1) Use the divergence theorem to find the outward flux of the field $\mathbf{F} = (xz)\boldsymbol{i} + (yz)\boldsymbol{j} + \boldsymbol{k}$ across the boundary of the region which is the entire surface of the upper cap cut from the solid sphere $x^2 + y^2 + z^2 \le 25$ by the plane $z = 3$

Big Hint: = ………….. = $\int_0^{2\pi} \int_0^4 \int_3^{\sqrt{25-r^2}} 2z\ (rdzdrd\theta)$ =…….

2. (Read Carefully) Use Stokes' theorem to evaluate the counterclockwise circulation of the field $\mathbf{F} = y^2\boldsymbol{i} - y\boldsymbol{j} + 3z^2\boldsymbol{k}$ around the boundary of the ellipse in which the plane $2x + 6y - 3z = 6$ meets the cylinder $x^2 + y^2 = 1$ (counterclockwise).

BIG HINT: Curl(F) is easy. Next choose your surface S in the plane $2x + 6y - 3z = 6$. **Now compute n**.dδ by the formula $\mp\frac{\nabla g}{|g_z|}\ dydx$. Your projected region in the xy-plane is the region inside $x^2 + y^2 = 1$

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3. (Read Carefully) Use Stokes' theorem to evaluate the counterclockwise circulation of the field $\mathbf{F} = \sin x^2\boldsymbol{i} + \left(e^{y^2} + x^2\right)\boldsymbol{j} + \left(z^4 + 2x^2\right)\boldsymbol{k}$ around the boundary of the triangle in the first octant cut by the plane $\frac{x}{3} + \frac{y}{2} + z = 1$.

BIG HINT: Curl(F) is easy. By Stokes' Thm. , we can choose our surface S in the plane $\frac{x}{3} + \frac{y}{2} + z = 1$ **Now compute n**.dδ by the formula $\mp\frac{\nabla g}{|g_z|}\ dydx$. Your projected region in the xy-plane is the triangle in the 1st quadrant bounded by $\frac{x}{3} + \frac{y}{2} = 1$ and the coordinate axes.

4. Use the divergence theorem to find the outward flux of the field $\mathbf{F} = (xy)\boldsymbol{i} + \left(y^2 + e^{xz^2}\right)\boldsymbol{j} + \sin(xy)\boldsymbol{k}$ over the surface of the region bounded by the parabolic cylinder $z = 1 - x^2$ and the planes $z = 0$, $y = 0$, and $y + z = 2$

Big Hint: = ………….. = $\int_{-1}^{1} \int_0^2 \int_0^{1-x^2} 3y\ \ dzdydx$=………

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5) Solve the DE (x + 2)siny dx + xcosy dy = 0.

6) a) Change the DE $3(1 + x^2)y' = (1 + 2x)y^{5/3} - 2xy$ to a linear DE **Then STOP!!**

Big Hint: It is a Bernoulli DE.

6b) Use an integrating factor to change the following D.E to an exact DE. **Then STOP!**

$$6xy\,dx + (4y + 9x^2)dy = 0$$

6c) Section 2.5 ABC: 13 (Homogenous)

7a) (About the Uniqueness Theorem.)
Find **all** solutions of $y' = 4\cos(\,y\sin(y + 2x)\,) - 6$; $y(0) = 0$.
(Hint: Try $y = kx$ for some k.)

7b) (About the Uniqueness Theorem.) Consider the differential equation y ' = f(x; y).
Assume that f(x; y) has continuous partial derivatives (w.r.t x & y) for all values of x and y.
Can the two functions y_1 (x) = x^2 & y_2(x) = - x^2
both be solutions to this differential equation? Justify your answer
(i.e. if yes, give an example of such an f(x; y) and if no, supply a proof).

Big Hint: Impossible because Both solutions have the common propery y(0)= …..
So this contradicts the Uniqueness theorem 1.2 (?)……..