Topic: numerical integration
Read: Ch 19: 19.1,2,3,4 ,6 Ch 20: 20.4

Handwork problem (also includes MATLAB applications):
HW10_1 First, compute the integral analytically. Then estimate the integral to 6 decimal places, as instructed.

$$\int_0^3 \frac{dx}{(3x+1)^3}$$

a) **handwork** Use multiple applications of the trapezoid rule, with n=6.

b) **handwork** Apply the composite trapezoid rule, with n=6.

c) **MATLAB** Apply the composite trapezoid rule, with n=6, 12 & 24

d) **handwork** Use multiple applications of Simpson's 1/3 rule, with n=6.

e) **handwork** Apply the composite Simpson's 1/3 rule, with n=6.

f) **MATLAB** Apply the composite Simpson's 1/3 rule, with n= 6, 12 & 24

for all cases, handwork & MATLAB: Compare all results with the exact integral, and compute the relative errors using MATLAB and publish as pdf.

Coding problems:
HW10_2 20.15 The work done on an object is equal to the force times the distance moved in the direction of the force. The velocity of an object in the direction of a force is given by:

$$v = 4t \qquad 0 \le t \le 5,$$
$$v = 20 + (5-t)^2 \qquad 5 \le t \le 15$$

where v is in m/s. With a step size h=0.2, determine the work done if a constant force of 200 N is applied for all t

a) using Simpson's 1/3 rule (composite formula)
b) using the MATLAB function `trapz`

HW10_3 A Using Newton's second law, it can be shown that the period T of a pendulum with length L and maximum angle of deflection $\theta_0$is given by:

$$T = 4\sqrt{\frac{L}{g}}\int_0^{\pi/2} \frac{1}{\sqrt{1-k^2\sin^2(x)}}dx$$

where $k = \sin(\theta_0)$. Use MATLAB function `integral` to estimate the period for a pendulum for any L=0.2m and $\theta_0 = 30°$.

HW10_4 19.21 A manufactured metal sphere has density that varies with the distance from its center.

r (mm)	0	0.12	0.24	0.36	0.49	0.62	0.79	0.86	0.93	1
ρ (gm/cm^3)	6	5.81	5.14	4.29	3.39	2.7	2.19	2.1	2.04	2

Estimate the particle's mass and average density (i.e., total mass divided by total volume) as accurately as possible. Watch units! Some helpful info:

$$\boldsymbol{m = \int_0^r \rho(r)A(r)dr; \quad where, A(r) = 4\pi r^2}$$

Print all results to the screen using `fprintf`.