

※ 考生請注意：本試題可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Explain the following terms: (16%)
 - 1) Conservation of mechanical force. (4%)
 - 2) Elastic impact. (4%)
 - 3) Mathematically express center of mass, center of gravity and center of volume. (8%)
2. As shown in Figure 1, a rod AB with length l is moving by leaning against a stair. Rod A is moving along the ground to the right at constant velocity V_A . Please determine the following instant conditions (1) angular velocity ω_{AB} , (6%) (2) angular acceleration α_{AB} , (6%) and (3) velocity of the center O , V_O . (6%). (18%)

Figure 1

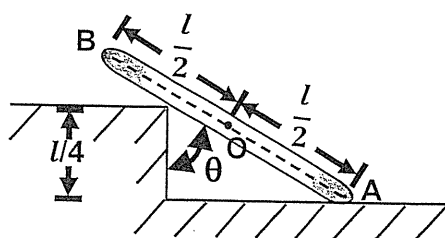
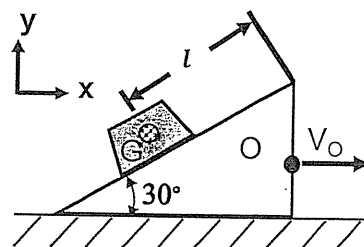
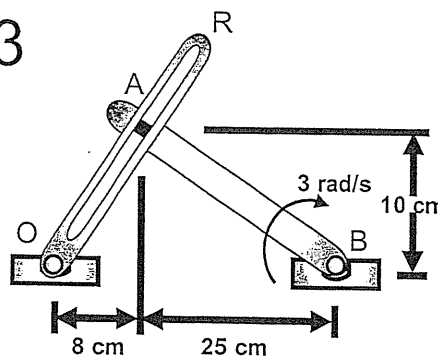


Figure 2



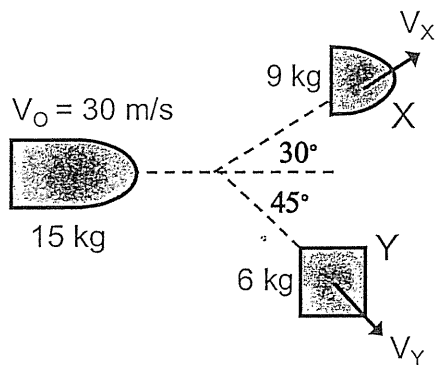
3. A triangular block O contains a wedge angle 30° , on top rests a sliding gold block G, as shown in Figure 2. Assume the velocity of block O, $V_O = 8 \text{ m/s}$ to the right, and the acceleration $a_O = 3 \text{ m/s}^2$. Meanwhile, the rate change of the distance between the gold block G and the top of the triangular block O is $l' = 6 \text{ m/s}$ and $l'' = 5 \text{ m/s}^2$. Please determine the (1) velocity (6%); (2) acceleration of gold block G. (6%). (12%)
4. The rod AB is rotating at an angular velocity of 3 rad/s and the point A is a pin that slides on the groove of the connecting rod OR, as shown in Figure 3. Please determine (1) the relative velocity of the pin A to the OR (9%); (2) the angular velocity of the OR. (9%). (18%)

Figure 3



5. Assume a cannon shell weights at 15 kg that flies at an instant velocity 30 m/s before exploded. The explosion results in the shell breaks into two pieces, in which one of the pieces X weights 9 kg and the other one Y weights 6 kg. The velocity and direction of the two shell pieces are shown in Figure 4. Please determine (1) V_X and V_Y (9%); (2) the increase of the kinetic energy through the explosion. (9%). (18%)

Figure 4



6. A block-spring system is shown in Figure 5, where the system is statically balanced at $x = 0$. Please derive the equation of motion and the natural frequency based on x . If the system is released while the springs are undeformed, please determine the (1) maximum velocity (9%); (2) maximum acceleration. (9%). (18%)

Figure 5

