

Name: \_\_\_\_\_  
(please print)

ID #: \_\_\_\_\_

**Please circle your section number.**

<u>Section</u>	<u>Time</u>	<u>Instructor</u>	<u>Page</u>	<u>Score</u>
01	8:05	K. Bonn	2	_____/6
03	9:05	C. Sarami	3	_____/8
04	9:05	P. Balachowski	4	_____/9
05	10:05	A. Baartmans	5	_____/10
06	11:05	L. Erlebach		
07	11:05	V. Puente Vera		
08	12:05	O. Paez Osuna		
09	2:05	M. Gopal	Part One Total	_____/33
10	8:05	A. Andreev		
11	3:05	B. Francis	Part Two Total	_____/67
12	3:05	S. Sy		
13	4:05	S. Sy	<b>TOTAL</b>	_____/100

Instructions Regarding Calculator Use:

- Part One - Calculators are NOT allowed.
- Part Two - You may work on Part Two at any time, **but you must hand in Part One before taking out your calculator.** In other words, please keep your calculator off your desk (e.g., under your chair) until after you've handed in Part One.

Note: **Once you've handed in Part One, you may not return to it later on during the exam period.**

**Part One — Calculators are NOT allowed**

Justify all answers and show all work. **Circle your final answer.** No work, no credit!

1. Find a unit vector in the same direction as  $\vec{v} = 2\vec{i} - \vec{j} + 3\vec{k}$ .

\_\_\_\_ /2 pts.

2. Find a non-zero vector perpendicular to both  $\vec{u} = \vec{i} - 3\vec{k}$  and  $\vec{v} = 2\vec{i} - \vec{j} - \vec{k}$ .

\_\_\_\_ /4 pts.

3. Evaluate  $\int (3x^3 + 1)^5 x^2 dx$

\_\_\_\_ /4 pts.

4. Evaluate  $\int_0^{\frac{\pi}{2}} (\sin x)(\cos^2 x) dx$

\_\_\_\_ /4 pts.

5. Evaluate  $\int_0^{\infty} e^{-x} dx$

\_\_\_\_ /4 pts.

6. Evaluate  $\int x^2 e^x dx$

\_\_\_\_ /5 pts.

7. Find the Taylor polynomial of degree 3, approximating the function

$$f(x) = \frac{1}{x} \quad \text{for } x \text{ near } 2.$$

\_\_\_\_ /6 pts.

8. Find the general solution (in terms of real functions only) for the differential equation

$$\frac{d^2 y}{dt^2} + 4 \frac{dy}{dt} + 13y = 0$$

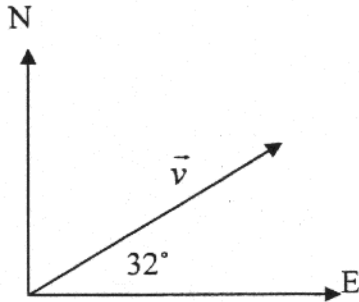
\_\_\_\_ /4 pts.

**Part Two — Calculators Allowed**

Justify all answers and show all work. **Circle your final answer.** No work, no credit! (If you obtain an answer or part of an answer with your calculator, please indicate what you punched into your calculator and what the output was.)

You may work on this section at any time, **but you must hand in Part I before taking out your calculator.**

9. The velocity vector  $\vec{v}$  of an airplane is shown below. Write  $\vec{v}$  in component form if the speed of the airplane is 300 mph. Answer to 2 decimal places.



\_\_\_\_ /4 pts.

10. Find the equation of a plane through the point  $(1, -1, 4)$  **parallel** to the plane that has equation  $3x + 2y - z = 1$ .

\_\_\_\_ /4 pts.

11. For each of the following **three** parts, use the information given about vectors

$\vec{a}$ ,  $\vec{b}$ ,  $\vec{c}$ , and  $\vec{d}$ ; circle one of the given choices, and then give a supporting statement for your choice.

$$\vec{a} = \vec{i} - \vec{j} + 2\vec{k}, \quad \vec{b} = -3\vec{i} + 3\vec{j} + 3\vec{k}, \quad \vec{c} = -2\vec{i} + 2\vec{j} - 4\vec{k}, \quad \text{and} \quad \vec{d} = \vec{i} + \vec{j} - \vec{k}$$

I.  $\vec{a}$  and  $\vec{b}$  are perpendicular, parallel, neither (circle one)

Because:

\_\_\_\_ /2 pts.

II.  $\vec{a}$  and  $\vec{c}$  are perpendicular, parallel, neither (circle one)

Because:

\_\_\_\_ /2 pts.

III. The angle formed by  $\vec{a}$  and  $\vec{d}$  is  $< 90^\circ$ ,  $> 90^\circ$ ,  $= 90^\circ$  (circle one)

Because:

\_\_\_\_ /2 pts.

12. The table below gives values for a function  $f$ .

$x$	0	2	4	6	8	10
$f(x)$	2	3	7	12	25	39

a. Use the **Trapezoid Rule** with  $n = 5$  to estimate  $\int_0^{10} f(x)dx$

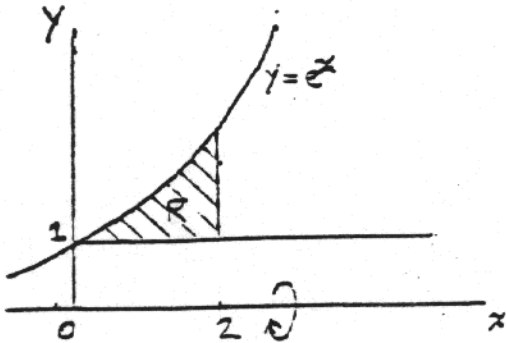
\_\_\_\_ /4 pts.

b. If you plot a graph for  $y = f(x)$ , it is concave up. Is the estimate from part (a) an underestimate or an overestimate? **Circle your answer.**

\_\_\_\_ /2 pts.



13. Set up (but DO NOT evaluate) the integral for the volume of the solid of revolution generated by rotating the plane region **R** bounded by  $y = e^x$ ,  $y = 1$  and  $x = 2$  about the  $x$ -axis.

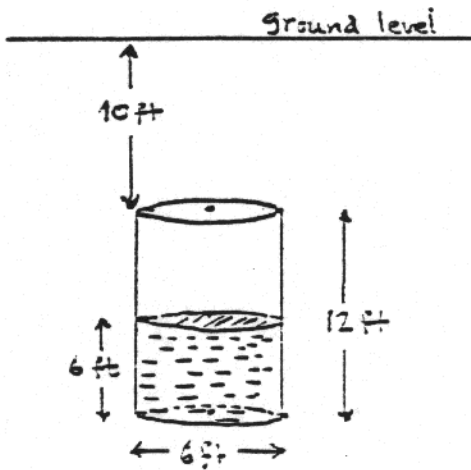


\_\_\_\_ /6 pts.

14. A thin rectangular plate of dimensions  $5 \text{ cm} \times 4 \text{ cm}$  is bounded by the lines  $x = 0$ ,  $x = 5$ ,  $y = 0$ , and  $y = 4$ . The mass density at the point  $P(x,y)$  is  $\delta(x,y) = \frac{3y}{1+y^3} \text{ gm/cm}^2$ . Set up (but DO NOT evaluate) the integral for the total mass of this plate. **Include a sketch.**

\_\_\_\_ /6 pts.

15. A fuel oil tank is an upright cylinder and is buried so that its circular top is 10 ft. below ground level. The tank has a radius of 3 ft., is 12 ft. high, and is half full of oil. Set up (but DO NOT evaluate) the integral for the work done in pumping all the oil to the surface. Oil weighs  $50 \text{ lbs/ft}^3$ .

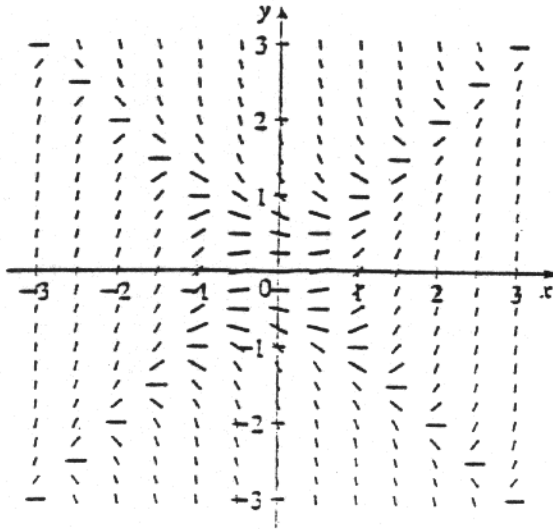


\_\_\_\_ /6 pts.

16. A ball is dropped from a height of 8 ft. and starts bouncing. Each bounce is  $\frac{2}{3}$  of the height of the bounce before. Use a **geometric series** to find the total vertical distance traveled by the ball.

\_\_\_\_ /6 pts.

- 17a. A slope field for the differential equation  $y' = x^2 - y^2$  is shown. Sketch the solution of the initial-value problem  $y' = x^2 - y^2$ ,  $y(0) = 1$ . Use **your graph** to estimate the value of  $y(1)$ .



$y(1)$  is approximately \_\_\_\_\_

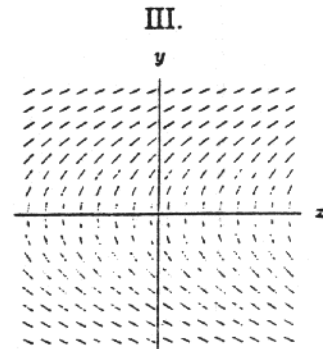
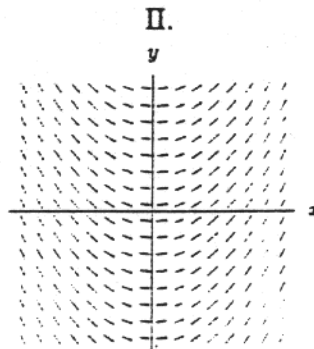
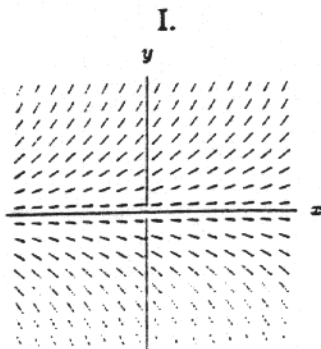
\_\_\_\_\_/4 pts.

- 17b. Referring to the initial value problem in part (a) above, use **Euler's method** with step size  $\Delta x = 0.5$  to estimate  $y(1)$ , starting at the point  $(0, 1)$ .

$y(1)$  is approximately \_\_\_\_\_

\_\_\_\_\_/5 pts.

18. Select the slope field (I, II, or III) that matches the differential equation  $\frac{dy}{dx} = \frac{1}{y}$ . Explain why.



Slope Field: \_\_\_\_\_ Explanation: \_\_\_\_\_

\_\_\_\_\_/4 pts.

19. Set up (but DO NOT evaluate) the differential equation for the following problem. Define all variables.

Water leaks out of an upright cylindrical tank at a rate proportional to the square root of the depth of the water at that time.

differential equation: \_\_\_\_\_

define all variables: \_\_\_\_\_

\_\_\_\_\_/4 pts.

20. A yam is put in a  $200^{\circ}\text{C}$  oven at 2:00 p.m. and heats up according to the differential equation

$$\frac{dH}{dt} = -0.0288(H-200) \quad [t \text{ in minutes}]$$

If the temperature of the yam was  $10^{\circ}\text{C}$  when it was put in the oven, find the temperature of the yam at 2:45 p.m.

\_\_\_\_ /6 pts.