(1) Write a FORTRAN program to find a real root of the equation $x^3 - 2x - 5 = 0$ by using Bisection Method

```
program bisection
implicit none
INTEGER::n,i
REAL::a,b,c,f,p,f1,f2,f3
WRITE(*,*)"Enter initial point a="
read*,a
WRITE(*,*)"Enter End point b="
read*,b
WRITE(*,*)"Enter iteration no. n="
read*,n
WRITE(*,*)"Enter tollerence =p"
read*,p
f1=f(a)
f2=f(b)
if (f1*f2>0) then
write (*,13)a,b
stop
end if
13  format (2x,'there is no root between',1x,f4.2,1x,'and',1x,f4.2)
do i=1,n
c=(a+b)/2.0
write (*,*)i,a,b,c
f3=f(c)
if (f1*f3<0.0) then
b=c
f2=f3
else
a=c
f1=f3
```

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```
end if
if (ABS(b-a)<p) GOTO 15
if (i==n) then
write (*,*)'there is no root between ',n,' iteration'
stop
end if
end do
15write (*,*)'desired root=',c
end program
function f(x)
f=x**3-2*x-5
return
end
```

(2) Write a FORTRAN program to evaluate $\int_a^b e^{-\frac{x}{2}}$ by using Trapezoidal rule

```
    program trapezoidal
INTEGER::n,x
REAL::a,b,h,s,v,f,g,e,exv
read (*,*)a,b,n
h=(b-a)/float(n)
s=0.0
do x=1,n-1
s=s+f(a+x*h)
end do
v=(h/2.0)*(f(a)+f(b)+2*s)
write (*,13)v
13  format (2x,'calculated value of integration=',f12.5)
exv=g(b)-g(a)
write (*,14)exv
14  format (2x,'exact value =',1x,f12.5)
e=exv-v
write (*,*)'error=',e
```

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```
end program
function f(x)
f=EXP(-x/2)
return
end
function g(y)
g=-2*EXP(-y/2)
end
```

(3) Write a FORTRAN program to solve the following system of equations by Gauss-Jordan Method

$$x+2y+z=8$$
$$2x+3y+4z=20$$
$$4x+3y+2z=16$$

```
program gau_elewp
implicit none
REAL::a(3,4),la,t,m1,x(3),s1
INTEGER::n,i,j,k,p,s,l
read (*,*)n
read (*,*)((a(i,j),j=1,n+1),i=1,n)
do k=1,n-1
p=k
la=ABS(a(k,k))
do i=k+1,n
if (ABS(a(i,k))>la) then
la=ABS(a(i,k))
p=i
end if
end do
if (p.ne.k) then
do j=k,n+1
t=a(p,j)
```

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```
a(p,j)=a(k,j)
a(k,j)=t
end do
end if
do s=k+1,n
m1=a(s,k)/a(k,k)
do l=1,n+1
a(s,l)=a(s,l)-m1*a(k,l)
end do
end do
end do
x(n)=a(n,n+1)/a(n,n)
do i=n-1,1,-1
s1=0
do j=i+1,n
s1=s1+a(i,j)*x(j)
end do
x(i)=(a(i,n+1)-s1)/a(i,i)
end do
do i=1,n
write (6,15)(a(i,j),j=1,n+1)
end do
15  format(4x,5(f10.5))
do i=1,n
write (*,13)i,x(i)
end do
13  format (2x,'x',i1,'=',f7.4)
end program
```

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(4) Write a FORTRAN program to evaluate $\int_a^b (1 - e^{-\frac{x}{2}})\, dx$ by using Simpson's $\frac{3}{8}$-th rule

```
    program simpson_3_8
INTEGER::n,x
REAL::a,b,h,f,g,s,exv,v,e
read (*,*)a,b,n
h=(b-a)/float(n)
s=0.0
do x=1,n-1
if (MOD(x,3).eq.0) then
s=s+2*f(a+x*h)
else
s=s+3*f(a+x*h)
end if
end do
v=(3*h/8.0)*(f(a)+f(b)+s)
write (*,13)v
13  format (2x,'calculated value=',1x,f12.5)
exv=g(b)-g(a)
write (*,14)exv
14  format (2x,'exact value=',1x,f12.5)
e=exv-v
write (*,*)'error=',e
end program
function f(x)
f=1-EXP(-x/2)
return
end
function g(y)
g=y+2*EXP(-y/2)
end
```

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(5) Write a FORTRAN program to apply Euler's Method to the IVP $\frac{dy}{dx} = x + y,\ y(0) = 0$ at x=0 to x=1.0 taking h=0.2

```
program euler_modified_euler
implicit none
INTEGER::i,n
REAL::a,b,x,y,g,er,y0,h,y1,er1
read (*,*)a,b,n,y0
h=(b-a)/n
x=a
y=y0
y1=y0
write (*,13)
13  format (3x,'x(i)',7x,'eu_y(i)',3x,'exact value',4x,'eu_error',5x,'
do i=1,n+1
er=ABS(g(x)-y)
er1=ABS(g(x)-y1)
write (*,14)x,y,g(x),er,y1,er1
14      format (2x,f5.2,5(5x,f8.5))
call euler(h,x,y)
call m_euler(h,x,y1,y)
x=a+i*h
end do
end program
subroutine euler(h,x,y)
implicit none
REAL::x,y,h,f
y=y+h*f(x,y)
end subroutine
subroutine m_euler(h,x,y1,y)
implicit none
REAL::x,y1,h,f,y
y1=y1+h*(.5*(f(x,y1)+f(x+h,y)))
```

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```
end subroutine
REAL function f(x,y)
f=x+y
return
end
REAL function g(x)
g=-1+exp(x)-x
return
end
```

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