

Same instructions as in Mission 1. See Mission 1 for details.

**Problem 16** Your PRINTED NAME below indicates you have:

(a.) Your PRINTED NAME below indicates you have:

(a.) I have read §1.1 – 1.4 of Cook: \_\_\_\_\_.

(b.) I have attempted 10 problems either from Stewart(see below) or the end of chapter problems in my notes:\_\_\_\_\_.

§ 12.6 #'s 3, 5, 7, 11, 13, 15, 21, 23, 25, 35, 37

§ 13.1 #'s 11, 17, 19, 21, 23, 25, 27, 29\*, 31, 39, 43, 50

§ 13.2 #'s 3, 7, 9, 11, 13, 14, 15, 16, 17, 19, 21, 25, 27, 33, 35, 37, 39, 41, 45\*, 51, 55

§ 13.3 #'s 1, 5, 7, 13, 16, 17, 21, 25, 29, 39, 42\*, 45, 47, 56\*, 63\*

§ 13.4 #'s 9, 11, 13, 15, 17, 22, 37, 39, 41, 44

**Problem 17** Find parametrizations of the curves described below: (if the curve has more than one connected piece you may need to parametrize each piece separately)

(a) the hyperbola  $(x - 1)^2 - (y + 3)^2 = 1$  in the plane.

(b) a circle of radius 7 centered at  $(1, 1, 3)$  in the  $z = 3$  plane.

(c) a circle of radius 7 centered at  $(3, 4, 5)$  in the  $x + y + z = 12$  plane.

**Problem 18** Name the following surfaces: (use Mathematica or Sage etc. to plot these )

(a)  $x^2 + z^2 = y^2$

(b)  $x^2 + 2y^2 + 4z^2 = 1$

(c)  $y - x^2 = z^2$

(d)  $(24 + x^2 + y^2 + z^2)^2 = 100(x^2 + y^2)$

**Problem 19** Find a parametrization of the cylinder  $y^2 + 3z^2 = 1$  for  $1 \leq x \leq 4$ . Use  $t, \theta$  as the notation for your parameters.

**Problem 20** Find the cylindrical and spherical coordinates of the point  $P = (1, 1, 4)$ .

**Problem 21** Parametrize the tangent line to  $\vec{r}(t) = \langle t^2, \cos(t^2), \sin(t^2) \rangle$  at the point  $(1, \cos 1, \sin 1)$ .

**Problem 22** Calculate the derivative  $\frac{d}{dt}$  of  $\langle t^2, e^t, \cosh t^2 \rangle \times \langle t, t^2, t^3 \rangle$ .

**Problem 23** Show  $\frac{d^2}{dt^2} (\vec{A} \cdot \vec{B}) = \frac{d^2 \vec{A}}{dt^2} \cdot \vec{B} + 2 \frac{d\vec{A}}{dt} \cdot \frac{d\vec{B}}{dt} + \vec{A} \cdot \frac{d^2 \vec{B}}{dt^2}$ . Conjecture the result for the  $n$ -th derivative.

**Problem 24** Let  $\vec{C}$  be a constant vector. Calculate  $\int (t\vec{C} + t^2 \hat{x}) dt$ . If it helps, let  $\vec{C} = \langle a, b, c \rangle$ , but, you can solve this without resorting to components.

**Problem 25** Find the arclength function based at the origin for the curve parametrized by  $x = 2t^3$ ,  $y = 2t^3$  and  $z = t^3$  for  $t \geq 0$ . Name this curve and provide its parametrization with respect to arclength.

**Problem 26** Find the  $T, N, B$  frame for the curve  $\vec{\gamma}(t) = \langle 2 + 3t, 2 + 4 \cos t, 1 + 4 \sin t \rangle$ . Also, calculate the curvature and torsion of the curve.

**Problem 27** Suppose  $x = e^{-t} \cos(t)$  and  $y = e^{-t} \sin(t)$  and  $z = e^{-t}$  for  $0 \leq t \leq 4\pi$ . Calculate and simplify the tangent, normal and binormal vector fields for the curve parametrized by the given scalar parametric equations.

**Problem 28** Suppose two ninja begin travelling the paths given below. To begin, at  $t = 0$ , a relatively slow genin level ninja sets off in a NE direction given by

$$\vec{r}_1(t) = \langle -10 + t, 1 + t \rangle.$$

However, at the same time  $t = 0$ , an enemy Jonin sets off in a NW direction given by

$$\vec{r}_2(t) = \langle 20 - 4t, 6 + t \rangle.$$

Both of these paths are placed in a forest thick with a mist which lowers visibility to near zero. Suppose the Jonin level ninja has advanced tracking skills that allow him to pick up on the faintest of scents. If he crosses the path of an enemy he can smell it and then alter his path to pursue and attack the enemy genin. Should the genin worry? Is he in danger? ( a Jonin is no match for a typical genin in a usual battle, if the Jonin catches the genin it's game over for the lowly genin)

**Problem 29** Suppose the velocity is given by  $\vec{v}(t) = \langle t, 3, t \sinh(t^2) \rangle$  for some particle which has initial position  $(1, 2, 3)$ . Find for  $t \geq 0$  the:

- (a) acceleration at time  $t$
- (b) position at time  $t$
- (c) speed at time  $t$
- (d) distance travelled at time  $t$  (in terms of an integral)

**Problem 30** Suppose  $\vec{\gamma}(t) = \langle 3 \cos(t^2), 3 \sin(t^2), 2t + 1 \rangle$  is the position of a particle at time  $t$ . Find  $a_T$  and  $a_N$  components of the acceleration of this particle at time  $t$ .