Name________________________

1-9	/45	12	/15
10	/5	13	/28
11	/10	Total	/103

MATH 251 Exam 1 Version A Fall 2020

Sections 517 P. Yasskin

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

1. The points $A = (1,2,3)$ and $B = (25,10,9)$ are the endpoints of the diameter of a sphere. If $C = (a,b,c)$ is the center and r is the radius, what is $a+b+c+r$?

a. 38

b. 51

c. 64

d. 76

e. 194

2. If $\vec{u}$ points Up and $\vec{v}$ points NorthEast, in what direction does $\vec{u} \times \vec{v}$ point?

a. SouthEast

b. SouthWest

c. NorthWest

d. Down

3. The Galactic Federation is trying to keep a stasis pod stationary in intergalactic space where there is no gravity. They already have 2 tractor beams pulling on the pod with the forces

$$\vec{F}_1 = \langle 3,1,2 \rangle \qquad \vec{F}_2 = \langle -2,4,1 \rangle$$

They now apply a 3^{rd} tractor beam with the force, $\vec{F}_3 = \langle a,b,c \rangle$, to keep the pod stationary. What is $a+b+c$?

a. -9

b. -1

c. 0

d. 1

e. 9

4. The thrusters on the Starship Galileo exert the force $\vec{F} = \langle 2,3,-1 \rangle$ which moves the ship from $P = (4,3,5)$ to $Q = (5,4,3)$. Find the work done by the thrusters.

a. $W = 1$

b. $W = 3$

c. $W = 5$

d. $W = 7$

e. $W = 9$

5. Find the tangent vector, $\vec{v}$, to the curve $\vec{r}(t) = (t^3, t^2, t)$ at the point $(8,4,2)$. Then find its dot product with $\vec{F} = \langle 1,2,3 \rangle$.

a. $\vec{F} \cdot \vec{v} = (12,4,1)$

b. $\vec{F} \cdot \vec{v} = (12,8,3)$

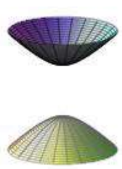
c. $\vec{F} \cdot \vec{v} = 7$

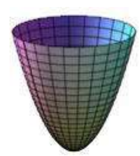
d. $\vec{F} \cdot \vec{v} = 17$

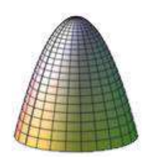
e. $\vec{F} \cdot \vec{v} = 23$

6. Which of the following is the graph of the equation $z^2 = 4 + (x-1)^2 + (y-3)^2$?

a 

b 

c 

d 

7. A point has spherical coordinates $(\rho,\phi,\theta) = \left(\sqrt{2}, \frac{\pi}{4}, \frac{\pi}{6}\right)$. If its rectangular coordinates are (x,y,z), then $xyz =$

a. $\frac{3}{4}$

b. $\frac{3}{2}$

c. $\frac{\sqrt{3}}{2}$

d. $\frac{\sqrt{3}}{4}$

e. $\frac{\sqrt{3}}{8}$

8. Find the area of the triangle with two edges $\vec{v} = \langle -2,1,3\rangle$ and $\vec{w} = \langle 1,0,2\rangle$.

a. $A = \frac{1}{2}\sqrt{27}$

b. $A = \sqrt{27}$

c. $A = \frac{1}{2}\sqrt{54}$

d. $A = \sqrt{54}$

e. $A = 27$

9. Find the volume of the parallelepiped with edges $\vec{u} = \langle 3,-2,1\rangle$, $\vec{v} = \langle -2,1,3\rangle$ and $\vec{w} = \langle 1,0,2\rangle$.

a. $V = 19$

b. $V = 9$

c. $V = \frac{9}{2}$

d. $V = -9$

e. $V = -19$

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

10. (5 points) Find a parametric equation of the line which is perpendicular to the plane $3x + 2y - z = 4$ and passes through the point $(3, 5, 1)$.

11. (10 points) Find a normal equation of the plane which contains the line $(x, y, z) = (3 - 2t, 2 + t, 2 + 2t)$ and passes through the point $(3, 4, 1)$.

12. (15 points) Consider the two planes

$$y + z = 3$$
$$x + 2y + z = 4$$

a. (4 pts) Find the angle (in degrees) between the planes.

b. (4 pts) Find a direction vector, $\vec{v}$, for the line of intersection of the planes.

c. (4 pts) Find a point, P, on the line of intersection of the planes.

d. (3 pts) Find a parametric equation for the line of intersection of the planes.

13. (28 points) For the parametric curve $\vec{r}(t) = \left(\frac{1}{3}t^3, t^2, 2t\right)$ compute each of the following:

a. (3 pts) velocity $\vec{v}$

$\vec{v} =$ ______________

b. (3 pts) acceleration $\vec{a}$

$\vec{a} =$ ______________

c. (3 pts) jerk $\vec{j}$

$\vec{j} =$ ______________

d. (3 pts) speed $|\vec{v}|$ (Simplify!)
HINT: The quantity inside the square root is a perfect square.

$|\vec{v}| =$ ______________

e. (2 pts) tangential acceleration a_T

$a_T =$ ______________

f. (2 pts) the values of t where the curve passes thru the points

$A = \left(\frac{1}{3}, 1, 2\right)$ $t =$ ______________

$B = (9, 9, 6)$ $t =$ ______________

g. (4 pts) arc length between $\left(\frac{1}{3}, 1, 2\right)$ and $(9, 9, 6)$

$L =$ ______________

h. (4 pts) A wire has the shape of this curve between $\left(\frac{1}{3}, 1, 2\right)$ and $(9, 9, 6)$. Find the mass of the wire if the linear mass density is $\delta = 3yz$.

$M =$ ______________

i. (4 pts) A wire has the shape of this curve. Find the work done by the force $\vec{F} = (0, z, -y)$ which pushes a bead along the wire from $\left(\frac{1}{3}, 1, 2\right)$ to $(9, 9, 6)$.

$W =$ ______________