1. The exam will last from 9:40 to 11:00 p.m. Use a #2 pencil to make entries on the answer sheet. Enter the following ID information now, before the exam starts.

2. In the section labelled NAME (Last, First, M.I.) enter your last name, then fill in the empty circle for a blank, then enter your first name, another blank, and finally your middle initial.

3. Under STUDENT # enter your 9-digit Rutgers ID number.

4. Enter 203 under COURSE.

5. VERY IMPORTANT: Under CODE enter the exam code given above.

6. During the exam, you may use a calculator and are allowed one handwritten 8.5" by 11" sheet of paper with whatever information you want (both sides OK). You may not use electronic communication devices. Please make sure your phone is turned off.

7. The exam consists of 17 multiple choice questions. For each multiple choice question mark only one answer on the answer sheet. There is no deduction of points for an incorrect answer, so even if you cannot work out the answer to a question, you should make an educated guess.

8. Before starting the exam, make sure that your copy contains all 17 questions. Raise your hand if this is not the case, and a proctor will help you. Also raise your hand during the exam if you have a question.

9. A proctor may check your name sticker and your student ID sometime during the exam. Please have them ready.

10. You are not allowed to give, solicit, or receive help on the exam, except help from a proctor. You may not change your seat without permission from a proctor.

11. Please sign below to indicate that you have read and understood these instructions.

12. When you are done, please hand in both the questions and your answer sheet.

SIGNATURE: ________________________________
1. A 100-kg fireman starts at rest and slides down a vertical pole with a constant downward acceleration of 4.0 m/s². The magnitude of the friction force that the pole exerts on the fireman is closer to:
   a) 1000 N  
   b) 1400 N  
   c) 400 N  
   d) 1600 N  
   e) 600 N

2. A 100-kg fireman is sliding down a vertical pole. His speed is 6.0 m/s when he reaches the floor. At this time he lets go of the pole, so there is no more friction. He manages to stop the center of his body in 0.40 m by bending his ankles and knees. What is the magnitude of the average force that the floor exerts on his feet while stopping him, assuming a constant rate of deceleration?
   a) 5500 N  
   b) 1500 N  
   c) 4500 N  
   d) 240 N  
   e) 600 N

3. A car travels at 40 km/h for 30 minutes and 60 km/h for 15 minutes. What is its average speed in km/h.
   a) 50.0  
   b) 45.0  
   c) 52.3  
   d) 46.7  
   e) none of these

4. A toy rocket is launched upward with a net acceleration of 10 m/s² for 3 s. It then slows down at the rate of 10 m/s² until it reaches its maximum altitude. How high does it go?
   a) 30 m  
   b) 45 m  
   c) 60 m  
   d) 75 m  
   e) 90 m

5. A bullet shot straight up returns to its starting point in 10 s. Its initial speed was
   a) 9.8 m/s  
   b) 25.5 m/s  
   c) 49 m/s  
   d) 36.5 m/s  
   e) 98 m/s

6. Which one of the following operations will not change a vector?
   a) Translate it parallel to itself  
   b) Reverse its direction  
   c) Rotate it through an angle less than 360°  
   d) Multiply it by a constant factor  
   e) Add a constant vector to it

7. A swimmer heading directly across a river 200 m wide reaches the opposite bank in 6 minutes 40 seconds. She is swept downstream 300 m. How fast can she swim in still water?
   a) 0.50 m/s  
   b) 1.24 m/s  
   c) 1.42 m/s  
   d) 1.83 m/s  
   e) 0.45 m/s

8. A girl throws a rock horizontally with a velocity of 10 m/s from a bridge. It falls 20 m to the water below. How far does the rock travel horizontally before striking the water? (use g=10 m/s²)
   a) 14 m  
   b) 16 m  
   c) 20 m  
   d) 24 m  
   e) 25 m
9. A ball thrown horizontally from a point 24 m above the ground strikes the ground after traveling horizontally a distance of 18 m. With what speed was it thrown? (Use g=10 m/s in this problem)
   a) 6.10 m/s
   b) 7.40 m/s
   c) 8.22 m/s
   d) 8.41 m/s
   e) 8.96 m/s

10. A child drops a toy at rest from a point 4 m above the ground at the same instant her friend throws a ball upward at 6 m/s from a point 1 m above the ground. At what distance above the ground do the ball and toy cross paths?
   a) 1.49 m
   b) 1.98 m
   c) 2.45 m
   d) 2.78 m
   e) 2.98 m

11. A child’s toy is suspended from the ceiling by means of a string. The earth pulls downward on the toy with its weight force of 8 N. If this is the “action force”, what is the “reaction force”?
   a) The string pulling upwards on the toy with an 8 N force
   b) The ceiling pulling upward on the string with an 8 N force
   c) The string pulling downward on the ceiling with an 8 N force
   d) The toy pulling upward on the earth with an 8 N force
   e) There is no “reaction force” because the toy is suspended

12. Florence weighs 120 lbs when she stands on the bathroom scale at home. What will she see the bathroom scale read when she stands on it in an elevator that is accelerating upward at 4 ft/s²? (take g=32 ft/s²)
   a) 120 lb
   b) 135 lb
   c) 105 lb
   d) 168 lb
   e) 72 lb

13. Two cardboard boxes full of books are in contact with each other on a frictionless, horizontal table. Box H has twice the mass of box G. If you push on the box G with a horizontal force $F$, then box H will experience a net force of
   a) $2F/3$
   b) $F$
   c) $3F/2$
   d) $2F$
   e) $F/3$

14. A wooden block slides directly down an inclined plane at a constant velocity of 6 m/s. What is the value of the coefficient of kinetic friction ($\mu_k$) if the plane makes an angle of 25° with the horizontal?
   a) 0.50
   b) 0.47
   c) 0.37
   d) 0.91
   e) 2.1
15. A girl attaches a rock to a string which she then swings counterclockwise in a horizontal circle. The string breaks at point P on the sketch, which shows a bird’s eye view (i.e. seen from above). Which of the five curves most closely resembles the trajectory that the rock will follow?

a) A  
b) B  
c) C  
d) D  
e) E

16. To move a large crate across a rough, horizontal floor, you push on it with a force $F$ at an angle of 21 below the horizontal (as shown in the figure). What is the force needed to start the crate moving, given that the mass of the crate is 32 kg and the coefficient of static friction between the crate and the floor is 0.57? (use $g = 10 \text{ m/s}^2$.)

a) 320 N  
b) 150 N  
c) 275 N  
d) 182 N  
e) 250 N

17. A mass of 15 kg is suspended by three cords. What is the tension in cord A?

a) 147 N  
b) 135 N  
c) 104 N  
d) 98 N  
e) none of the other answers