Advanced Dynamics
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Module No # 05
Lecture No # 25
Kinetics of a System of Particles – III

We will continue discussing the kinetics of a system of particles.

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In this lecture we will solve problems based on what we discussed in the past 2 lectures.

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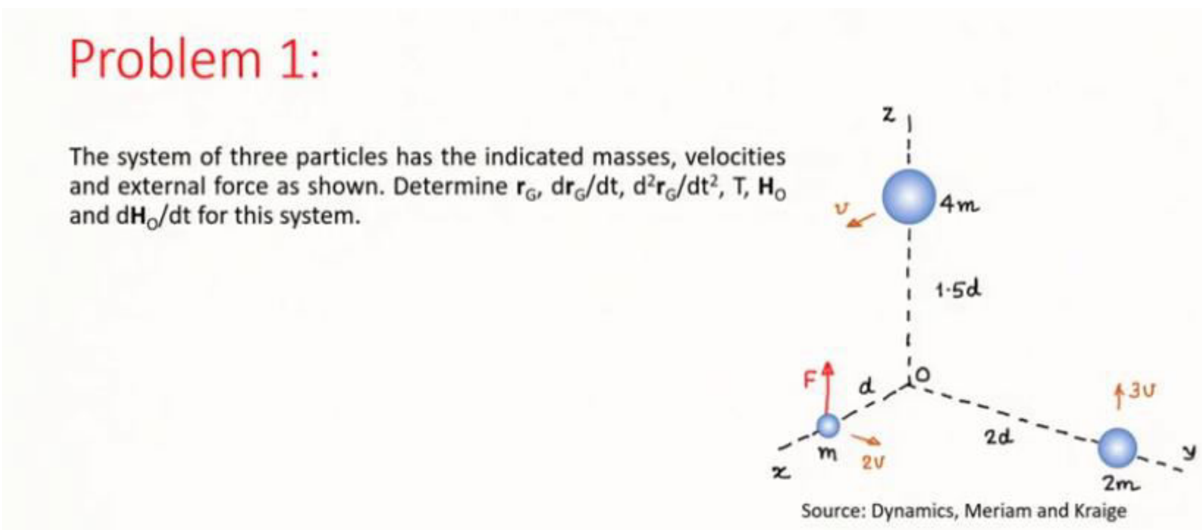

The above slide presents the first problem.

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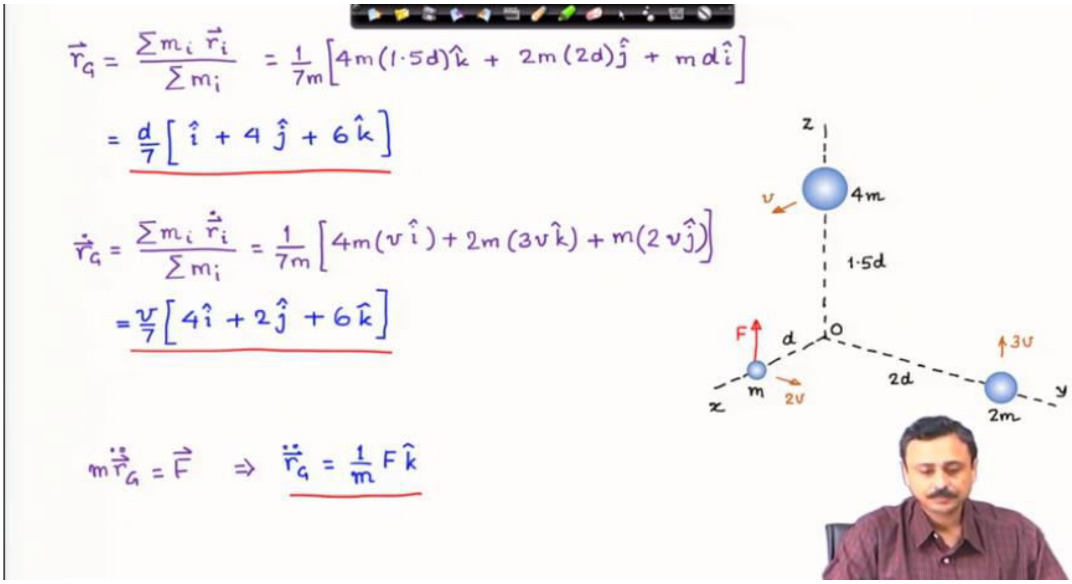

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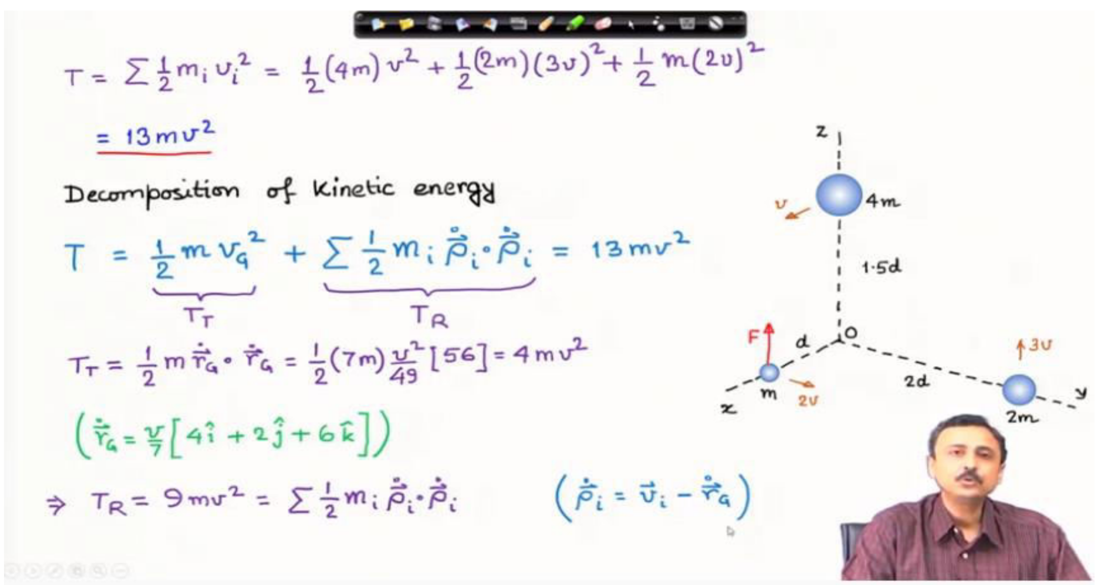

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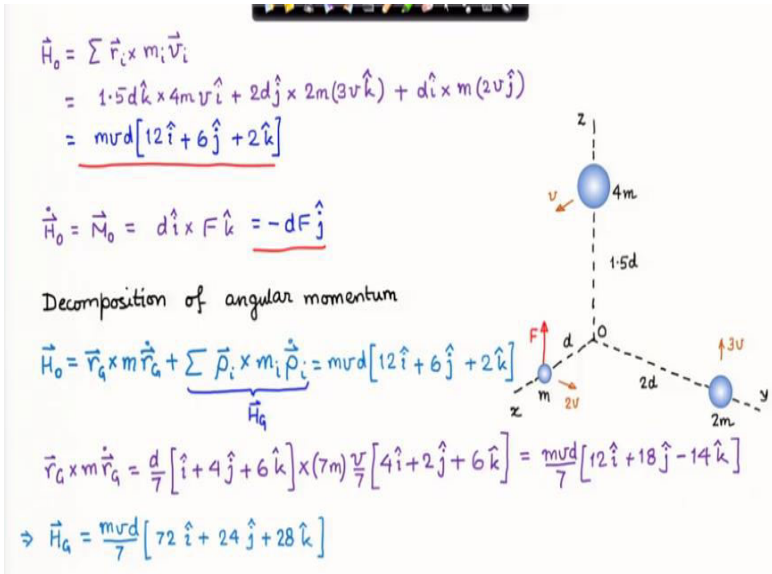

The detailed solution is presented in the 3 slide above.

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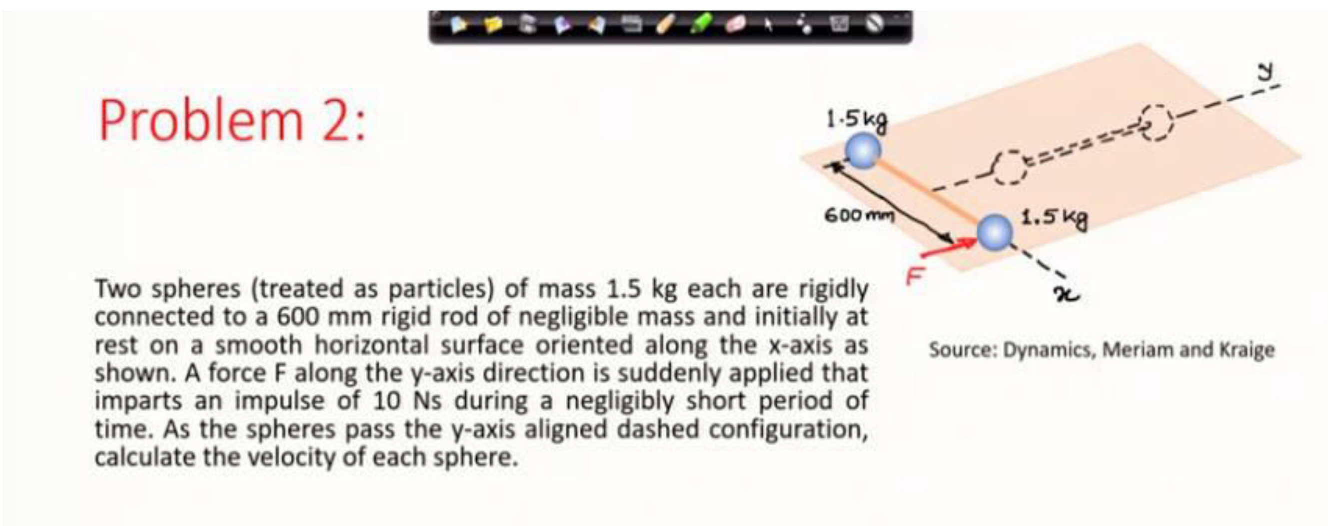

The second problem is presented in the slide above.

We use the impulse momentum relation for the center of mass of the system. The change of linear momentum of the center of mass is equal to the impulse of force that acts on the system. Using this idea, we obtain

Impulse - momentum form

$$\Delta\vec{G} = \vec{G}_2 - \vec{G}_1 = \int_{t_1}^{t_2} \vec{F}\, dt$$

$$\Rightarrow m v_x \hat{i} + m v_y \hat{j} - 0 = 10\hat{j} \text{ Ns}$$

$$\Rightarrow v_x = 0, \quad v_y = \frac{10}{3} \text{ m/s}$$

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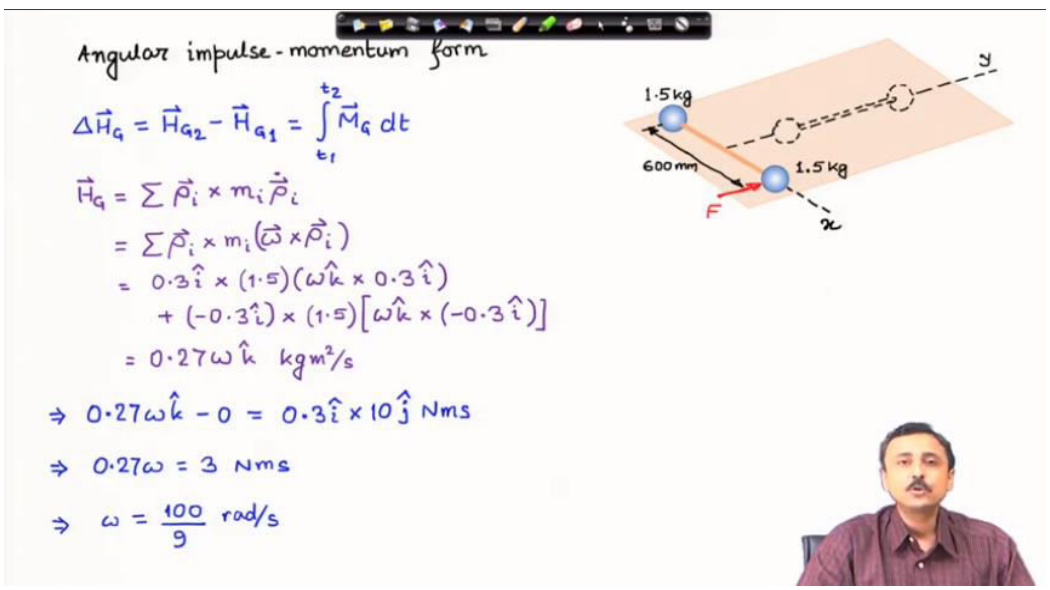

Now we look at the angular impulse momentum relation as shown in the slide above: the change of angular momentum about the center of mass is equal to the moment the impulse of the moment about the center of mass. Using this, we get the angular velocity of this system. Now the angular velocity of the system tells us how the system will change its orientation as time progresses. Thus, the linear impulse momentum equation tells us how the center of mass will move, and the angular impulse momentum equation tells us how the rigid frame is going to change its orientation.

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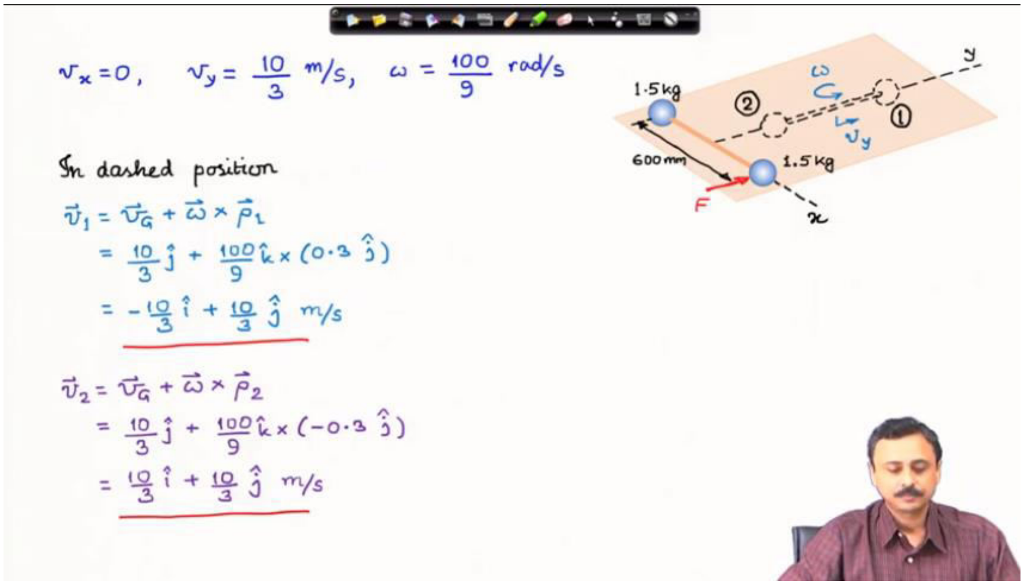

Finally, using these two information, we calculate the velocities of the two balls as presented in the slide above.

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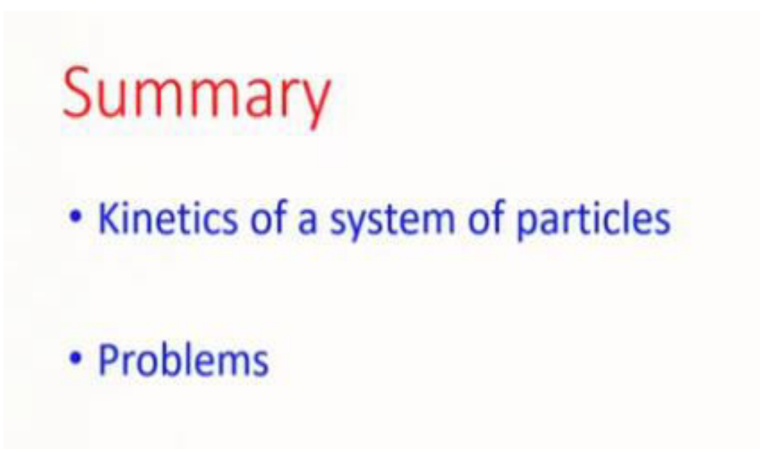

The discussions are summarized in the slide above.