NAME _____

10-DIGIT PUID _____

REC. INSTR. _____ REC. TIME _____

LECTURER _____

INSTRUCTIONS:

1. There are 7 different test pages (including this cover page). Make sure you have a complete test.
2. Fill in the above items in print.
3. Do any necessary work for each problem on the space provided or on the back of the pages of this test booklet. Circle your answers in this test booklet. No partial credit will be given, but if you show your work on the test booklet, it may be used in borderline cases.
4. No books, notes, calculators or any electronic devices may be used on this exam.
5. Each problem has 8 points. The maximum possible score is 100 points. You get 4 points for attempting the exam.
6. Using a #2 pencil, fill in each of the following items on your scantron sheet:
   (a) On the top left side, write your name (last name, first name), and fill in the little circles.
   (b) On the bottom left side, under SECTION NUMBER, put 0 in the first column and then enter the 3-digit section number. For example, for section 016 write 0016. Fill in the little circles.
   (c) On the bottom, under TEST/QUIZ NUMBER, write 01 and fill in the little circles.
   (d) On the bottom, under STUDENT IDENTIFICATION NUMBER, write in your 10–digit PUID, and fill in the little circles.
   (e) Using a #2 pencil, put your answers to questions 1–12 on your answer sheet by filling in the circle of the letter of your response. Double check that you have filled in the circles you intended. If more than one circle is filled in for any question, your response will be considered incorrect. Use a #2 pencil.
7. After you have finished the exam, hand in your scantron sheet and your test booklet to your recitation instructor.

1. Find a vector of length 1 that points in the direction opposite to $\langle 2, -2, 1\rangle$.

A. $\left\langle -\frac{4}{3}, \frac{4}{3}, -\frac{2}{3}\right\rangle$

B. $\left\langle -2, 2, -1\right\rangle$

C. $\left\langle \frac{4}{3}, -\frac{4}{3}, \frac{2}{3}\right\rangle$

D. $\left\langle -\frac{2}{3}, \frac{2}{3}, -\frac{1}{3}\right\rangle$

E. $\left\langle \frac{2}{3}, -\frac{2}{3}, \frac{1}{3}\right\rangle$

2. If $\vec{a} = 2\vec{i} - \vec{j} + 4\vec{k}$ and $\vec{b} = \vec{j} + \frac{1}{2}\vec{k}$, compute the vector projection of $\vec{b}$ onto $\vec{a}$.

A. $\frac{2}{\sqrt{21}}\vec{i} - \frac{1}{\sqrt{21}}\vec{j} + \frac{4}{\sqrt{21}}\vec{k}$

B. $-\frac{2}{\sqrt{21}} + \frac{1}{\sqrt{21}}\vec{j} - \frac{4}{\sqrt{21}}\vec{k}$

C. $\frac{2}{7}\vec{i} - \frac{1}{7}\vec{j} + \frac{4}{7}\vec{k}$

D. $\frac{2}{21}\vec{i} - \frac{1}{21}\vec{j} + \frac{4}{21}\vec{k}$

E. $-\frac{2}{21}\vec{i} + \frac{1}{21}\vec{j} - \frac{4}{21}\vec{k}$

3. Because of a northeast wind with magnitude of 4 lb., a toy boat moves 20 feet in the direction of due east. Calculate the work done by the wind.

A. 80 ft–lb

B. $40\sqrt{2}$ ft–lb

C. 40 ft–lb

D. $20\sqrt{2}$ ft–lb

E. $80\sqrt{2}$ ft–lb

4. If $\vec{u} = 2\vec{i} + 3\vec{j} - \vec{k}$ and $\vec{v} = \vec{i} + 2\vec{j} - \vec{k}$, then $\vec{u} \times \vec{v}$ is equal to

A. $-\vec{i} + \vec{j} + \vec{k}$

B. $-\vec{i} - \vec{j} + \vec{k}$

C. $\vec{i} + \vec{j} + \vec{k}$

D. $-\vec{i} + 2\vec{j} + 3\vec{k}$

E. $-5\vec{i} + 2\vec{j} + \vec{k}$

5. Which of the following alternatives are correct?

   I) The vectors $\langle 1, 2, 0\rangle$ and $\langle -1, 1, 3\rangle$ are not othogonal.

   II) There is no vector $\vec{v}$ such that $\langle 1, 2, 0\rangle \times \vec{v} = \langle -1, 1, 3\rangle$.

   III) The volume of the parallelepiped determined by the vectors $\langle 0, 1, 0\rangle, \langle 1, 2, 0\rangle$ and $\langle -1, 1, 3\rangle$ is equal to 3.

   A. I and II are true, but III is false.

   B. I and III are true, but II is false.

   C. I and III are false, but II is true.

   D. I, II and III are true.

   E. I, II and III are false.

6. The area of the region bounded by the curves $y = \sin x$ and $y = \cos x$ for $0 \leq x \leq \dfrac{\pi}{2}$ is equal to

   A. $\sqrt{2} - 1$

   B. 0

   C. $2(\sqrt{2} - 1)$

   D. $\sqrt{3} - 1$

   E. $2\sqrt{3} - 1$

7. The area of the region bounded by the curves $y = \frac{1}{x}, y = x$ and $y = \frac{x}{4}$ for $x > 0$ is equal to

   (Do not evaluate the integral.)

   A. $\int_0^1 \left(\frac{1}{x} - x\right) dx + \int_1^2 \left(x - \frac{x}{4}\right) dx$

   B. $\int_0^2 \left(\frac{1}{x} - \frac{x}{4}\right) dx$

   C. $\int_0^1 \left(\frac{x}{4} - x\right) dx + \int_1^2 \left(\frac{x}{4} - \frac{1}{x}\right) dx$

   D. $\int_0^1 \left(x - \frac{x}{4}\right) dx + \int_1^2 \left(\frac{1}{x} - \frac{x}{4}\right) dx$

   E. $\int_0^1 \left(\frac{x}{4} - \frac{1}{x}\right) dx + \int_1^2 \left(\frac{x}{4} - x\right) dx$

8. Find the volume of the solid obtained by rotating the region bounded by $y = \sqrt{x}$ and $y = 2x$ about the x–axis.

   A. $\frac{\pi}{72}$

   B. $\frac{\pi}{48}$

   C. $\frac{\pi}{64}$

   D. $\frac{\pi}{24}$

   E. $\frac{\pi}{96}$

9. Set up an integral for the volume of the solid obtained by rotating the region bounded by the curves

$$y = \tan x, \quad y = x. \quad x = \frac{\pi}{3}$$

about the y–axis. Note $\tan x \geq x$ for $0 \leq x \leq \frac{\pi}{2}$.

A. $\displaystyle\int_0^{\frac{\pi}{3}} \pi(x - \tan x)dx$

B. $\displaystyle\int_0^{\frac{\pi}{3}} (\tan x - x)dx$

C. $\displaystyle\int_0^{\frac{\pi}{3}} \pi(x^2 - \tan^2 x)dx$

D. $\displaystyle\int_0^{\frac{\pi}{3}} 2\pi(\tan^2 x - x^2)dx$

E. $\displaystyle\int_0^{\frac{\pi}{3}} 2\pi x(\tan x - x)dx$

10. If the work required to stretch a spring 1 ft beyond its natural length is 12 ft-lb, how much work is needed to stretch it 6 in beyond its natural length?

A. 6 ft–lb

B. 3 ft–lb

C. 4 ft–lb

D. $\frac{5}{2}$ ft–lb

E. 2 ft–lb

11. Find the value of c such that the average value of $f(x) = \dfrac{1}{x}$ on the interval $[1, 3]$ is equal to $f(c)$.

$c =$

A. $\dfrac{2}{\ln 3}$

B. $\dfrac{1}{4} + \dfrac{1}{\ln 3}$

C. $\dfrac{\ln 3}{3}$

D. $1 - \dfrac{1}{\ln 3}$

E. $\dfrac{3}{2 \ln 3}$

12. Evaluate $\displaystyle\int_0^1 \frac{y}{e^{2y}} dy$.

A. $2e^{-2}$

B. $\dfrac{1}{3}(1 + e^{-2})$

C. $\dfrac{1}{4}(1 - 3e^{-2})$

D. $\dfrac{3}{4}(e^{-2} - 2)$

E. $e^{-2} + 1$