1. NO CALCULATORS ALLOWED
2. UNLESS OTHERWISE INSTRUCTED, SIMPLIFY ALL ANSWERS COMPLETELY
3. SHOW PROPER & CONCISE PRECALCULUS LEVEL WORK TO JUSTIFY YOUR ANSWERS

[FILL IN THE BLANKS] **SCORE: _____ / 7 PTS**

② IF ALL CORRECT COORDINATES
① IF ONLY 2 CORRECT COORDINATES

[a] You start at the origin in 3D, and move 11 units right, 9 units down, and 12 units backward. You are now at the point with co-ordinates $(-12, 11, -9)$, you are in octant 6 ①, and you are 12 ① units away from the yz – plane.

[b] If $\vec{a} \cdot \vec{b} = 9$, then the angle between $\vec{a}$ and $\vec{b}$ is ACUTE ①.

[c] The equation of the xz – trace of the sphere $(x+2)^2 + (y-3)^2 + (z-1)^2 = 19$ is $(x+2)^2 + (z-1)^2 = 10$ ②.

Three forces act on an object. **SCORE: _____ / 8 PTS**

Force 1 has magnitude 8 newtons and direction angle 60°.
Force 2 has magnitude 12 newtons and direction angle 150°.
Force 3 has magnitude 5 newtons and direction angle 270°.

[a] Find the resultant of the three forces. Write your answer as a linear combination of $\vec{i}$ and $\vec{j}$.

$8\langle \cos 60^\circ, \sin 60^\circ\rangle$
$+12\langle \cos 150^\circ, \sin 150^\circ\rangle$
$+5\langle \cos 270^\circ, \sin 270^\circ\rangle$
$= \langle 4, 4\sqrt{3}\rangle + \langle -6\sqrt{3}, 6\rangle + \langle 0, -5\rangle$ ① ① ½
$= \langle 4-6\sqrt{3}, 1+4\sqrt{3}\rangle$
$=$ ½ $(4-6\sqrt{3})\vec{i} + (1+4\sqrt{3})\vec{j}$ ①

① FOR THIS FORMAT (USING $\vec{i}, \vec{j}$)

[b] The resultant of the three forces acted on the object as it moved from $(-3, 2)$ to $(-1, -4)$, where all coordinates are measured in meters. Find the work done, and give appropriate units for your answer.

$\vec{d} = \langle -1 - -3, -4-2\rangle = \langle 2, -6\rangle$
$\langle 4-6\sqrt{3}, 1+4\sqrt{3}\rangle \cdot \langle 2, -6\rangle = 8 - 12\sqrt{3} - 6 - 24\sqrt{3}$ ①
$= 2 - 36\sqrt{3}$ ① Nm OR J ① FOR EITHER ANSWER

Write $\vec{g} = <11, 7>$ as the sum of 2 vectors, one perpendicular to $\vec{d} = <-4, 2>$ and one parallel to $\vec{d}$. **SCORE: _____ / 5 PTS**

$$\text{PROJ}_{\vec{d}}\vec{g} = \frac{\langle 11,7\rangle \cdot \langle -4,2\rangle}{\langle -4,2\rangle \cdot \langle -4,2\rangle}\langle -4,2\rangle = \frac{-30}{20}\langle -4,2\rangle = -\frac{3}{2}\langle -4,2\rangle$$

(1) (1)

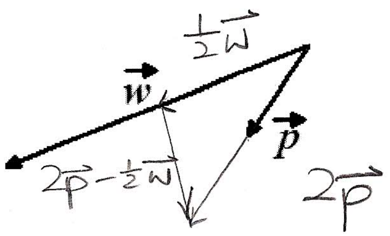
$$= \langle 6,-3\rangle$$ (1)

$$\langle 11,7\rangle - \langle 6,-3\rangle = \langle 5,10\rangle$$ (1)

$$\langle 11,7\rangle = \langle 6,-3\rangle + \langle 5,10\rangle$$

(1) FOR THIS FORMAT / EQUATION

For the vectors shown below, sketch the vector $2\vec{p} - \frac{1}{2}\vec{w}$. **SCORE: _____ / 2 PTS**



Let $\vec{d} = 6\vec{j} - 2\sqrt{3}\,\vec{i}$. **SCORE: _____ / 8 PTS**

[a] Find a vector $\vec{s}$ in the **opposite** direction as $\vec{d}$, such that $\|\vec{s}\| = 3$. Write your answer in component form.

$$-\frac{3}{\|\vec{d}\|}\vec{d} = -\frac{3}{\sqrt{12+36}}\langle -2\sqrt{3}, 6\rangle$$

$$= -\frac{3}{\sqrt{48}}\langle -2\sqrt{3}, 6\rangle$$ ($\frac{1}{2}$) ($\frac{1}{2}$) (1)

$$= -\frac{3}{4\sqrt{3}}\langle -2\sqrt{3}, 6\rangle = \left\langle \frac{3}{2}, \frac{-3\sqrt{3}}{2}\right\rangle$$ (1)

[b] If $\vec{p}$ is a vector with magnitude 6 which makes an angle of 135° with $\vec{d}$, find $\vec{p}\cdot\vec{d}$.

$$\|\vec{p}\|\,\|\vec{d}\|\cos\theta = 6(4\sqrt{3})\cos 135^\circ$$ (1)

$$= 6(4\sqrt{3})\left(-\frac{\sqrt{2}}{2}\right)$$

$$= -12\sqrt{6}$$ (1)

[c] Find the direction angle of $\vec{d}$.

$$\theta_{\vec{d}} = \pi + \tan^{-1}\frac{6}{-2\sqrt{3}}$$

$$= \pi + \tan^{-1}(-\sqrt{3}) = \pi - \frac{\pi}{3} = \frac{2\pi}{3}$$

(1) (1) (1)