An example of exponential decrease: Radioactive decay

Uranium 239 is an unstable isotope of uranium that decays rapidly: this means that it loses some of its mass because of radioactivity. We want to determine the rate of decay. We place 10 grams of U^{239} in a container and measure the amount remaining at 1-minute intervals. The table records the amounts.

t = time in minutes	A(t) = grams remaining at time t
0	10.00
1	9.71
2	9.43
3	9.16
4	8.89
5	8.63

Round all your answers to two decimal places.

a) Show that these are exponential data.

Hint: use the characteristic property of exponential functions, that is compute 9.71/10.00, 9.43/9.71 etc. Are the results constant?

b) Find A(6) that is, A at t=6 minutes.

c) What is the percentage decay rate each minute? Explain in natural language what this number means.

d) * *Hard for the moment, optional* * Find A at t = 30 seconds.

e) Write an exponential function to express A as a function of t (measured in minutes).

f) When is A = 6.50 g? You can use a spreadsheet to extend the table up to the desired row.

g) The half-life of a radioactive substance is the time required for a quantity to reduce to half of its initial value. What is the half-life of U^{239}? Use the table as in f).

Solutions

a) because the ratio between A(t) and A(t-1) is always about 0.971 **b)** 8.38 g **c)** 2,9% **d)** 9.85
e) $A(t)=0{,}971^t$ **f)** between 14 and 15 minutes **g)** between 23 and 24 minutes