Name (print, last first): $\qquad$ Signature: $\qquad$
On my honor, I have neither given nor received unauthorized aid on this examination.

## YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

(1) Code your test number on your answer sheet (use lines 76 - 80 on the answer sheet for the 5 -digit number). Code your name on your answer sheet. DARKEN CIRCLES COMPLETELY. Code your UFID number on your answer sheet.
(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. Circle your answers on the test form. At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
(4) Blacken the circle of your intended answer completely, using a $\# 2$ pencil or blue or black ink. Do not make any stray marks or some answers may be counted as incorrect.
(5) The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you believe that no listed answer is correct, leave the form blank.
(6) Hand in the answer sheet separately.

$$
g=9.80 \mathrm{~m} / \mathrm{s}^{2}
$$

1. A 0.02 kg bullet is shot from a 10 kg rifle. The rifleman stops the recoil of the rifle by exerting a force of 250 N on it for 0.1 s . What is the bullet's initial speed in $\mathrm{m} / \mathrm{s}$ ?
(1) 1250
(2) 1700
(3) 2500
(4) 3200
(5) 4800
2. Billiard ball A, moving in the positive $x$ direction, strikes stationary ball B. The balls have the same mass. After the collision, ball A is traveling at an angle of $45^{\circ}$ with respect to the $x$-axis, with speed $15 \mathrm{~m} / \mathrm{s}$; and ball B is traveling at an angle of $30^{\circ}$ with respect to the $x$-axis. What is the speed of A before the collision?

(1) $29 \mathrm{~m} / \mathrm{s}$
(2) $25 \mathrm{~m} / \mathrm{s}$
(3) $19 \mathrm{~m} / \mathrm{s}$
(4) $14 \mathrm{~m} / \mathrm{s}$
(5) $9 \mathrm{~m} / \mathrm{s}$
3. A 0.02 kg bullet initially traveling at $500 \mathrm{~m} / \mathrm{s}$ imbeds itself in a 2 kg block. What is the kinetic energy of the block immediately after the collision?

(1) 24.5 J
(2) 19.8 J
(3) 15.6 J
(4) 33.4 J
(5) 8.3 J
4. Two masses, $M_{1}$ and $M_{2}$, undergo a 1-dimensional elastic collision. At 2 s before the collision, the distance between the objects is 200 m . At 1 s before the collision, the distance between the objects is 100 m . Before the collision, $M_{1}$ is moving in the positive $x$ direction and $M_{2}$ is at rest. After the collision, $M_{2}$ is traveling in the positive $x$ direction with speed $75 \mathrm{~m} / \mathrm{s}$. What is the velocity of $M_{1}$ after the collision, in $\mathrm{m} / \mathrm{s}$ ?
(1) $-25 \mathrm{~m} / \mathrm{s}$
(2) $-75 \mathrm{~m} / \mathrm{s}$
(3) $+25 \mathrm{~m} / \mathrm{s}$
(4) $+75 \mathrm{~m} / \mathrm{s}$
(5) $+175 \mathrm{~m} / \mathrm{s}$
5. A 5 -kg mass is held in equilibrium by 2 ropes as shown. What is the value of $T_{2}$, the tension in rope 2 ?
(1) 36 N
(2) 43 N
(3) 52 N
(4) 65 N
(5) 79 N
6. A uniform ladder of length 6 m and mass 75 kg leans precariously in equilibrium against a wall. The force $F_{W}$ of the wall on the ladder is horizontal. Let $H$ denote the horizontal component of the floor's force on the ladder, and let $V$ denote the vertical component. These two components satisfy the equation $H=\mu_{s} V$, where $\mu_{s}$ is the coefficient of static friction. What is the value of $\mu_{s}$ ?

(1) 0.29
(2) 0.17
(3) 0.38
(4) 0.47
(5) 0.56
7. The crankshaft of an auto is initially rotating at 3000 rpm . The rotation of the crankshaft begins to decrease at a constant rate, and it stops rotating 15 s later. What is the magnitude of the angular acceleration of the crankshaft, in $\mathrm{rad} / \mathrm{s}^{2}$ ?
(1) 21
(2) 5
(3) 36
(4) 12
(5) 43
8. The radius of an auto's tires is 0.5 m . The tires rotate without slipping. The auto starts from rest and accelerates uniformly to $30 \mathrm{~m} / \mathrm{s}$ in 6 s . The auto then decelerates uniformly for 10 s and comes to rest. Through what angle do the auto's tires rotate during the 16 s time interval?
(1) 480 rad
(2) 240 rad
(3) 120 rad
(4) 960 rad
(5) 60 rad
