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MATH 251

Exam 1 Version A

Fall 2018

Sections 504/505

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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 3rd 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. $W = 0$
 - b. $W = 10$
 - c. $W = 22$
 - d. $W = 33$
 - e. $W = 34$
3. If \vec{u} points Up and \vec{v} points SouthEast, where does $\vec{u} \times \vec{v}$ point?
- a. Down
 - b. NorthEast
 - c. SouthWest
 - d. NorthWest
 - e. South

4. Convert the polar equation $r = 4 \cos \theta$ to rectangular coordinates and identify the shape of the curve.
- Circle of radius 4 centered at a point on the x -axis.
 - Circle of radius 4 centered at a point on the y -axis.
 - Circle of radius 2 centered at a point on the x -axis.
 - Circle of radius 2 centered at a point on the y -axis.
 - 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 $2x + 2z = 15$.
- 0°
 - 30°
 - 45°
 - 60°
 - 90°
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 $x + y + z =$
- 3
 - 1
 - 0
 - 1
 - 3

7. The graph of the equation $x^2 + y^2 - z = -1$ is a
- Hyperboloid of 1 sheet
 - Hyperboloid of 2 sheets
 - Cone
 - Elliptic Paraboloid opening up
 - Elliptic Paraboloid opening down
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 $\vec{b} = \langle 3, 2, 1 \rangle$.
- $-4x + 8y - 4z = 0$
 - $-4x - 8y - 4z = 0$
 - $-4x + 8y - 4z = 32$
 - $-4x - 8y - 4z = 32$
 - $-4x - 8y - 4z = 16$
9. Find the area of the triangle with adjacent edges $\vec{a} = \langle 1, 2, 3 \rangle$ and $\vec{b} = \langle 3, 2, 1 \rangle$.
- $\frac{1}{2}\sqrt{6}$
 - $\sqrt{6}$
 - $2\sqrt{6}$
 - $4\sqrt{6}$
 - $2\sqrt{2}$

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

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

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

$$\vec{v} = \underline{\hspace{2cm}}$$

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

$$\frac{ds}{dt} = \underline{\hspace{2cm}}$$

c. (6 pts) The tangential acceleration a_T

$$a_T = \underline{\hspace{2cm}}$$

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

$$M = \underline{\hspace{2cm}}$$

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

$$\bar{z} = \underline{\hspace{2cm}}$$

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 $(9,6,9)$ by the force $\vec{F} = (2y, 3x, z)$.

$$W = \underline{\hspace{2cm}}$$

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

$$\vec{a} = \frac{\quad}{\vec{b}} + \frac{\quad}{\vec{c}}$$