

April 25, 2021

```
[107]: import math as m
      ##3.1.1
      #///    ///
      a=2*1e-3
      =1.7*1e-3
      D =30*1e-3
      h=10*1e-3
      B =0.5
      Dm=D -a
      k=0.3
      0=m.pi*4*1e-7
      #///    ///

      ##3.2.1

      Sm=m.pi*Dm**2/4
      S =h*m.pi*D
      Sm_S =Sm/S
      Bm=B *1/Sm_S *(1+k)
      print(' Sm= %.3e\n' %Sm, 'S = %.3e\n' %S , 'Sm/S = %.3e\n' %Sm_S , 'Bm= %.3e\n' %Bm)

      Hm=32*1e3
      Bm_Hm=Bm/Hm
      print(' Bm_Hm= %.3e\n' %Bm_Hm)
      Lm=round((Bm_Hm*( /( 0*(1+k)))*Sm_S )+0.001,3)

      print(' Lm= %.3e\n' %Lm, 'Dm= %.3e\n' %Dm)

      Sm= 6.158e-04
      S = 9.425e-04
      Sm/S = 6.533e-01
      Bm= 9.949e-01

      Bm_Hm= 3.109e-05

      Lm= 2.200e-02
      Dm= 2.800e-02
```

```
[108]: #
if 0:
    Bm=0.95 #
    Hm=32*1e3 #
    Dm=m.sqrt((B*4*D*h*(1+k))/(Bm))
    Dm=round(Dm) #
    Sm=m.pi*Dm**2/4
    Sm_S =Sm/S
    Bm_Hm=Bm/Hm
    Lm=Bm_Hm*(/(0*(1+k)))*Sm_S
    print(' Lm= %.3e\n' %Lm,'Dm= %.3e\n' %Dm,'Sm_S = %.3e\n' %Sm_S )
```

```
[109]: ###3.2.2
Bm_Hm= 0*(1+k)*S /Sm*Lm/
Hm2=20*1e3 # y
Bm2=Bm_Hm*Hm2
#
Bm_izm=0.97
Hm_izm=31*1e3
Φm=Bm*Sm #
Φ =B *S
B =Φ /S
print(' Φm= %.3e\n' %Φm,'Φ = %.3e\n' %Φ , 'B = %.3e\n' %B )
```

```
Φm= 6.126e-04
Φ = 4.712e-04
B = 5.000e-01
```

```
[110]: import math as m
###4.1.1
#/// ///
a=7
b=7
c=30
d=0.2
h=50
S0=2500
Fizm=10
f=a
#/// ///
d0=0.2
d1=0.22
lamb=1.5
eps=3
0=m.pi*4*1e-7
```

```
[111]: f0_list=[0.6,0.55,0.5]
f0=f0_list[0] # ( )
w=m.ceil(4*f0*(c-eps-2*lamb)*(h-lamb-f)/(m.pi*d1**2)) # ,
↪
print('w= ', '%.0f'%w)
```

w= 15721

```
[112]: Omax1=d /0.15 # 1
Omin1=d /0.2
print(' Omin1=', Omin1, '\n Omax1=', '%.3f'% Omax1)

Omin2=a*0.1 # 2
Omax2=a*0.2
print('\n Omin2=', Omin2, '\n Omax2=', Omax2)
```

Omin1= 1.0  
Omax1= 1.333

Omin2= 0.7000000000000001  
Omax2= 1.4000000000000001

```
[119]: # ,
min = 1e10
if Omin1< Omin2:
    O=round( Omin2,2)
else:
    O=round( Omin1,2)
print(' O=', O)
print(' O, ')
O=0.9
print(' O=', O)
```

O= 1.0

O,

O= 0.9

```
[120]: Omax= O+d #
Omin= O-d
print(' Omax=', Omax, '\n Omin=', Omin)
```

Omax= 1.1  
Omin= 0.7

```
[121]: def x_ ( O, Omax= Omax,w=w,k1=1):
    global Ze_max,Ze_min
    global I min,Gb4_max,Gb4_min,I max
    #4.1.3.2.
```

```

#                                     B=0.2
B=0.2 #0,3
#
#
X_=c/2
print('X_=',X_)
#      . 7      X'/max      Zb/max
print(' 0=', 0)
print('X_/ 0=',X_/ 0)

#      (      <35      1.3)
Zb_max=X_/ 0 /1.3
print('Zb_max=',Zb_max)
Zb=Zb_max* 0
print('Zb=',Zb)
Z_a=a
print('Z_a=',Z_a)
Z__b=Z_a
print('Z__b=',Z__b)
x__max= Z__b/ 0*1.3
x__=x__max* 0
print('x__=', '%.3f'%x__)
#
m1=(Z__b+(x__- 0/2))/2
m2=(Zb+(X_- 0))/2
print('m1=%f'%m1, '\nm2=%f'%m2)

G1= 0*((2*b*1e-3)/(m.pi*(( /m2)+0.5)))
print('\n\nG1=', '%.3f e-9'%(G1*1e9))

G2= 0*0.52*b*1e-3
G3= 0*(a*b*1e-3/ 0)
G4= 0*0.26*b*1e-3
print('G2=', '%.3f e-9'%(G2*1e9))
print('G3=', '%.3f e-9'%(G3*1e9))
print('G4=', '%.3f e-9'%(G4*1e9))

G5= 0*((2*b*1e-3)/(m.pi*(( 0/m1)+1)))
print('m1=',m1, '\n\nG5=', '%.3fe-9'%(G5*1e9))
#      2

G6= 0*0.077* 0*1e-3
G7= 0*m1*1e-3/4
G8=2*G6+2*G7
print('G6=', '%.3f e-9'%(G6*1e9))
print('G7=', '%.3f e-9'%(G7*1e9))

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```

print('G8=', '%.3f e-9'%(G8*1e9))

Gb4=G1+G2+G3+3*(G4+G5)+2*(G6+G7+G8)
print('\nGb4=', '%.3f e-9'%(Gb4*1e9))

Rb4=1/Gb4
print('\nRb4=', '%.3f e6'%(Rb4*1e-6))

Gb2=G1+G2+G3+2*(G4+G5+G8)
print('\nGb2=', '%.3f e-9'%(Gb2*1e9))
Rb2=1/Gb2
print('\nRb2=', '%.3f e6'%(Rb2*1e-6))

R_ms=Rb4*2

print('\nR_ms=', '%.3f e6'%(R_ms*1e-6))
#4.1.3.3.
ro=0.0174

#lsr=2*(2*(c-eps-lamb)/k1+3*a+2*eps+4*lamb) # -
lsr=4*(h+lamb)/k1+2*eps # -

q=m.pi*d0**2/4
ow=2*m.pi*50
Ra_r=ro*lsr*1e-3*w/q
Ra_im=ow*w**2/R_ms
Ze=(Ra_r**2+Ra_im**2)**0.5
if 0== 0max:
    Ze_min=(Ra_r**2+Ra_im**2)**0.5
    print('\nZe_min= %.2f e3'%(Ze_min*1e-3))
else:
    Ze_max=(Ra_r**2+Ra_im**2)**0.5
    print('\nZe_max= %.2f e3'%(Ze_max*1e-3))
print('lsr=%.2f'%lsr)

print('\nRa_r=%.2f'%Ra_r)
print('Ra_im=%.2f'%Ra_im)

#4.1.3.4.
I=(B*2*a*b*R_ms*10**(-6))/(w*(2**0.5))
print('I= %f'%I)
j=I/q
print('j<=2..2.5 j= %.2f'%j)
U=I*Ze
print('U= %.2f'%U)
if 0== 0max:

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```

        I_max=I
        Gb4_max=Gb4
    else:
        I_min=I
        Gb4_min=Gb4

```

```

[122]: x_ ( 0= 0max)
        print('\n\n\n\n\n')
        x_ ( 0= 0min)
        print('dZe=%.2e'%(Ze_max-Ze_min))

```

```

X_ = 15.0
0 = 1.1
X_/ 0 = 13.636363636363635
Zb_max = 10.489510489510488
Zb = 11.538461538461538
Z_a = 7
Z__b = 7
x__ = 9.100
m1 = 7.775000
m2 = 12.719231

```

```

G1 = 11.197 e-9
G2 = 4.574 e-9
G3 = 55.977 e-9
G4 = 2.287 e-9
m1 = 7.775

```

```

G5 = 4.906e-9
G6 = 0.106 e-9
G7 = 2.443 e-9
G8 = 5.098 e-9

```

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Gb4 = 108.622 e-9

```

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Rb4 = 9.206 e6

```

```

Gb2 = 96.331 e-9

```

```

Rb2 = 10.381 e6

```

```

R_ms 18.413 e6

```

```

Ze_min = 4.60 e3
lsr = 212.00

```

Ra\_r=1845.93  
Ra\_im=4216.94  
I= 0.016232  
j<=2..2.5 j= 0.52  
U= 74.72

X\_= 15.0  
O= 0.7  
X\_/ O= 21.42857142857143  
Zb\_max= 16.483516483516485  
Zb= 11.538461538461538  
Z\_a= 7  
Z\_\_b= 7  
x\_\_= 9.100  
m1=7.875000  
m2=12.919231

G1= 11.197 e-9  
G2= 4.574 e-9  
G3= 87.965 e-9  
G4= 2.287 e-9  
m1= 7.875

G5= 5.143e-9  
G6= 0.068 e-9  
G7= 2.474 e-9  
G8= 5.083 e-9

Gb4= 141.276 e-9

Rb4= 7.078 e6

Gb2= 128.763 e-9

Rb2= 7.766 e6

R\_ms 14.157 e6

Ze\_max= 5.79 e3  
lsr=212.00

```

Ra_r=1845.93
Ra_im=5484.65
I= 0.012480
j<=2..2.5 j= 0.40
U= 72.22
dZe=1.18e+03

```

```

[123]: dZe=Ze_max-Ze_min
print('dZe=%e'%dZe)
S=dZe/(2*d )
print('S=%e'%S)
print('S0=%e'%S0)
k1=(S/S0)**0.5
print('k1=%f'%k1)
w_new=w/k1
print('w_new=%f'%w_new)

```

```

dZe=1.183691e+03
S=2.959227e+03
S0=2.500000e+03
k1=1.087976
w_new=14449.772695

```

```

[124]: w-w_new

```

```

[124]: 1271.227305175953

```

```

[125]: z=0
while m.fabs(S-S0)>1:
    print(' Omin=', Omin)
    print(' Omax=', Omax)
    z=z+1
    w_new=round(w_new)
    x_ ( 0= Omin,w=w_new)
    x_ ( 0= Omax,w=w_new)
    print('\n\n\n\n\n')
    dZe=Ze_max-Ze_min
    print('dZe=%e'%dZe)
    S=dZe/(2*d )
    print('S=%e'%S)
    k1=(S/S0)**0.5
    print('k1=%f'%k1)
    w_new=w_new/k1
    print('w_new=%f'%w_new)
    print('\n\n\n\n\n')
print('z=%d'%z)
m.fabs(S-S0)
print('w_new=%f'%round(w_new))

```



Omin= 0.7  
Omax= 1.1  
X\_ = 15.0  
O= 0.7  
X\_/ O= 21.42857142857143  
Zb\_max= 16.483516483516485  
Zb= 11.538461538461538  
Z\_a= 7  
Z\_\_b= 7  
x\_\_= 9.100  
m1=7.875000  
m2=12.919231

G1= 11.197 e-9  
G2= 4.574 e-9  
G3= 87.965 e-9  
G4= 2.287 e-9  
m1= 7.875

G5= 5.143e-9  
G6= 0.068 e-9  
G7= 2.474 e-9  
G8= 5.083 e-9

Gb4= 141.276 e-9

Rb4= 7.078 e6

Gb2= 128.763 e-9

Rb2= 7.766 e6

R\_ms 14.157 e6

Ze\_max= 4.93 e3  
lsr=212.00

Ra\_r=1696.69  
Ra\_im=4633.66  
I= 0.013578  
j<=2..2.5 j= 0.43  
U= 67.00  
X\_ = 15.0  
O= 1.1  
X\_/ O= 13.636363636363635  
Zb\_max= 10.489510489510488  
Zb= 11.538461538461538

Z\_a= 7  
Z\_\_b= 7  
x\_\_= 9.100  
m1=7.775000  
m2=12.719231

G1= 11.197 e-9  
G2= 4.574 e-9  
G3= 55.977 e-9  
G4= 2.287 e-9  
m1= 7.775

G5= 4.906e-9  
G6= 0.106 e-9  
G7= 2.443 e-9  
G8= 5.098 e-9

Gb4= 108.622 e-9

Rb4= 9.206 e6

Gb2= 96.331 e-9

Rb2= 10.381 e6

R\_ms 18.413 e6

Ze\_min= 3.95 e3  
lsr=212.00

Ra\_r=1696.69  
Ra\_im=3562.64  
I= 0.017660  
j<=2..2.5 j= 0.56  
U= 69.69

dZe=9.884916e+02  
S=2.471229e+03  
k1=0.994229  
w\_new=14533.872536

Omin= 0.7  
Omax= 1.1  
X\_ = 15.0  
O= 0.7  
X\_/ O= 21.42857142857143  
Zb\_max= 16.483516483516485  
Zb= 11.538461538461538  
Z\_a= 7  
Z\_\_b= 7  
x\_\_= 9.100  
m1=7.875000  
m2=12.919231

G1= 11.197 e-9  
G2= 4.574 e-9  
G3= 87.965 e-9  
G4= 2.287 e-9  
m1= 7.875

G5= 5.143e-9  
G6= 0.068 e-9  
G7= 2.474 e-9  
G8= 5.083 e-9

Gb4= 141.276 e-9

Rb4= 7.078 e6

Gb2= 128.763 e-9

Rb2= 7.766 e6

R\_ms 14.157 e6

Ze\_max= 4.99 e3  
lsr=212.00

Ra\_r=1706.56  
Ra\_im=4687.69  
I= 0.013499  
j<=2..2.5 j= 0.43  
U= 67.34  
X\_ = 15.0

O= 1.1  
X\_/ O= 13.636363636363635  
Zb\_max= 10.489510489510488  
Zb= 11.538461538461538  
Z\_a= 7  
Z\_\_b= 7  
x\_\_= 9.100  
m1=7.775000  
m2=12.719231

G1= 11.197 e-9  
G2= 4.574 e-9  
G3= 55.977 e-9  
G4= 2.287 e-9  
m1= 7.775

G5= 4.906e-9  
G6= 0.106 e-9  
G7= 2.443 e-9  
G8= 5.098 e-9

Gb4= 108.622 e-9

Rb4= 9.206 e6

Gb2= 96.331 e-9

Rb2= 10.381 e6

R\_ms 18.413 e6

Ze\_min= 3.99 e3  
lsr=212.00

Ra\_r=1706.56  
Ra\_im=3604.18  
I= 0.017558  
j<=2..2.5 j= 0.56  
U= 70.02

dZe=1.000871e+03  
S=2.502177e+03

k1=1.000435  
w\_new=14527.677053

Omin= 0.7  
Omax= 1.1  
X\_ = 15.0  
O= 0.7  
X\_/ O= 21.42857142857143  
Zb\_max= 16.483516483516485  
Zb= 11.538461538461538  
Z\_a= 7  
Z\_\_b= 7  
x\_\_= 9.100  
m1=7.875000  
m2=12.919231

G1= 11.197 e-9  
G2= 4.574 e-9  
G3= 87.965 e-9  
G4= 2.287 e-9  
m1= 7.875

G5= 5.143e-9  
G6= 0.068 e-9  
G7= 2.474 e-9  
G8= 5.083 e-9

Gb4= 141.276 e-9

Rb4= 7.078 e6

Gb2= 128.763 e-9

Rb2= 7.766 e6

R\_ms 14.157 e6

Ze\_max= 4.98 e3  
lsr=212.00

Ra\_r=1705.85  
Ra\_im=4683.82

I= 0.013505  
j<=2..2.5 j= 0.43  
U= 67.32  
X\_= 15.0  
O= 1.1  
X\_/ O= 13.636363636363635  
Zb\_max= 10.489510489510488  
Zb= 11.538461538461538  
Z\_a= 7  
Z\_\_b= 7  
x\_\_= 9.100  
m1=7.775000  
m2=12.719231

G1= 11.197 e-9  
G2= 4.574 e-9  
G3= 55.977 e-9  
G4= 2.287 e-9  
m1= 7.775

G5= 4.906e-9  
G6= 0.106 e-9  
G7= 2.443 e-9  
G8= 5.098 e-9

Gb4= 108.622 e-9

Rb4= 9.206 e6

Gb2= 96.331 e-9

Rb2= 10.381 e6

R\_ms 18.413 e6

Ze\_min= 3.98 e3  
lsr=212.00

Ra\_r=1705.85  
Ra\_im=3601.21  
I= 0.017565  
j<=2..2.5 j= 0.56  
U= 69.99

```
dZe=9.999840e+02
S=2.499960e+03
k1=0.999992
w_new=14528.116296
```

```
z=3
w_new=14528.000000
```

```
[126]: m.fabs(S-S0)
```

```
[126]: 0.04002425237104035
```

```
[127]: w_new=round(w_new)
#4.1.3.7.
Fsum=w_new**2*(I min**2*Gb4_min/(Omin*1e-3)-I max**2*Gb4_max/(Omax*1e-3))
print('Fsum=%.2f'%Fsum)
print('Fizm=%.2f'%Fizm)
print('Fizm>Fsum*5..10')
print('%.2f>%.2f..%.2f'%(Fizm,Fsum*5,Fsum*10))
```

```
Fsum=1.34
Fizm=10.00
Fizm>Fsum*5..10
10.00>6.69..13.39
```

```
[ ]:
```