

國立清華大學 105 學年度碩士班考試入學試題

系所班組別：動機系 丙組

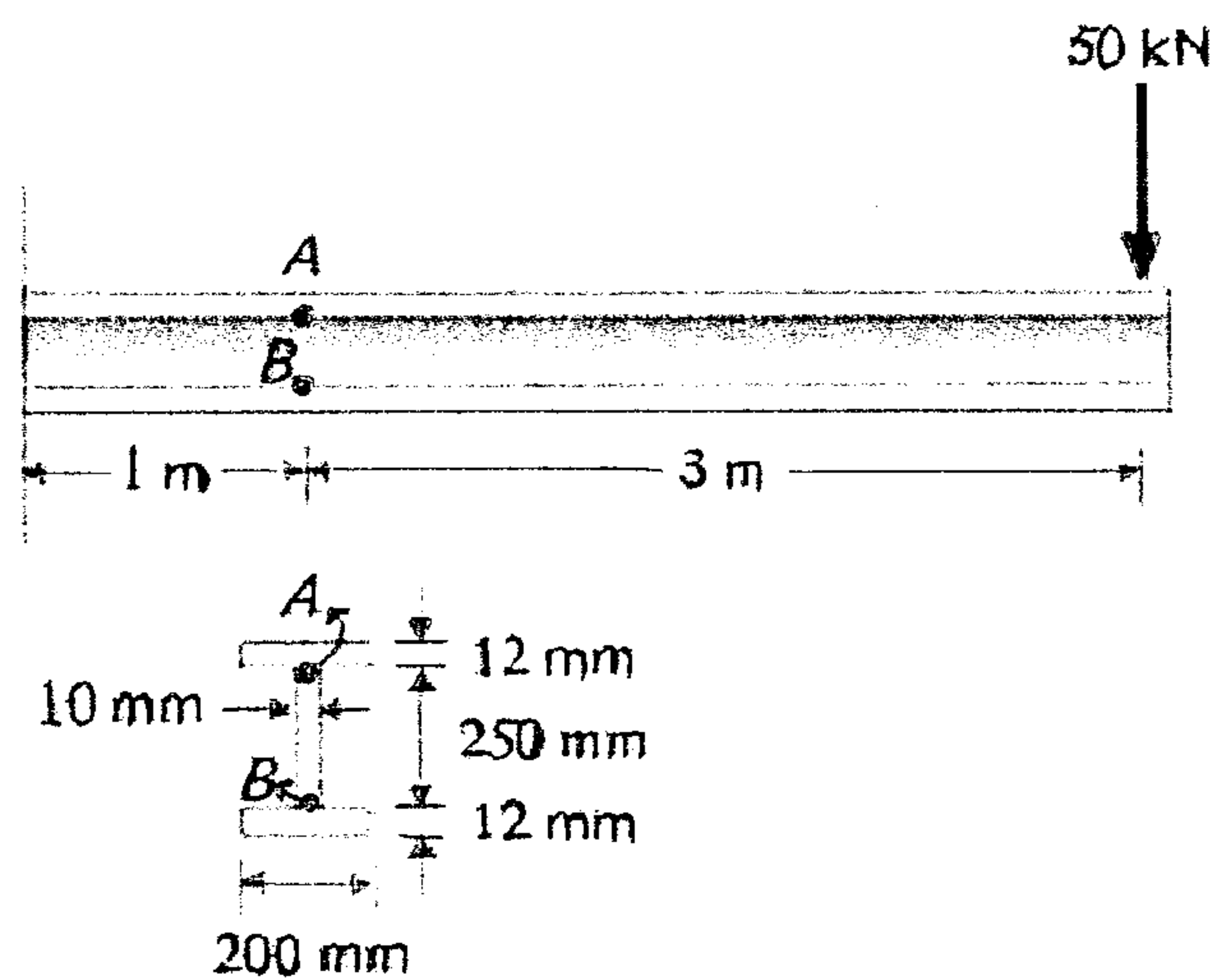
考試科目（代碼）：工程力學 (1301)

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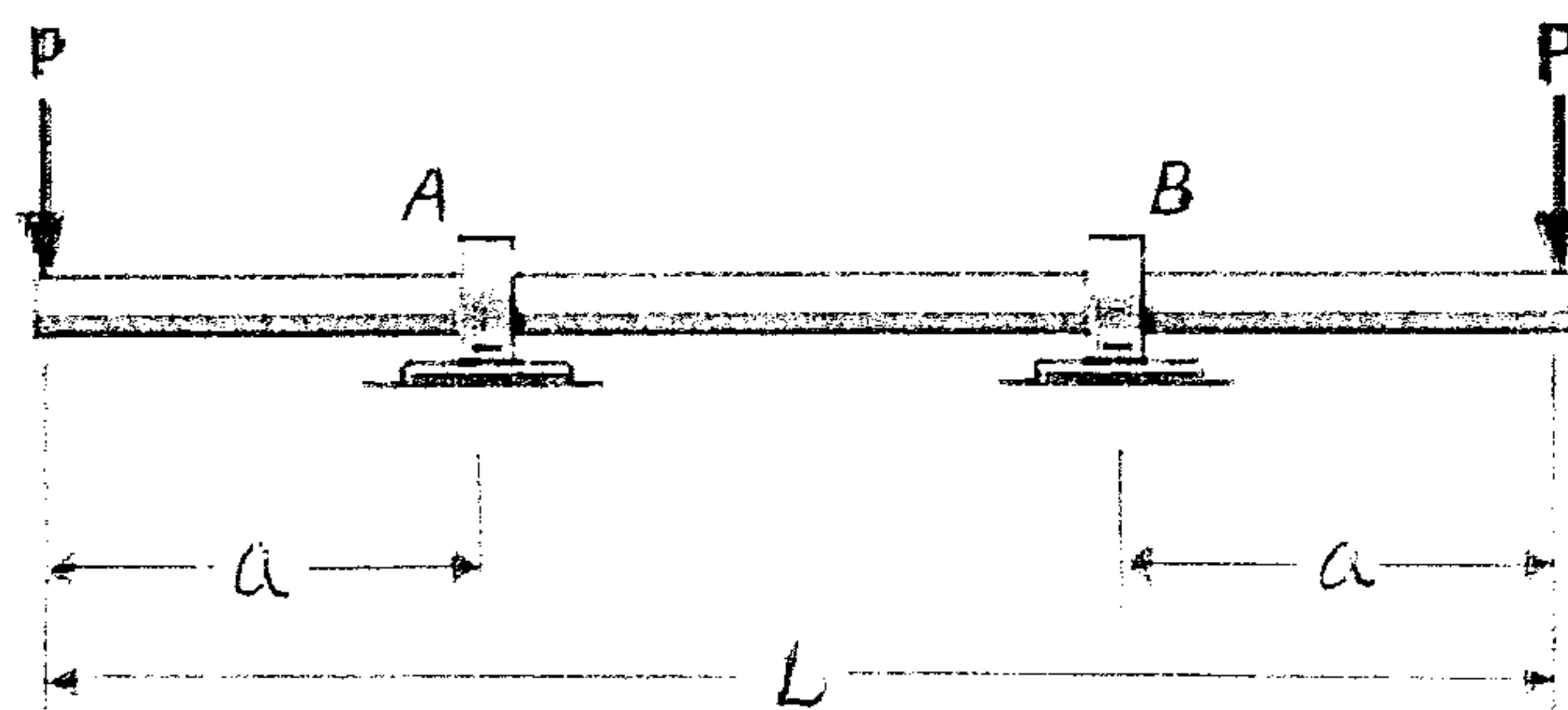
*請在【答案卷】作答

I. (Mechanics of Materials)

I-1 The wide-flange beam is subjected to the 50-kN force. Determine the principal stresses in the beam at point A located on the web at the bottom of the upper flange. Although it is not very accurate, use the shear formula to calculate the shear stress. (25%)



I-2 At what distance a should the bearing supports at A and B be placed so that the deflection at the center of the shaft is equal to the deflection at its ends? The bearings exert only vertical reactions on the shaft. EI is constant. **YOU MUST USE THE AREA-MOMENT METHOD.** (25%)



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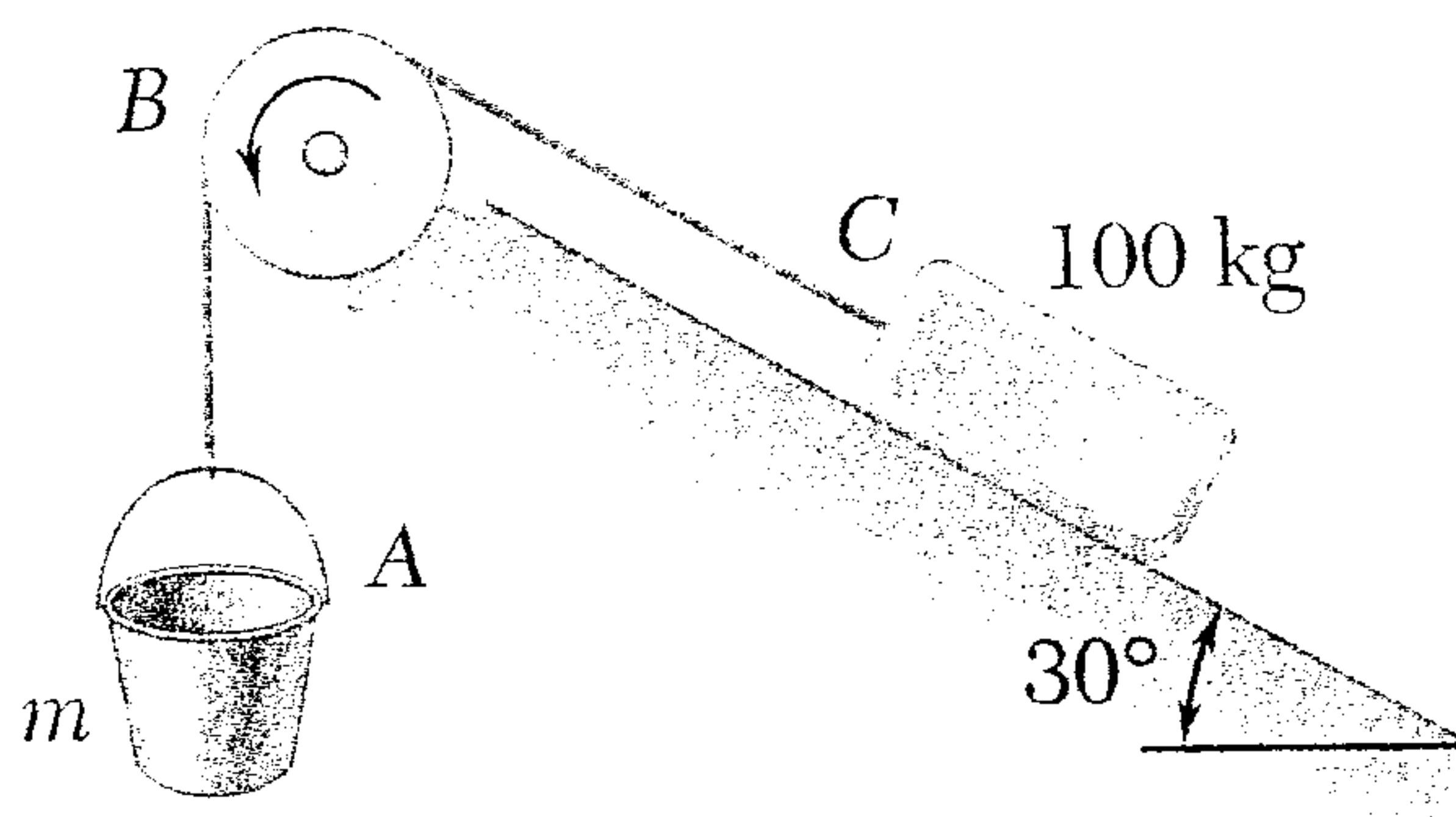
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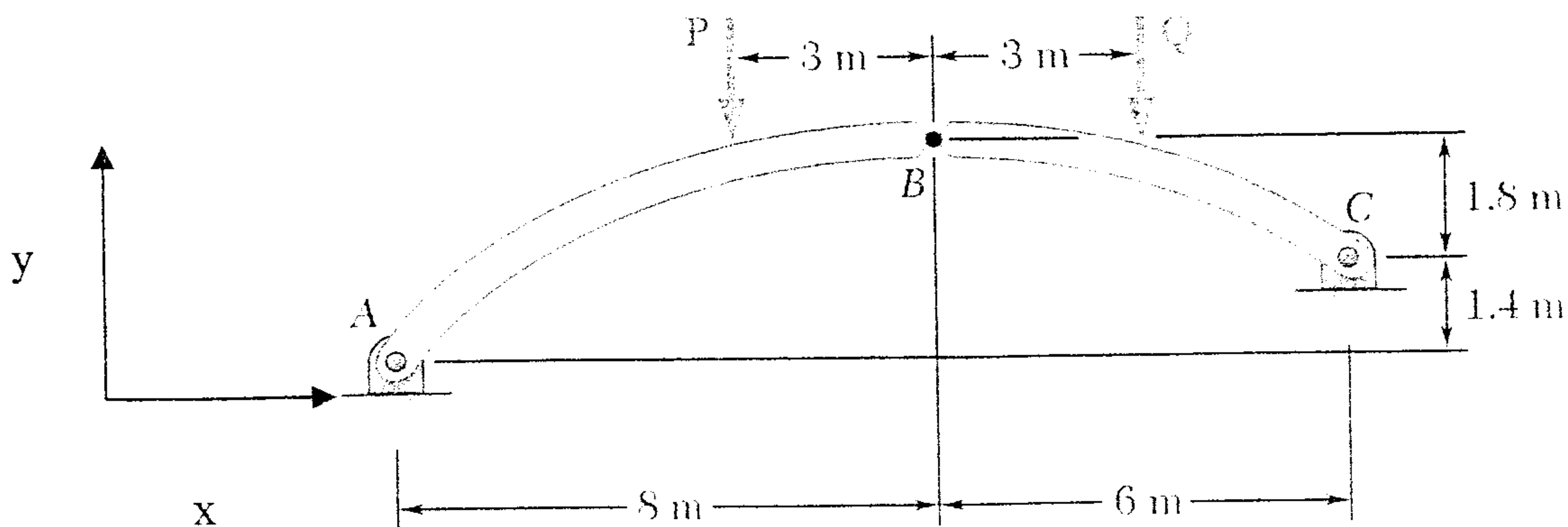
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II. (Statics)

II-1. Bucket A and block C are connected by a cable that passes over drum B . Knowing that drum B rotates slowly counterclockwise and that the coefficients of friction at all surfaces are $\mu_s = 0.35$ and $\mu_k = 0.25$, determine the smallest combined mass m of the bucket and its contents for which block C will (a) remain at rest, (b) start moving up the incline, (c) continue moving up the incline at a constant speed. (30 Points)



II-2. The axis of the three-hinge arch ABC is a parabola with the vertex at B . Knowing that $P = 112$ N and $Q = 140$ N, determine (a) the components (A_x and A_y) of the reaction at A , (b) the components (B_x and B_y) of the force exerted at B on segment AB . (20 Points)



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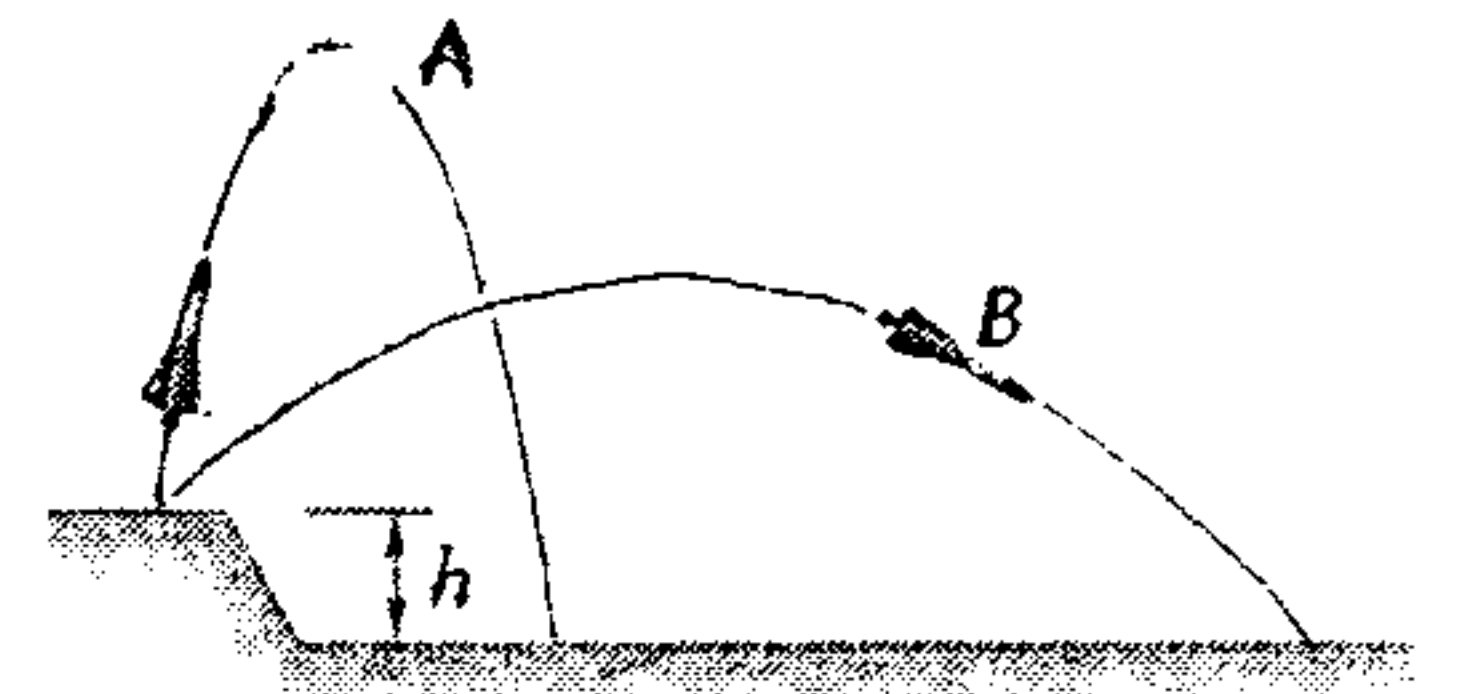
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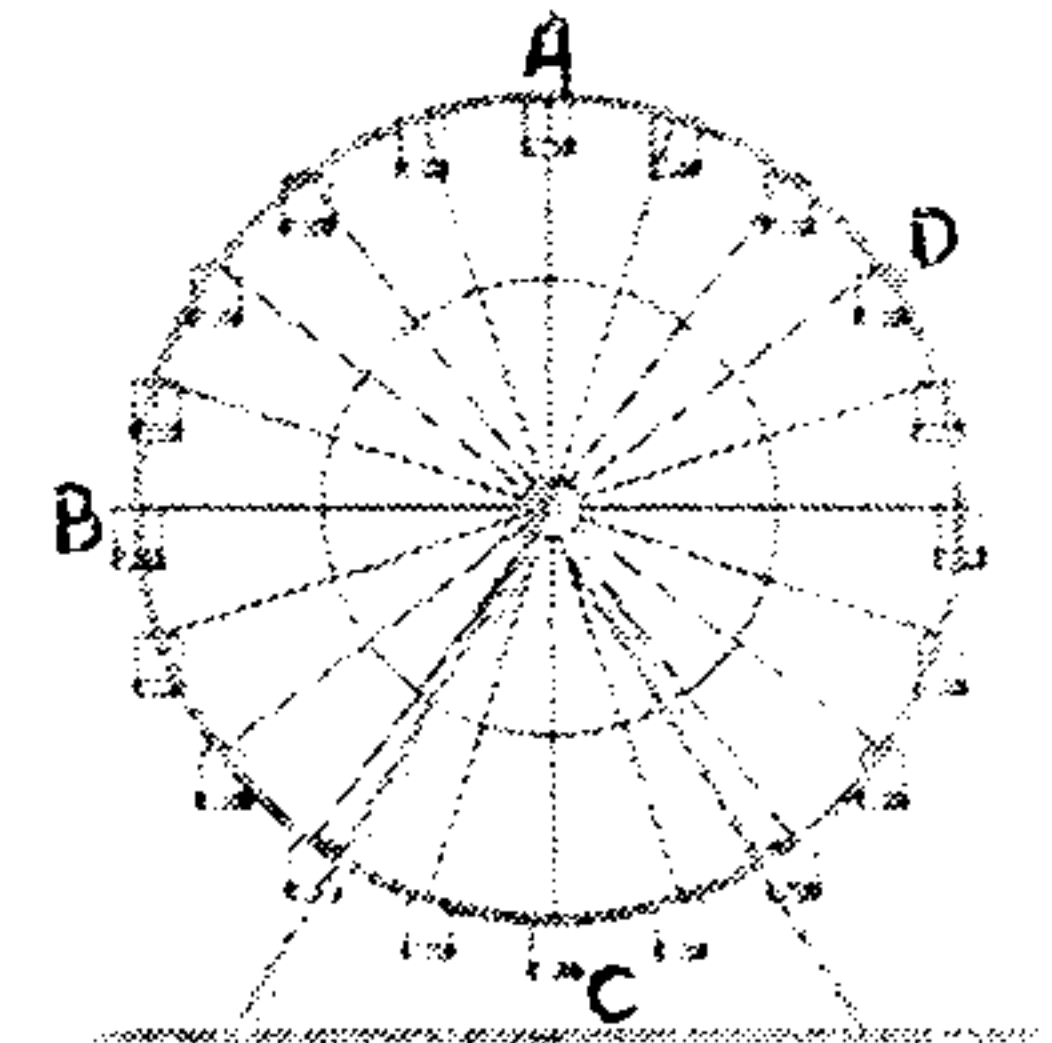
III. (Dynamics) The following 25 questions are multiple-choice questions that ask you to select **only one** answer choice from a list of choices. You will receive **2 points** for each correct answer and **0.5 points** will be deducted from total score of correct answers for each incorrect answer and **no points** will be awarded for unanswered questions. (本大題共 25 題，總分 50 分。皆為單選題，每題答對 2 分，答錯倒扣 0.5 分，不答該題不計分。本大題倒扣完為止。)

1. Two model rockets are fired simultaneously from a ledge and follow the trajectories shown. Neglecting air resistance, which of the rockets will hit the ground first?



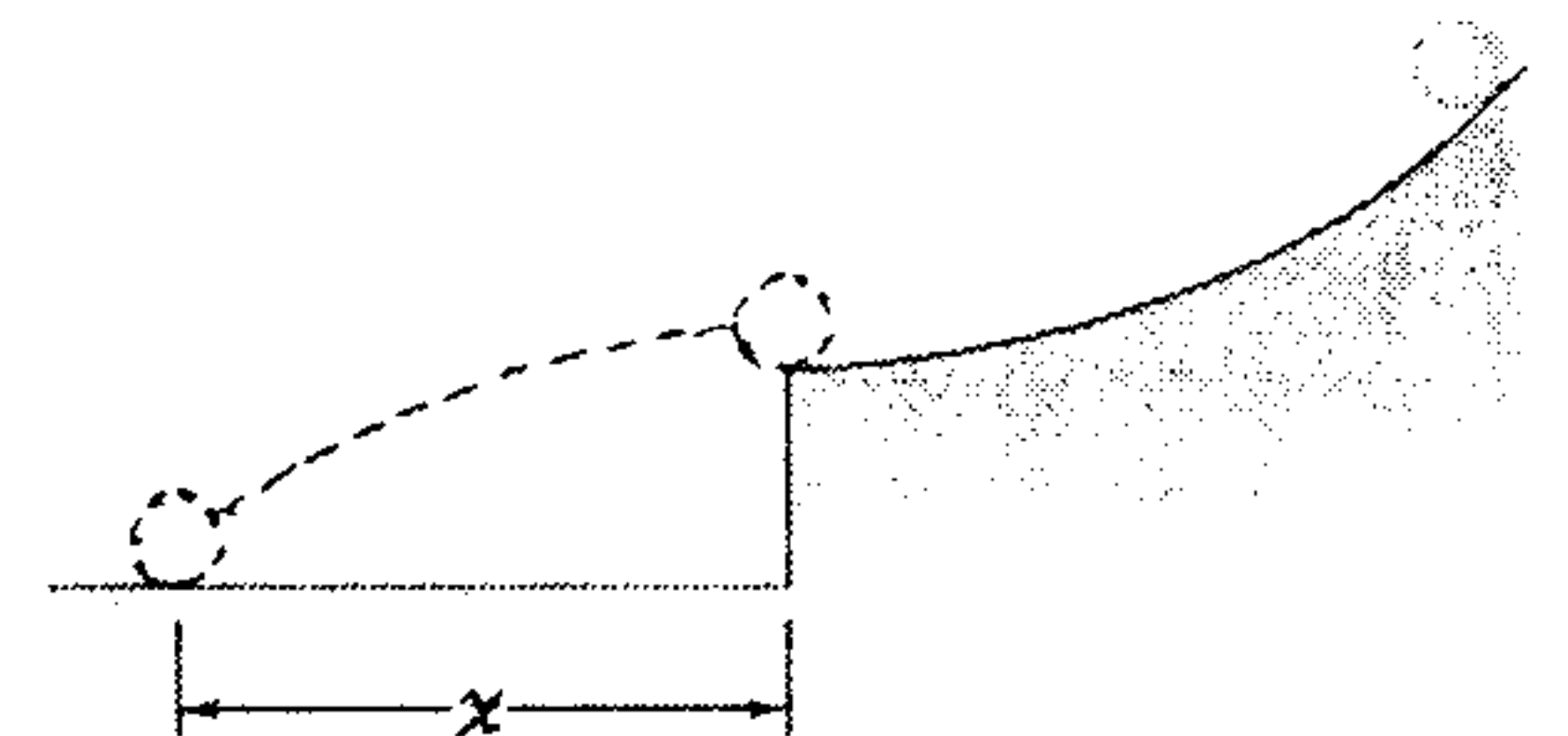
- (a) They hit at the same time. (b) The answer depends on h . (c) A (d) B

2. People sit on a Ferris wheel at Points A, B, C and D. The Ferris wheel travels at a constant angular velocity. At the instant shown, which person experiences the largest force from his or her chair (back and seat)? Assume you can neglect the size of the chairs, that is, the people are located the same distance from the axis of rotation.



- (a) A (b) B (c) C (d) D (e) The force is the same for all the passengers.

3. A round object of mass m and radius r is released from rest at the top of a curved surface and rolls without slipping until it leaves the surface with a horizontal velocity as shown. Will a solid sphere, a solid cylinder or a hoop travel the greatest distance c ?

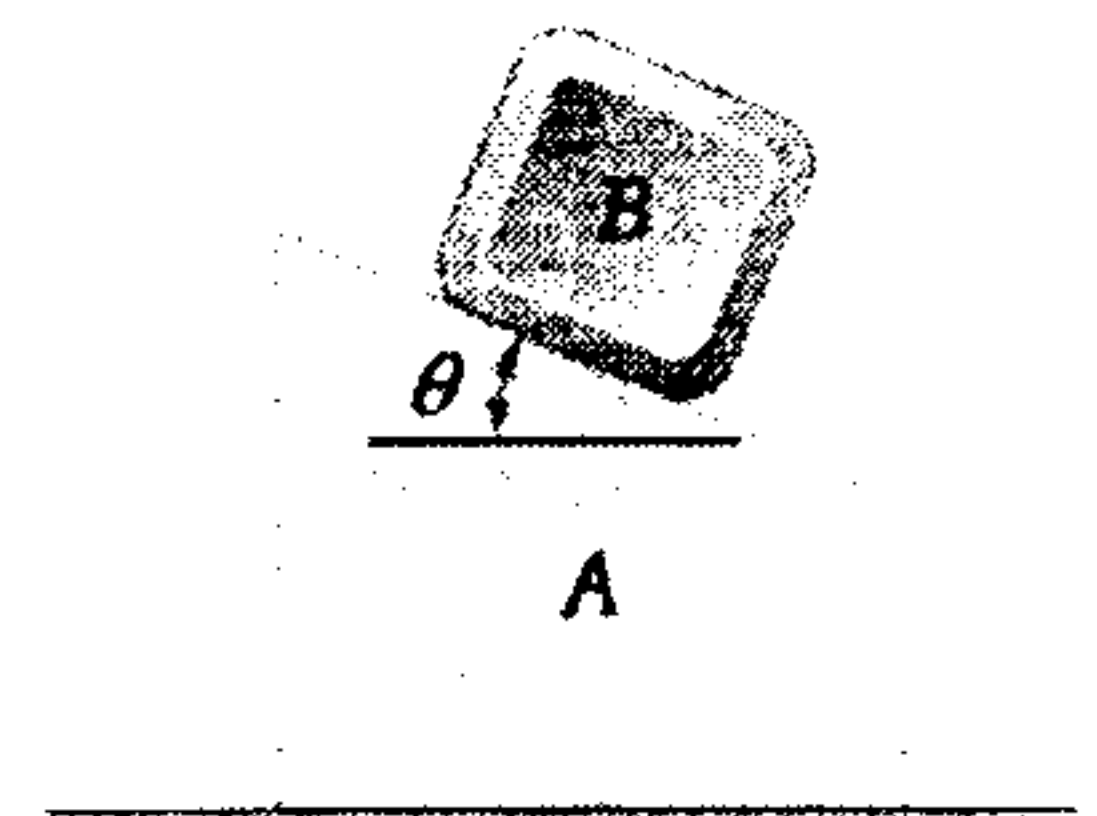


- (a) A solid sphere (b) A solid cylinder (c) A hoop (d) They will all travel the same distance.

4. Ball A is thrown straight up with an initial speed v_0 and reaches a maximum elevation h before falling back down. When A reaches its maximum elevation, a second ball is thrown straight upward with the same initial speed v_0 . At what height, y , will the balls cross paths?

- (a) $y = 0$ (b) $y = h$ (c) $y < h/2$ (d) $y = h/2$ (e) $y > h/2$

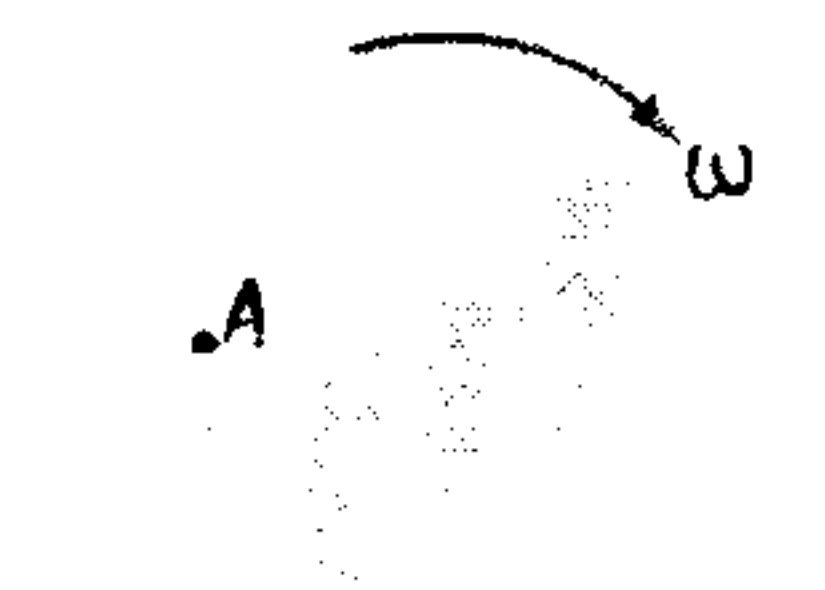
5. Blocks A and B are released from rest in the positions shown. Neglecting friction between all surfaces, which figure below best indicates the direction α of the acceleration of block B?



- (a) (b) (c) (d) (e)

6. Following the previous question, the normal force between block A and the ground is
- (a) less than the weight of A plus the weight of B
 (b) equal to the weight of A plus the weight of B
 (c) greater than the weight of A plus the weight of B

7. The ball rolls without slipping on the fixed surface as shown. What is the direction of the velocity of Point A?



- (a) \rightarrow (b) \downarrow (c) \uparrow (d) \searrow (e) \nearrow

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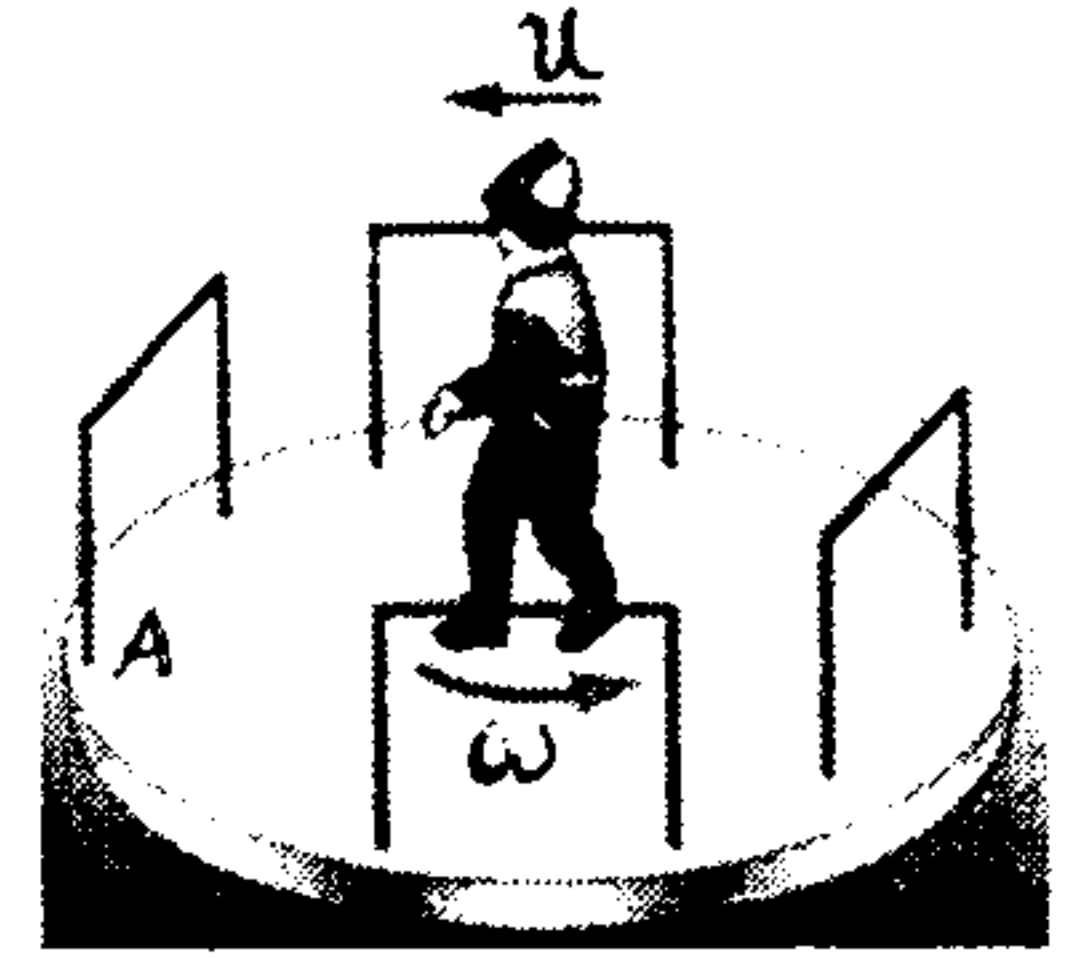
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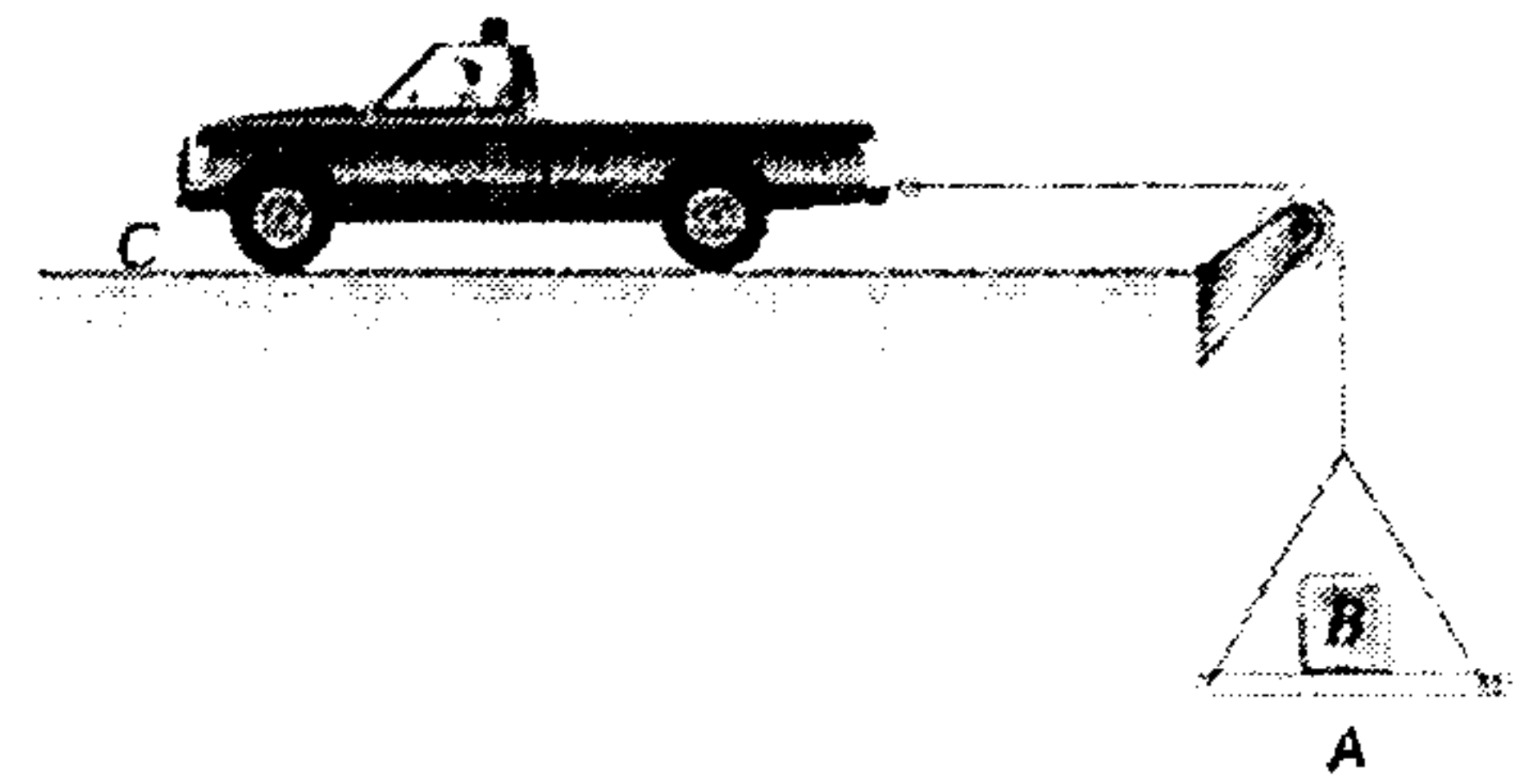
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*請在【答案卷】作答

8. A child walks across merry-go-round A with a constant speed u relative to A . The merry-go-round undergoes fixed axis rotation about its center with a constant angular velocity counterclockwise. When the child is at the center of A , as shown, what is the direction of his acceleration when viewed from above.

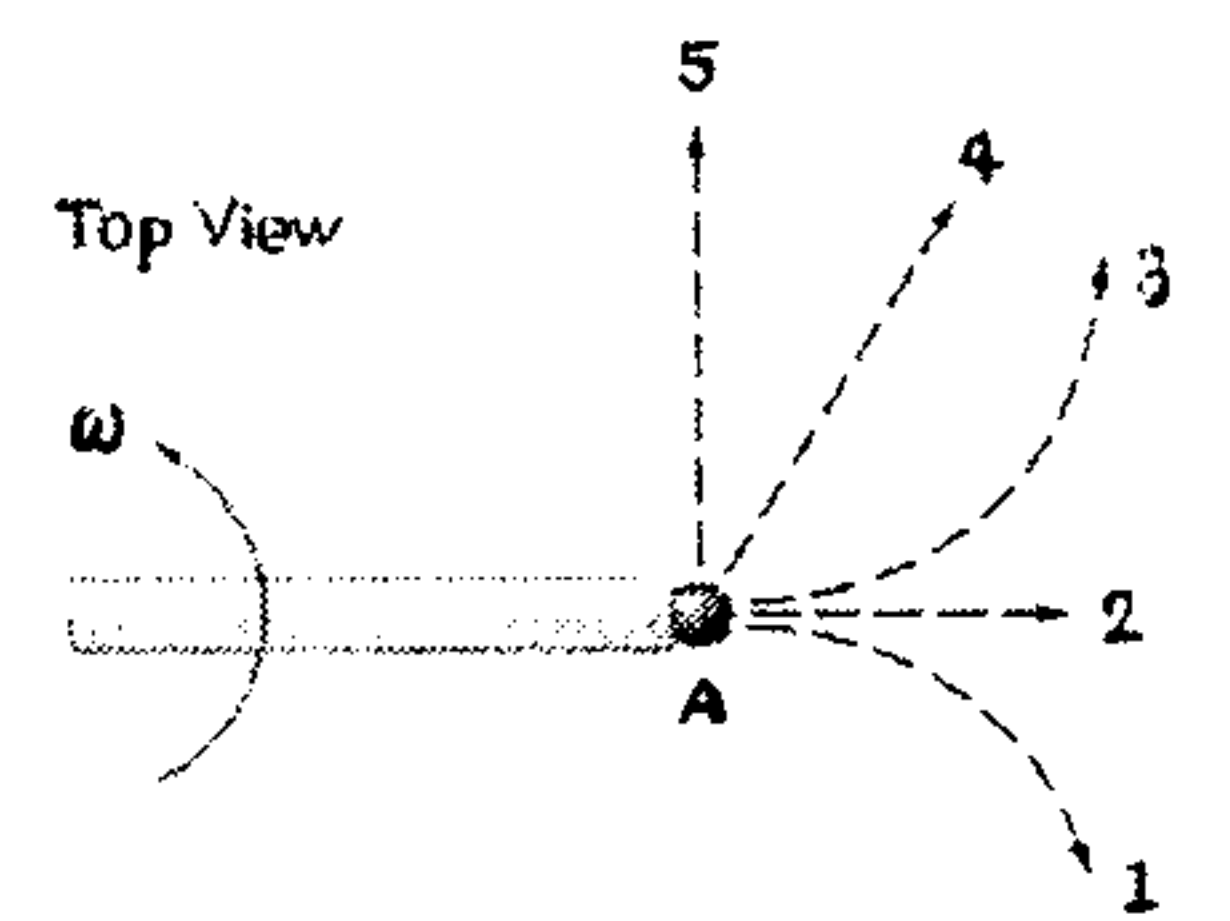


- (a) \rightarrow (b) \leftarrow (c) \uparrow (d) \downarrow (e) The acceleration is zero.
9. A 1000 N boulder B is resting on a 200 N platform A when truck C accelerates to the left with a constant acceleration. Which of the following statements are true?



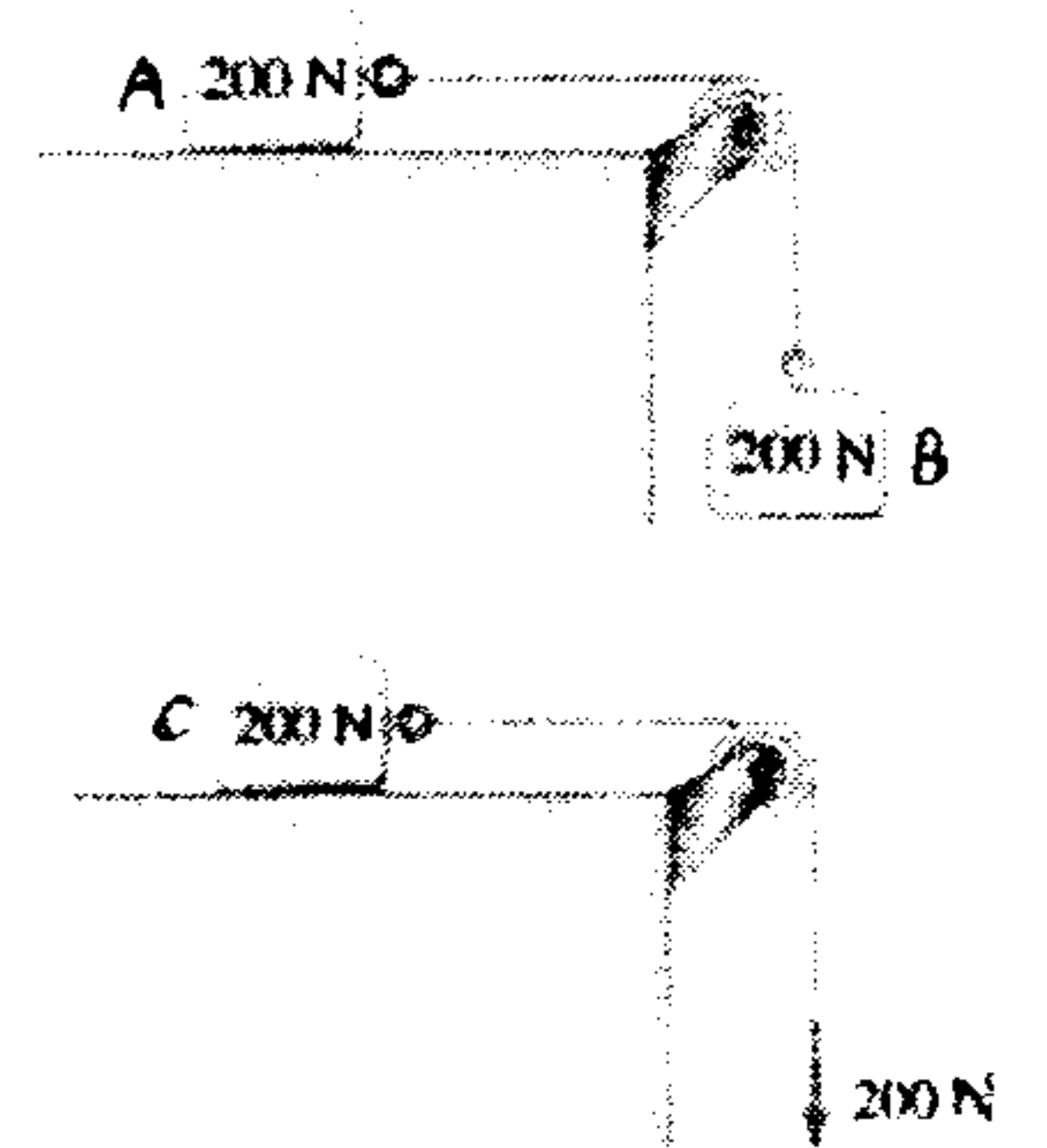
- (a) The tension in the cord connected to the truck is 200 N
 (b) The tension in the cord connected to the truck is 1200 N
 (c) The normal force between A and B is 1000 N
 (d) The normal force between A and B is 1200 N
 (e) The tension in the cord connected to the truck is greater than 1200 N

10. Marble A is placed in a hollow tube, and the tube is swung in a horizontal plane causing the marble to be thrown out. As viewed from the top, which of the following choices best describes the path of the marble after leaving the tube?



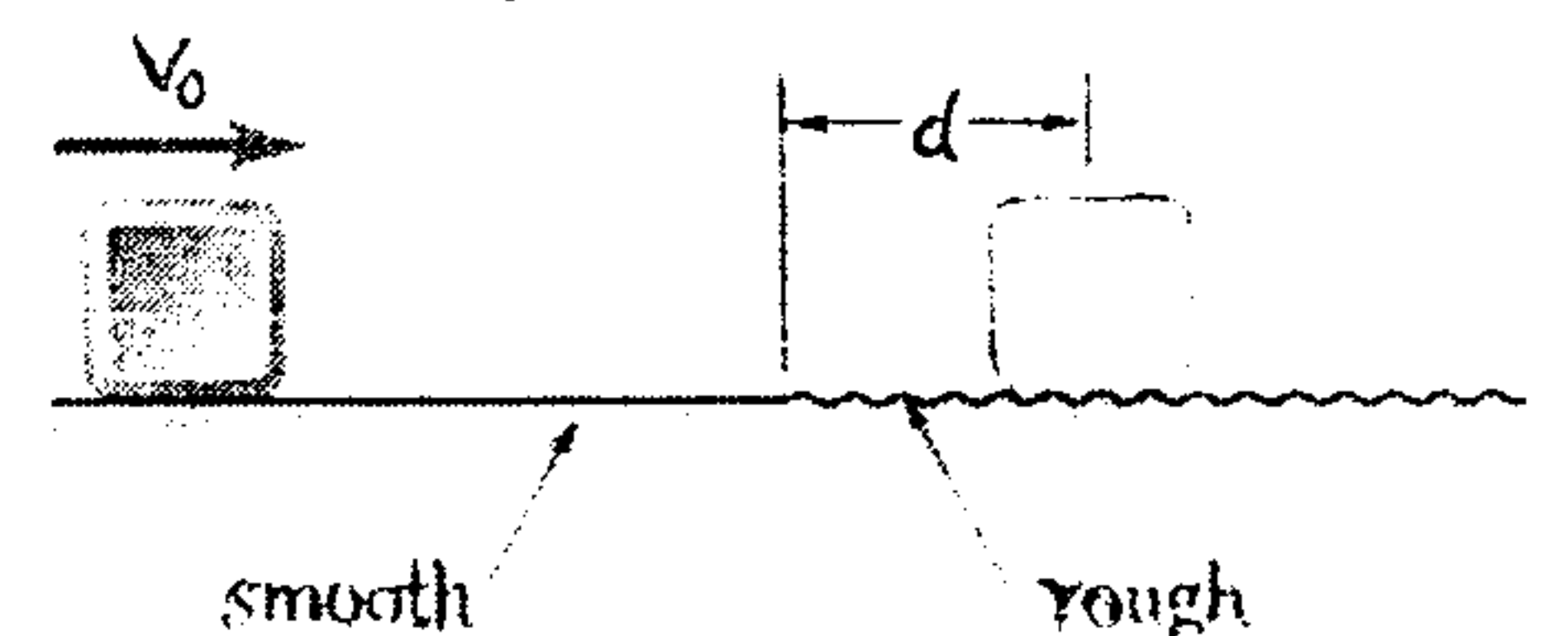
- (a) 1 (b) 2 (c) 3 (d) 4 (e) 5

11. The two systems shown start from rest. On the left, two 200 N weights are connected by an inextensible cord, and on the right, a constant 200 N force pulls on the cord. Neglecting all frictional forces, which of the following statements is true?



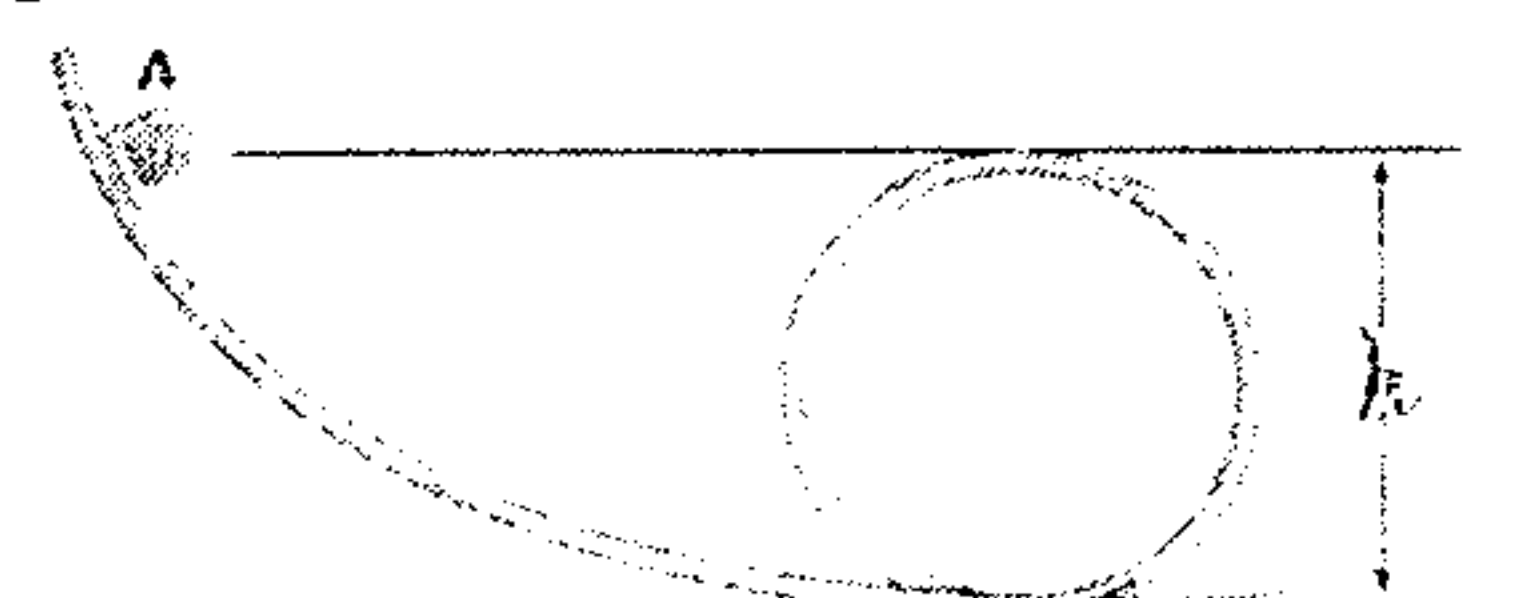
- (a) Block A will not move
 (b) Blocks A and C will have the same acceleration
 (c) Block A will have a larger acceleration than block C
 (d) Block C will have a larger acceleration than block A
 (e) None of the above

12. Block A is traveling with a speed v_0 on a smooth surface when the surface suddenly becomes rough with a coefficient of friction of μ causing the block to stop after a distance d . If block A were traveling twice as fast, that is, at a speed $2v_0$, how far will it travel on the rough surface before stopping?



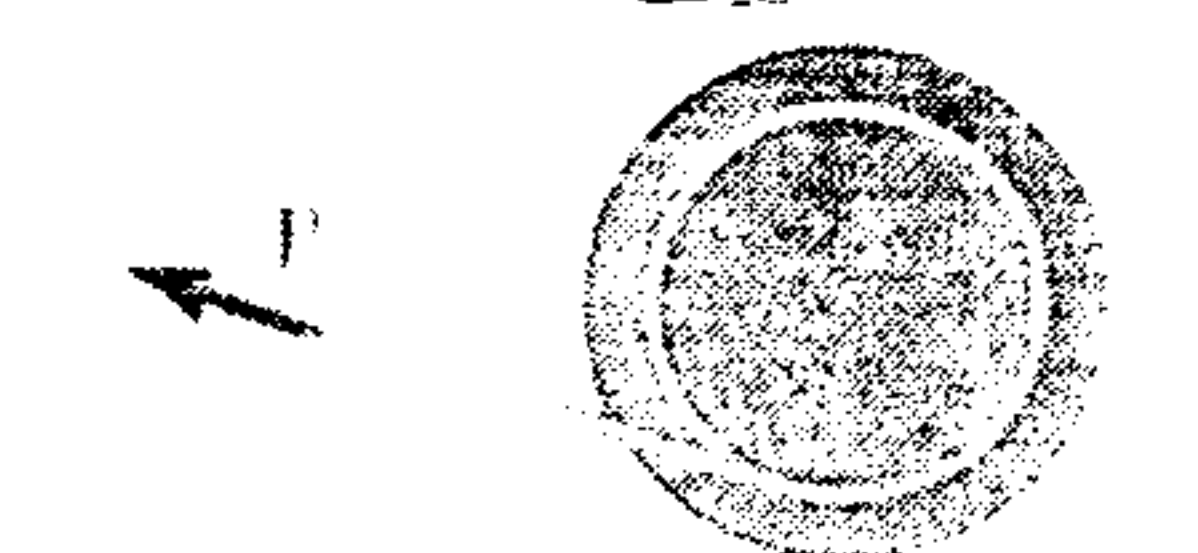
- (a) $d/2$ (b) d (c) $\sqrt{2}d$ (d) $2d$ (e) $4d$

13. Block A is released from rest and slides down the frictionless ramp to the loop. The maximum height h of the loop is the same as the initial height of the block. Will A make it completely around the loop without losing contact with the track?



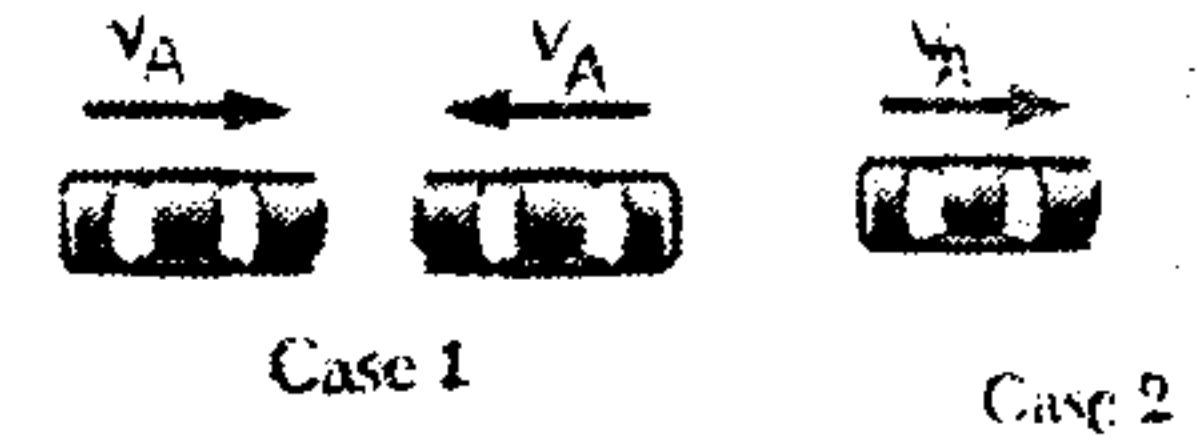
- (a) Yes (b) No (c) need more information

14. A cord is attached to a spool when a force P is applied to the cord as shown. Assuming the spool rolls without slipping, what direction does the spool move?



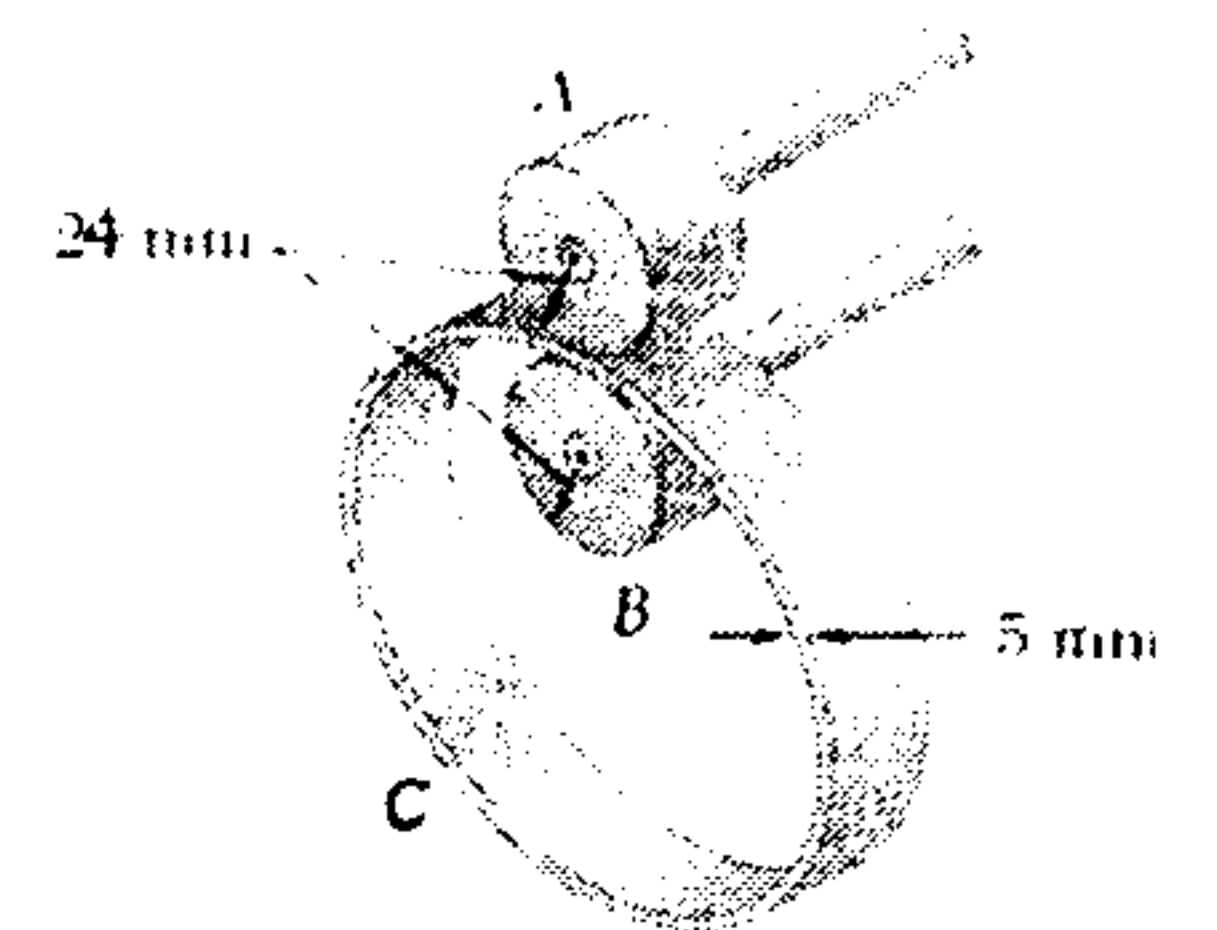
- (a) left (b) right (c) It would not move.

15. The expected damages associated with two types of perfectly plastic collisions are to be compared. In the first case, two identical cars traveling at the same speed impact each other head on. In the second case, the car impacts a massive concrete wall. In which case would you expect the car to be more damaged?



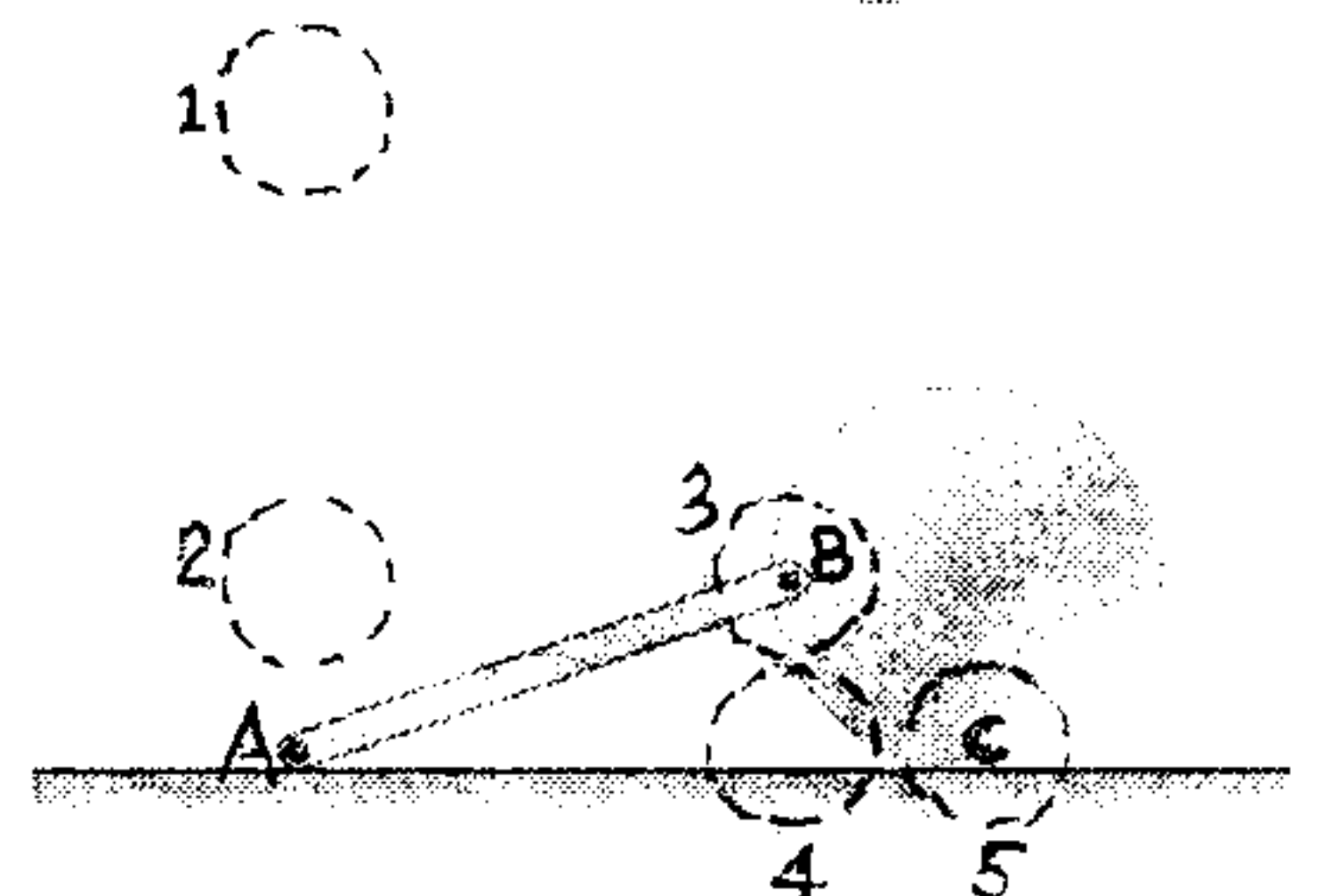
- (a) Case 1 (b) Case 2 (c) The same damage in each case

16. Knowing that wheel A rotates with a constant angular velocity and that no slipping occurs between ring C and wheel A and wheel B, which of the following statements concerning the angular speeds are true?



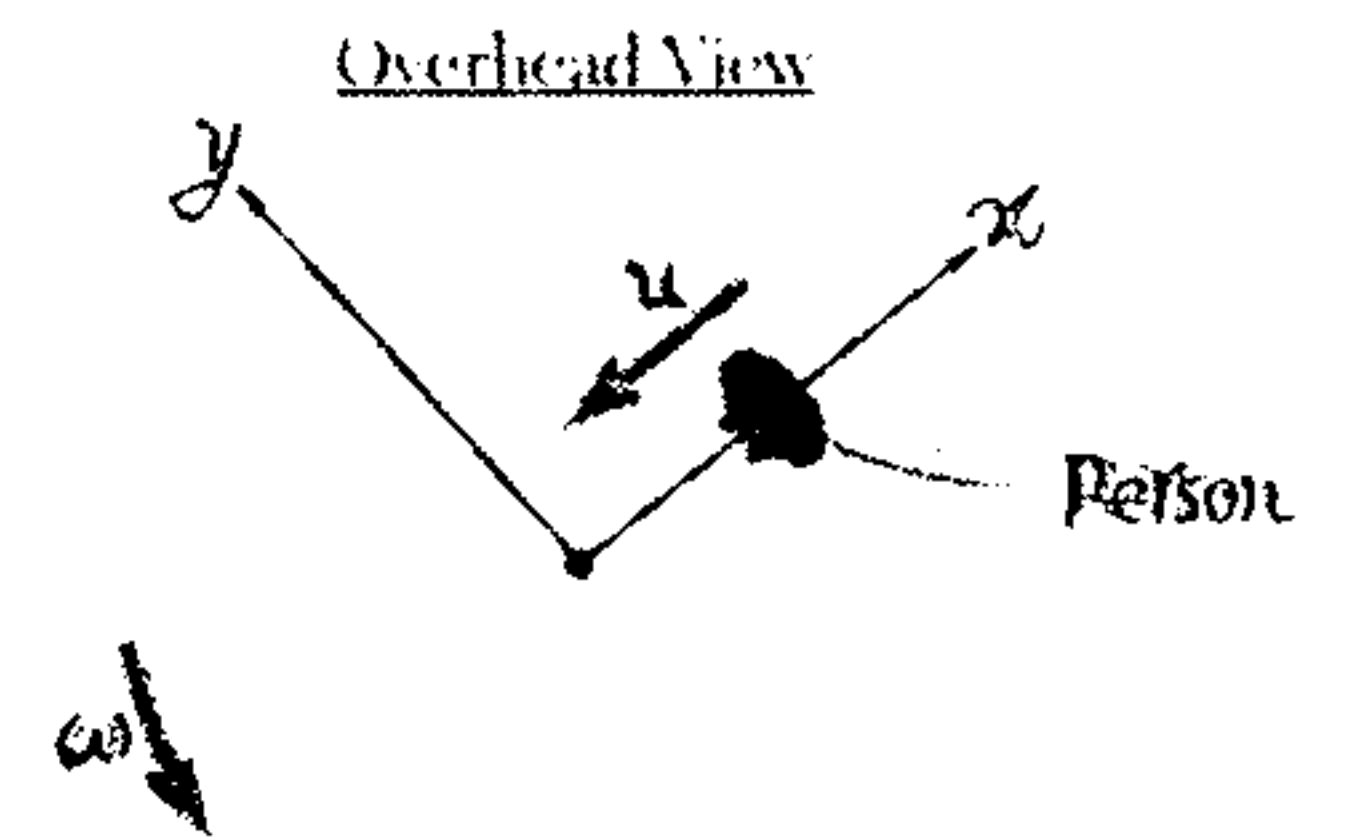
- (a) $\omega_a = \omega_b$ (b) $\omega_a > \omega_b$ (c) $\omega_a < \omega_b$ (d) $\omega_a = \omega_c$ (e) the contact points between A and C have the same acceleration

17. The disk rolls without sliding on the fixed horizontal surface. At the instant shown, the instantaneous center of zero velocity for rod AB would be located in which region?



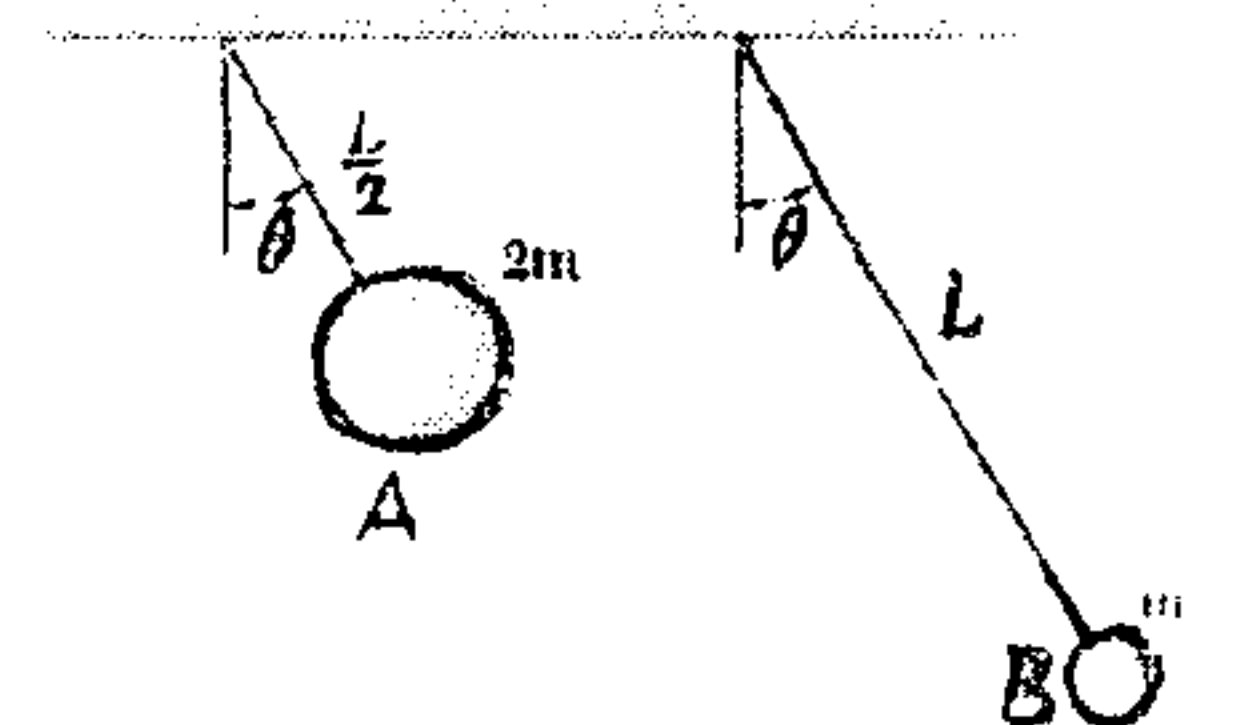
- (a) region 1 (b) region 2 (c) region 3 (d) region 4 (e) region 5

18. A person walks radially inward on a platform that is rotating counterclockwise about its center. Knowing that the platform has a constant angular velocity ω and the person walks with a constant speed u relative to the platform, what is the direction of the acceleration of the person at the instant shown?



- (a) Negative x (b) Negative y (c) Negative x and positive y
(d) Positive x and positive y (e) Negative x and negative y

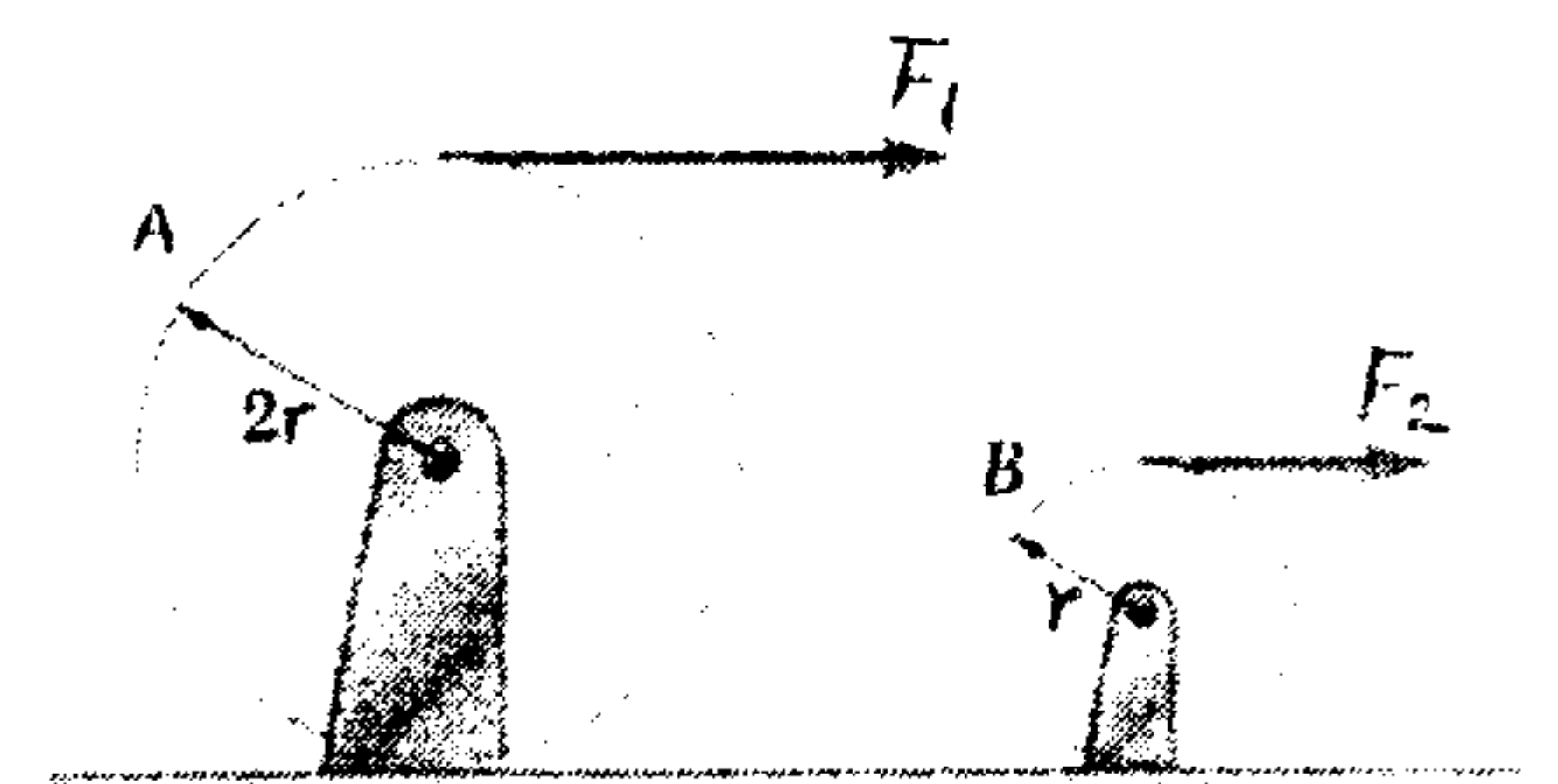
19. Two pendulums, A and B, with the masses and lengths shown are released from rest. Which system has a larger mass moment of inertia about its pivot point?



- (a) A (b) B (c) They are the same.

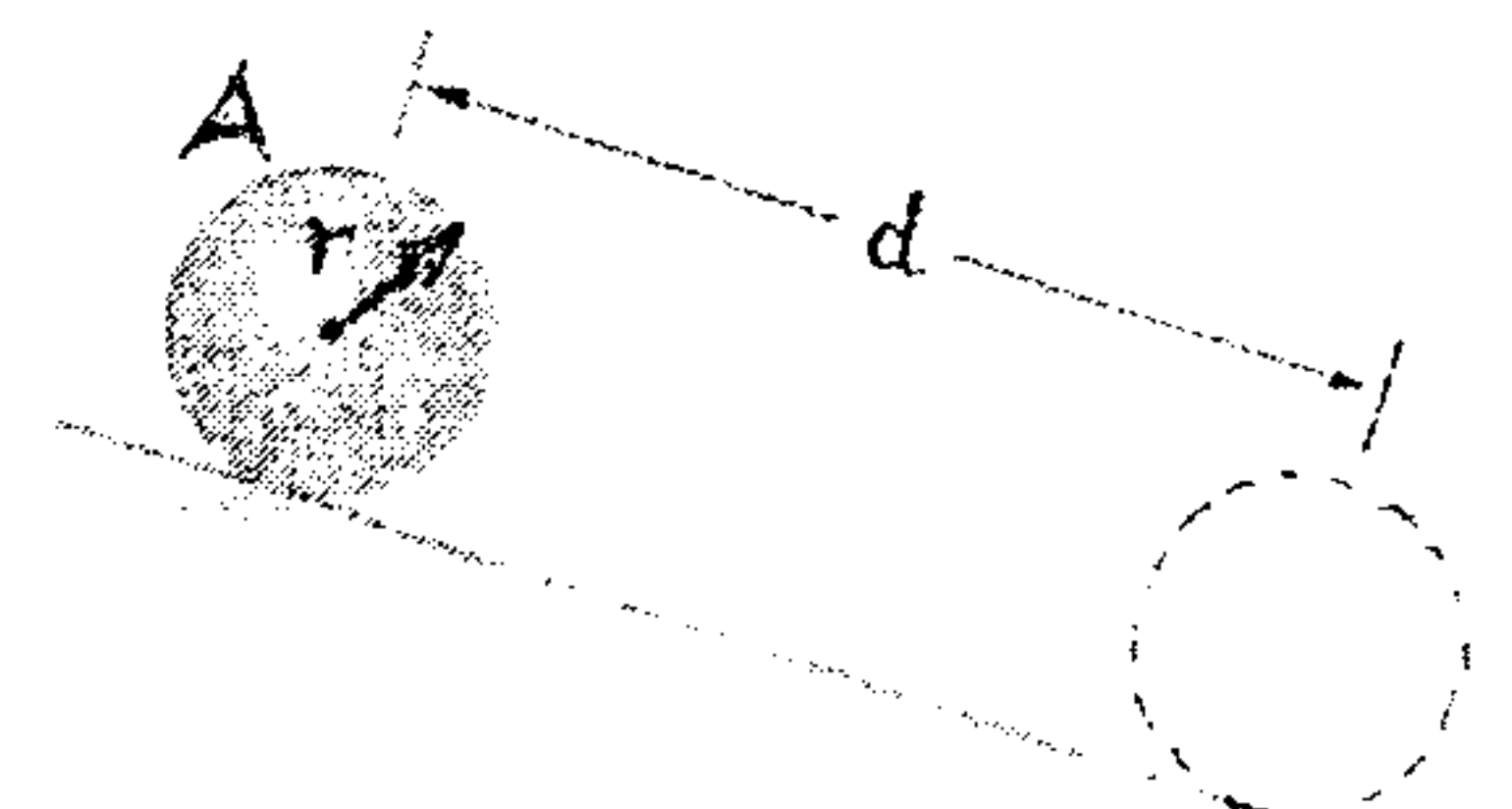
20. Following the previous question, which system has a larger angular acceleration immediately after release? (a) A (b) B (c) They are the same.

21. Two solid cylinders, A and B, have the same mass m and the radii $2r$ and r respectively. Each is accelerated from rest with a force applied as shown. In order to impart identical angular accelerations to both cylinders, what is the relationship between F_1 and F_2 ?



- (a) $F_1 = 0.5F_2$ (b) $F_1 = F_2$ (c) $F_1 = 2F_2$ (d) $F_1 = 4F_2$ (e) $F_1 = 8F_2$

22. A solid steel sphere A of radius r and mass m is released from rest and rolls without slipping down an incline as shown. After traveling a distance d the sphere has a speed v . If a solid steel sphere of radius $2r$ is released from rest on the same incline, what will its speed be after rolling a distance d ?



- (a) $0.25v$ (b) $0.5v$ (c) v (d) $2v$ (e) $4v$

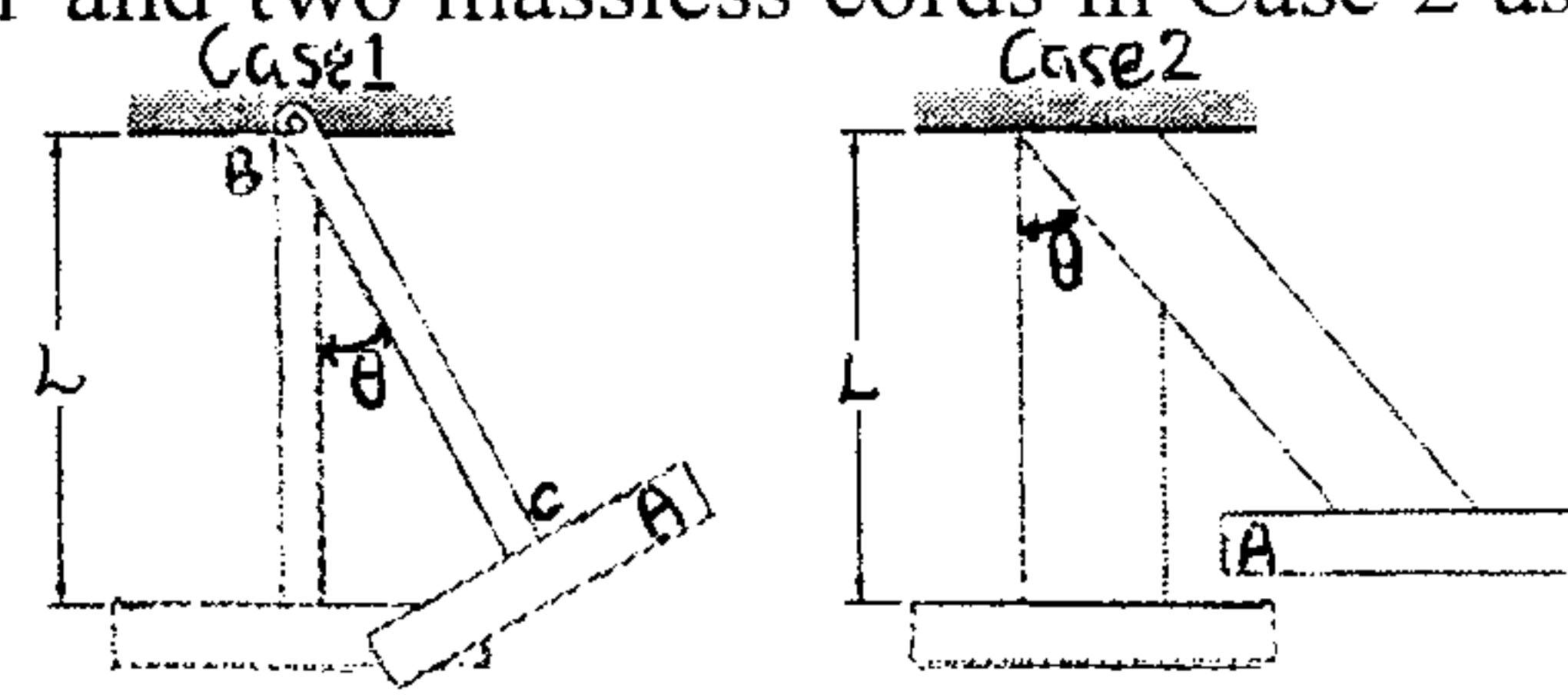
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23. Slender bar A is rigidly connected to a massless rod BC in Case 1 and two massless cords in Case 2 as shown. The vertical thickness of bar A is negligible compared to L . In both cases A is released from rest at an angle $\theta = \theta_0$. When $\theta = 0^\circ$ which system will have the larger kinetic energy?

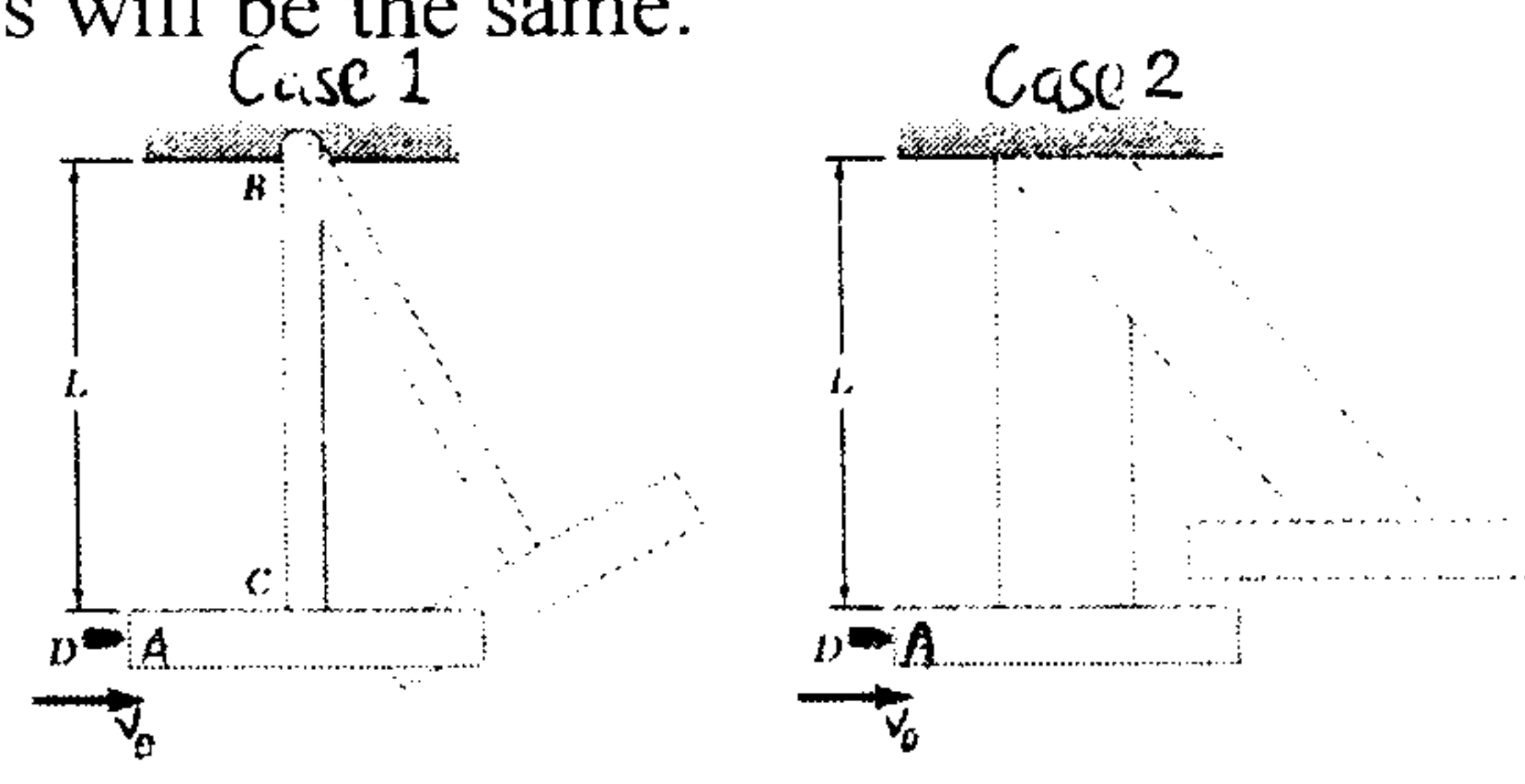


(a) Case 1 (b) Case 2 (c) The kinetic energy will be the same.

24. Following the previous question, how will the speeds of the centers of gravity compare for the two cases when $\theta = 0^\circ$?

(a) Case 1 will be larger. (b) Case 2 will be larger. (c) The speeds will be the same.

25. Following the previous question, if bullet D strikes A with a speed v_0 and becomes embedded in it, how will the speeds of the center of gravity of A immediately after the impact compare for the two cases? (a) Case 1 will be larger.



(b) Case 2 will be larger. (c) The speeds will be the same.