

PASS MOCK EXAM

– FOR PRACTICE ONLY –

Course: MAAE 2101

Facilitator: Bryan Little

Dates and locations of mock exam take-up: Tuesday, October 13th from 6:00-9:00 PM in ME 3380

It is **most beneficial** to you to write this mock midterm **UNDER EXAM CONDITIONS**. This means:

- Complete the midterm in 1.5 hour(s).
- Work on your own.
- Keep your notes and textbook closed.
- Attempt every question.

After the time limit, go back over your work with a different colour or on a separate piece of paper and try to do the questions you are unsure of. Record your ideas in the margins to remind yourself of what you were thinking when you take it up at PASS.

The purpose of this mock exam is to give you practice answering questions in a timed setting and to help you to gauge which aspects of the course content you know well and which are in need of further development and review. Use this mock exam as a **learning tool** in preparing for the actual exam.

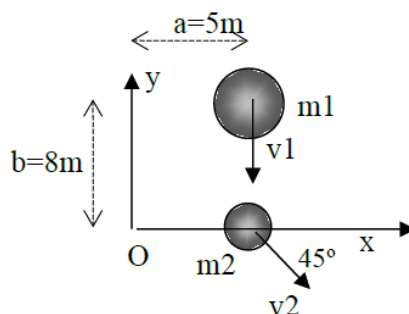
Please note:

- Come to the PASS session with your mock exam complete. There, you can work with other students to review your work.
- Often, there is not enough time to review the entire exam in the PASS session. Decide which questions you most want to review – the Facilitator may ask students to vote on which questions they want to discuss.
- Facilitators do not bring copies of the mock exam to the session. Please print out and complete the exam before you attend.
- **Facilitators do not produce or distribute an answer key for mock exams.** Facilitators help students to work together to compare and assess the answers they have. If you are not able to attend the PASS session, you can work alone or with others in the class.

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1) SHORT QUESTIONS [10 marks]

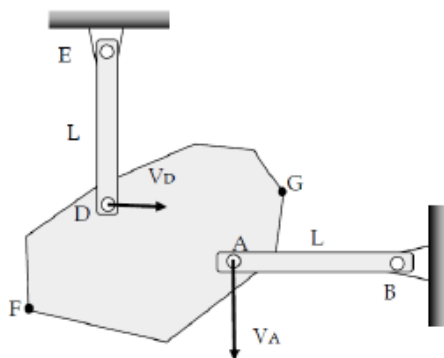
Two spheres with masses $m_1 = 6 \text{ kg}$ and $m_2 = 2 \text{ kg}$ are free to move on a horizontal surface without any friction or any other forces. At the moment shown, the velocities of the spheres are $v_1 = -4j \text{ m/s}$ and $v_2 = 2i - 2j \text{ m/s}$ at an angle of 45° as shown in the figure.



- (a) The total linear momentum of the system is (express in i and j):
- (b) Find the location of the centre of mass between the two spheres. The angular momentum of the system about the centre of mass is:

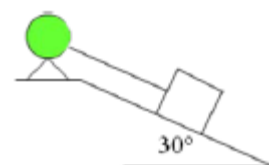
The velocities V_D and V_A are shown on the following linkage. The links AB and DE have the same length L . Find:

- (c) The instantaneous centre of rotation for each of the three links AB, DE, and AD. Show them by C1, C2, and C3, respectively.
- (d) The velocity of point F (graphically).



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(e) A motor pulls a 10 kg block up a smooth incline at a constant velocity of 20 m/s. What is the power supplied by the motor?



(f) The 20 g bullet is fired horizontally at 1200 m/s into the 300 g block resting on a smooth surface. If the bullet becomes embedded in the block, what is the velocity of the block immediately after the impact?



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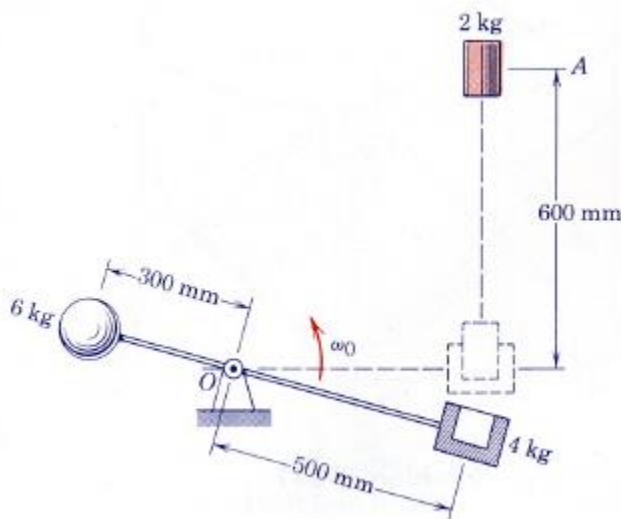
- (g) Two exact same balls are moving on the same axis at equal speeds but in opposite directions. If they collide head-on, find the post-impact velocities is:
- Restitution factor is 1
 - Restitution factor is 0
 - What is the pre-impact linear momentum of the system?
 - What is the post-impact linear momentum of the system?



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LONG QUESTIONS [10 marks each]

2. The 6 kg sphere and the 4 kg block are secured to the arm of the negligible mass that rotates in the vertical plane about a horizontal axis at O. The 2 kg cylinder is released from rest at A and falls into the recess in the block when the arm has reached the horizontal position. At the instant of engagement, the arm has an angular velocity $\omega_0 = 2 \text{ rad/s}$ (counterclockwise). Determine the angular velocity ω of the arm immediately after the cylinder has wedged itself in the block.



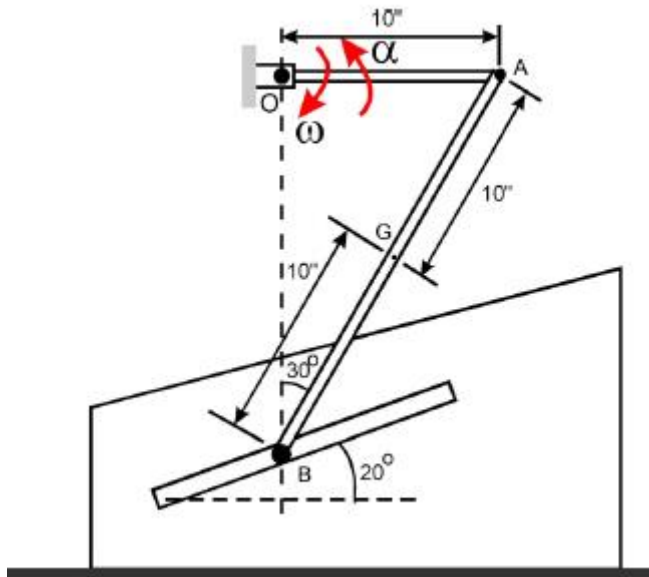
SOLUTION

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3) At the instant shown, OA is horizontal, ω is 0.8 rad/s (clockwise), and $\alpha = 0.4 \text{ rad/s}^2$ (counterclockwise). Determine the velocity (v_B) and the acceleration (a_B) of the point B.

HINT: If you are solving this problem graphically, draw the velocity and acceleration diagrams to $\frac{1}{2}$ scale to obtain reasonable accuracy.



SOLUTION

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