Name______________________

MATH 251 Exam 1 Version B Fall 2018

Sections 504/505 P. Yasskin

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|---|---|---|---|
| 1-9 | /54 | 11 | /16 |
| 10 | /36 | Total | /106 |

Multiple Choice: (6 points each. No part credit.)

**1**. 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

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

If they apply a $3^{\text{rd}}$ tractor beam on the pod, what should its force $\vec{F}_3$ be to keep the pod stationary?

**a**. $\vec{F}_3 = \langle 2,3,2\rangle$

**b**. $\vec{F}_3 = \langle 2,-3,-2\rangle$

**c**. $\vec{F}_3 = \langle 2,3,-2\rangle$

**d**. $\vec{F}_3 = \langle -2,3,2\rangle$

**e**. $\vec{F}_3 = \langle -2,-3,2\rangle$

**2**. The Galactic Federation moves a stasis pod from $(2,3,4)$ to $(6,9,0)$ by applying the $2$ forces:

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

How much work is done by the force $\vec{F}_1$ only?

**a**. $W = 10$

**b**. $W = 22$

**c**. $W = 33$

**d**. $W = 34$

**e**. $W = 0$

**3**. If $\vec{u}$ points Up and $\vec{v}$ points SouthEast, where does $\vec{u}\times\vec{v}$ point?

**a**. Down

**b**. NorthWest

**c**. NorthEast

**d**. SouthWest

**e**. South

**4**. Convert the polar equation $r = 4\cos\theta$ to rectangular coordinates and identify the shape of the curve.

- **a**. Circle of radius $2$ centered at a point on the $x$-axis.
- **b**. Circle of radius $2$ centered at a point on the $y$-axis.
- **c**. Circle of radius $4$ centered at a point on the $x$-axis.
- **d**. Circle of radius $4$ centered at a point on the $y$-axis.
- **e**. Parabola opening to the right.

**5**. Find the angle between the direction of the line $(x,y,z) = (3+3t, 3-3t, 4)$ and the normal to the plane $2x + 2z = 15$.

- **a**. $90°$
- **b**. $60°$
- **c**. $45°$
- **d**. $30°$
- **e**. $0°$

**6**. Find the point where the line $(x,y,z) = \vec{r}(t) = (t+2, t-2, 2t-1)$ intersects the plane $3x - y + 2z = 12$. At this point $x + y + z =$

- **a**. $3$
- **b**. $1$
- **c**. $0$
- **d**. $-1$
- **e**. $-3$

**7**. The graph of the equation $x^2 + y^2 - z = -1$ is a

**a**. Hyperboloid of $1$ sheet

**b**. Hyperboloid of $2$ sheets

**c**. Cone

**d**. Elliptic Paraboloid opening down

**e**. Elliptic Paraboloid opening up

**8**. Find the equation of the plane thru the point $P = \langle 1,2,3 \rangle$ tangent to the vectors $\vec{a} = \langle 1,2,3 \rangle$ and $\vec{b} = \langle 3,2,1 \rangle$.

**a**. $-4x - 8y - 4z = 0$

**b**. $-4x + 8y - 4z = 0$

**c**. $-4x - 8y - 4z = 16$

**d**. $-4x - 8y - 4z = 32$

**e**. $-4x + 8y - 4z = 32$

**9**. Find the area of the triangle with adjacent edges $\vec{a} = \langle 1,2,3 \rangle$ and $\vec{b} = \langle 3,2,1 \rangle$.

**a**. $2\sqrt{2}$

**b**. $4\sqrt{6}$

**c**. $2\sqrt{6}$

**d**. $\sqrt{6}$

**e**. $\frac{1}{2}\sqrt{2}$

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

**10**. (36 points) For the twisted cubic $\vec{r}(t) = \left(2t, \frac{t^3}{3}, t^2\right)$ compute each of the following:

**a**. (6 pts) The velocity $\vec{v}$

$\vec{v} =$ ____________________

**b**. (6 pts) The speed $\frac{ds}{dt}$ (Simplify!)

$\frac{ds}{dt} =$ ____________________

**c**. (6 pts) The tangential acceleration $a_T$

$a_T =$ ____________________

**d**. (6 pts) The mass of a wire in the shape of this twisted cubic between $(0,0,0)$ and $(6,9,9)$ if the linear mass density is $\delta = xz$.

$M =$ ____________________

**e**. (6 pts) The $z$-component of the center of mass of the wire between $(0,0,0)$ and $(6,9,9)$ if the linear mass density is $\delta = xz$.

$\bar{z} =$ ____________________

**f**. (6 pts) The work done to move a bead along of a wire in the shape of this twisted cubic between $(0,0,0)$ and $(6,9,9)$ by the force $\vec{F} = (3y, 4x, z)$.

$W =$ ____________________

**11**. (15 points) Write the vector $\vec{a} = \langle 2, 6, 2 \rangle$ as the sum of two vectors $\vec{b}$ and $\vec{c}$ with $\vec{b}$ parallel to $\vec{d} = \langle 1, 2, -1 \rangle$ and $\vec{c}$ perpendicular to $\vec{d}$.
Check $\vec{c}$ is perpendicular to $\vec{d}$.

$\vec{a} =$ ____________________ + ____________________

$\vec{b}$ $\vec{c}$