10. Compute $\int_C (12xy)\,dx + (6x^2 - 7e^y + 2y)\,dy$ where C consists of three line segments. The first line segment for C starts at $(1,2)$ and goes to $(8,75)$; the second segment is from $(8,75)$ to $(198,706)$; and the third segment is from $(198,706)$ to $(3,4)$.

$$\text{integral} = \left. 6x^2 y - 7e^y + y^2 \right]_{(1,2)}^{(3,4)}$$

$$= \boxed{6 \cdot 9 \cdot 4 - 7e^4 + 16 - (12 - 7e^2 + 4)}$$

11. Find the volume of the solid bounded by $z = 18 - x^2 - y^2$ and $z = x^2 + y^2 - 18$.

intersection is $18 - r^2 = r^2 - 18$

$$36 = 2r^2$$
$$18 = r^2$$
$$3\sqrt{2} = r$$

$$\int_0^{2\pi} \int_0^{3\sqrt{2}} \int_{r^2-18}^{18-r^2} r\,dz\,dr\,d\theta = 4\pi \int_0^{3\sqrt{2}} r(18 - r^2)\,dr = 4\pi \left. \left(9r^2 - \frac{r^4}{4} \right) \right]_0^{3\sqrt{2}}$$

$$= 4\pi \left(9 \cdot 18 - \frac{81 \cdot 4}{4} \right) = \boxed{4\pi \cdot 81}$$