



## Center for Academic Resources in Engineering (CARE) Peer Exam Review Session

Math 231 — Engineering Calculus

### Midterm 2 Worksheet

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*The problems in this review are designed to help prepare you for your upcoming exam. Questions pertain to material covered in the course and are intended to reflect the topics likely to appear in the exam. Keep in mind that this worksheet was created by CARE tutors, and while it is thorough, it is not comprehensive. In addition to exam review sessions, CARE also hosts regularly scheduled tutoring hours.*

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Tutors are available to answer questions, review problems, and help you feel prepared for your exam during these times:

Tutors: September 29th, 7-9:00 PM Yash, Aadya, Aditya, Amishi

Can't make it to a session? Here's our schedule by course:

<https://care.grainger.illinois.edu/tutoring/schedule-by-subject>

Solutions will be available on our website after the last review session that we host.

Step-by-step login for exam review session:

1. Log into Queue @ Illinois: <https://queue.illinois.edu/q/queue/979>
2. Click "New Question"
3. Add your NetID and Name
4. Press "Add to Queue"

**Please be sure to follow the above steps to add yourself to the Queue.**

Good luck with your exam!

1. Use differentials to approximate

$$\sqrt{24.8}$$

- (a) 4.80
- (b) 4.98
- (c) 5.02
- (d) 5.20

2. A quantity  $P(t)$  decays exponentially. Suppose

$$P(2) = 72 \quad \text{and} \quad P(6) = 18$$

What is  $P(0)$ ?

- (a) 99
- (b) 108
- (c) 144
- (d) 288

3. The surface area of a spherical balloon is decreasing at  $24\pi \text{ cm}^2/\text{s}$ . At the instant when the radius is 3 cm, how quickly is the volume of the balloon changing?

- (a)  $-24\pi \text{ cm}^3/\text{s}$
- (b)  $-36\pi \text{ cm}^3/\text{s}$
- (c)  $36\pi \text{ cm}^3/\text{s}$
- (d)  $-72\pi \text{ cm}^3/\text{s}$

4. Consider the curve

$$x^2 + xy + y^2 = 12$$

At which of the following points does the curve have a vertical tangent?

- (a)  $(2, -4)$  and  $(-2, 4)$
- (b)  $(4, -2)$  and  $(-4, 2)$
- (c) All four points above
- (d) None of the points above

5. If

$$y = (x^2 + 1)^{\sin(x)}$$

which expression equals  $y'$ ?

- (a)  $(x^2 + 1)^{\sin(x)} \left[ \cos(x) \ln(x^2 + 1) + \frac{2x \sin(x)}{x^2 + 1} \right]$
- (b)  $(x^2 + 1)^{\sin(x)} \left[ \cos(x) + \frac{2x \sin(x)}{x^2 + 1} \right]$
- (c)  $(x^2 + 1)^{\sin(x)} \left[ \sin(x) \ln(x^2 + 1) + \frac{2x \cos(x)}{x^2 + 1} \right]$
- (d)  $\sin(x)(x^2 + 1)^{\sin(x)-1}(2x)$

6. A 10 m ladder leans against a vertical wall. The bottom of the ladder moves away from the wall at 2 m/s. At an instant when the bottom is 6 m from the wall, how quickly is the area of the triangle formed by the wall, floor, and ladder changing?

- (a)  $-\frac{7}{2} \text{ m}^2/\text{s}$
- (b)  $\frac{7}{2} \text{ m}^2/\text{s}$
- (c)  $8 \text{ m}^2/\text{s}$
- (d)  $16 \text{ m}^2/\text{s}$

7. Let

$$f(x) = x^2 - 6x + 11$$

Which statement is correct?

- (a)  $f$  has a local maximum of 2 at  $x = 3$ .
- (b)  $f$  has a local minimum of 2 at  $x = 3$ .
- (c)  $f$  has a local minimum of 3 at  $x = 2$ .
- (d)  $f$  has no local extrema.

8. Which definite integral is represented by

$$\lim_{n \rightarrow \infty} \sum_{k=1}^n \left(1 + \frac{3k}{n}\right)^2 \frac{3}{n}?$$

- (a)  $\int_1^4 x^2 dx$
- (b)  $\int_1^3 x^2 dx$
- (c)  $\int_0^4 x^2 dx$
- (d)  $\int_1^4 x^3 dx$

9. A function  $f$  is approximated on  $[0, 8]$  using 4 equal subintervals. Suppose

$$L_4 = 14 \quad \text{and} \quad R_4 = 22$$

What is

$$f(8) - f(0)?$$

- (a) 2
- (b) 4
- (c) 8
- (d) 16

10. Suppose  $f(x) \geq 0$  on  $[0, 2]$  and  $f(x) \leq 0$  on  $[2, 5]$ , with

$$\int_0^2 f(x) dx = 5$$

and

$$\int_2^5 f(x) dx = -3$$

Which pair gives

$$\left( \int_0^5 f(x) dx, \text{ total geometric area between } f \text{ and the } x\text{-axis} \right)?$$

- (a) (2, 2)
- (b) (8, 8)
- (c) (2, 8)
- (d) (8, 2)

11. Define

$$F(x) = \int_2^x (t^3 - 4t + 1) dt$$

What is  $F'(x)$ ?

- (a)  $\frac{x^4}{4} - 2x^2 + x$
- (b)  $x^3 - 4x + 1$
- (c)  $x^3 - 4x$
- (d) 1

12. Consider

$$\int \frac{x^9}{(1+x^2)^6} dx$$

Which substitution leads most directly to evaluating the integral?

- (a)  $u = 1 + x^2$
- (b)  $u = 1 + \frac{1}{x^2}$
- (c)  $u = x^9$
- (d)  $u = (1 + x^2)^6$

13. For  $x > 0$ , evaluate

$$\int (\ln x)^2 dx$$

- (a)  $x(\ln x)^2 - 2x \ln x + 2x + C$
- (b)  $x(\ln x)^2 - 2x \ln x + C$
- (c)  $x(\ln x)^2 + 2x \ln x - 2x + C$
- (d)  $\frac{(\ln x)^3}{3} + C$

14. When applying integration by parts to

$$\int x^3 e^x dx$$

which choice is most appropriate according to LIATE?

- (a)  $u = x^3, dv = e^x dx$
- (b)  $u = e^x, dv = x^3 dx$
- (c)  $u = x^3 e^x, dv = dx$
- (d) Integration by parts should not be used.