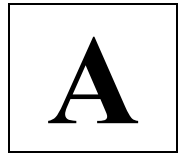


- 1) Print your name, test form number (above), and nine-digit student number in the section of the answer card labeled "STUDENT IDENTIFICATION".
- 2) Bubble your test form number (**ABOVE**) in columns 1-3, skip column 4, then bubble in your student number in columns 5-13.
- 3) For each free-response question, show all relevant work supporting your answer. **Clearly box or underline your final answer.** "Correct" answers which are not supported by adequate calculations and/or reasoning will be counted wrong.
- 4) For each multiple-choice question, select the answer most nearly correct, **circle this answer on your test**, and bubble it in on your answer card. **Show all relevant work on your quiz.**
- 5) Be prepared to present your Buzzcard as you turn in your test. Scores will be posted to WebAssign after they have been graded. **Quiz grades become final when the next quiz is given.**
- 6) You may use a simple scientific calculator capable of logarithms, exponentials, and trigonometric functions. **Programmable engineering calculators with text or graphical capabilities are not allowed. Wireless devices are prohibited.**



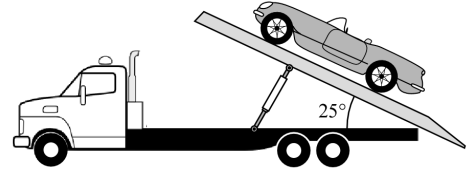
Your test form is: **422**

The image shows a Scantron answer card for a student named George P. Burdell. The student identification section contains the name and the student number 123 900987654. The test form number 422 is written above the card. Annotations on the card include: "WRITTEN information for human benefit" in column 4, "Test Form Number from YOUR test column 4 is blank" pointing to the empty column 4, and "YOUR student number starts in column 5" pointing to the start of the student number. A box labeled "Your answers" is drawn around the first four columns of the answer grid. The card also includes the text "STUDENT IDENTIFICATION", "A THRU I", "SCN-151-10", and "© SCANTRON CORPORATION 2002. To Register 1-800-722-8876. P2206 999-10. ALL RIGHTS RESERVED." and "SCANTRON FORM NO. F-16885-SCN-10".

Our next test will be on Monday, March 9!

The following problem will be hand-graded. Show all your work for this problem. Make no marks and leave no space on your answer card for it.

- [I] A flatbed wrecker is hauling a car, travelling west at a constant speed $v_0 = 16$ m/s. Due to an engineering flaw, the hydraulics engage while the truck is in motion, tilting the flatbed up to an angle $\theta = 25^\circ$ above the horizontal. To make matters worse, the straps anchoring the car to the flatbed have sheared off, leaving only friction to hold the car on the wrecker! The friction coefficients between the wheels and the bed are $\mu_s = 0.67$ and $\mu_k = 0.40$.

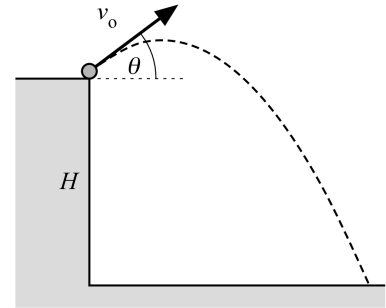


- (A) (10 points) Draw a free body diagram for the car, which does not slip as the wrecker continues moving at speed v_0 . Use Newton's laws to determine the friction force acting on the car. Express your answer as a multiple of mg , the gravitational force on the car. You will be graded on the quality of your diagram as much as the validity of your final answer!
- (B) (10 points) The driver of the wrecker realizes his predicament, and quickly brakes to a stop. Determine the maximum braking acceleration that the wrecker have without allowing the car to slip forward and launch itself off the inclined truck bed? Draw a new free-body diagram for the car as it accelerates to a stop along with the truck. Be sure to draw the acceleration vector for the car, because it will impact how you use Newton's laws to find a_{\max} .

The following problem will be hand-graded. Show all your work for this problem. Make no marks and leave no space on your answer card for it.

- [III] You are standing atop a cliff of unknown height H . You throw a stone off the cliff with a speed $v_0 = 15.0$ m/s, directed at an angle of 36.9° above the horizontal. You time the flight of the stone, finding that it takes a total time $\Delta t_v = 3.25$ seconds to strike the valley floor below.

(15 points) What is the velocity of the stone at the moment it hits the valley floor?



Question value 5 points — mark your answer in space #1 on the answer card.

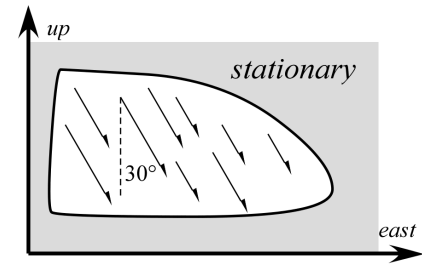
- (01) What is the height H of the cliff?

- (a) $H = 12.8$ m
- (b) $H = 29.3$ m
- (c) $H = 22.5$ m
- (d) $H = 51.8$ m
- (e) $H = 3.01$ m

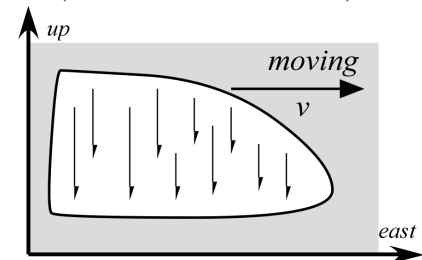
The following problem will be hand-graded. Show all your work for this problem. Make no marks and leave no space on your answer card for it.

- [III] You are driving your car in a rainstorm. When stopped at a traffic light and facing eastward, you see the rain fall *forward* (i.e. also eastward), making an angle $\theta = 30.0^\circ$ relative to the vertical (top figure). When the light turns green, you begin travelling east, and find that when your speed is $v = 36$ kph, the rain appears to be falling straight down (bottom figure).

(15 points) If you turn your car around, and travel *westward* at the same speed v , what angle will the raindrops appear to fall, relative to the vertical?



(view out side window)

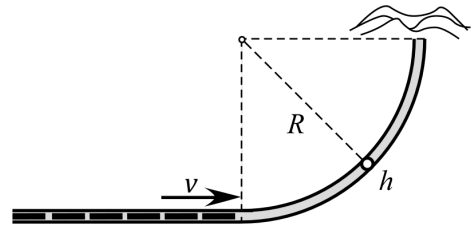


Question value 5 points — mark your answer in space #2 on the answer card.

- (02) Although the rain is actually falling east of vertical, if you travel east quickly enough, the rain will appear to fall west of vertical (i.e. “backwards”, from your perspective in the car). At what eastward speed will the rain appear to fall 30° west of vertical? [Hint a good vector diagram makes a big difference here!]

- (a) 24 kph
- (b) 18 kph
- (c) 48 kph
- (d) 72 kph
- (e) 62 kph

A train traveling east through the mountains enters a northward bend with radius of curvature R . Just as it enters the curve with speed v , the satellite uplink indicates that an avalanche has blocked the track, 90° around the bend. The train must brake to a stop before it rounds the bend, or it will be derailed by the debris field.



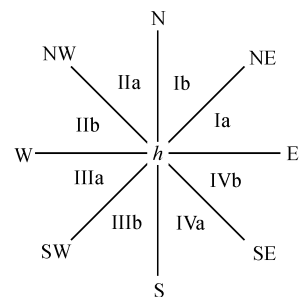
- Question value 5 points*
- (03) What is the magnitude of the tangential acceleration that will stop the train just as it reaches the debris?

- (a) $a_{tan} \geq v^2 \cdot 2\pi$
 (b) $a_{tan} \geq v^2/\pi R$
 (c) $a_{tan} \geq v/R$
 (d) $a_{tan} \geq v^2/2R$
 (e) $a_{tan} \geq 2v/\pi R$

- (04) Consider the train when it is halfway through the turn, at position h in the diagram above. What will be the train's *angular* speed ω around the bend, at that point?

- (a) $\omega_h = v / \sqrt{2}R$
 (b) $\omega_h = 2v / \pi$
 (c) $\omega_h = v / 2R$
 (d) $\omega_h = \pi R / 4v$
 (e) $\omega_h = 4v / \pi R$

- Question value 5 points*
- (05) In the figure at right, the eight cardinal compass directions split the map into octants: Ia/Ib, IIa/IIb, IIIa/IIIb, and IVa/IVb. When the train is at position h , halfway through the turn, in which octant will its total acceleration vector lie?



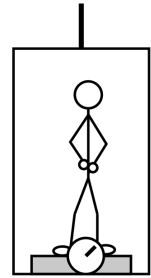
- (a) \vec{a}_h lies in octant IVa.
 (b) \vec{a}_h lies in octant IIb.
 (c) \vec{a}_h lies in octant IIIb.
 (d) \vec{a}_h lies in octant IIIa.
 (e) \vec{a}_h lies in octant Ib.

Bob stands on a spring scale in an express elevator. Starting from ground level at $t = 0$, the elevator accelerates smoothly upward (with constant magnitude a) until it is halfway to the penthouse, and which point it accelerates smoothly to a stop (with the same constant magnitude a) right at the penthouse. While accelerating upward, the scale reads a force $U = 960$ N. While accelerating downward, the scale reads a force $D = 720$ N.

Question value 5 points

(06) What is Bob's *perceived weight* during the first stage of the ascent?

- (a) 960 N
- (b) 720 N
- (c) "Perceived weight" is undefined for an *accelerating* body.
- (d) 840 N
- (e) 240 N



Question value 5 points

(07) What is Bob's *true weight* (i.e., the gravitational force mg acting on Bob) during the first stage of the ascent?

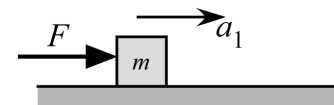
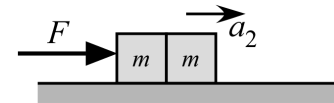
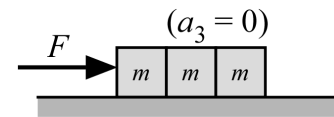
- (a) 960 N
- (b) 840 N
- (c) 240 N
- (d) 480 N
- (e) 720 N

Question value 5 points

(08) What is the magnitude of the elevator's acceleration, during either stage of the ascent?

- (a) $a = 2.5 \text{ m/s}^2$
- (b) $a = 9.8 \text{ m/s}^2$
- (c) $a = 14 \text{ m/s}^2$
- (d) $a = 4.9 \text{ m/s}^2$
- (e) $a = 1.4 \text{ m/s}^2$

Three identical blocks are placed on a *rough* horizontal surface. When a horizontal force F is applied to the blocks (top), they move along the surface at constant speed. When one block is removed (middle), the force F is sufficient to impart an acceleration of magnitude a_2 to the two remaining blocks. When a second block is removed (bottom), the force F imparts an acceleration of magnitude a_1 to the last remaining block.



Question value 5 points

(09) Qualitatively, compare the acceleration a_1 to the acceleration a_2 .

- (a) $a_1 = a_2$
- (b) $a_1 > 2a_2$
- (c) $a_2 < a_1 < 2a_2$
- (d) $a_1 = 2a_2$
- (e) $0 < a_1 < a_2$

Question value 5 points

(10) If $a_1 = 0.3 g$, what is the coefficient of friction between the blocks and the surface?

- (a) $\mu_k = 0.10$
- (b) $\mu_k = 0.20$
- (c) $\mu_k = 0.05$
- (d) $\mu_k = 0.15$
- (e) $\mu_k = 0.30$

PHYS 2211 BCD Recitation TA and Room Assignments

Tests will be returned in recitation, in the week *after* the test. In order to ensure that you receive your test back as soon as possible, please enter your recitation section from the table above on the front of this test.

	Clough 123	Clough 125	Clough 127	Clough 131	Clough 325
MONDAY					
2:05 – 2:55 pm				B01 Greenway, Lucas	B05 Baker, Caitlin
3:05 – 3:55 pm				B02 Greenway, Lucas	C02 Eswar, Aditya
4:05 – 4:55 pm	C01 Eswar, Aditya			B06 Greenway, Lucas	
TUESDAY					
1:05 – 1:55 pm					C04 Liberi, Brandon
2:05 – 2:55 pm		D02 Zhou, Jiarun		C03 Baker, Caitlin	
3:05 – 3:55 pm					B04 Strauss, Hunter
4:05 – 4:55 pm					B03 Strauss, Hunter
5:05 – 5:55 pm	C09 Eswar, Aditya			D04 Strauss, Hunter	
WEDNESDAY					
1:05 – 1:55 pm		B09 Ravipati, Akshay			
2:05 – 2:55 pm		D01/D05 Liberi, Brandon			
3:05 – 3:55 pm			C05 Ravipati, Akshay		
4:05 – 4:55 pm			C06/D06 Eswar, Aditya		
THURSDAY					
2:05 – 2:55 pm				B08 Zhou, Jiarun	C07 Baker, Caitlin
3:05 – 3:55 pm			B07 Tao, Liangyu		D07 Baker, Caitlin
4:05 – 4:55 pm			C08/D03 Tao, Liangyu		
5:05 – 5:55 pm					
6:05 – 6:55 pm			C10/D09 Tao, Liangyu		