Exercises discussed in class:

1. Show that
$$D = \frac{|d_1 - d_2|}{\sqrt{a^2 + b^2 + c^2}}$$
is the distance between the parallel planes $ax + by + cz + d_1 = 0$ and $ax + by + cz + d_2 = 0$ (Section 12.5: Exercise 75).

2. Prove the following formulas
   (a) $\dfrac{d}{dt}|\mathbf{r}(t)| = \dfrac{\mathbf{r}(t) \cdot \mathbf{r}'(t)}{|\mathbf{r}(t)|}$ (Section 13.2: Exercise 57).
   (b) $\dfrac{d}{dt}[\mathbf{r}(t) \times \mathbf{r}'(t)] = \mathbf{r}(t) \times \mathbf{r}''(t)$ (Section 13.2: Exercise 55).

3. Prove the following formulas.
   (a) $\dfrac{d}{dt}[\mathbf{u}(t) \cdot \mathbf{v}(t)] = \mathbf{u}'(t) \cdot \mathbf{v}(t) + \mathbf{u}(t) \cdot \mathbf{v}'(t)$
   (b) $\dfrac{d}{dt}[\mathbf{u}(t) \times \mathbf{v}(t)] = \mathbf{u}'(t) \times \mathbf{v}(t) + \mathbf{u}(t) \times \mathbf{v}'(t)$

Exercises by Maxima/wxMaxima: The following web pages provide wxMaxima demonstration for each exercise.

1. Vectors and Their Operations (`https://vps63.heliohost.us/e-math/2110/page3.html`)
   (a) Find the plane that contains the line of intersection of $x - z = 1$ and $y + 2z = 3$ and is perpendicular to $x + y - 2z = 1$ (Section 12.5: Exercise 40).
   (b) Let $\langle 1, 1, 0\rangle + t\langle 1, -1, 2\rangle$ and $\langle 2, 0, 2\rangle + s\langle -1, 1, 0\rangle$ be two lines.
      i. Find the point of the intersection.
      ii. Find a linear equation of the plane that contains these lines. (Section 12.5: Exercise 64.)

2. Drawing Space Curves (`https://vps63.heliohost.us/e-math/2110/page4.html`)
   (a) Graph the curve $\langle t, t^2, e^{-t}\rangle$.
   (b) Graph the curve $\langle e^{-t}\cos 5t, e^{-t}\sin 5t, e^{-t}\rangle$.
   (c) Graph the curve $\langle \cos t, \sin t, \ln t\rangle$.

3. Differentiate Vector Functions (`https://vps63.heliohost.us/e-math/2110/page5.html`)
   (a) Find the unit tangent vector to $\langle 4\sqrt{t}, t^2, t\rangle$ at $t = 1$.
   (b) Find the equation of the tangent line (itself parametrized with s) to the curve $\langle e^t, te^t, te^{t^2}\rangle$ (parametrized by t) at $t = 0$.
   (c) Integrate the curve $\langle 0, 4/(1 + t^2), 2t/(1 + t^2)\rangle$ from $t = 0$ to $t = 1$.
   (d) Differentiate the cross product of $\langle \sin t, \cos t, t\rangle$ and $\langle t, \cos t, \sin t\rangle$.

Key formulas to memorize:

1. $x = x_0 + at$; $y = y_0 + bt$; $z = z_0 + ct$ [Line through (x_0, y_0, z_0) and parallel to $\mathbf{a} = \langle a, b, c\rangle$]
2. $a(x-x_0)+b(y-y_0)+c(z-z_0) = 0$ [Plane through (x_0, y_0, z_0) and orthogonal to $\mathbf{n} = \langle a, b, c\rangle$]
3. $ax + by + cz + d = 0$ [Plane orthogonal to $\mathbf{n} = \langle a, b, c\rangle$]
4. $\dfrac{|ax_1 + by_1 + cz_1 + d|}{\sqrt{a^2 + b^2 + c^2}}$ [Distance from a point (x_1, y_1, z_1) to a plane $ax + by + cz + d = 0$]
5. $\langle x, y, z\rangle = \mathbf{r}(s_0) + t\,\mathbf{r}'(s_0)$ [Tangent line to $\mathbf{r}(s)$ at $s = s_0$]
6. $\dfrac{d}{dt}[\mathbf{u}(t) \cdot \mathbf{v}(t)] = \mathbf{u}'(t) \cdot \mathbf{v}(t) + \mathbf{u}(t) \cdot \mathbf{v}'(t)$
7. $\dfrac{d}{dt}[\mathbf{u}(t) \times \mathbf{v}(t)] = \mathbf{u}'(t) \times \mathbf{v}(t) + \mathbf{u}(t) \times \mathbf{v}'(t)$

Online quiz No.2: Start online quiz at the course website.