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MATH 251

Exam 1B Fall 2015

Sections 511/512 (circle one)

P. Yasskin

1-12	/60
13	/16
14	/12
15	/12
Total	/100

Multiple Choice: (5 points each. No part credit.)

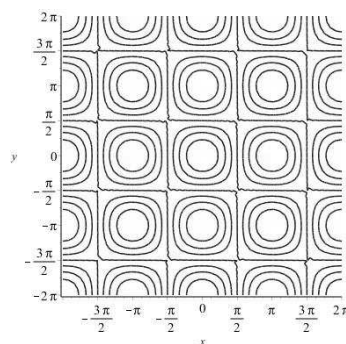
1. If $\vec{a} = (2, -1, 2)$ and $\vec{b} = (1, 2, 5)$, then $|\vec{a} + 2\vec{b}| =$

- a. 1
- b. 3
- c. 5
- d. 9
- e. 13

2. The plot at the right is the contour plot of which function?

HINT: Where is the level set with value 0?

- a. $\sin(x) \cos(y)$
- b. $\sin(x) \sin(y)$
- c. $\cos(x) \cos(y)$
- d. $\cos(x) \sin(y)$
- e. $\sin(xy)$



3. Suppose $\text{proj}_{\vec{v}}\vec{u} = (3, 1)$. Which of the following is **inconsistent** with this fact?

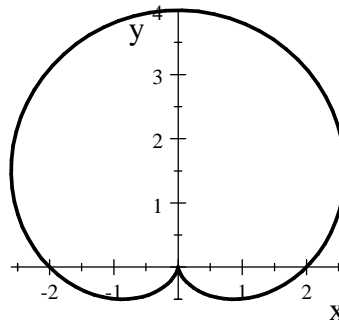
- a. $\text{proj}_{\perp\vec{v}}\vec{u} = (2, -6)$
- b. $\text{proj}_{\perp\vec{v}}\vec{u} = (-2, 5)$
- c. $\vec{u} = (4, -2)$
- d. $\vec{v} = (6, 2)$
- e. $\vec{v} = (-3, -1)$

4. Find the asymptotes of the hyperbola $4(x - 2)^2 - 9(y - 3)^2 = 36$.

- a. $y = 2 \pm \frac{3}{2}(x - 3)$
- b. $y = 2 \pm \frac{2}{3}(x - 3)$
- c. $y = 3 \pm \frac{3}{2}(x - 2)$
- d. $y = 3 \pm \frac{2}{3}(x - 2)$
- e. $y = -3 \pm \frac{2}{3}(x + 2)$

5. The plot at the right is the graph of which polar curve?

- a. $r = 2 + 2\cos\theta$
- b. $r = 2 - 2\cos\theta$
- c. $r = 2 + 2\sin\theta$
- d. $r = 2 - 2\sin\theta$



6. If \vec{u} points SOUTHEAST and \vec{v} points NORTH, where does $\vec{u} \times \vec{v}$ point?

- a. UP
- b. DOWN
- c. SOUTHWEST
- d. WEST
- e. NORTHEAST

7. Find the plane through the points $A = (2,3,4)$, $B = (1,3,5)$ and $C = (2,1,5)$. Its z -intercept is:

- a. 0
- b. 5
- c. 10
- d. 15
- e. $\frac{15}{2}$

8. Compute $\lim_{h \rightarrow 0} \frac{(2x + 3y + 3h)^2 - (2x + 3y)^2}{h}$

- a. $2x + 3y$
- b. $4x + 6y$
- c. $6x + 9y$
- d. $8x + 12y$
- e. $12x + 18y$

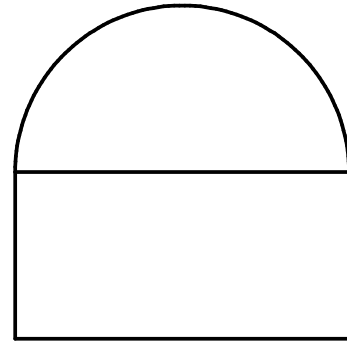
9. Find the plane tangent to the graph of $z = x^3e^{2y}$ at $(2, 1)$. The z -intercept is

- a. $-32e^2$
- b. $-8e^2$
- c. 0
- d. $8e^2$
- e. $32e^2$

10. If $T(3,2) = 4$ and $\frac{\partial T}{\partial x}(3,2) = -0.4$ and $\frac{\partial T}{\partial y}(3,2) = 0.2$, estimate $T(2.8, 2.3)$.

- a. 3.7
- b. 3.8
- c. 3.86
- d. 3.9
- e. 4.14

11. A semicircle sits on top of a rectangle of width $2r$ and height h . If the radius increases from 3 cm to 3.03 cm while the height decreases from 4 cm to 3.98 cm, use the linear approximation to determine whether the area increases or decreases and by how much.



- a. increases by $0.09\pi - 0.12$
b. increases by $0.09\pi + 0.12$
c. increases by $0.09\pi + 0.36$
d. decreases by $0.09\pi + 0.36$
e. decreases by $0.09\pi + 0.12$
12. The brightness of a candle at the origin seen from the point (x, y, z) is $B = \frac{1}{x^2 + y^2 + z^2}$. A moth is at $\vec{r} = (-1, 2, 2)$ and has velocity $\vec{v} = (3, 2, 1)$. What is the rate of change of the brightness as seen by the moth?
- a. $-\frac{2}{3}$
b. $-\frac{2}{27}$
c. $-\frac{2}{81}$
d. $-\frac{3}{4}$
e. $\frac{15}{16}$

Work Out: (Points indicated. Part credit possible. Show all work.)

13. (16 points) For the parametric curve $\vec{r}(t) = \left(\frac{2}{3}t, t^2, t^3\right)$ compute each of the following:

a. velocity \vec{v}

b. speed $|\vec{v}|$ HINT: The quantity inside the square root is a perfect square.

c. arc length $L = \int_{(0,0,0)}^{(2,9,27)} ds$

d. acceleration \vec{a}

e. unit binormal \hat{B}

f. tangential acceleration a_T

14. (12 points) A wire has the shape of the parametric curve $\vec{r}(t) = \left(\frac{2}{3}t, t^2, t^3\right)$ between $(0, 0, 0)$ and $(2, 9, 27)$. Find the mass of the wire if the linear mass density is $\rho = yz$. Don't simplify the answer.

15. (12 points) A mass slides along a wire which has the shape of the parametric curve $\vec{r}(t) = \left(\frac{2}{3}t, t^2, t^3\right)$ between $(0, 0, 0)$ and $(2, 9, 27)$ under the action of the force $\vec{F} = (3z, 2y, x)$. Find the work done by the force.