocket weighs 120 tons.

Hey chat since I am not Mr Alex, I'm just making it NOT SI UNIT, but in the end the speed will be in km/s. Though later in WS make it SI Unit. Anyways new formula

$$m_1v_1 = m_2v_2 + m_3v_3$$

Other than the stupid numbers it's simple, very simple.

$$120000 * 8 = 115000 * 10 + 5000 * v_3$$
$$960000 = 1150000 + 5000v_3$$
$$-190000 = 5000v_3$$
$$v_3 = -38km/s$$

2.6 6.

A block of mass 4 kg is moving on a smooth floor at 7.5 m/s (towards the positive x-axis) towards a second block of mass 6 kg which is at rest. The two blocks have a perfect elastic collision. (g is $10m/s^2$)

a. Determine the velocity of each block after the collision.

b. If the second block m_2 initially moving to the left with a velocity of 15 m/s, determine the velocity of each block after the collision.

2.6.1 a.

I swear this is a god given right, anyways another formula!!!

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$
$$4 * 7,5 + 6 * 0 = 4v_1 + 6v_2$$
$$30 = 4v_1 + 6v_2$$
$$15 = 2v_1 + 3v_2$$

Next, since it is a perfect elastic collision, the coefficient for elasticity (e) will be 1, reminding, if it is a perfect elastic collision, e = 1, if it is a imperfect inelastic collision it is e = $0 < x < 1$, and if e is a perfect inelastic collision, e = 0. Another formula drop!!!

$$e = \frac{-(v_2 - v_1)}{u_2 - u_1}$$
$$1 = \frac{v_1 - v_2}{0 - 7,5}$$
$$-7,5 = v_1 - v_2$$

Now do the process of elimination, I'm going to find v_2

$$15 = 2v_1 + 3v_2$$
$$-7,5 = v_1 - v_2$$

$$15 = 2v_1 + 3v_2$$
$$-15 = 2v_1 - 2v_2$$

$$30 = 5v_2$$
$$v_2 = 6m/s$$

$$-7,5 = v_1 - 6$$
$$v_1 = -1,5m/s$$

2.6.2 b.

Same thing, just replace 0 with -15 m/s

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$
$$4 * 7,5 + 6 * -15 = 4v_1 + 6v_2$$
$$-60 = 4v_1 + 6v_2$$
$$-30 = 2v_1 + 3v_2$$

$$e = \frac{-(v_2 - v_1)}{u_2 - u_1}$$
$$1 = \frac{v_1 - v_2}{-15 - 7,5}$$
$$-22,5 = v_1 - v_2$$

$$-30 = 2v_1 + 3v_2$$
$$-22,5 = v_1 - v_2$$

$$-30 = 2v_1 + 3v_2$$
$$-45 = 2v_1 - 2v_2$$
$$15 = 5v_2$$
$$v_2 = 3m/s$$

$$-22,5 = v_1 - 3$$
$$v_1 = -19,5m/s$$

2.7 7.

A 50 gram bullet being shooted to hanging block, 3 kg, with speed 305 m/s. Then bullet embedded into block resulting block swing upwards. Calculate the height of swing from initial position (g = $10m/s^2$)
Using the law of conservation of combined momentum, the formula is

$$m_1u_1 + m_2u_2 = (m_1 + m_2)V$$

Why? It is because the bullet is now inside the block, while the block (in this case indestructible) hence the mass is combined, and the velocity of the bullet is now negated, and the position of the block goes up from the combined velocity.

$$0,05 * 305 + 3 * 0 = (0.05 + 3)V$$
$$15.25 = 3.05V$$
$$V = 5m/s$$

Now to find height, use the velocity formula from the conservation of mechanical energy formula

$$V^2 = 2gh$$
$$25 = 2(10)h$$
$$\frac{25}{20} = h$$
$$h = 1,25m$$

2.8 8.

A bullet of mass 70 g is fired into a ballistic pendulum of mass 2 kg. The bullet enters the block and the block swings to a height of 18 cm. What is the velocity of the bullet when it is fired? (g = $10m/s^2$)

Practically the same as the last number, except mr got this wrong on his answer sheet, you'll see why later. First find the combined V

$$V = \sqrt{2gh}$$
$$V = \sqrt{2(10)(0.18)}$$

$$V = \sqrt{3.6}$$
$$V = 1.89m/s$$

$$m_1u_1 + m_2u_2 = (m_1 + m_2)V$$
$$0.07 * 0_1 + 2 * 0 = (0.07 + 2)1.89$$
$$0.07u_1 = (2.07)1.89$$
$$u_1 = \frac{3.9123}{0.07}$$
$$u_1 \approx 56m/s$$

2.9 9.

From a height of 12 m above the floor, a ball is dropped vertically freely. After bouncing, the ball rises to a height of 3 m. The height of the second bounce is?

Another formula drop! this one's easy, since the e = $0 < x < 1$, it rebounds but not to the original height.

$$\sqrt{\frac{h_2}{h_1}} = \sqrt{\frac{h_1}{h}}$$

Square both sides

$$\frac{h_2}{h_1} = \frac{h_1}{h}$$
$$\frac{h_2}{3} = \frac{3}{12}$$
$$\frac{h_2}{3} = \frac{1}{4}$$
$$h_2 = \frac{3}{4}m$$

2.10 10.

Ball being dropped from height h above the ground. If height of second bounce is $\frac{h}{16}$, calculate the first bounce.
Simple enough, just the same as the last one (I already squared both sides)

$$\frac{h_2}{h_1} = \frac{h_1}{h}$$

$$\frac{\frac{h}{16}}{h_1} = \frac{h_1}{h}$$

$$\frac{h^2}{16} = h_1^2$$

$$h_1 = \frac{h}{4}m$$

Yeah I'm done, see you in chemistry reaction rate!!