Read Me First: Show all essential work very neatly. Use correct notation when presenting your computations. Write using complete sentences. Remember this: "=" denotes "equals" , "⇒" denotes "implies" , and "⇔" denotes "is equivalent to". *Vector objects must be denoted by using arrows.* Since a correct answer really consists of all the magic transformations, do not "box" your final results. Show me all the magic on the page clearly. Eschew Obfuscation.

---

1. (5 pts.) Obtain parametric equations for the line through the points (-4,-4,1) and (2,0,2).

---

2. (5 pts.) Obtain a vector equation for the line through (-1,-2, 3) and parallel to the line defined by $\langle x,y,z\rangle = \langle -6,0,-10\rangle + t\langle 2,-\pi,3\rangle$, where t is any real number.

---

3. (5 pts.) Obtain parametric equations for the line obtained when the two planes defined by $x + y + 2z = 5$ and $x - 2y + z = 10$ intersect.

---

4. (5 pts.) What is the radius of the sphere with center (1,1,1) that is tangent to the plane defined by $x + 2y + 2z = 11$ and what is the point of tangency?

5. (5 pts.) What point (x_0,y_0) is four-fifths of the way from P = (-2,-3) to Q = (48,7) ??

6. (5 pts.) Suppose **v** = <-3,-2, 1> and **w** = <-1,1,1>. Then

v•**w** =

7. (5 pts.) Suppose **v** = <-3,-2, 1> and **w** = <-1,1,1>. Then

v × **w** =

8. (5 pts.) Suppose **v** = <-3,-2, 1> and **w** = <-1,1,1>. Then

$\text{proj}_{\mathbf{w}}(\mathbf{v})$ = ,

and the component of **v** perpendicular to **w** is

$\mathbf{w}_2$ = .

---

9. (5 pts.) Suppose **v** = <-3,-4, 5> and **w** = <-1,1,1>.
If α, β, and γ are the direction angles of **v**, then

$\cos(\alpha)$ = ,

$\cos(\beta)$ = ,and

$\cos(\gamma)$ = .

---

10. (5 pts.) Suppose **v** = <-3,-2, 1> and **w** = <-1,1,1>. What is the exact value of the angle θ between **v** and **w** ??

θ =

---

11. (5 pts.) Write a point-normal equation for the plane perpendicular to **v** = <-3,-2,1> and containing the point (-1,2,-3).

---

12. (5 pts.) Which point on the line defined the vector equation
<x,y,z> = <1,1,1> + t<2,-1,-1> is nearest the point, (0,-1,0)?

13. (5 pts.) Find the exact value of the acute angle θ of intersection of the two planes defined by the two equations

$$x - 3y = -5 \quad \text{and} \quad 2y - 4z = 7.$$

θ =

14. (5 pts.) Write an equation for the plane which contains the line defined by <x,y,z> = <1,2,3> + t<3, -2, 1> and is perpendicular to the plane defined by x - 2y + z = 0.

15. (5 pts.) Obtain an equation for the plane tangent to the sphere defined by

$$(x-1)^2 + (y+2)^2 + (z-3)^2 = 9$$

at the point (2, -4, 5), which is actually on the sphere.

16. (5 pts.) The equation

$$r = 4\cos(\theta) - 10\sin(\theta)$$

is that of a cylinder in cylindrical coordinates. Obtain an equivalent equation in terms of rectangular coordinates (x,y,z). Provide a vector equation for the straight line that is the axis of symmetry.

17. (5 pts.) The point (-3,-4,-5) is in rectangular coordinates. Convert this to spherical coordinates (ρ,θ,ϕ). [Inverse trig fun?]

(ρ,θ,ϕ) = .

18. (5 pts.) Do the lines defined by the equations

<x,y,z> = <0,1,2> + t<4,-2,2> and <x,y,z> = <1,1,-1> + t<1,-1,4>

intersect? Justify your answer, for *yes* or *no* does not suffice.

19. (5 pts.) What is the area of the triangle in three space with vertices at P = (-3, 0, 0), Q = (0, 4, 0), and R = (0 , 0, 4).

20. (5 pts.) Do the three 2-space sketches of the traces in each of the coordinate planes of the surface defined by

$$z = 1 - \frac{x^2}{9} - \frac{y^2}{4} .$$

Do not attempt to do a 3 - space sketch. If you don’t have enough space below, say where any additional work is.