Your solutions should be neat, correct and complete. Same instructions as Mission 1 apply here.

Recommended Homework from Textbook: problems:

5.2, 5.3, 5.7, 5.14, 5.24, 5.31, 5.32, 5.34, 5.40, 5.42, 5.63, 5.72, 5.77, 5.80, 5.103, 5.114.

I also reccommend you work on understanding whatever details of lecture seem mysterious at first.

Required Reading 3 [1pt] Your signature below indicates you have read:

(a.) I read Lectures 9, 10, 11, 13 and 15 by Cook as announced in Blackboard: ____________________.

(b.) I read Chapters 5 and 6 of the required text: ____________________.

Problem 21 [3pts] Problem 5.36 (inclined plane)

Problem 22 [3pts] Problem 5.66 (inclined plane)

Problem 23 [3pts] Problem 5.68 (inclined plane)

Problem 24 [3pts] Problem 5.92 (inclined plane with pulleys)

Problem 25 [3pts] Problem 5.108 (v-dependent force)

Problem 26 [3pts] Problem 5.44 (flat race track with friction)

Problem 27 [3pts] A velocity-dependent friction force of $F_f = cv^3$ acts on a falling mass. Find the terminal velocity and draw a free-body diagram to illustrate the direction of the gravitational and friction forces. What are the dimensions of the constant c ?

Problem 28 [3pts] We define **gradients** $\nabla f = \frac{\partial f}{\partial x}\hat{\mathbf{x}} + \frac{\partial f}{\partial y}\hat{\mathbf{y}}$ for $f = f(x, y)$ or, for three dimensional cases, $g = g(x, y, z)$, we define $\nabla g = \frac{\partial g}{\partial x}\hat{\mathbf{x}} + \frac{\partial g}{\partial y}\hat{\mathbf{y}} + \frac{\partial g}{\partial g}\hat{\mathbf{z}}$. Geometrically, $f(x, y) = k$ has a solution set which is a curve, sometimes called the level-k curve. Geometrically, $g(x, y, z) = k$ has a solution set which is a surface, sometimes called the level k-surface. Calculate the gradient vector field of each function below.

(a.) $f(x, y) = x^2 + 2y^2$,

(b.) $f(x, y) = e^{xy}$,

(c.) $g(x, y, z) = ax + by + cz$ where a, b, c are constants,

(d.) $g(x, y, z) = (x^2 + y^2 + z^2)^n$ where $n \in \mathbb{Z}$.

Problem 29 [3pts] Let C_1 be the helix parametrized by $\vec{\mathbf{r}}_1(t) = \langle \cos t, \sin t, t \rangle$ for $t \in [0, 2\pi]$. Also, let C_2 be the line from $(1, 0, 0)$ to $(1, 0, 2\pi)$ parametrized by $\vec{\mathbf{r}}_2(t) = \langle 1, 0, t \rangle$. Both parametrizations have $0 \leq t \leq 2\pi$.

(a.) if $\vec{\mathbf{F}}_1 = (x + y)\hat{\mathbf{x}} + (y + z)\hat{\mathbf{y}} + (z + x)\hat{\mathbf{z}}\rangle$ then calculate $\int_{C_1} \vec{\mathbf{F}}_1 \bullet d\vec{\mathbf{r}}$ and $\int_{C_2} \vec{\mathbf{F}}_1 \bullet d\vec{\mathbf{r}}$

(b.) if $\vec{\mathbf{F}}_2 = x^3\hat{\mathbf{x}} + y^2\hat{\mathbf{y}} + z\hat{\mathbf{z}}$ then calculate $\int_{C_1} \vec{\mathbf{F}}_1 \bullet d\vec{\mathbf{r}}$ and $\int_{C_2} \vec{\mathbf{F}}_1 \bullet d\vec{\mathbf{r}}$

Problem 30 [3pts] Find the potential energy function for the vector field in the previous problem which is conservative. Calculate the work done by the force for **any** path which begins at $(1, 0, 0)$ and ends at $(0, 0, 2\pi)$.