

Devoir 3

R-K

1.

$$\begin{bmatrix} \dot{q} \\ \ddot{q} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -w_0^2 & 0 \end{bmatrix} \begin{bmatrix} q \\ \dot{q} \end{bmatrix}$$

2.

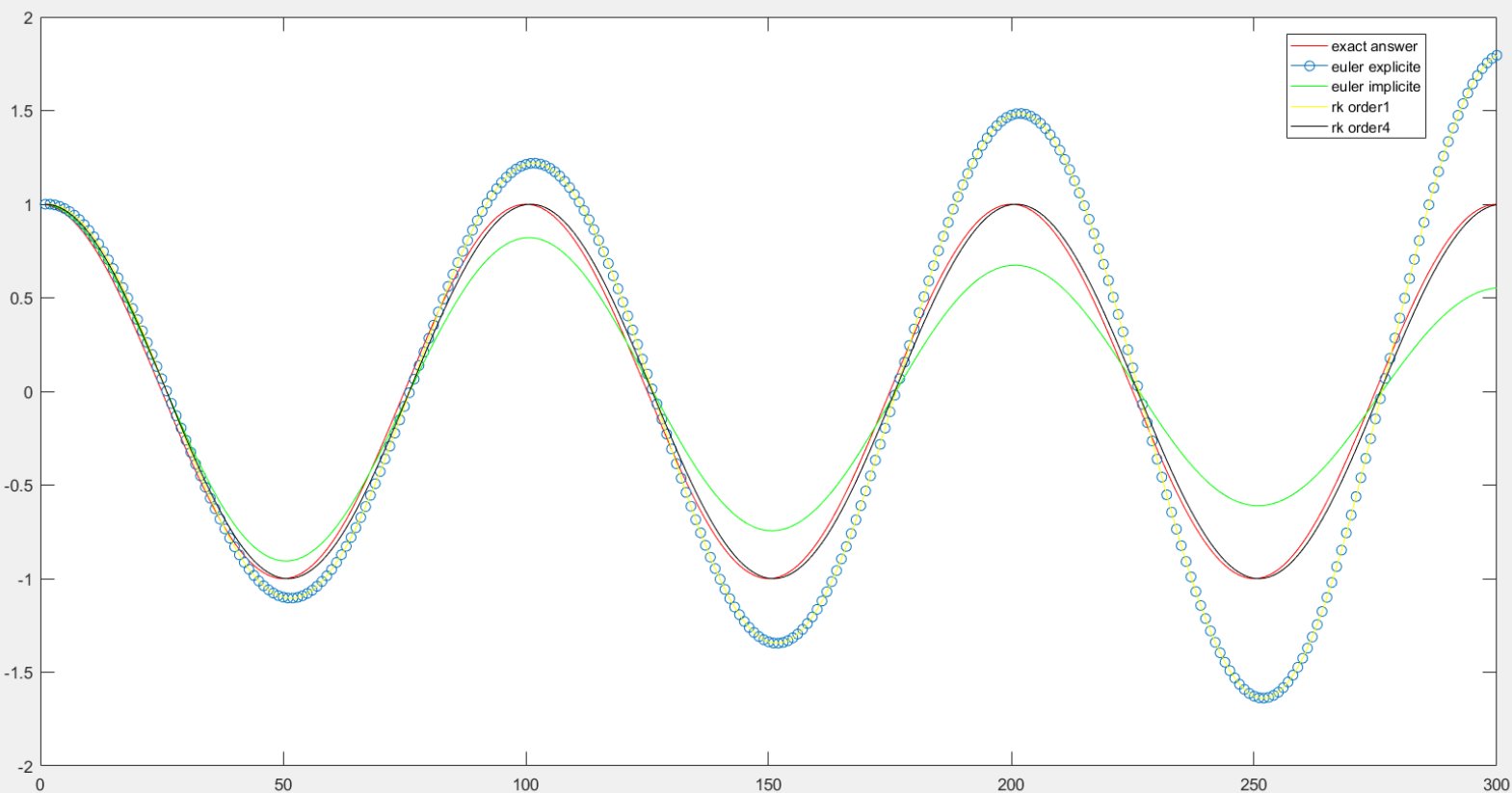
```
clear all;
w0=2*pi;
q0=1;
dq0=0;
T0=3;
n=300;
dt=T0/n;
%exact result
plot(1:n,cos(2*pi*(1:n)*dt),'r-')
hold on;
%euler explicite
A=[1 dt;-w0^2*dt 1];
[X1,A1]=eig(A);
U(:,1)=[q0;dq0];
for i=1:n-1
    U(:,i+1)=A*U(:,i);
    E(i)=1/2*((U(2,i))^2+w0^2*(U(1,i))^2);
end
plot(1:n,U(1,:),'b-')
hold on;

%euler implicite
B=inv([1 -dt;w0^2*dt 1]);
[X2,B1]=eig(B);
U2(:,1)=[q0;dq0];
for i=1:n-1
    U2(:,i+1)=B*U2(:,i);
    E2(i)=1/2*((U2(2,i))^2+w0^2*(U2(1,i))^2);
end
plot(1:n,U2(1:2,:),'g-')
hold on;
%R-K
%ordre 1
C=[0 1;-w0^2 0];
U3(:,1)=[q0;dq0];
for i=1:n-1
    U3(:,i+1)=U3(:,i)+C*U3(:,i)*dt;
end
```

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plot(1:n,U3(1,:), 'y-')
hold on;
%ordre 4
U4(:,1)=[q0;dq0];
for i=1:n-1
    k1=C*U4(:,i);
    k2=C*(U4(:,i)+1/2*k1*dt);
    k3=C*(U4(:,i)+1/2*k2*dt);
    k4=C*(U4(:,i)+k3*dt);
    U4(:,i+1)=U4(:,i)+(k1+2*k2+2*k3+k4)/6*dt;
    E4(i)=1/2*((U4(2,i))^2+w0^2*(U4(1,i))^2);
end
plot(1:n,U4(1,:), 'k-')
3.

```



On peut voir que RUNGE KUTTA de ordre 4 est le plus précis.

4. Pour E de RK4

E4														
1x299 double														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392
	290	291	292	293	294	295	296	297	298	299				
1	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392	19.7392

On peut voir que il reste constant.