

VER AA

STUDENT NAME \_\_\_\_\_

STUDENT NUMBER: \_\_\_\_\_

Closed Book Test

Duration: 100min

**PART I IN THE SCANTRON SHEETS ENTER THE ANSWERS TO THE FOLLOWING 7 QUESTIONS. (6 BEST ANSWERS COUNT FOR THE 60% OF THIS TEST MARK)**

- A bullet is fired through a board, 14.0 cm thick, with its line of motion perpendicular to the face of the board. If it enters with a speed of 450 m/s and emerges with a speed of 220 m/s, what is the bullet's acceleration as it passes through the board?

a)  $-500 \text{ km/s}^2$     b)  $-550 \text{ km/s}^2$     c)  $-360 \text{ km/s}^2$     d)  $-520 \text{ km/s}^2$     e)  $-275 \text{ km/s}^2$
- A 0.20-km wide river has a uniform flow speed of 3.0 m/s toward the east. A boat with a speed of 8.0 m/s relative to the water leaves the south bank and heads in such a way that it crosses to a point directly north of its departure point. How long does it take the boat to cross the river?

a) 32 s    b) 23 s    c) 25 s    d) 27 s    e) 17 s
- A race car moving with a constant speed of 60 m/s completes one lap around a circular track in 50 s. What is the magnitude of the acceleration of the race car?

a)  $8.8 \text{ m/s}^2$     b)  $7.5 \text{ m/s}^2$     c)  $9.6 \text{ m/s}^2$     d)  $6.3 \text{ m/s}^2$     e)  $5.3 \text{ m/s}^2$
- A ball is thrown horizontally from the top of a building 100m high. The ball strikes the ground at a point 65 m horizontally away from and below the point of release. What is the magnitude of velocity of the ball just before it strikes the ground?

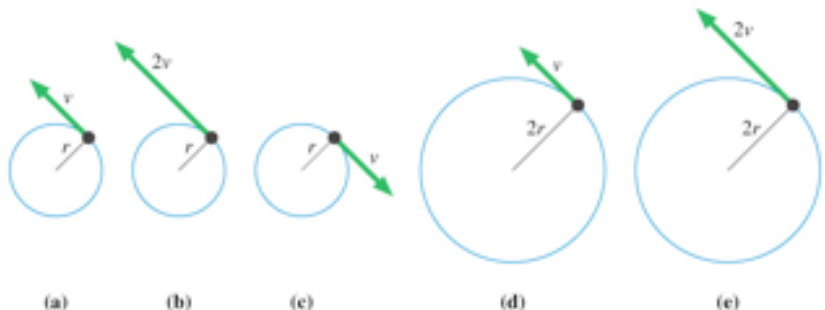
a) 47 m/s    b) 44 m/s    c) 39 m/s    d) 36 m/s    e) 14 m/s
- A 7.0-kg object is suspended by a string from the ceiling of an elevator that is accelerating downward at a rate of  $2.4 \text{ m/s}^2$ . What is the tension in the string?

a) 49 N    b) 36 N    c) 62 N    d) 13 N    e) 52 N
- If the only forces acting on a 1.0-kg mass are  $F_1 = (3i - 8j) \text{ N}$  and  $F_2 = (5i + 3j) \text{ N}$ , what is the magnitude of the acceleration of the particle?

a)  $1.5 \text{ m/s}^2$     b)  $6.5 \text{ m/s}^2$     c)  $4.7 \text{ m/s}^2$     d)  $9.4 \text{ m/s}^2$     e)  $7.2 \text{ m/s}^2$

7 In each case below same mass  $m$  is spinning on the piece of string.  
 Rank in order, from largest to smallest, the magnitude of the Tensions (T)a to (T)e of particles a to e.

- A)  $T_b > T_e > T_a > T_d > T_c$   
 B)  $T_b > T_e > T_a = T_c > T_d$   
 C)  $T_b > T_a = T_c = T_e > T_d$   
 D)  $T_b = T_e > T_a = T_c > T_d$   
 E) None of the above



**PART II: OPEN ENDED PROBLEMS**

**IN THE EXAMINATION BOOKLETS ENTER THE FULL SOLUTIONS TO 4 OUT OF 5 PROBLEMS BELOW.**

**(INDICATE CLEARLY WHICH 4 PROBLEMS ARE TO BE MARKED BY TA) THIS PART OF THE TEST WILL CONSTITUTE 52 OF THE WEIGHT OF THE TEST)**

- 1 A ball is tossed from an upper-story window of a building. The ball is given an initial velocity of 8.00 m/s at an angle of  $20.0^\circ$  below the horizontal. It strikes the ground 3.00 s later.
- (a) How far horizontally from the base of the building does the ball strike the ground? (4P)
  - (b) Find the height from which the ball was thrown. (4P)
  - (c) What is the velocity of the ball when it strikes the ground? (5P)

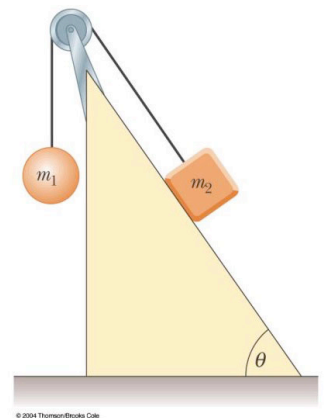
- 2 A motorist drives along a straight road at a constant speed of 15.0 m/s. Just as she passes a parked motorcycle police officer, the officer starts to accelerate at  $2.00 \text{ m/s}^2$  to overtake her. Assuming the officer maintains this acceleration,
- a) determine the time it takes the police officer to reach the motorist. (4P)
  - b) Find the speed of the officer as he overtakes the motorist (4P)
  - c) Find the total displacement of the officer as he overtakes the motorist. (5P)

- 3 An automobile is moving at speed of 2.00 m/s along a circular road of radius 20 m.
- A) Find the time it takes to make one full circle when the car is still moving at constant speed. (3P)
  - B) Find the car radial acceleration during this time. (3P)

Then its speed starts increasing at a rate of  $0.600 \text{ m/s}^2$  while it stays on the same road. When the instantaneous speed of the automobile is 4.00 m/s, find

- (C) the tangential acceleration component (2P)
  - (D) the radial acceleration component, (2P)
  - (E) the magnitude and direction of the total acceleration with respect to the radius (3P)
- 4 The largest-caliber anti-aircraft gun operated by the German air force during World War II was the 12.8-cm Flak 40. This weapon fired a 25.8-kg shell with a muzzle speed of 880 m/s. What propulsive force was necessary to attain the muzzle speed within the 5.00-m barrel? (The shell moves horizontally with constant acceleration and negligible friction.) (Muzzle speed = exit speed) (13P)

- 5 Two objects are connected by a light string that passes over a frictionless pulley, as in Figure. Draw free-body diagrams of both objects. The incline is frictionless and if  $m_1 = 2.00 \text{ kg}$ ,  $m_2 = 6.00 \text{ kg}$ , and  $\theta = 57.0^\circ$ .
- a) draw clear and neat free body diagrams for both masses (3P)
  - b) write the Newton's Laws in proper form for the components of the forces acting on the body (3P)
  - c) find the accelerations of the objects, (2P)
  - d) find the tension in the string, (3P)
  - e) find the speed of each object 2.00 s after being released from rest. (2P)



Ver BB

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**PART I IN THE SCANTRON SHEETS ENTER THE ANSWERS TO THE FOLLOWING 7 QUESTIONS. (6 BEST ANSWERS COUNT FOR THE 60% OF THIS TEST MARK)**

1. A bullet is fired through a board, 24.0 cm thick, with its line of motion perpendicular to the face of the board. If it enters with a speed of 450 m/s and emerges with a speed of 221 m/s, what is the bullet's acceleration as it passes through the board?

- a)  $-500 \text{ km/s}^2$     b)  $-550 \text{ km/s}^2$     c)  $-320 \text{ km/s}^2$     d)  $-520 \text{ km/s}^2$     e)  $-275 \text{ km/s}^2$

2. A 0.20-km wide river has a uniform flow speed of 6.0 m/s toward the east. A boat with a speed of 10.0 m/s relative to the water leaves the south bank and heads in such a way that it crosses to a point directly north of its departure point. How long does it take the boat to cross the river?

- a) 32s    b) 23 s    c) 25 s    d) 27 s    e) 17 s

3. A race car moving with a constant speed of 55 m/s completes one lap around a circular track in 36 s. What is the magnitude of the acceleration of the race car?

- a)  $8.8 \text{ m/s}^2$     b)  $7.5 \text{ m/s}^2$     c)  $9.6 \text{ m/s}^2$     d)  $6.3 \text{ m/s}^2$     e)  $5.3 \text{ m/s}^2$

4. A ball is thrown horizontally from the top of a building 90m high. The ball strikes the ground at a point 60 m horizontally away from and below the point of release. What is the magnitude of velocity of the ball just before it strikes the ground?

- a) 47 m/s    b) 44 m/s    c) 42m/s    d) 36 m/s    e) 14 m/s

5. A 6.0-kg object is suspended by a string from the ceiling of an elevator that is accelerating downward at a rate of  $2.6 \text{ m/s}^2$ . What is the tension in the string?

- a) 49 N    b) 36 N    c) 62 N    d) 43 N    e) ) 52 N

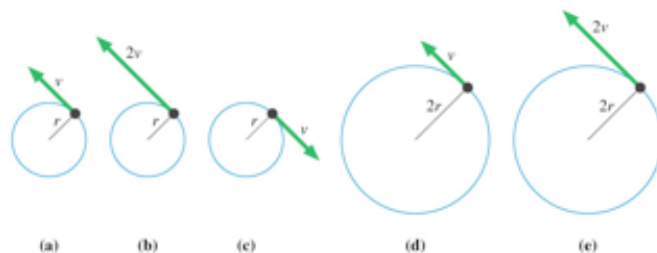
6. If the only forces acting on a 1.0-kg mass are  $F_1 = (2i + 8j) \text{ N}$  and  $F_2 = (4i - 3j) \text{ N}$ , what is the magnitude of the acceleration of the particle?

- a)  $1.5 \text{ m/s}^2$     b)  $6.5 \text{ m/s}^2$     c)  $4.7 \text{ m/s}^2$     d)  $9.4 \text{ m/s}^2$     e)  $7.8 \text{ m/s}^2$

7. In each case below same mass  $m$  is spinning on the piece of string.

Rank in order, from largest to smallest, the magnitude of the Tensions (T)a to (T)e of particles a to e.

- A.  $T_b > T_e > T_a > T_d > T_c$   
 B.  $T_b = T_e > T_a = T_c > T_d$   
 C.  $T_b > T_a = T_c = T_e > T_d$   
 D.  $T_b > T_e > T_a = T_c > T_d$   
 E. None of the above



**PART II: OPEN ENDED PROBLEMS**

**IN THE EXAMINATION BOOKLETS ENTER THE FULL SOLUTIONS TO 4 OUT OF 5 PROBLEMS BELOW.**

**(INDICATE CLEARLY WHICH 4 PROBLEMS ARE TO BE MARKED BY TA) THIS PART OF THE TEST WILL CONSTITUTE 52 OF THE WEIGHT OF THE TEST)**

- 1 A ball is tossed from an upper-story window of a building. The ball is given an initial velocity of 9.00 m/s at an angle of  $30.0^\circ$  below the horizontal. It strikes the ground 2.00 s later.
- (a) How far horizontally from the base of the building does the ball strike the ground? (4P)
  - (b) Find the height from which the ball was thrown. (4P)
  - (c) What is the velocity of the ball when it strikes the ground? (5P)

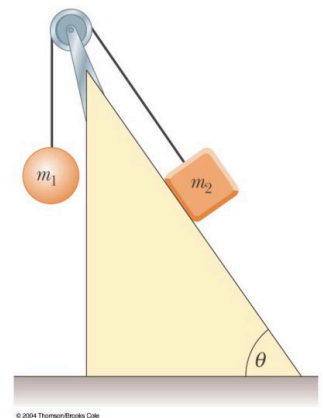
- 2 A motorist drives along a straight road at a constant speed of 16.0 m/s. Just as she passes a parked motorcycle police officer, the officer starts to accelerate at  $3.00 \text{ m/s}^2$  to overtake her. Assuming the officer maintains this acceleration,
- a) determine the time it takes the police officer to reach the motorist. (4P)
  - b) Find the speed the total displacement of the officer as he overtakes the motorist (4P)
  - c) Find the total displacement of the officer as he overtakes the motorist. (5P)

- 3 An automobile is moving at speed of 3.00 m/s along a circular road of radius 30 m.
- A) Find the time it takes to make one full circle when the car is still moving at constant speed. (3P)
  - B) Find the car radial acceleration during this time. (3P)

Then its speed starts increasing at a rate of  $0.500 \text{ m/s}^2$  while it stays on the same road. When the instantaneous speed of the automobile is 5.00 m/s, find

- (C) the tangential acceleration component (2P)
  - (D) the radial acceleration component, and (2P)
  - (E) the magnitude and direction of the total acceleration with respect to the radius (3P)
- 4 The largest-caliber anti-aircraft gun operated by the German air force during World War II was the 12.8-cm Flak 40. This weapon fired a 26.8-kg shell with a muzzle speed of 890 m/s. What propulsive force was necessary to attain the muzzle speed within the 5.00-m barrel? (The shell moves horizontally with constant acceleration and negligible friction.) (Muzzle speed = exit speed) (13P)

- 5 Two objects are connected by a light string that passes over a frictionless pulley, as in Figure. Draw free-body diagrams of both objects. The incline is frictionless and if  $m_1 = 3.00 \text{ kg}$ ,  $m_2 = 5.00 \text{ kg}$ , and  $\theta = 53.0^\circ$ .
- a) draw clear and neat free body diagrams for both masses (3P)
  - b) write the Newton's Laws in proper form for the components of the forces acting on the body (3P)
  - c) find the accelerations of the objects, (2P)
  - d) find the tension in the string, (3P)
  - e) find the speed of each object 1.00 s after being released from rest. (2P)



Ver CC

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1. A bullet is fired through a board, 17.0 cm thick, with its line of motion perpendicular to the face of the board. If it enters with a speed of 455 m/s and emerges with a speed of 225 m/s, what is the bullet's acceleration as it passes through the board?

a)  $-500 \text{ km/s}^2$     b)  $-550 \text{ km/s}^2$     c)  $-320 \text{ km/s}^2$     d)  $-460 \text{ km/s}^2$     e)  $-275 \text{ km/s}^2$

2. A 0.20-km wide river has a uniform flow speed of 5.0 m/s toward the east. A boat with a speed of 8.0 m/s relative to the water leaves the south bank and heads in such a way that it crosses to a point directly north of its departure point. How long does it take the boat to cross the river?

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4. A ball is thrown horizontally from the top of a building 80m high. The ball strikes the ground at a point 60 m horizontally away from and below the point of release. What is the magnitude of velocity of the ball just before it strikes the ground?

a) 47 m/s    b) 44 m/s    c) 42 m/s    d) 36 m/s    e) 14 m/s

5. A 5.0-kg object is suspended by a string from the ceiling of an elevator that is accelerating downward at a rate of  $2.6 \text{ m/s}^2$ . What is the tension in the string?

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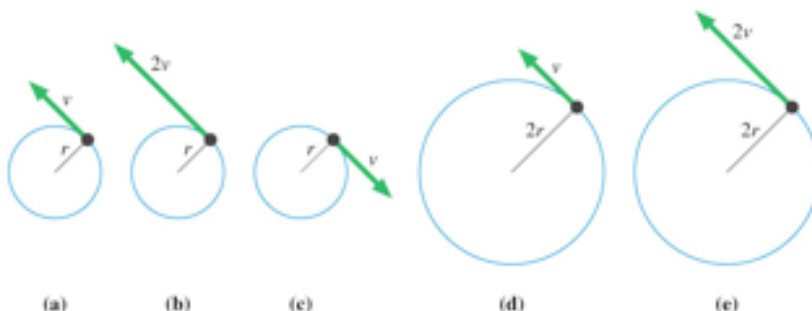
6. If the only forces acting on a 1.0-kg mass are  $F_1 = (3i - 8j) \text{ N}$  and  $F_2 = (3i + 5j) \text{ N}$ , what is the magnitude of the acceleration of the particle?

a)  $1.5 \text{ m/s}^2$     b)  $6.7 \text{ m/s}^2$     c)  $4.7 \text{ m/s}^2$     d)  $9.4 \text{ m/s}^2$     e)  $7.2 \text{ m/s}^2$

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 C)  $T_b > T_e > T_a = T_c > T_d$   
 D)  $T_b > T_a = T_c = T_e > T_d$   
 E) None of the above



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- 1 A ball is tossed from an upper-story window of a building. The ball is given an initial velocity of 8.00 m/s at an angle of  $10.0^\circ$  below the horizontal. It strikes the ground 4.00 s later.
- (a) How far horizontally from the base of the building does the ball strike the ground? (4P)
  - (b) Find the height from which the ball was thrown. (4P)
  - (c) What is the velocity of the ball when it strikes the ground? (5P)

- 2 A motorist drives along a straight road at a constant speed of 14.0 m/s. Just as she passes a parked motorcycle police officer, the officer starts to accelerate at  $2.00 \text{ m/s}^2$  to overtake her. Assuming the officer maintains this acceleration,
- a) determine the time it takes the police officer to reach the motorist. (4P)
  - b) Find the speed the total displacement of the officer as he overtakes the motorist (4P)
  - c) Find the total displacement of the officer as he overtakes the motorist. (5P)

- 3 An automobile is moving at speed of 2.50 m/s along a circular road of radius 30 m.
- A) Find the time it takes to make one full circle when the car is still moving at constant speed. (3P)
  - B) Find the car radial acceleration during this time. (3P)

Then its speed starts increasing at a rate of  $0.400 \text{ m/s}^2$  while it stays on the same road. When the instantaneous speed of the automobile is 4.00 m/s, find

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  - b) write the Newton's Laws in proper form for the components of the forces acting on the body (3P)
  - c) find the accelerations of the objects, (2P)
  - d) find the tension in the string, (3P)
  - e) find the speed of each object 1.60 s after being released from rest. (2P)

