This worksheet has a system of ode's (a second order and a first order), a power series solution near 0 to use for inital conditions, and a function W of the vairables that I want to compute for certain values of x < π/2. W is a ratio of 2 positive values and that ratio seems to be negative when evalf is applied to the answer.!!! The true answer (without the evalf) are positive. Also, applying evalf to the correct answers does not produce those silly negative answers.

```
> restart;
> alias(B=b(x));alias(Bp=diff(b(x),x));alias(f=F(x));alias(fp=diff(F(x),x));alias(fpp=diff(F(x),x,x));
```

$$B$$
$$B, Bp$$
$$B, Bp, f$$
$$B, Bp, f, fp$$
$$B, Bp, f, fp, fpp \qquad (1)$$

```
> eq1 := sin(x)*(1+B*cos(x)^2)*fpp-(2*((f^2-2*B)*cos(x)^2-f^2+3*B*(1/2)-1))*cos(x)*fp+2*sin(x)*((f^2-3*B*(1/2))*cos(x)^2-f^2+(1/2)*B-1/2)*f = 0;eq2 := (-B*cos(x)^6+(B-1)*cos(x)^4+cos(x)^2)*fp^2+2*f*cos(x)*sin(x)*(cos(x)-1)*(cos(x)+1)*(1+B*cos(x)^2)*fp+cos(x)*sin(x)*Bp+B*cos(x)^6*f^2-(2*(B-1/2))*f^2*cos(x)^4+B*cos(x)^2*f^2-f^2+B = 0;
```

$$eq1 := \sin(x)\left(1+B\cos(x)^2\right) fpp - 2\left(\left(f^2-2B\right)\cos(x)^2 - f^2 + \frac{3B}{2} - 1\right)\cos(x)\, fp + 2\sin(x)\left(\left(f^2 - \frac{3B}{2}\right)\cos(x)^2 - f^2 + \frac{B}{2} - \frac{1}{2}\right) f = 0$$

$$eq2 := \left(-B\cos(x)^6 + (B-1)\cos(x)^4 + \cos(x)^2\right) fp^2 + 2 f\cos(x)\sin(x)\left(\cos(x)-1\right)\left(\cos(x)+1\right)\left(1+B\cos(x)^2\right) fp + \cos(x)\sin(x)\, Bp + B\cos(x)^6 f^2 - 2\left(B - \frac{1}{2}\right) f^2\cos(x)^4 + B\cos(x)^2 f^2 - f^2 + B = 0 \qquad (2)$$

```
> f2p:=solve(eq1,fpp);
```

$$f2p := -\frac{1}{\sin(x)\left(1+B\cos(x)^2\right)}\left(2\sin(x) f^3\cos(x)^2 - 2\cos(x)^3 fp\, f^2 - 3\sin(x) f B\cos(x)^2 + 4\cos(x)^3 fp\, B - 2\sin(x) f^3 + 2\cos(x) fp\, f^2 + \sin(x) f B - 3\cos(x) fp\, B - \sin(x) f + 2\cos(x) fp\right) \qquad (3)$$

```
> fs:=x^8*(127/604800*C+653/17010*(C^5)+2/81*(C^7)+773/1020600*(C^3))+x^6*(17/5670*(C^3)-4/81*(C^5)+31/15120*C)+x^4*((1/9)*C^3+7/360*C)+(1/6)*x^2*C+C:
> Bs:=x^6*(20/189*(C^4)+4/315*(C^2))+4*x^4*C^2*(1/45)+2*x^2*C^2*(1/3):
> Digits:=15:
> ic:=(c)->{F(1e-5)=subs([x=1e-5,C=c],fs),D(F)(1e-5)=subs([x=1e-5,C=c],diff(fs,x)),b(1e-5)=subs([x=1e-5,C=c],Bs)}:

> nans:=dsolve({eq1,eq2} union ic(c),{f,B},numeric,stiff=true,
```

```
parameters=[c]);
```

$$nans := \mathbf{proc}(x\_rosenbrock)\ \ldots\ \mathbf{end\ proc} \quad (4)$$

```
> W:=fp^2*cos(x)/f^2;
```

$$W := \frac{fp^2 \cos(x)}{f^2} \quad (5)$$

```
> Wp:=simplify(subs(fpp=f2p,diff(W,x)));
```

$$Wp := -\frac{1}{f^3 \sin(x) \left(1 + B \cos(x)^2\right)} \left(4\, fp \left(\frac{\cos(x) \sin(x) \left(1 + B \cos(x)^2\right) fp^2}{2} - f \left(-\frac{1}{4} + \left(f^2 - \frac{7\,B}{4}\right) \cos(x)^4 + \left(-f^2 + \frac{5\,B}{4} - \frac{3}{4}\right) \cos(x)^2\right) fp + \cos(x) \left(\left(f^2 - \frac{3\,B}{2}\right) \cos(x)^2 - f^2 + \frac{B}{2} - \frac{1}{2}\right) f^2 \sin(x)\right)\right) \quad (6)$$

```
> k:='k': for k from 4 to 5 do nans(parameters=[k]); evalf(eval([W,
  Wp], nans(Pi/2-1e-10)),5); end do;
```

$$[c = 4.]$$
$$[-482.73, -1.3965\ 10^8]$$
$$[c = 5.]$$
$$[-5.6838\ 10^6, 1.4948\ 10^{13}] \quad (7)$$

```
> k:='k': for k from 4 to 5 do nans(parameters=[k]); eval([W,Wp],
  nans(Pi/2-1e-10)); end do;
```

$$[c = 4.]$$
$$[0.0131412243081803, -1.31416436948280\ 10^8]$$
$$[c = 5.]$$
$$[154.729383663460, -1.54702786932958\ 10^{12}] \quad (8)$$

```
> evalf([0.0131412243081803, -1.31416436948280*10^8],5);
```

$$[0.013141, -1.3142\ 10^8] \quad (9)$$