Panel 1

ES204 Mechanical Systems

Translation
Lecture 10

Dr. Fisher

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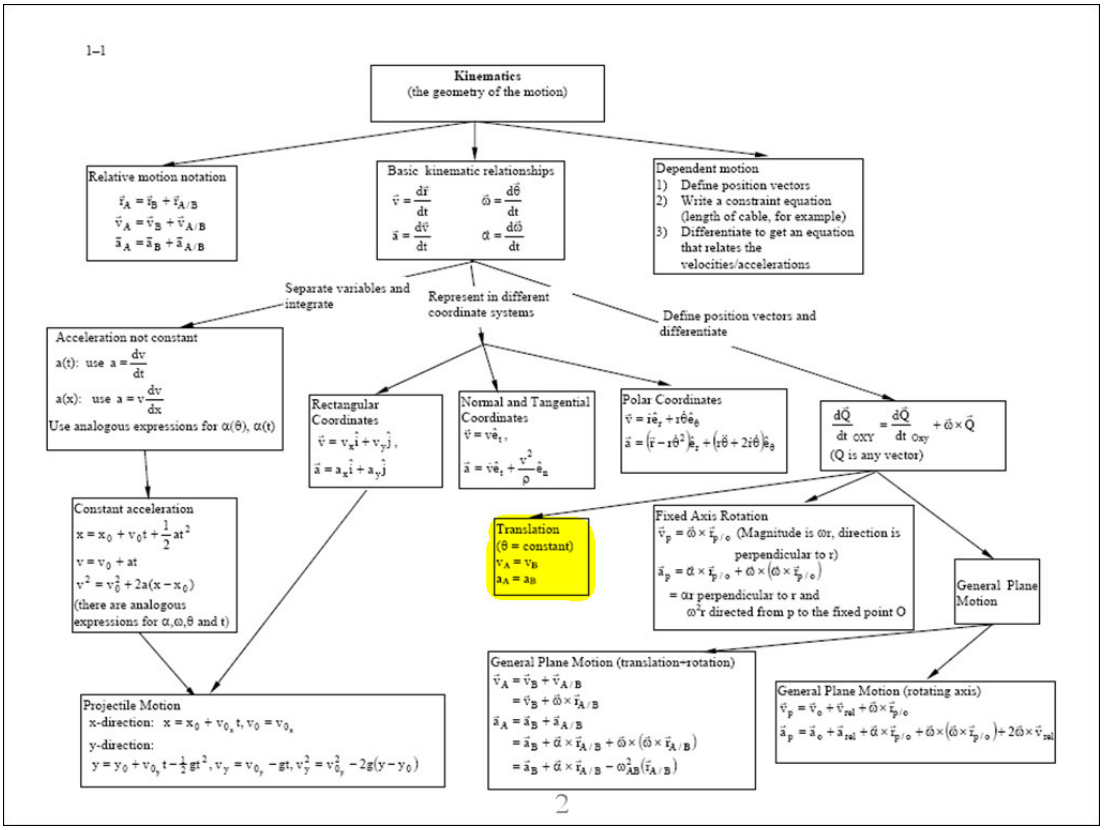
Panel 2



Panel 3

Rigid body motion

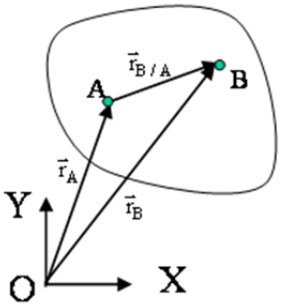
Three types of motion

(every line remains parallel to original orientation)

(every point travels in a circle about a fixed point)

(a combination of translation + rotation)

Translation

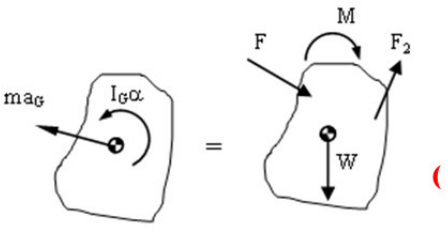


When an object is translating every point on the object has the same velocity and acceleration

3

Panel 4

Review of linear and angular momentum (rate)



Kinetic Diagram (KD)

Free Body Diagram (FBD)

$$\frac{d\vec{P}_{sys}}{dt} = \sum F + \sum \dot{m}_i \vec{v}_i - \sum \dot{m}_o \vec{v}_o$$

$$\frac{d\vec{L}_{sys_o}}{dt} = \sum \vec{M}_o + \sum \vec{r} \times \dot{m}_i \vec{v}_i - \sum \vec{r} \times \dot{m}_o \vec{v}_o$$

4

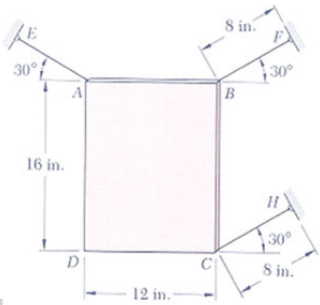
Panel 5

The thin plate ABCD weighs 16 lb and is held in position by the three inextensible wires AE, BF, and CH. Wire AE is then cut. Determine :

(a) the acceleration of the plate,

(b) the tension in wires BF and CH immediately after wire AE has been cut.

(*taken from Vector Mechanics for Engineers, 5th Edition by Beer & Johnston*)



What kinetic approach do we want to use?

What key words tell us the approach to use?

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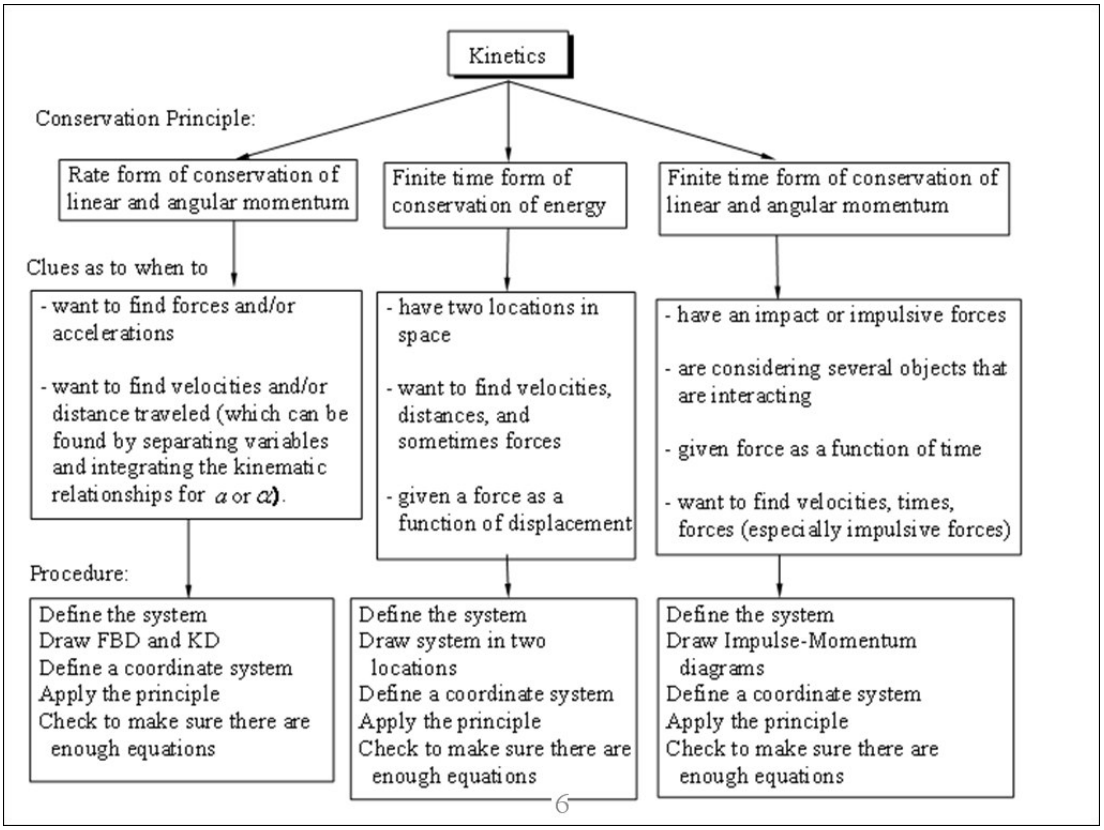
Panel 6



6

Panel 7

The thin plate ABCD weighs 16 lb and is held in position by the three inextensible wires AE, BF, and CH. Wire AE is then cut. Determine :

(a) the acceleration of the plate,

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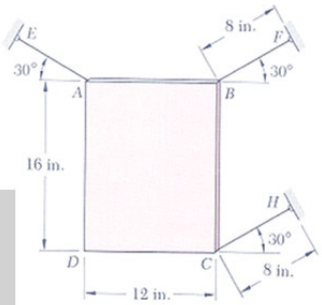
(*taken from Vector Mechanics for Engineers, 5th Edition by Beer & Johnston*)



FBD KD

FBD KD

7

Panel 8

FBD KD

What Rate equations do we want to write and in what directions?

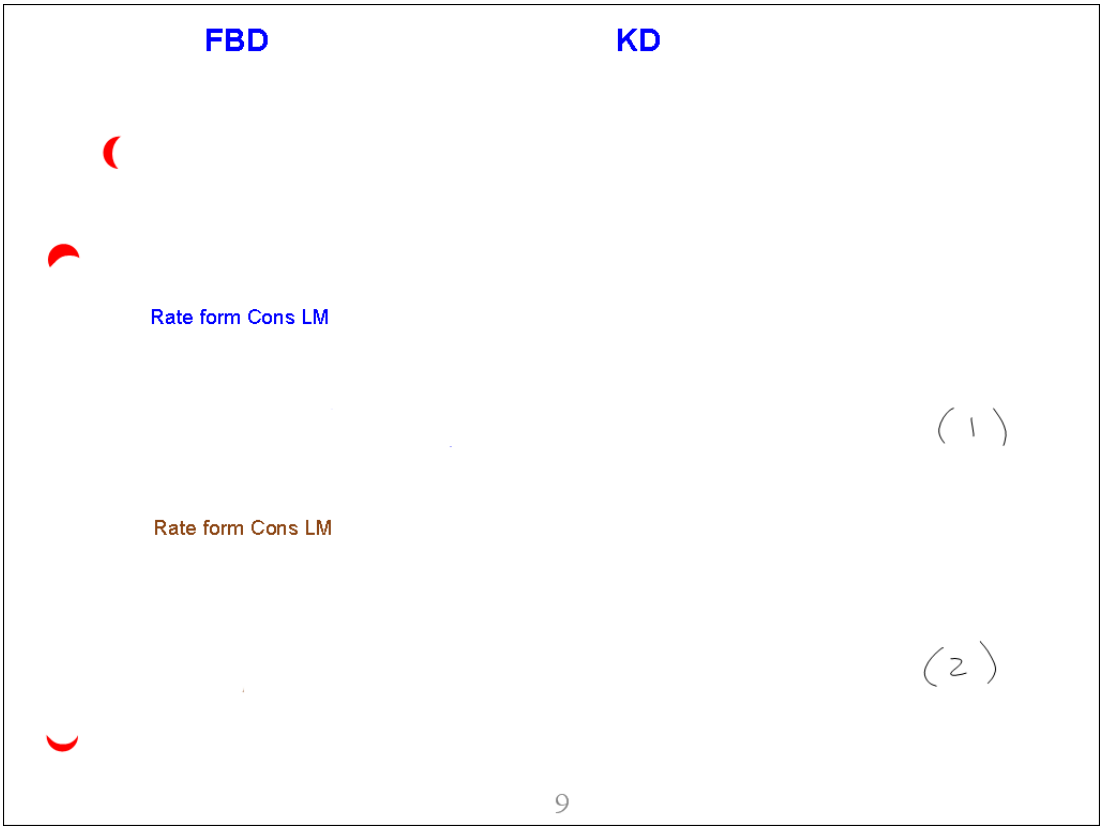
LM rate eq 1 direction?

LM rate eq2 direction?

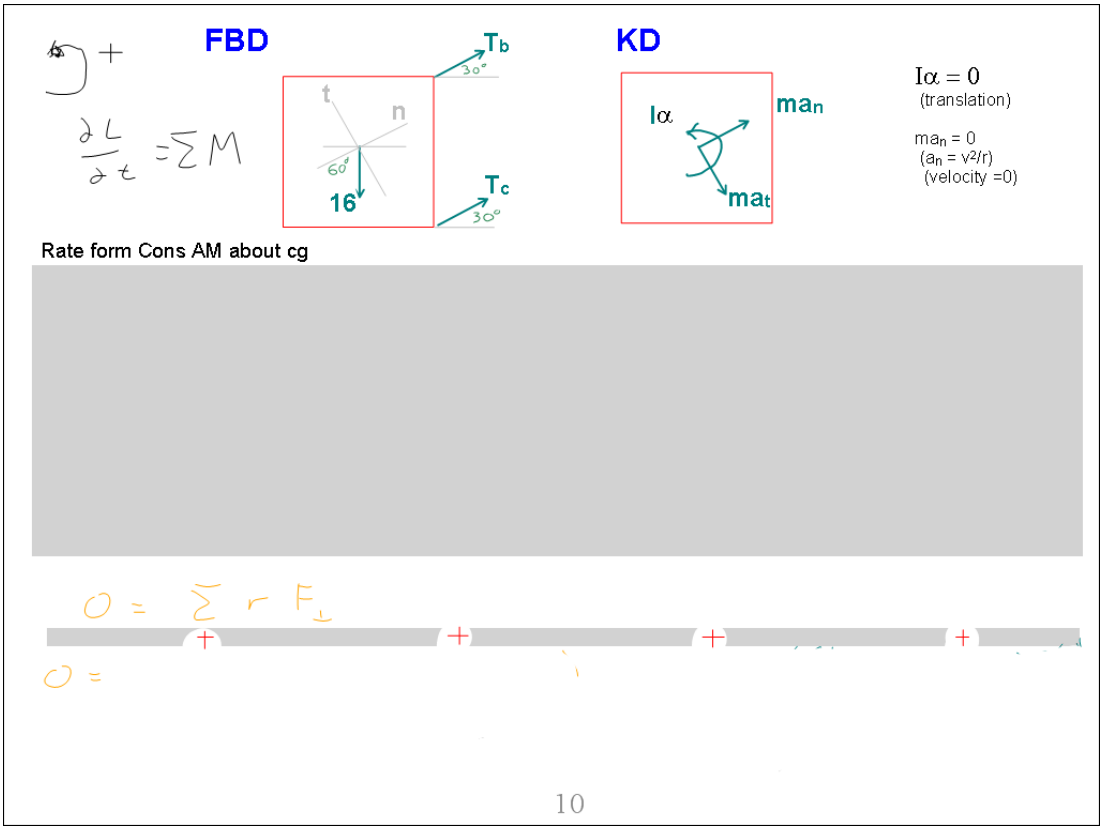
AM rate about which point

8

Panel 9

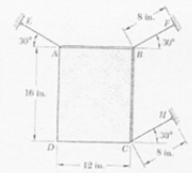


Panel 10



Panel 11

16.20 The thin plate ABCD weighs 16 lb and is held in position by the three inextensible wires AE, BF, and CH. Wire AE is then cut. Determine :
(a) the acceleration of the plate,
(b) the tension in wires BF and CH immediately after wire AE has been cut.
(*taken from Vector Mechanics for Engineers, 5th Edition by Beer & Johnston*)



FBD

t translation

$a_G = 27.89$ ft/s²

$T_B = 5.732$ lb

$T_A = 2.268$ lb

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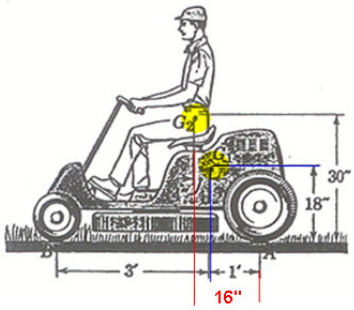
Panel 12

The riding mower has a weight of 280 lb with a center of mass at G_1. The operator weighs 180 lb with a center of mass at G_2. Calculate the minimum coefficient of static friction that will permit the front wheels of the mower to lift off of the ground as the mower starts to move forwards.
(*taken from an unknown source*)



Which Kinetic approach do we want?

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Panel 13

The riding mower has a weight of 280 lb with a center of mass at G_1. The operator weighs 180 lb with a center of mass at G_2. Calculate the minimum coefficient of static friction that will permit the front wheels of the mower to lift off of the ground as the mower starts to move forwards.
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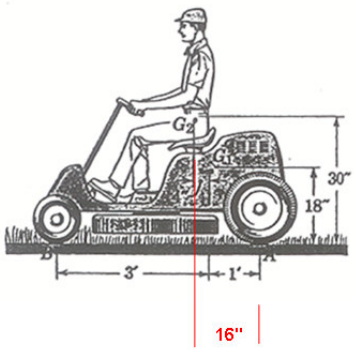

FBD KD

FBD KD

13

Panel 14

FBD KD

$\frac{dL_{sys}}{dt} = \Sigma M$ (1)

$\frac{dP_y}{dt} = \Sigma F_y$ (2)

$\frac{dP_x}{dt} = \Sigma F_x$ (3)

Eq	Un
1	a_g
2	ω
3	N

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