

Directions: No books or notes may be used during this exam. Important formulas are provided for you. Graphing calculators and palmtop or laptop computers are not allowed. Write everything on the exam booklet provided. Always include **three** significant digits in your numerical answers.

$$\begin{aligned} \text{If } ax^2 + bx + c = 0, \text{ then } x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} & \sin \theta &= \frac{\text{opp}}{\text{hyp}} & \cos \theta &= \frac{\text{adj}}{\text{hyp}} & \tan \theta &= \frac{\text{opp}}{\text{adj}} \\ c^2 &= a^2 + b^2 & c^2 &= a^2 + b^2 - 2ab \cos C & \frac{\sin A}{a} &= \frac{\sin B}{b} = \frac{\sin C}{c} & \sin 2\theta &= 2 \sin \theta \cos \theta \\ v_x &= v \cos \theta & v_y &= v \sin \theta & v &= \sqrt{v_x^2 + v_y^2} & \theta &= \tan^{-1}\left(\frac{v_y}{v_x}\right) \\ \bar{v}_{AVE} &= \frac{\Delta \bar{x}}{\Delta t} & \bar{a}_{AVE} &= \frac{\Delta \bar{v}}{\Delta t} & \bar{v} &= \frac{d\bar{x}}{dt} & \bar{a} &= \frac{d\bar{v}}{dt} & g &= 9.80 \text{ m/sec}^2 \\ \bar{x} &= \bar{x}_o + \bar{v}_o t + \frac{1}{2} \bar{a} t^2 & \bar{v} &= \bar{v}_o + \bar{a} t & v^2 &= v_o^2 \pm 2a\Delta x & \bar{v}_{AVE} &= \frac{\bar{v} + \bar{v}_o}{2} \\ t_1 &= \sqrt{\frac{2h}{g}} & R_1 &= v_o \sqrt{\frac{2h}{g}} & t_2 &= \frac{2v_o \sin \theta}{g} & R_2 &= \frac{v_o^2 \sin 2\theta}{g} & h_2 &= \frac{v_o^2 \sin^2 \theta}{2g} \\ \Sigma \bar{F} &= 0 & \Sigma \bar{F} &= m\bar{a} & \bar{F}_g &= m\bar{g} & a &= g \sin \theta & v &= \sqrt{2gh} \end{aligned}$$

Question 1: WRITE THE FORM DESIGNATOR FOR THIS EXAM (A) IN THE ANSWER BOX FOR QUESTION #1 ON THE FIRST PAGE OF THE EXAM BOOKLET.

Questions 2-6 (5 pts. each) Multiple Choice. You will be graded on your answer only. It is not necessary to show your work for these problems. Put the answers in the proper box on the first page of your test booklet.

- Two objects accelerate along straight lines starting from rest. In the same amount of time, the first object moves four times as far as the second object. The magnitude of the acceleration of the first object is a . What is the magnitude of the acceleration of the second object? (A) $a/16$ (B) $a/4$ (C) $a/2$ (D) a (E) $2a$ (F) $4a$ (G) $16a$.
- One object moves on flat level ground to the east at 10.0 m/s with respect to the ground. Another object moves horizontally on flat level ground 60.0 degrees south of east at the same speed. What is the relative speed between these two objects? (A) zero (B) 5.00 m/s (C) 8.66 m/s (D) 10.0 m/s (E) 17.3 m/s (F) 20.0 m/s.
- When is the acceleration of an object equal to its weight? (A) when the object's mass is zero (B) when the object's weight is zero (C) when the object's mass is 1.00 kg (D) when the object is in free-fall (E) never.
- An object is always moving on one straight line at 5.00 m/s. It is subject to only three forces: (10.0 N, 90.0 degrees), (10.0 N, 210 degrees) and the third force is unknown. The directions are given in standard polar form. What is the direction of the third force? (A) 30.0 degrees (B) 180 degrees (C) 300 degrees (D) 330 degrees.
- An object starts from rest and then slides down an incline of length L with no friction. How long does it take to reach the bottom? θ is the angle between the incline and a horizontal line. (A) $(2L/(g \tan \theta))^{1/2}$ (B) $(2L/g)^{1/2}$ (C) $(2L/(g \sin \theta))^{1/2}$ (D) $(2L/(g \cos \theta))^{1/2}$ (E) None of the previous four answers are correct.

TURN THE PAGE OVER

Work the following three problems on the front of the next three pages of your exam booklet. Show your solutions in a well-organized fashion. Partial credit will be given for proper translations and for identification of the relevant equation(s). **No credit is given for an answer without showing HOW you got the answer.** Work each problem on a separate page, **in numerical order**. WRITE THE PROBLEM NUMBER AT THE TOP OF EACH PAGE ON YOUR EXAM BOOKLET.

7. (25 pts.) **Major Work Out**

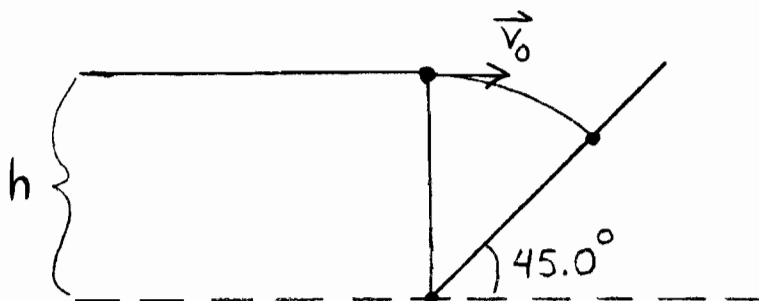
An athlete is hanging from a horizontal metal bar doing pull-ups. Her muscles generate an upward force of 950 N and her mass is 75.0 kg. At what rate does she accelerate upward?

8. (25 pts.) **Old Friends Meet Again**

Two old friends spot each other when they are 50.0 m meters apart. At this instant they are both moving toward one another at 2.00 m/s with respect to the ground. They both accelerate toward each other. The one on the left accelerates at 2.00 m/s^2 and the one on the right accelerates at 3.00 m/s^2 . How much time does it take for them to arrive at the same location?

9. (25 pts.) **Case #3 Projectile Motion**

An object is launched horizontally with initial speed v_0 to the right from the top of a cliff of height h . The ground rises at a 45.0-degree angle from the base of the cliff. The magnitude of the acceleration due to gravity is g . What is the projectile's time-of-flight in terms of v_0 , h and/or g ? (See diagram below.)



WHEN YOU TURN IN YOUR EXAM, SHOW YOUR I.D. CARD AND SIGN THE CLASS LIST.