> restart; #Ond Scalat where hbar noted as h because is more covenable;

> $eq6 := \frac{2\,m}{h^2}\cdot\left(E+\frac{e^2}{\rho}+\frac{L^2}{2\cdot m\cdot\rho^2}-\frac{h^2}{2\cdot m}k\right)\cdot\frac{\rho^2}{R}\cdot f(\rho)+diff(\rho\cdot f(\rho),\rho,\rho)$;#Onduscular;

$$eq6 := \frac{2\,m\left(E+\frac{e^2}{\rho}+\frac{L^2}{2\,m\,\rho^2}-\frac{h^2\,k}{2\,m}\right)\rho^2 f(\rho)}{h^2\,R}+2\,\frac{d}{d\rho}f(\rho)+\rho\left(\frac{d^2}{d\rho^2}f(\rho)\right) \quad (1)$$

> $change\_of\_vars := \{\,\mathrm{rho}=rb\cdot r, f(\mathrm{rho})=g(r)\,\}$;

$$change\_of\_vars := \{\rho=rb\,r, f(\rho)=g(r)\} \quad (2)$$

> PDEtools:-dchange(change_of_vars, eq6, [g(r), r]);

$$\frac{2\,m\left(E+\frac{e^2}{rb\,r}+\frac{L^2}{2\,m\,rb^2\,r^2}-\frac{h^2\,k}{2\,m}\right)rb^2\,r^2\,g(r)}{h^2\,R}+\frac{2\left(\frac{d}{dr}g(r)\right)}{rb}+\frac{r\left(\frac{d^2}{dr^2}g(r)\right)}{rb} \quad (3)$$

> $eq1 := \frac{2\,m\left(E+\frac{e^2}{rb\,r}+\frac{L^2}{2\,m\,rb^2\,r^2}-\frac{h^2\,k}{2\,m}\right)rb^2\,r^2\,g(r)}{h^2\,R}+\frac{2\left(\frac{d}{dr}g(r)\right)}{rb}+\frac{r\left(\frac{d^2}{dr^2}g(r)\right)}{rb}$;

$$eq1 := \frac{2\,m\left(E+\frac{e^2}{rb\,r}+\frac{L^2}{2\,m\,rb^2\,r^2}-\frac{h^2\,k}{2\,m}\right)rb^2\,r^2\,g(r)}{h^2\,R}+\frac{2\left(\frac{d}{dr}g(r)\right)}{rb}+\frac{r\left(\frac{d^2}{dr^2}g(r)\right)}{rb} \quad (4)$$

>

> $subs\left(E=\frac{m\cdot e^4}{32\cdot\mathrm{Pi}^2\cdot\epsilon^2\cdot h^2}\cdot E0, rb=\frac{4\cdot\mathrm{Pi}\cdot\epsilon\cdot h^2}{m\cdot e^2}, eq1\right)$;

$$\frac{32\,h^2\left(\frac{m\,e^4\,E0}{32\,\pi^2\,\epsilon^2\,h^2}+\frac{e^4\,m}{4\,\pi\,\epsilon\,h^2\,r}+\frac{L^2\,m\,e^4}{32\,\pi^2\,\epsilon^2\,h^4\,r^2}-\frac{h^2\,k}{2\,m}\right)\pi^2\,\epsilon^2\,r^2\,g(r)}{m\,e^4\,R}+\frac{\left(\frac{d}{dr}g(r)\right)m\,e^2}{2\,\pi\,\epsilon\,h^2}+\frac{m\,e^2\,r\left(\frac{d^2}{dr^2}g(r)\right)}{4\,\pi\,\epsilon\,h^2} \quad (5)$$

>

> $eq2 := \left(E0+\frac{8\cdot\mathrm{Pi}\cdot\epsilon}{r}+\frac{L^2}{h^2\cdot r^2}-16\cdot\frac{h^4\cdot k\cdot\pi^2\cdot\epsilon^2}{m^2\cdot e^4}\right)\cdot\frac{r^2}{R}\cdot g(r)+diff(r\cdot g(r),r,r)$;

$$eq2 := \frac{\left(E0+\frac{8\,\pi\,\epsilon}{r}+\frac{L^2}{h^2\,r^2}-\frac{16\,h^4\,k\,\pi^2\,\epsilon^2}{m^2\,e^4}\right)r^2\,g(r)}{R}+2\,\frac{d}{dr}g(r)+r\left(\frac{d^2}{dr^2}g(r)\right) \quad (6)$$

> $eq2 := \left(E0+\frac{8\,\pi\,\epsilon}{r}+\frac{L^2}{h^2\cdot r^2}-\frac{16\,h^4\,k\,\pi^2\,\epsilon^2}{m^2\,e^4}\right)\cdot\frac{r^2}{R}\cdot g(r)+2\,\frac{d}{dr}g(r)+r\left(\frac{d^2}{dr^2}g(r)\right)$;

$$eq2 := \frac{\left(E0+\frac{8\,\pi\,\epsilon}{r}+\frac{L^2}{h^2\,r^2}-\frac{16\,h^4\,k\,\pi^2\,\epsilon^2}{m^2\,e^4}\right)r^2\,g(r)}{R}+2\,\frac{d}{dr}g(r)+r\left(\frac{d^2}{dr^2}g(r)\right) \quad (7)$$

> $TFreeOrd := \left(\frac{E0}{R}+\frac{8\,\pi\,\epsilon}{r\cdot R}+\frac{L^2}{h^2\,r^2\cdot R}-\frac{16\,h^4\,k\,\pi^2\,\epsilon^2}{m^2\,e^4\cdot R}\right)\cdot r^2\cdot g(r)$;

(8)

$$TFreeOrd := \left(\frac{E0}{R} + \frac{8\,\pi\,\epsilon}{r\,R} + \frac{L^2}{h^2\,r^2\,R} - \frac{16\,h^4\,k\,\pi^2\,\epsilon^2}{m^2\,e^4\,R}\right) r^2\,g(r) \qquad \textbf{(8)}$$

> $sort\left(\left(\frac{E0}{R}r^2 + \frac{8\,\pi\,\epsilon}{R}r + \frac{L^2}{h^2\cdot R} - \frac{16\,h^4\,k\,\pi^2\,\epsilon^2}{m^2\,e^4\,R}r^2\right), r\right);$

$$\frac{E0\,r^2}{R} - \frac{16\,h^4\,k\,\pi^2\,\epsilon^2\,r^2}{m^2\,e^4\,R} + \frac{8\,\pi\,\epsilon\,r}{R} + \frac{L^2}{h^2\,R} \qquad \textbf{(9)}$$

> $eq2 := \left(\frac{E0\,r^2}{R} - \frac{16\,h^4\,k\,\pi^2\,\epsilon^2\,r^2}{m^2\,e^4\,R} + \frac{8\,\pi\,\epsilon\,r}{R} + \frac{L^2}{h^2\,R}\right)\cdot g(r) + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right);$

#Onduscular equation.

$$eq2 := \left(\frac{E0\,r^2}{R} - \frac{16\,h^4\,k\,\pi^2\,\epsilon^2\,r^2}{m^2\,e^4\,R} + \frac{8\,\pi\,\epsilon\,r}{R} + \frac{L^2}{h^2\,R}\right) g(r) + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right) \qquad \textbf{(10)}$$

> *restart;*

#ScrodingeScal where hbar noted as h because is more covenable;we start from eqation 19.8 Feyman

> $eq1 := \frac{2\,m}{h^2}\cdot\left(E + \frac{e^2}{\rho}\right)\cdot\rho\cdot f(\rho) + diff(\rho\cdot f(\rho), \rho, \rho);$*#Schrodinger;*

$$eq1 := \frac{2\,m\left(E + \frac{e^2}{\rho}\right)\rho\,f(\rho)}{h^2} + 2\,\frac{d}{d\rho}\,f(\rho) + \rho\left(\frac{d^2}{d\rho^2}\,f(\rho)\right) \qquad \textbf{(11)}$$

> $change\_of\_vars := \{\,\mathrm{rho} = rb\cdot r, f(\mathrm{rho}) = g(r)\,\};$

$$change\_of\_vars := \{\rho = rb\,r, f(\rho) = g(r)\} \qquad \textbf{(12)}$$

> *PDEtools:-dchange(change_of_vars, eq1, [g(r), r]);*

$$\frac{2\,m\left(E + \frac{e^2}{rb\,r}\right)rb\,r\,g(r)}{h^2} + \frac{2\left(\frac{d}{dr}\,g(r)\right)}{rb} + \frac{r\left(\frac{d^2}{dr^2}\,g(r)\right)}{rb} \qquad \textbf{(13)}$$

> $eq2 := \frac{2\,m\left(E + \frac{e^2}{rb\,r}\right)rb^2\,r\,g(r)}{h^2} + \frac{d^2}{dr^2}(\,r\cdot g(r)\,);$*#we multiply rb ;*

$$eq2 := \frac{2\,m\left(E + \frac{e^2}{rb\,r}\right)rb^2\,r\,g(r)}{h^2} + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right) \qquad \textbf{(14)}$$

> $subs\left(E = \frac{m\cdot e^4}{32\cdot \mathrm{Pi}^2\cdot\epsilon^2\cdot h^2}\cdot E0, rb = \frac{4\cdot\mathrm{Pi}\cdot\epsilon\cdot h^2}{m\cdot e^2}, eq2\right);$

#with wacuum permittivity ϵ and E0=energy in Rythberg unit

$$\frac{32\left(\frac{m\,e^4\,E0}{32\,\pi^2\,\epsilon^2\,h^2} + \frac{e^4\,m}{4\,\pi\,\epsilon\,h^2\,r}\right)\pi^2\,\epsilon^2\,h^2\,r\,g(r)}{m\,e^4} + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right) \qquad \textbf{(15)}$$

> $eq2 := 32\cdot\left(\frac{E0}{32\cdot h^2} + \frac{\mathrm{Pi}\cdot\epsilon}{4\cdot h^2\cdot r}\right)\cdot h^2\cdot r\cdot g(r) + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right);$

$$eq2 := 32\left(\frac{E0}{32\,h^2} + \frac{\pi\,\epsilon}{4\,h^2\,r}\right)h^2\,r\,g(r) + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right) \qquad \textbf{(16)}$$

> $eq2 := 32\left(\frac{E0}{32} + \frac{\pi\,\epsilon}{4\cdot r}\right)\cdot r\cdot g(r) + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right);$

$$eq2 := 32\left(\frac{E0}{32}+\frac{\pi\epsilon}{4r}\right) r\, g(r) + 2\frac{d}{dr} g(r) + r\left(\frac{d^2}{dr^2} g(r)\right) \quad \textbf{(17)}$$

> $eq2 := \left(E0 + \frac{8\cdot\pi\cdot\epsilon}{r}\right)\cdot r\cdot g(r) + \frac{d^2}{dr^2}(r\cdot g(r));$

$$eq2 := \left(E0+\frac{8\pi\epsilon}{r}\right) r\, g(r) + 2\frac{d}{dr} g(r) + r\left(\frac{d^2}{dr^2} g(r)\right) \quad \textbf{(18)}$$

> restart;# we have the Schrodinger Scaled equation with wacuum permittivity ϵ

> $eq3 := \left(E0 + \frac{8\cdot\pi\cdot\epsilon}{\rho}\right)\cdot \rho\cdot f(\rho) + \frac{d^2}{d\rho^2}(\rho\cdot f(\rho));$ #eqation (1) with wacuum permittivity ϵ

$$eq3 := \left(E0+\frac{8\pi\epsilon}{\rho}\right) \rho\, f(\rho) + 2\frac{d}{d\rho} f(\rho) + \rho\left(\frac{d^2}{d\rho^2} f(\rho)\right) \quad \textbf{(19)}$$

> restart;#now we have the Schrodinger Scaled eq1 with wacuum permittivity ϵ;

> $eq1 := \left(E0 + \frac{8\cdot\pi\cdot\epsilon}{\rho}\right)\cdot \rho\cdot f(\rho) + \frac{d^2}{d\rho^2}(\rho\cdot f(\rho));$

$$eq1 := \left(E0+\frac{8\pi\epsilon}{\rho}\right) \rho\, f(\rho) + 2\frac{d}{d\rho} f(\rho) + \rho\left(\frac{d^2}{d\rho^2} f(\rho)\right) \quad \textbf{(20)}$$

> $change\_of\_vars := \left\{\text{rho} = rb\cdot r, f(\text{rho}) = g(r)\cdot\frac{2\cdot R - r\cdot rb}{2\cdot R}\right\};$

$$change\_of\_vars := \left\{\rho = rb\, r, f(\rho) = \frac{g(r)\,(-rb\, r + 2R)}{2R}\right\} \quad \textbf{(21)}$$

> PDEtools:-dchange(change_of_vars, eq1, [g(r), r]);

$$\frac{\left(E0+\frac{8\pi\epsilon}{rb\, r}\right) rb\, r\, g(r)\,(-rb\, r+2R)}{2R} + \frac{2\left(\frac{\left(\frac{d}{dr} g(r)\right)(-rb\, r+2R)}{2R} - \frac{g(r)\, rb}{2R}\right)}{rb} + \frac{r\left(\frac{\left(\frac{d^2}{dr^2} g(r)\right)(-rb\, r+2R)}{2R} - \frac{\left(\frac{d}{dr} g(r)\right) rb}{R}\right)}{rb} \quad \textbf{(22)}$$

> $eq2 := simplify\left(\frac{\left(E0+\frac{8\pi\epsilon}{rb\, r}\right) rb\, r\, g(r)\,(-rb\, r+2R)}{2R} + \frac{2\left(\frac{\left(\frac{d}{dr} g(r)\right)(-rb\, r+2R)}{2R} - \frac{g(r)\, rb}{2R}\right)}{rb} + \frac{r\left(\frac{\left(\frac{d^2}{dr^2} g(r)\right)(-rb\, r+2R)}{2R} - \frac{\left(\frac{d}{dr} g(r)\right) rb}{R}\right)}{rb}\right);$

$$eq2 := \frac{1}{2\, rb\, R}\left((-r^2\, rb + 2Rr)\left(\frac{d^2}{dr^2} g(r)\right) + (-4\, rb\, r + 4R)\left(\frac{d}{dr} g(r)\right) + 2\left(-\frac{r^2\, E0\, rb^2}{2} + r\,(E0\, R - 4\pi\epsilon)\, rb + 8R\pi\epsilon - 1\right) rb\, g(r)\right) \quad \textbf{(23)}$$

> $eq2 := \frac{(-r^2\, rb + 2\, R\, r) \cdot r}{2\, rb\, R} \cdot \left(\frac{d^2}{dr^2}\, g(r)\right) + \frac{(-4\, rb\, r + 4\, R)}{2\, rb\, R} \cdot \left(\frac{d}{dr}\, g(r)\right) + \frac{2}{R} g(r) \left(-\frac{r^2\, E0\, rb^2}{2} + r\,(E0\, R - 4\,\pi\,\epsilon)\, rb + 8\, R\,\pi\,\epsilon - 1\right);$

$$eq2 := \frac{(-r^2\, rb + 2\, R\, r)\, r \left(\frac{d^2}{dr^2}\, g(r)\right)}{2\, rb\, R} + \frac{(-4\, rb\, r + 4\, R)\left(\frac{d}{dr}\, g(r)\right)}{2\, rb\, R} + \frac{2\, g(r)\left(-\frac{r^2\, E0\, rb^2}{2} + r\,(E0\, R - 4\,\pi\,\epsilon)\, rb + 8\, R\,\pi\,\epsilon - 1\right)}{R} \tag{24}$$

> $eq2 := \frac{(-r\, rb + 2\, R) \cdot r}{2\, rb\, R} \cdot \left(\frac{d^2}{dr^2}\, g(r)\right) + \frac{(-4\, rb\, r + 4\, R)}{2\, rb\, R} \cdot \left(\frac{d}{dr}\, g(r)\right) + \frac{2}{R} g(r) \cdot \left(-\frac{r^2\, E0\, rb^2}{2} + r\,(E0\, R - 4\,\pi\,\epsilon)\, rb + 8\, R\,\pi\,\epsilon - 1\right);$

$$eq2 := \frac{(-rb\, r + 2\, R)\, r \left(\frac{d^2}{dr^2}\, g(r)\right)}{2\, rb\, R} + \frac{(-4\, rb\, r + 4\, R)\left(\frac{d}{dr}\, g(r)\right)}{2\, rb\, R} + \frac{2\, g(r)\left(-\frac{r^2\, E0\, rb^2}{2} + r\,(E0\, R - 4\,\pi\,\epsilon)\, rb + 8\, R\,\pi\,\epsilon - 1\right)}{R} \tag{25}$$

> $eq2 := \frac{r}{2\, rb\, R} \cdot \left(\frac{d^2}{dr^2}\, g(r)\right) + \frac{(-4\, rb\, r + 4\, R)}{2\, rb\, R \cdot (-r\, rb + 2\, R)} \cdot \left(\frac{d}{dr}\, g(r)\right) + \frac{2 \cdot g(r)}{R \cdot (-r\, rb + 2\, R)} \cdot \left(-\frac{r^2\, E0\, rb^2}{2} + r\,(E0\, R - 4\,\pi\,\epsilon)\, rb + 8\, R\,\pi\,\epsilon - 1\right);\#\frac{(-4\, rb\, r + 4\, R)}{(-r\, rb + 2\, R)} \sim 2;$

$$eq2 := \frac{r\left(\frac{d^2}{dr^2}\, g(r)\right)}{2\, rb\, R} + \frac{(-4\, rb\, r + 4\, R)\left(\frac{d}{dr}\, g(r)\right)}{2\, rb\, R\,(-rb\, r + 2\, R)} + \frac{2\, g(r)\left(-\frac{r^2\, E0\, rb^2}{2} + r\,(E0\, R - 4\,\pi\,\epsilon)\, rb + 8\, R\,\pi\,\epsilon - 1\right)}{R\,(-rb\, r + 2\, R)} \tag{26}$$

> $eq2 := r\left(\frac{d^2}{dr^2}\, g(r)\right) + 2\, \frac{d}{dr}\, g(r) + \frac{2\, rb\left(-\frac{r^2\, E0\, rb^2}{2} + r\,(E0\, R - 4\,\pi\,\epsilon)\, rb + 8\, R\,\pi\,\epsilon - 1\right)}{-rb\, r + 2\, R} g(r);$

$$eq2 := r\left(\frac{d^2}{dr^2}\, g(r)\right) + 2\, \frac{d}{dr}\, g(r) + \frac{2\, rb\left(-\frac{r^2\, E0\, rb^2}{2} + r\,(E0\, R - 4\,\pi\,\epsilon)\, rb + 8\, R\,\pi\,\epsilon - 1\right) g(r)}{-rb\, r + 2\, R} \tag{27}$$

> $TFreeOrd := simplify\left(\frac{2\, rb\left(-\frac{r^2\, E0\, rb^2}{2} + r\,(E0\, R - 4\,\pi\,\epsilon)\, rb + 8\, R\,\pi\,\epsilon - 1\right)}{-rb\, r + 2\, R}\right);$

$$TFreeOrd := \frac{rb\,(-r^2\, E0\, rb^2 + 2\, E0\, R\, r\, rb - 8\,\pi\,\epsilon\, r\, rb + 16\, R\,\pi\,\epsilon - 2)}{-rb\, r + 2\, R} \tag{28}$$

> $series\left(\frac{rb\left(-r^2\,E0\,rb^2+2\,E0\,R\,r\,rb-8\,\pi\,\epsilon\,r\,rb+16\,R\,\pi\,\epsilon-2\right)}{-rb\,r+2\,R},r\right);$

$$\frac{rb\left(16\,R\,\pi\,\epsilon-2\right)}{2\,R}+\frac{1}{2}\,\frac{rb\left(2\,E0\,R\,rb-8\,\pi\,\epsilon\,rb\right)+\frac{rb^2\left(8\,R\,\pi\,\epsilon-1\right)}{R}}{R}\,r+\frac{1}{2}\,\frac{-rb^3\,E0+\frac{rb^3\left(2\,E0\,R^2-1\right)}{2\,R^2}}{R}\,r^2-\frac{1}{8}\,\frac{rb^4}{R^4}\,r^3-\frac{1}{16}\,\frac{rb^5}{R^5}\,r^4-\frac{1}{32}\,\frac{rb^6}{R^6}\,r^5+\mathrm{O}\left(r^6\right) \quad \textbf{(29)}$$

> $eq3:=r\left(\frac{d^2}{dr^2}\,g(r)\right)+2\,\frac{d}{dr}\,g(r)+\left(\frac{rb\left(16\,R\,\pi\,\epsilon-2\right)}{2\,R}+\frac{1}{2}\,\frac{rb\left(2\,E0\,R\,rb-8\,\pi\,\epsilon\,rb\right)+\frac{rb^2\left(8\,R\,\pi\,\epsilon-1\right)}{R}}{R}\,r+\frac{1}{2}\,\frac{-rb^3\,E0+\frac{rb^3\left(2\,E0\,R^2-1\right)}{2\,R^2}}{R}\,r^2\right)\cdot g(r);$ #Aproximative

$$eq3:=r\left(\frac{d^2}{dr^2}\,g(r)\right)+2\,\frac{d}{dr}\,g(r)+\left(\frac{rb\left(16\,R\,\pi\,\epsilon-2\right)}{2\,R}+\frac{\left(rb\left(2\,E0\,R\,rb-8\,\pi\,\epsilon\,rb\right)+\frac{rb^2\left(8\,R\,\pi\,\epsilon-1\right)}{R}\right)r}{2\,R}+\frac{\left(-rb^3\,E0+\frac{rb^3\left(2\,E0\,R^2-1\right)}{2\,R^2}\right)r^2}{2\,R}\right)g(r) \quad \textbf{(30)}$$

> $\frac{rb\left(16\,R\,\pi\,\epsilon-2\right)}{2\,R}+\frac{1}{2}\,\frac{rb\left(2\,E0\,R\,rb-8\,\pi\,\epsilon\,rb\right)+\frac{rb^2\left(8\,R\,\pi\,\epsilon-1\right)}{R}}{R}\,r+\frac{1}{2}\,\frac{-rb^3\,E0+\frac{rb^3\left(2\,E0\,R^2-1\right)}{2\,R^2}}{R}\,r^2=\frac{E0\,r^2}{R}-\frac{16\,h^4\,k\,\pi^2\,\epsilon^2\,r^2}{m^2\,e^4\,R}+\frac{8\,\pi\,\epsilon\,r}{R}+\frac{L^2}{h^2\,R};$
#Aproximation;

$$\frac{rb\left(16\,R\,\pi\,\epsilon-2\right)}{2\,R}+\frac{\left(rb\left(2\,E0\,R\,rb-8\,\pi\,\epsilon\,rb\right)+\frac{rb^2\left(8\,R\,\pi\,\epsilon-1\right)}{R}\right)r}{2\,R}+\frac{\left(-rb^3\,E0+\frac{rb^3\left(2\,E0\,R^2-1\right)}{2\,R^2}\right)r^2}{2\,R}=\frac{E0\,r^2}{R}-\frac{16\,h^4\,k\,\pi^2\,\epsilon^2\,r^2}{m^2\,e^4\,R}+\frac{8\,\pi\,\epsilon\,r}{R}+\frac{L^2}{h^2\,R} \quad \textbf{(31)}$$

> $solve\left(\left\{\frac{1}{2}\,\frac{-rb^3\,E0+\frac{rb^3\left(2\,E0\,R^2-1\right)}{2\,R^2}}{R}=\frac{E0}{R}-\frac{16\,h^4\,k\,\pi^2\,\epsilon^2}{m^2\,e^4\,R},\right.\right.$

$$\left\{\frac{\left(rb\,(2\,E0\,R\,rb - 8\,\pi\,\epsilon\,rb) + \frac{rb^2\,(8\,R\,\pi\,\epsilon - 1)}{R}\right)}{2\,R} = \frac{8\,\pi\,\epsilon}{R}, \frac{rb\,(16\,R\,\pi\,\epsilon - 2)}{2\,R} = \frac{L^2}{h^2\,R}\right\},$$

$$\{R, k, E0\}\Bigg);$$

$$\left\{E0 = \frac{32\,\pi^2\,\epsilon^2\,h^2\,(h^2\,rb^3 + 2\,rb\,h^2 + 2\,L^2)}{rb\,(h^4\,rb^2 + 2\,L^2\,h^2\,rb + L^4)}, R = \frac{rb\,h^2 + L^2}{8\,\pi\,\epsilon\,h^2\,rb}, k = \frac{m^2\,e^4\,(h^2\,rb^6 + 2\,h^2\,rb^3 + 4\,rb\,h^2 + 4\,L^2)}{rb\,h^2\,(h^4\,rb^2 + 2\,L^2\,h^2\,rb + L^4)}\right\} \quad \textbf{(32)}$$

> $R := \frac{rb\,h^2 + L^2}{8\,\pi\,\epsilon\,h^2\,rb};$

$$R := \frac{rb\,h^2 + L^2}{8\,\pi\,\epsilon\,h^2\,rb} \quad \textbf{(33)}$$

> $subs\left(rb = \frac{4\cdot\mathrm{Pi}\cdot\epsilon\cdot h^2}{m\cdot e^2}, \frac{rb\,h^2 + L^2}{8\,\pi\,\epsilon\,h^2\,rb}\right);$

$$\frac{\left(\frac{4\,\pi\,\epsilon\,h^4}{m\,e^2} + L^2\right)m\,e^2}{32\,\pi^2\,\epsilon^2\,h^4} \quad \textbf{(34)}$$

> $simplify\left(\frac{\left(\frac{4\,\pi\,\epsilon\,h^4}{m\,e^2} + L^2\right)m\,e^2}{32\,\pi^2\,\epsilon^2\,h^4}\right);$

$$\frac{4\,\pi\,\epsilon\,h^4 + L^2\,m\,e^2}{32\,\pi^2\,\epsilon^2\,h^4} \quad \textbf{(35)}$$

> *restart*;

> $m := 9.109\cdot 10^{-31}$; $\epsilon := 8.8541878128 \times 10^{-12}$; hbar $:= \frac{6.6256}{2\cdot\mathrm{Pi}}\cdot 10^{-34}$; $e := 1.602\cdot 10^{-19}$; $c :=$ 299792458; $h := 6.6256\cdot 10^{-34}$; $rb := 5.292410932\ 10^{-11}$; $a := 20\cdot 21\cdot \mathrm{hbar}^2$; $l := 20$; $Tq :=$ $1.76536\cdot 10^{-19}$; $\mu := 5.78\cdot 10^{-5}$;*#magnetron Bohr#E0:=1;#m=[kg]*; $\epsilon = \left[\frac{C}{N\cdot m^2}\right]$; $h = [J\cdot s]$ **or**$[eV\cdot s]$; $e = [C]$;

$$m := 9.109000000\ 10^{-31}$$
$$\epsilon := 8.854187813\ 10^{-12}$$
$$\hbar := 1.054496991\ 10^{-34}$$
$$e := 1.602000000\ 10^{-19}$$
$$c := 299792458$$
$$h := 6.625600000\ 10^{-34}$$
$$rb := 5.292410932\ 10^{-11}$$
$$a := 4.670248397\ 10^{-66}$$
$$l := 20$$
$$Tq := 1.765360000\ 10^{-19}$$
$$\mu := 0.00005780000000 \quad \textbf{(36)}$$

> $evalf\left(\frac{4\,\pi\,\epsilon\,\text{hbar}^4 + a\cdot m\,e^2}{32\,\pi^2\,\epsilon^2\,\text{hbar}^4}\right);$

$$3.566211881\ 10^{22} \tag{37}$$

> $evalf\left(\frac{4\,\pi\,\epsilon\,\text{hbar}^4 + l\cdot(l+1)\cdot\text{hbar}^2\cdot m\cdot e^2}{32\,\pi^2\,\epsilon^2\,\text{hbar}^4}\right);$

$$3.566211881\ 10^{22} \tag{38}$$

> $restart;$

> $eqOnd := \left(\frac{E0\,r^2}{R} - \frac{16\,h^4\,k\,\pi^2\,\epsilon^2\,r^2}{m^2\,e^4\,R} + \frac{8\,\pi\,\epsilon\,r}{R} + \frac{l\cdot(l+1)}{R}\right)\cdot g(r) + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right)$;#Onduscular equation.

$$eq2 := \left(7.\ 10^{-44}\,r^2 + 6.014324624\ 10^{-33}\,r + 1.135135135\ 10^{-20}\right)g(r) + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right) \tag{39}$$

>

> $eqSchro := \frac{rb\left(-r^2\,E0\,rb^2 + 2\,E0\cdot R\cdot r\cdot rb - 8\cdot 3.14159\cdot\epsilon\cdot rb\cdot r + 16\,R\cdot\text{Pi}\cdot\epsilon - 2\right)}{-rb\,r + 2\,R}\cdot g(r) + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right)$;#Schrodinger scaled aproximation;

$$eq3 := \frac{5.292410932\ 10^{-11}\left(-6.014324624\ 10^{-33}\,r^2 + 8.409400328\,r + 1.646722082\ 10^{13}\right)g(r)}{-5.292410932\ 10^{-11}\,r + 7.400000000\ 10^{22}} + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right) \tag{40}$$

> $series\left(\frac{5.292410932\ 10^{-11}\left(-6.014324624\ 10^{-33}\,r^2 + 8.409400328\,r + 1.646722082\ 10^{13}\right)}{-5.292410932\ 10^{-11}\,r + 7.400000000\ 10^{22}}, r\right);$

$$1.177720263\ 10^{-20} + 6.014324627\ 10^{-33}\,r + 2.145571999\ 10^{-75}\,r^2 + 1.534493068\ 10^{-108}\,r^3 + 1.097455120\ 10^{-141}\,r^4 + 7.848896585\ 10^{-175}\,r^5 + O(r^6) \tag{41}$$

> $eqSchro := \left(2.145571999\ 10^{-75}\,r^2 + 6.014324627\ 10^{-33}\,r + 1.177720263\ 10^{-20}\right)\cdot g(r) + 2\,\frac{d}{dr}\,g(r) + r\left(\frac{d^2}{dr^2}\,g(r)\right)$;#Schrodinger scaled aproximation;

> $Ser := 2.145571999\ 10^{-75}\,r^2 + 1.534493068\ 10^{-108}\,r^3 + 1.097455120\ 10^{-141}\,r^4 + 7.848896585\ 10^{-175}\,r^5;$

$$Ser := 2.145571999\ 10^{-75}\,r^2 + 1.534493068\ 10^{-108}\,r^3 + 1.097455120\ 10^{-141}\,r^4 + 7.848896585\ 10^{-175}\,r^5 \tag{42}$$

> $subs(r = rb, Ser);$

$$6.009664236\ 10^{-96} \tag{43}$$

> $Ser1 := evalf(7.\ 10^{-44}\cdot rb^2);$

$$Ser1 := 1.960672943\ 10^{-64} \tag{44}$$

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