I give nubers to the constants. In the units given (hbar/2m - where I take hbar in ev*s, because that is what's on the grapgh)

$$Ae1 := -\frac{4.29 \cdot h^2}{2 \cdot 9.109 \cdot 10^{-31}}$$

$$-1.020206584 \quad (1)$$

$$h := 6.582119514 \cdot 10^{-16}$$

$$6.582119514\ 10^{-16} \quad (2)$$

$$Ag := -\frac{13.38 \cdot h^2}{2 \cdot 9.109 \cdot 10^{-31}}$$

$$-3.181903051 \quad (3)$$

$$Be1 := \frac{0.68 \cdot h^2}{2 \cdot 9.109 \cdot 10^{-31}}$$

$$0.1617110669$$

$$Bg := \frac{8.48 \cdot h^2}{2 \cdot 9.109 \cdot 10^{-31}}$$

$$2.016632128$$

$$Ce1 := \frac{4.87 \cdot h^2}{2 \cdot 9.109 \cdot 10^{-31}}$$

$$1.158136611 \quad (6)$$

$$Cg := \frac{13.15 \cdot h^2}{2 \cdot 9.109 \cdot 10^{-31}}$$

$$3.127206661 \quad (7)$$

$$ds := 0.044$$

$$0.044 \quad (8)$$

$$dg := 0.29$$

$$0.29 \quad (9)$$

$$a := 1$$

$$1 \quad (10)$$

Put the numbers in formula (kx=k, ky and kz =0)

$$es(K) := -ds + Ae1 \cdot K^2$$

$$K \rightarrow -ds + Ae1\ K^2 \quad (11)$$

$$eg(K) := -dg + Ag^2 \cdot K^2$$

$$K \rightarrow -dg + Ag^2\ K^2 \quad (12)$$

$$e(K) := Ae1 \cdot K^2 + \left(Be1^2 \cdot K^4\right)^{\frac{1}{2}}$$

$$K \rightarrow Ae1\ K^2 + \sqrt{Be1^2\ K^4} \quad (13)$$

$$eg1(K) := Ag \cdot K^2 + \left(Bg^2 K^4\right)^{\frac{1}{2}}$$

$$K \to Ag\,K^2 + \sqrt{Bg^2\,K^4} \tag{14}$$

$$e2(K) := Ae1 \cdot K^2 - \left(Be1^2 \cdot K^4\right)^{\frac{1}{2}}$$

$$K \to Ae1\,K^2 - \sqrt{Be1^2\,K^4} \tag{15}$$

$$eg2(K) := Ag^2 \cdot K^2 - \left(Bg^2 \cdot K^4\right)^{\frac{1}{2}}$$

$$K \to Ag^2\,K^2 - \sqrt{Bg^2\,K^4} \tag{16}$$

$$A := plot(e(K), K = -0.5 \,..\, 0.5)$$

$$PLOT(\ldots) \tag{17}$$

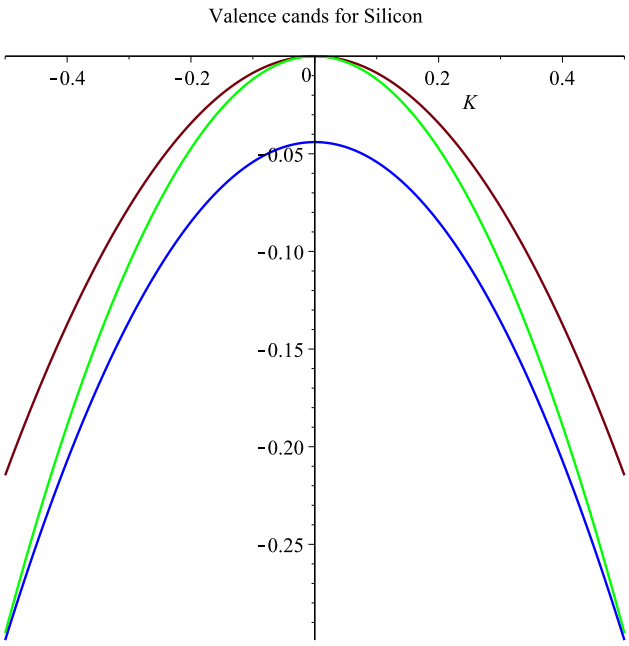
$$B := plot(e2(K), K = -0.5 \,..\, 0.5, color = green)$$

$$PLOT(\ldots) \tag{18}$$

$$C := plot(es(K), K = -0.5 \,..\, 0.5, color = blue)$$

$$PLOT(\ldots) \tag{19}$$

$$display(A, B, C)$$



$Ag := plot(eg(K), K = -0.3 .. 0.3, color = blue)$

$PLOT(\ldots)$

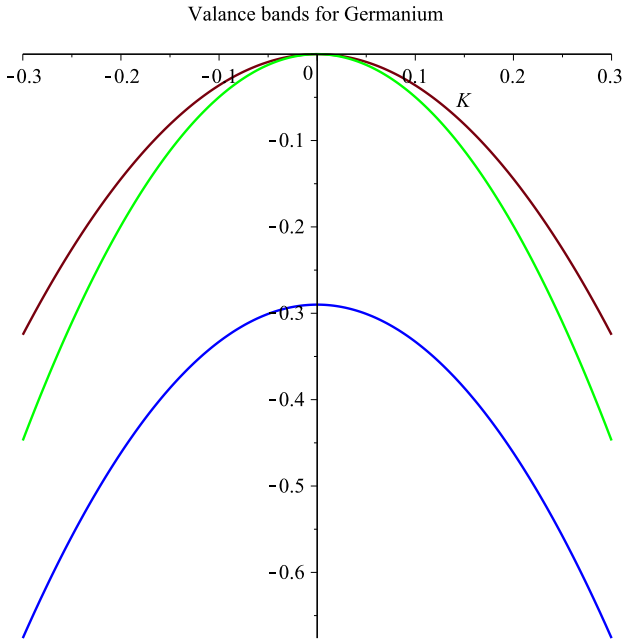
$Bg := plot(eg1(K), K = -0.3 .. 0.3)$

$PLOT(\ldots)$ **(21)**

$Cg := plot(eg2(K), K = -0.3 .. 0.3, color = green)$

$PLOT(\ldots)$ **(22)**

$display(Ag, Bg, Cg)$



b)for that part I need K in tems of kx and ky.

$Kt := \sqrt{kx^2 + ky^2 + kz^2}$

$$\sqrt{kx^2 + ky^2} \quad \textbf{(23)}$$

$kz := 0$

$$0 \quad \textbf{(24)}$$

$es(kx, ky) := Ae1 \cdot Kt^2 + \left(Be1^2 \cdot Kt^4 + Ce1^2 \cdot kx^2 \cdot ky^2\right)^{\frac{1}{2}}$

$$(kx, ky) \rightarrow Ae1\, Kt^2 + \sqrt{Be1^2\, Kt^4 + Ce1^2\, kx^2\, ky^2} \quad \textbf{(25)}$$

$es2(kx, ky) := Ae1 \cdot Kt^2 - \left(Be1^2 \cdot Kt^4 + Ce1^2 \cdot kx^2 \cdot ky^2\right)^{\frac{1}{2}}$

$$(kx, ky) \rightarrow Ae1\, Kt^2 - \sqrt{Be1^2\, Kt^4 + Ce1^2\, kx^2\, ky^2} \quad \textbf{(26)}$$

$es3(kx, ky) := -ds + Ae1 \cdot Kt^2$

$$(kx, ky) \rightarrow Ae1\, Kt^2 - ds \quad \textbf{(27)}$$

$A2 := plot3d(es(kx, ky), kx = -0.3 \,..0.3, ky = -0.3 \,..0.3, color = blue)$

$$PLOT3D(\ldots) \quad \textbf{(28)}$$

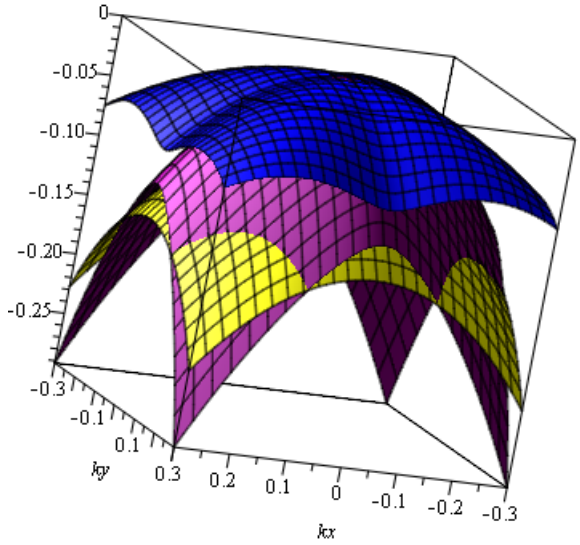
$B2 := plot3d(es2(kx, ky), kx = -0.3 \,..0.3, ky = -0.3 \,..0.3, color = purple)$

$$PLOT3D(\ldots) \tag{29}$$

$C2 := plot3d(es3(kx, ky), kx = -0.3..0.3, ky = -0.3..0.3, color = yellow)$

$$PLOT3D(\ldots) \tag{30}$$

$display(A2, B2, C2)$



$$eg(kx, ky) := Ag \cdot Kt^2 + \left(Bg^2 \cdot Kt^4 + Cg^2 \cdot kx^2 \cdot ky^2\right)^{\frac{1}{2}}$$

$$(kx, ky) \rightarrow Ag\, Kt^2 + \sqrt{Bg^2\, Kt^4 + Cg^2\, kx^2\, ky^2} \tag{31}$$

$$eg2(kx, ky) := Ag \cdot Kt^2 + \left(Bg^2 \cdot Kt^4 + Cg^2 \cdot kx^2 \cdot ky^2\right)^{\frac{1}{2}}$$

$$(kx, ky) \rightarrow Ag\, Kt^2 + \sqrt{Bg^2\, Kt^4 + Cg^2\, kx^2\, ky^2} \tag{32}$$

$$eg3(kx, ky) := -dg + Ag \cdot Kt^2$$

$$(kx, ky) \rightarrow Ag\, Kt^2 - dg \tag{33}$$

$A3 := plot3d(eg(kx, ky), kx = -0.5..0.5, ky = -0.5..0.5, color = blue)$

$$PLOT3D(\ldots) \tag{34}$$

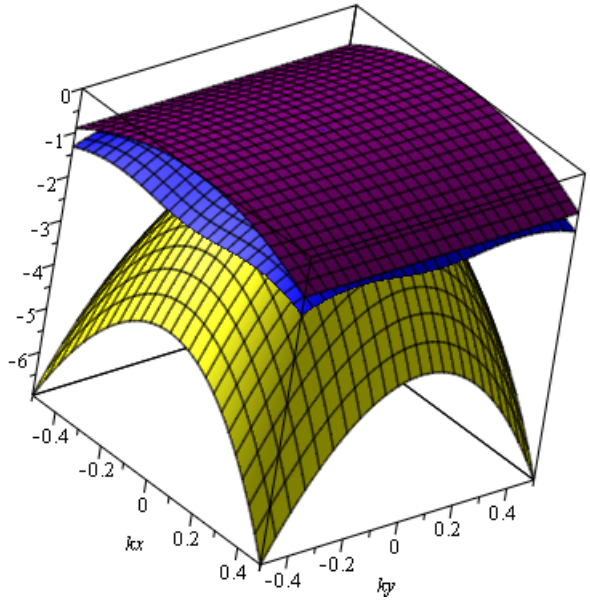
$B3 := plot3d(eg1(kx, ky), kx = -0.5..0.5, ky = -0.5..0.5, color = purple)$

$$PLOT3D(\ldots) \tag{35}$$

$C3 := plot3d(eg3(kx, ky), kx = -0.5 .. 0.5, ky = -0.5 .. 0.5, color = yellow)$

$PLOT3D(\ldots)$ **(36)**

$display(A3, B3, C3)$



c)To calculate effective mass we use equation (29) But plug in constatns withouth putting the m value in it, so our answer is in terms of m.

$$Ah := -\frac{4.29 \cdot h^2}{2 \cdot m}$$

$$-\frac{9.293061771\ 10^{-31}}{m} \quad \textbf{(37)}$$

$$Bh := \frac{0.68 \cdot h^2}{2 \cdot m}$$

$$\frac{1.473026108\ 10^{-31}}{m} \quad \textbf{(38)}$$

$$Ch := \frac{4.87 \cdot h^2}{2 \cdot m}$$

$$\frac{1.054946639\ 10^{-30}}{m} \tag{39}$$

$$Ahg := -\frac{13.38 \cdot h^2}{2 \cdot m}$$

$$-\frac{2.898395489\ 10^{-30}}{m} \tag{40}$$

$$Bhg := \frac{8.48 \cdot h^2}{2 \cdot m}$$

$$\frac{1.836950206\ 10^{-30}}{m} \tag{41}$$

$$Chg := \frac{13.15 \cdot h^2}{2 \cdot m}$$

$$\frac{2.848572547\ 10^{-30}}{m} \tag{42}$$

$$mh := \left(\frac{\frac{\mathrm{d}}{\mathrm{d}K} \left(\frac{\mathrm{d}}{\mathrm{d}K} \left(Ah \cdot K^2 + Bh \cdot K^2 \right) \right)}{h^2} \right)^{-1}$$

$$-0.2770083102\ m \tag{43}$$

$$mh2 := \left(\frac{\frac{\mathrm{d}}{\mathrm{d}K} \left(\frac{\mathrm{d}}{\mathrm{d}K} \left(Ah \cdot K^2 - Bh \cdot K^2 \right) \right)}{h^2} \right)^{-1}$$

$$-0.2012072434\ m \tag{44}$$

$$mhg := \left(\frac{\frac{\mathrm{d}}{\mathrm{d}K} \left(\frac{\mathrm{d}}{\mathrm{d}K} \left(Ahg \cdot K^2 + Bhg \cdot K^2 \right) \right)}{h^2} \right)^{-1}$$

$$-0.2040816328\ m \tag{45}$$

$$mhg2 := \left(\frac{\frac{\mathrm{d}}{\mathrm{d}K} \left(\frac{\mathrm{d}}{\mathrm{d}K} \left(Ahg \cdot K^2 - Bhg \cdot K^2 \right) \right)}{h^2} \right)^{-1}$$

$$-0.04574565415\ m \tag{46}$$

d) kx=ky=kz, so K=sqrt3*kx; also if I put Ah and etc with m variabl ein it - maple gives me prety messy answer so the answers for these are the nuber *m.

$$mh3 := evalf\left(\left(\frac{\frac{\mathrm{d}}{\mathrm{d}K} \left(\frac{\mathrm{d}}{\mathrm{d}K} \left(Ah \cdot \sqrt{3} \cdot K^2 + \sqrt{3} \cdot K^2 \cdot \left(Bh^2 + Ch^2 \right)^{\frac{1}{2}} \right) \right)}{h^2} \right)^{-1} \right)$$

$$0.9204539253 \tag{47}$$

$$mh4 := evalf\left(\left(\frac{\frac{d}{dK}\left(\frac{d}{dK}\left(Ah\cdot\sqrt{3}\cdot K^2-\sqrt{3}\cdot K^2\cdot\left(Bh^2+Ch^2\right)^{\frac{1}{2}}\right)\right)}{h^2}\right)^{-1}\right)$$

$$-0.06270608192 \quad \textbf{(48)}$$

$$mhg3 := evalf\left(\left(\frac{\frac{d}{dK}\left(\frac{d}{dK}\left(Ahg\cdot\sqrt{3}\cdot K^2+\sqrt{3}\cdot K^2\cdot\left(Bh^2+Ch^2\right)^{\frac{1}{2}}\right)\right)}{h^2}\right)^{-1}\right)$$

$$-0.06822249732 \quad \textbf{(49)}$$

$$mhg4 := evalf\left(\left(\frac{\frac{d}{dK}\left(\frac{d}{dK}\left(Ahg\cdot\sqrt{3}\cdot K^2-\sqrt{3}\cdot K^2\cdot\left(Bh^2+Ch^2\right)^{\frac{1}{2}}\right)\right)}{h^2}\right)^{-1}\right)$$

$$-0.03155394511 \quad \textbf{(50)}$$