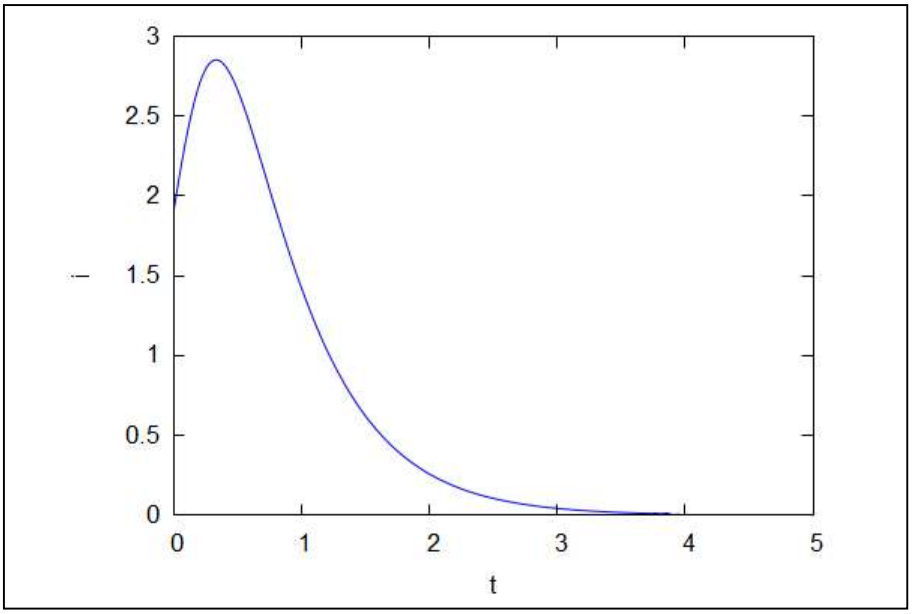
```
(%i1) alias(W, lambert_w);
(%o1) [W]

(%i2) alias(WW, generalized_lambert_w);
(%o2) [WW]

(%i3) numer:true;
(numer) true

(%i4) sol: rk([y, (y^2/x-x*y-2*x^2)],[x,y],[1.9, 5],[t,0,5,0.02])$

(%i5) wxplot2d ([discrete,makelist([p[1],p[2]],p,sol)], [xlabel,"t"],[ylabel,"i"])$
```

(%t5)




```
(%i6) sit(iv, g):=block([i0:iv[1], it0:iv[2]],
    [it0/i0+g,i0]
);
```

(%o6) $$sit(iv,g):=block\left([i0:iv_1,it0:iv_2],\left[\frac{it0}{i0}+g,i0\right]\right)$$

Peak

```
(%i7) im=i0+s0-g*log(s0/g)-g, s0=it0/i0+g;
```

(%o7) $$im=-g\,log\left(\frac{\frac{it0}{i0}+g}{g}\right)+\frac{it0}{i0}+i0$$

(%i8)
```
sim(iv, g):=block([i0:iv[1], it0:iv[2]],
    -g*log((it0/i0+g)/g)+it0/i0+i0
);
```

(%o8) $$sim(iv,g):=block\left([i0:iv_1,it0:iv_2],(-g)\ log\left(\frac{\frac{it0}{i0}+g}{g}\right)+\frac{it0}{i0}+i0\right)$$

(%i9)
```
diff(rhs(%), it0);
```

(%o9) $$\frac{d}{d\ it0}\ block\left([i0:iv_1,it0:iv_2],-g\ log\left(\frac{\frac{it0}{i0}+g}{g}\right)+\frac{it0}{i0}+i0\right)$$

(%i10)
```
%,factor;
```

(%o10) $$\frac{d}{d\ it0}\left(-\frac{iv_1\ g\ log\left(\frac{iv_1\ g+iv_2}{iv_1\ g}\right)-iv_2-iv_1^2}{iv_1}\right)$$

First integral

(%i11)
```
i0+s0-g*log(s0), s0=it0/i0+g;
```

(%o11) $$-g\ log\left(\frac{it0}{i0}+g\right)+\frac{it0}{i0}+i0+g$$

(%i12)
```
%,expand;
```

(%o12) $$-g\ log\left(\frac{it0}{i0}+g\right)+\frac{it0}{i0}+i0+g$$

(%i13)
```
sib(iv, g):=block([i0:iv[1], it0:iv[2]],
    -g*log(it0/i0+g)+it0/i0+i0+g
);
```

(%o13) $$sib(iv,g):=block\left([i0:iv_1,it0:iv_2],(-g)\ log\left(\frac{it0}{i0}+g\right)+\frac{it0}{i0}+i0+g\right)$$

(%i14)
```
sit([1.9,5],2);
```

(%o14) $$[4.631578947368421,1.9]$$

(%i15)
```
sim([1.9,5],2);
```

(%o15) $$2.85207763786478$$

```
(%i16) A:sib([1.9,5],2);
```

$$(A)\quad 3.465783276744889$$

```
(%i17) wkern3(y,g,a):=block([  d:y*(g*log(y)-y+a)],
         if not numberp(y) then 1/d
         elseif abs(d)>1e-16 then 1/d else nan
       );
```

$$(\%o17)\quad wkern3(y,g,a):=block\left([d:y\ (g\ log(y)-y+a)],if\ \ not\,numberp(y)\ then\ \frac{1}{d}\ \ elseif\ \ |d|>1.0\ 10^{-16}\ \ then\ \frac{1}{d}\ \ else\ \ nan\right)$$

```
(%i18) ilambint3(x, g, a ):=block([ r, u, ret:'nan, fr:-g, bb, cc, dd],
         if not numberp(x) then return('ilambint3(x,g, a)),
         bb: g*log(g)-g+a,
         if  x>0  and x < bb then (
              dd:-g*W(-%e^( (x-a)/g)/g),
              ret:fr*first(quad_qags( float(wkern3(u, g, a)) , u, g, dd, 'epsrel=1d-8))
           ) else if x=d then ret:0,
           ret
       );
```

$$(\%o18)\quad ilambint3(x,g,a):=block$$

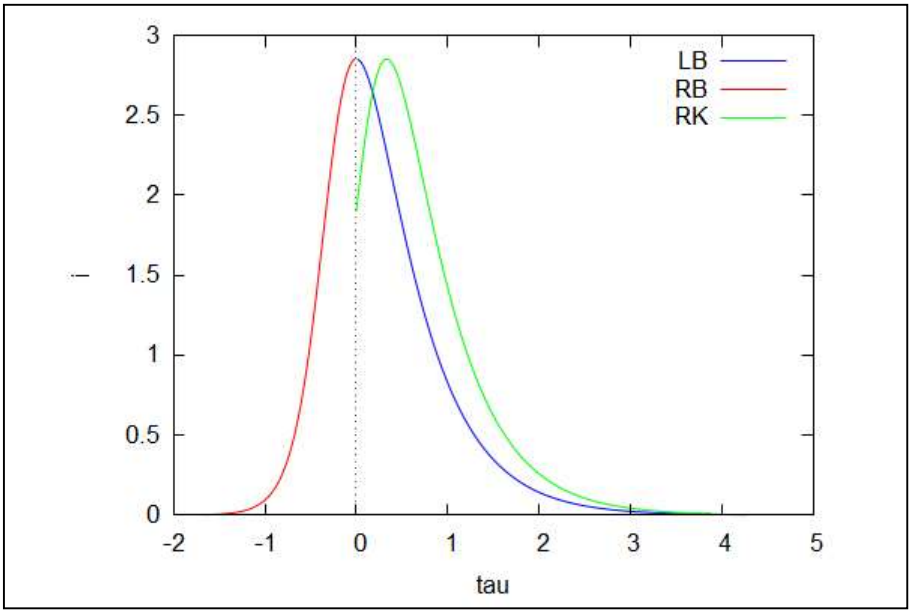
```
(%i19) ilambint4(x, g, a ):=block([ r, u, ret:'nan, fr:-g, bb, cc, dd],
         if not numberp(x) then return('ilambint4(x,g, a)),
         bb: g*log(g)-g+a,
         if  x>0 and x < bb then (
            dd:- (g*WW(-1,-%e^((x-a)/g)/g)),
            ret:fr*first(quad_qags( float(wkern3(u, g, a)) , u, g, dd, 'epsrel=1d-8))
         ) else if x=d then ret:0,
         ret
       );
```

$$(\%o19)\quad ilambint4(x,g,a):=block$$

(%i20) wxplot2d([[parametric,ilambint3(t, 2, A)/2, t, [t,0, 9]], [parametric,ilambint4(t, 2, A)/2, t, [t,0, 9]], [dis

plot2d: expression evaluates to non-numeric value somewhere in plotting range.
plot2d: expression evaluates to non-numeric value somewhere in plotting range.

(%t20)



(%o20)

(%i21)
```
tm(iv, g):=block([i0:iv[1], s0, it0:iv[2]],
   s0:it0/i0+g,
   first(quad_qags( float(1/(s0*exp(u) - g*u - (s0+i0) ) ) , u, 0, log(g/s0), 'epsrel=1d-8))
);
```

(%o21) *tm (iv , g) := block*

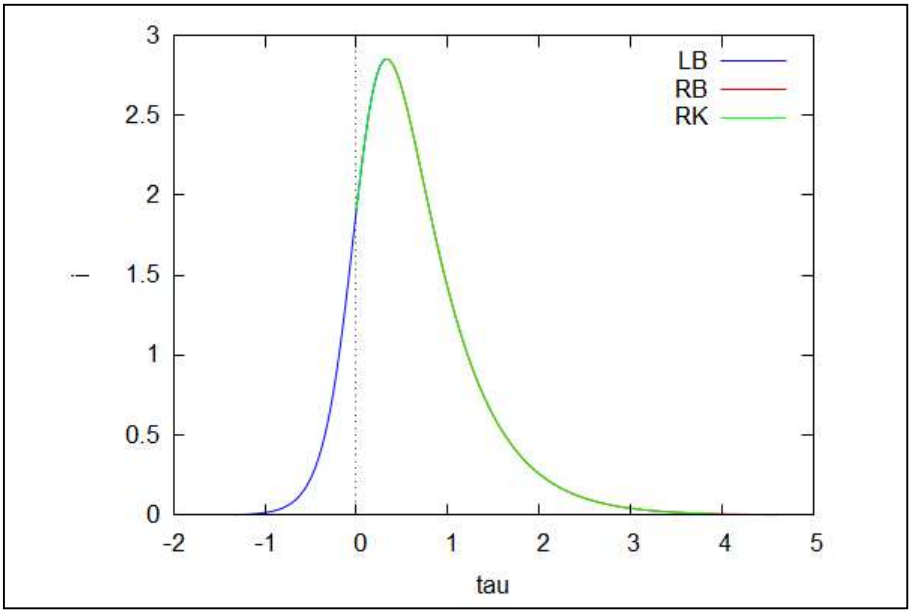
(%i22)
```
tq:tm([1.9,5],2);
```

(tq) *0.3326104094401284*

(%i23) wxplot2d([[parametric,ilambint4(t, 2, A)/2+tq, t, [t,0, 9]], [parametric,ilambint3(t, 2, A)/2+tq, t, [t,0,

plot2d: expression evaluates to non-numeric value somewhere in plotting range.
plot2d: expression evaluates to non-numeric value somewhere in plotting range.

(%t23)

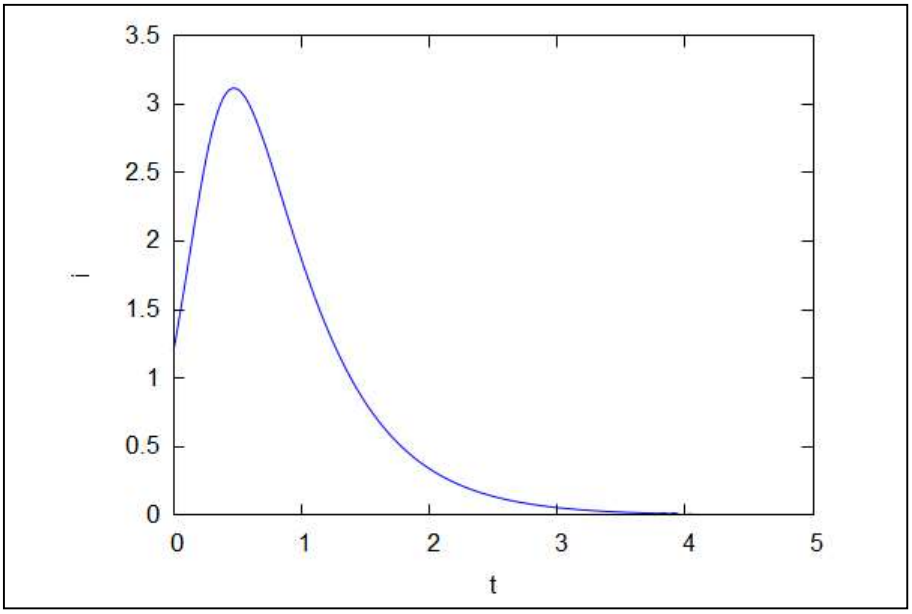


(%o23)

(%i24) sol1: rk([y, (y^2/x-x*y-2*x^2)],[x,y],[1.2, 5],[t,0,5,0.02])$

(%i25) wxplot2d ([discrete,makelist([p[1],p[2]],p,sol1)], [xlabel,"t"],[ylabel,"i"])$

(%t25)



(%i26) A:sib([1.2,5],2);

(A) *3.728349779834328*

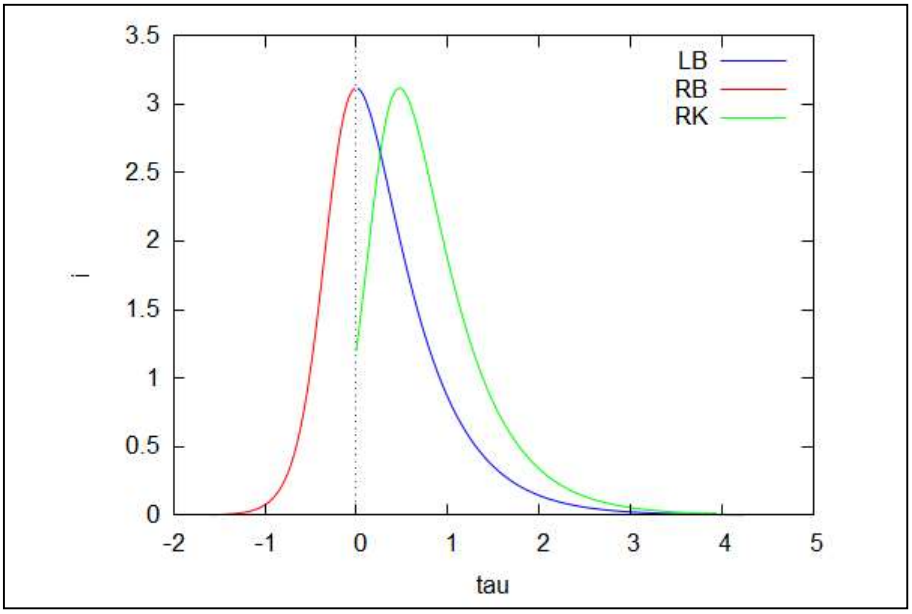
(%i27) sim([1.2,5],2);

(%o27) *3.114644140954218*

(%i28)
```
wxplot2d([[parametric,ilambint3(t, 2, A )/2, t, [t,0, 9]], [parametric,ilambint4(t, 2, A )/2, t, [t,0, 9]], [dis
```

plot2d: expression evaluates to non-numeric value somewhere in plotting range.
plot2d: expression evaluates to non-numeric value somewhere in plotting range.

(%t28)



(%o28)

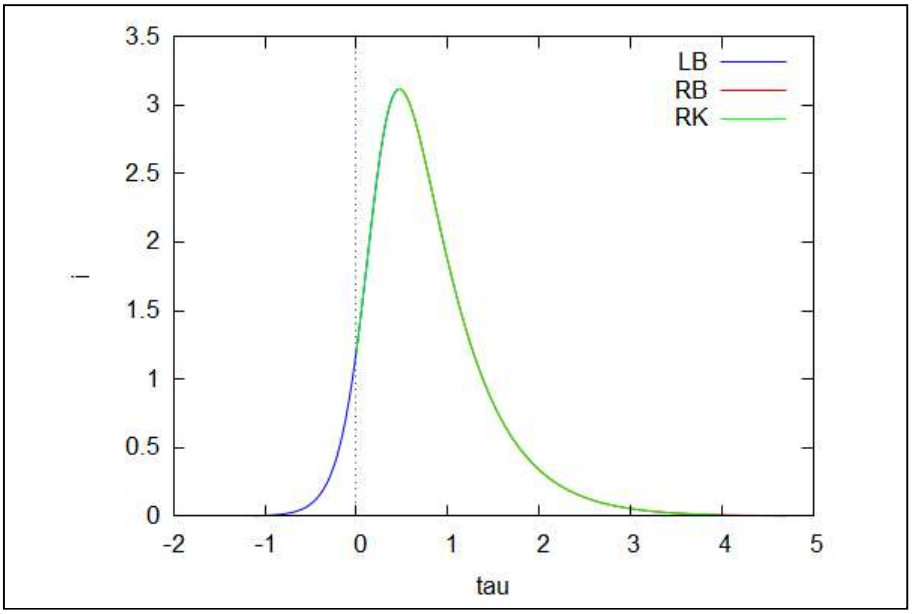
(%i29)
```
tq:tm([1.2,5],2);
```

(tq) *0.4722495515180245*

(%i30)
```
wxplot2d([[parametric,ilambint4(t, 2, A )/2+tq, t, [t,0, 9]], [parametric,ilambint3(t, 2, A )/2+tq, t, [t,0,
```

plot2d: expression evaluates to non-numeric value somewhere in plotting range.
plot2d: expression evaluates to non-numeric value somewhere in plotting range.

(%t30)



(%o30)

➔