Department of Physics, Ryerson University

PCS 211 — Fall 2013 — Midterm exam

Date: 25 October 2013 Duration: 90 minutes

Section#	Last Name	First Name	Student ID
[redacted]	[redacted]	[redacted]	[redacted]

Circle your instructor's name: Catherine Beauchemin | Devika Chithrani | (Dietmar Cordes) | Kausik Das | Jahan Tavakkoli

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- DO NOT OPEN THE EXAM UNTIL YOU ARE TOLD TO DO SO.
- This exam has **12 pages** including this cover. Before you begin, make sure your exam contains all pages and notify someone if it does not.
- This is a closed-book exam. Pens, pencils, erasers, rulers, calculators and your Ryerson ID are the only allowed items on your desk. PDAs, phones, and pagers must be turned off and placed at the front of the room. Coats, jackets, caps and bags must be placed at the front of the room. Being found in possession of unauthorized material will result in a charge of Academic Misconduct for violation of this course's requirements.
- Your Ryerson ID must be on your desk at all times.
- The exam pages must not be unstapled and must be manipulated with care: you will be responsible if pages are missing.

In answering the **11 multiple-choice questions**:

- Make sure you include all significant steps (such as equations and their numerical substitutions) in your solution, presented in a clear and logical order. Do all your calculations using at least **5 significant figures**. Select the option that is numerically closest to your answer; circle it in your exam and then copy your answer to the bubble sheet carefully **USING A PENCIL**.
- You will receive one (1) mark for every correct answer entered on your bubble sheet, and you will only receive credit for the answers entered on your bubble sheet. However, to be considered correct a bubble sheet answer must be supported by the calculations and steps you wrote in the exam. Your exam might be checked, and if your bubble sheet answer is not reasonably justified by the work written in your exam, credit will not be given.
- Each incorrect or blank entry, entry bubbled by pen, or multiple entries for a given bubble sheet question **will receive no (0) mark**.

Sign here indicating you have read and understood the above instructions:

Signature: [redacted]

(the exam will not be graded unless your signature is present)

Question 1: If $L = 3.3$ in, $s = 8.6$ in, $d = 2$ in, $\alpha = 36°$, and $\beta = 59°$, determine the distance between points A and B.

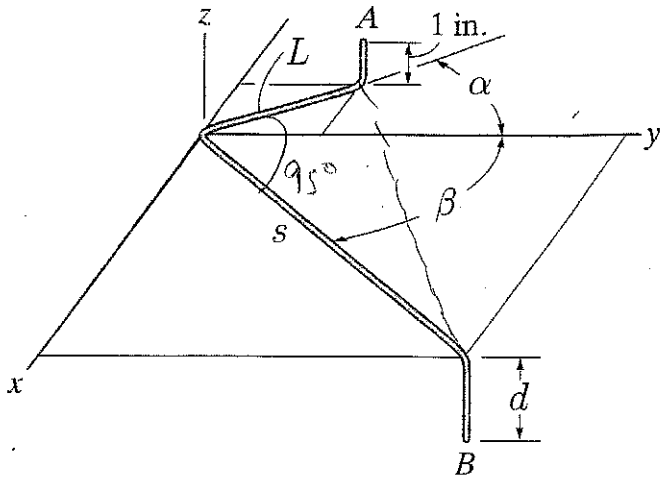
A) 9.94 in

B) 12.1 in

C) 14.9 in

D) 8.07 in

E) 6.45 in



$a^2 = b^2 + c^2 - 2bc \cos a$

$a^2 = (3.3)^2 + (8.6)^2 - 2(3.3)(8.6)\cos 95°$

$a = 9.476125788$ inches

Second distance b/w pt A & B = (a) from above + A 1 + 2

$= 12.476125$

≈ 12.1 in

Question 2: When vector $\vec{B}$ is added to vector $\vec{C} = -4\hat{\imath} - 2\hat{\jmath}$, the resultant vector is in the positive y direction and has a magnitude that is equal to the magnitude of $\vec{C}$. What is the magnitude of $\vec{B}$?

A) 8.71

B) 57.9

C) 7.61

D) 4.47

E) 4.70

$B + C = \left(\sqrt{x^2 + y^2}\right)$ of C

$B + \begin{pmatrix} -4 \\ -2 \end{pmatrix} = \sqrt{20}$

$\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} -4 \\ -2 \end{pmatrix} = \sqrt{20}$

$(x-4) + (y-2) = \sqrt{20}$

$|(B+C)| = \sqrt{20}$

Question 3: Determine the angle between F and the x-axis if $\theta_1 = 31°$ and $\theta_2 = 73°$.

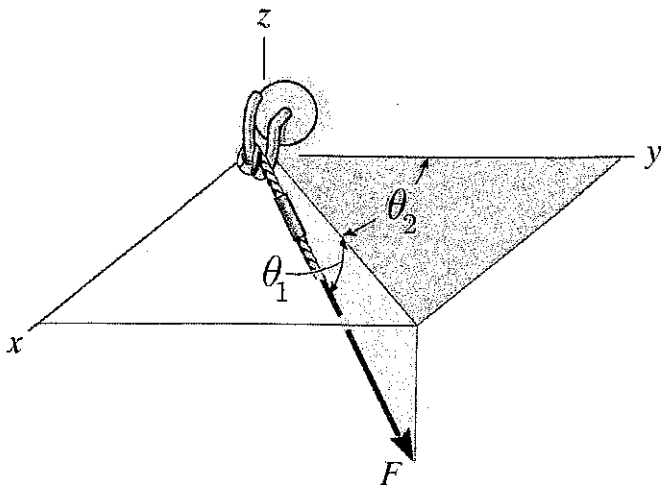
A) 17.0°

B) 34.9°

C) The information provided is insufficient to determine the requested angle.

D) 75.5°

E) 81.3°



Question 4: If $F_2 = 790$ N, $F_3 = 630$ N, and the resultant of these 3 forces is zero, determine the coordinate direction angle β_1 of force F_1.

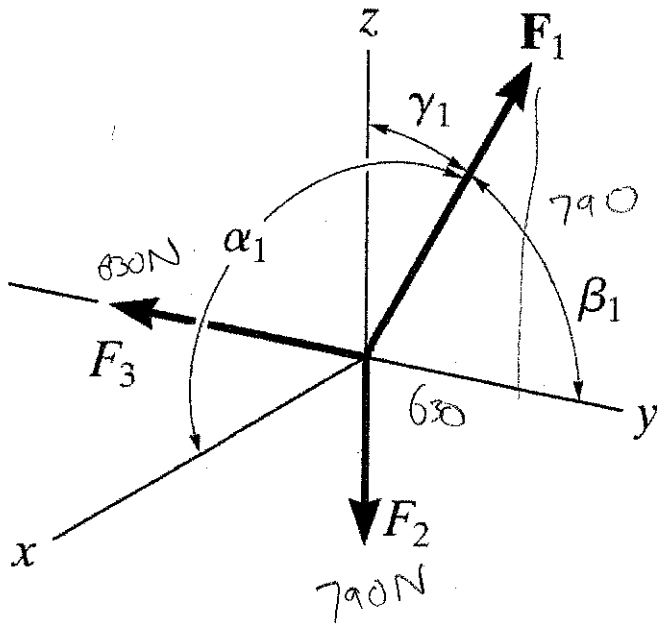
A) 45.0°

B) 38.6°

C) 51.4°

D) 58.1°

E) 31.9°



$x = ?$

$y = -630$ N $R = 0$.

$z = 790$N

$\sqrt{x^2 + y^2 + z^2} = 0$

$x - 630 + 790 = 0$

$x = -160$ N.

$\tan\theta = \frac{790}{630}$

$\theta = \tan^{-1}\left(\frac{790}{630}\right)$

$\theta = 51.428°$

Question 6: A rifle is aimed at the exact centre of a target located 94 m away. If the speed of the bullet as it exits the rifle is 250 m/s directed perfectly horizontally, at what distance from the centre of the target will the bullet hit this target (assume no wind and no friction)?

A) 59.3 cm

B) 184 cm

C) 69.3 cm

D) 34.7 cm

E) 0.00 cm → It will hit the target right in the centre.

Sol $S = 94\,m$ $U = 250\,m/s$

Question 7: Determine the weight of the ball I must hang at B so that my elephant at point A which weighs 11700 lb is in equilibrium as shown. Use $\theta = 37°$ and $\phi = 68°$.

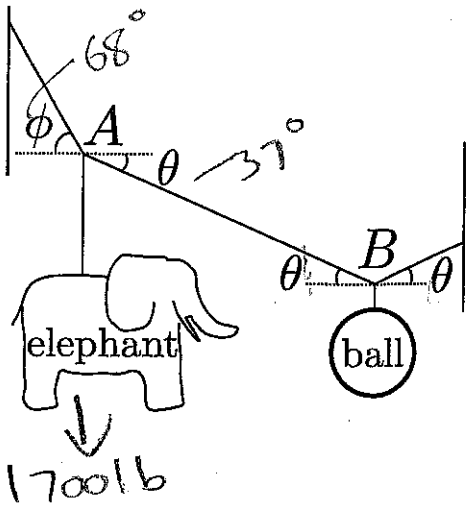
A) 1.02×10^4 lb

B) 2.11×10^4 lb

C) 5.46×10^3 lb

D) 5.12×10^3 lb

E) 3.36×10^4 lb



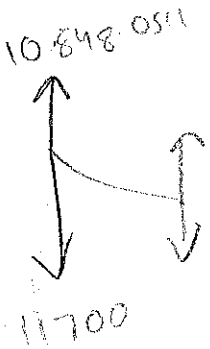
(A) = $11700 \sin 68°$ ↑

$11700 \cos 68°$ →

$10848.0511 + x = 11700$

$x = 11700 - 10848.0511$

$=$



$11700 \sin 68° = x \sin 37°$

$3806 = x \sin 37°$

$11700 \sin 68° - 11700 \sin 37° + x \sin 37°) = (11700 + x)$

$3806.8153 + x \sin 37° = 11700 + x$

$x \sin 37° - x = 11700 - 3806.8153$

$x(\sin 37° - 1) = 7893.184672$

$= 19822.90928$

Question 8: At time $t = 0$, a particle is located at $2\,\hat{\imath}$ m going at a speed of $-2\,\hat{\imath} - 5\,\hat{\jmath}$ m/s. If the particle maintains a constant acceleration of $-6\,\hat{\jmath}$ m/s^2, what is its distance from the origin at $t = 3$ s?

A) 42.2 m

B) 24.3 m

C) 52.2 m

D) 47.9 m

E) 46.0 m ✓

$\Delta x = v_i t + \frac{1}{2} a t^2$

Soll

$S = 2$ m $\quad V_i = -\sqrt{29}$

$a = -6 m/s^2$

$t = 0$

$t = 3$ s?

$a = \frac{v - u}{t}$

$-6 = \frac{V_f + \sqrt{29}}{3}$

$-6 = \frac{V_f + \sqrt{29}}{3 - 0}$

$-18 = V_f + \sqrt{29}$

$-18 + \sqrt{29} = V_f$

$V_f = -12.61484$

$V_f = \frac{S}{t}$ $\quad (12.61484) \times 3 = S$

$S = 37.8$ m

$S = ut + \frac{1}{2} a t^2$ $\quad S$

$= \sqrt{29}(3) + \frac{1}{2}(-6)(3)^2$

$16.15549 + 27 = 43.15 + 2$

$= 45.155 \approx 46$m

Question 9: Two blocks connected by a rope of negligible mass are dragged by a horizontal force $F = 52$ N. If $m_1 = 23$ kg, $m_2 = 46$ kg, and the coefficient of kinetic friction between each block and the surface is 0.447, what is the tension (T) in the rope?

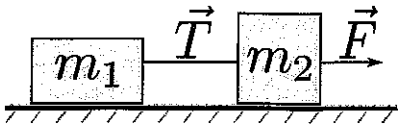
A) 150 N

B) 251 N

C) 17.3 N

D) 78.0 N

E) 52.0 N



Sol/

$F_r = NR = 0.447 \times 676.89 = 302.56983$

$R = (23 \times 9.81) + (46 \times 9.81)$

$225.63 + 451.26$

$= 676.89$ N

$T =$ forward - backward

$= 302.56983 - 52$

$= 250.56983$

≈ 251 N.

Question 10: An airplane moves at a constant speed of 130 m/s as it travels around a vertical loop which has a radius of 1.2 km. What is the magnitude of the normal force exerted by the seat on the 99 kg pilot of this plane at the bottom of this loop?

A) 982 N

B) 423 N

C) 960 N

D) 1.39×10^3 N

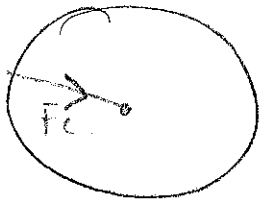
E) 2.37×10^3 N

Sol'n

$V = 130 m/s \quad r = 1200 m$

$f = ma$

$a_c = \frac{v^2}{r} = \frac{(130)^2}{1200m}$



$= 14.08$

$f = ma = 99 \times 14.083333$

$= 1394.24967$

$\approx 1.39 \times 10^3 N$

Question 11: A 38 kg mass is suspended by a string from the ceiling of an elevator that is moving upward with a speed which is decreasing at a constant rate of 5 m/s in each second. What is the tension in the string supporting the mass?

A) 563 N

B) 183 N

C) 190 N

D) 418 N

E) 373 N

Sol'n

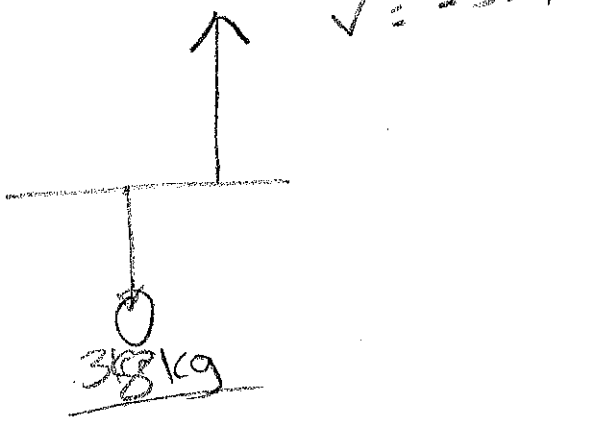
$T = ma + mg$

$= 38 \times a + 38(9.81)$

$= -190 + 372.78$

$= 182.78$

$\approx 183\ N$



$\downarrow = 372.78$