1. Line 1 passes through the points (1, 4, -2) and (2, 6, -2) and line 2 passes through the points (1, 4, -2) and (2, 4, 0). Note that both line pass through (1, 4, -2). Find the cosine of the angle formed by the two lines.

(a) $\frac{1}{\sqrt{2}}$

(b) $\frac{1}{2}$

(c) $\frac{1}{5}$

(d) $\frac{\sqrt{3}}{2}$

(e) $\frac{3}{4}$

(f) $\frac{2}{3}$

2. The path of a particle at time t is given by the parametric curve **r**(t)=<3sint, 3cost, -4t>. How far does the particle travel from t=0 to t=2 seconds?

(a) 3 units

(b) 2 units

(c) 12 units

(d) 5 units

(e) 10 units

(f) 9 units

3. Describe the level curves of the function $f(x, y) = \sqrt{1 - y + 2x^2}$.

(a) concentric circles

(b) concentric ellipses (not circles)

(c) parabolas with the same vertex

(d) parabolas with different vertices

(e) hyperbolas with the same vertex

(f) hyperbolas with different vertices

4. Find an equation of the tangent plane to the graph of $f(x,y) = \ln(2x+y)$ at $x=-1, y=3$.

(a) 2x+y-z=1

(b) 2x+y+z=5

(c) x-2y+z=7

(d) 3x+2y+z=3

(e) 2x+3y+z=7

(f) x+2y+3z=5

5. Find the largest value of the function $f(x,y) = xy + 2y^2$ at the point $(x,y) = (1,-2)$.

(a) $\sqrt{53}$

(b) $\sqrt{58}$

(c) $\sqrt{63}$

(d) $\sqrt{74}$

(e) $\sqrt{85}$

(f) $\sqrt{97}$

6. The function $f(x,y) = x^2 + 2y^2 + 4x^2y$ has two critical points. Classify them.

(a) maximum point at (0, 0), saddle point at (1/2, -1/4)

(b) minimum point at (0, 0), maximum point at (1/2, -1/4)

(c) saddle point at (0, 0), minimum point at (1/2, -1/4)

(d) maximum point (0, 0), minimum point at (1/2, -1/4)

(e) saddle point at (0, 0), maximum point at (1/2, -1/4)

(f) minimum point at (0, 0), saddle point at (1/2, -1/4)

7. In using Lagrange multipliers to minimize the function $f(x, y) = x^2 + y^2$ subject to the constraint $xy=2$ where $x>0$ and $y>0$, what is the value of the multiplier λ?

(a) -2

(b) -1

(c) 3/2

(d) 2

(e) 5/2

(f) -3/2

8. Approximate the value of $\sqrt{24} - \sqrt{5}$ using the tangent plane approximation to the function $f(x, y) = \sqrt{x} - \sqrt{y}$ at the point (25, 4).

(a) 2.60

(b) 2.65

(c) 2.70

(d) 2.75

(e) 2.80

(f) 2.85

Key: 1 (c), 2 (e), 3 (d), 4 (a), 5 (a), 6 (f), 7 (d), 8 (b)