**Logo, icon

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**Continuous Growth & Decay**

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Copy a question from this document and paste (with reparametizing) into your document. This allows you to quickly build a collection of regeneratable questions into a test, worksheet, presentation, or exam.

**Question**

**<EFOFEX>
id:fxe{31004986-0dcd-4e38-b7d1-8612ddedac8b}
FXGP:DP-YwcuScJ
FXData:

</EFOFEX>** is a radioactive isotope with a short half-life (measured in hours). A scientist has a <EFOFEX>
id:fxe{282dc125-e149-4da8-b7b0-54f47b91871f}
FXGP:DP-YwcuScJ
FXData:

</EFOFEX> sample of the isotope and is measuring its decay.

The mass, in milligrams, of **<EFOFEX>
id:fxe{c880ec3a-bba4-4b4a-b10d-bbc2136fd573}
FXGP:DP-YwcuScJ
FXData:

</EFOFEX>** remaining after t hours can be written as

<EFOFEX>
id:fxe{af8ba7fc-40f7-42cd-aec7-07a2570fb5b4}
FXGP:DP-YwcuScJ
FXData:

</EFOFEX>

Where *A* and *k* are constants.

The scientist notes that, after <EFOFEX>
id:fxe{c6e6cf16-de08-4ec7-996c-eafac4e9d0e7}
FXGP:DP-YwcuScJ
FXData:

</EFOFEX> hours, there are <EFOFEX>
id:fxe{47bbda61-26bb-4ae9-b4a9-d69b66423c25}
FXGP:DP-YwcuScJ
FXData:

</EFOFEX> of the isotope remaining.

1. Use this information to find *A* and *k*.

The scientist is interested in the half-life of the isotope.

1. Use your formula to calculate the half-life of the isotope, in hours, to 3 decimal places.

**Solution**

a) <EFOFEX>
id:fxe{9d5fa0a4-be0d-44b2-ab8d-23b2e49bdf38}
FXGP:DP-YwcuScJ
FXData:

</EFOFEX>

b) <EFOFEX>
id:fxe{cc289121-b51a-441c-8943-653a5e1a726a}
FXGP:DP-YwcuScJ
FXData:

</EFOFEX>

**Notes**

900 000+ variations.

**Question**

The population of a local government area during the 1996 census was <EFOFEX>
id:fxe{78ac4f79-0e17-46bc-92ec-10e664074d0c}
FXGP:DP-BDfZdK3
FXData:

</EFOFEX> but had grown to <EFOFEX>
id:fxe{c5a82ac0-be1f-466c-8bd5-62fed66d386c}
FXGP:DP-BDfZdK3
FXData:

</EFOFEX> by the time of the 2021 census.

Assuming that the population *P* is increasing exponentially and satisfies an equation of the form <EFOFEX>
id:fxe{e7e8b4d0-5cf8-4e42-be50-83cb9717464b}
FXGP:DP-BDfZdK3
FXData:

</EFOFEX> where *A* and *k* are constants and *t* is measured in years from the beginning of 1996.

1. Show that <EFOFEX>
   id:fxe{00264fac-0db4-485d-b6e4-428a7a531c8d}
   FXGP:DP-BDfZdK3
   FXData:

   </EFOFEX> satisfies <EFOFEX>
   id:fxe{80aa42f6-ff1c-4dff-b20a-4207f0510676}
   FXGP:DP-BDfZdK3
   FXData:

   </EFOFEX>
2. Determine the value of *A* and *k* and complete the equation.
3. Use your equation to predict the year when the population of the local area will have tripled to <EFOFEX>
   id:fxe{e8b9870e-0099-49d2-baea-0db73ec379f7}
   FXGP:DP-BDfZdK3
   FXData:

   </EFOFEX>.

**Solution**

a) <EFOFEX>
id:fxe{252d4988-91a5-4634-aa6d-5244bf13b583}
FXGP:DP-BDfZdK3
FXData:

</EFOFEX>

b) <EFOFEX>
id:fxe{2b3d635f-2ff7-4187-87ae-98c9ef8b3fd0}
FXGP:DP-BDfZdK3
FXData:

</EFOFEX>

c) <EFOFEX>
id:fxe{f52209ad-1647-4235-86cb-f43f90fecc18}
FXGP:DP-BDfZdK3
FXData:

</EFOFEX>

**Notes**

450 variations.

**Question**

Researchers have found that the amount of a new drug, *D*, that remains in a human body decreases according to the equation:

<EFOFEX>
id:fxe{9cbdf3dc-f4ac-49d7-b2e9-80e9a3513aa1}
FXGP:DP-AeVrWvh
FXData:

</EFOFEX>

where *D* is measured in mg and *t* is the time in hours.

1. Show that <EFOFEX>
   id:fxe{0a3a25ad-1dd9-4e82-9dc0-dbbf3e0bcb70}
   FXGP:DP-AeVrWvh
   FXData:

   </EFOFEX> is a solution to <EFOFEX>
   id:fxe{10b26996-06ef-464e-bf0c-e42ed83896c4}
   FXGP:DP-AeVrWvh
   FXData:

   </EFOFEX> where *A* is a constant.

When t = 0 there are <EFOFEX>
id:fxe{42297401-0766-4a44-994f-11990a9c79fd}
FXGP:DP-AeVrWvh
FXData:

</EFOFEX> of the drug in a patient’s body.

1. Use this information to find the value of A.
2. What will be the amount of the drug left in the patient’s body after <EFOFEX>
   id:fxe{ccdcdf6c-0ae5-4508-b9de-b9bb00e71d3b}
   FXGP:DP-AeVrWvh
   FXData:

   </EFOFEX> hours?
3. Calculate the half-life of the drug – the number of hours taken for the amount of the drug to halve in the patient’s body.

**Solution**

a) <EFOFEX>
id:fxe{b2187e87-7364-4b08-acb8-36c796849a6e}
FXGP:DP-AeVrWvh
FXData:

</EFOFEX>

b) <EFOFEX>
id:fxe{a02c3d78-2c1b-4b28-b080-a63bc00a40dc}
FXGP:DP-AeVrWvh
FXData:

</EFOFEX>

c) <EFOFEX>
id:fxe{851129ba-3229-49d3-a719-769acd6fb392}
FXGP:DP-AeVrWvh
FXData:

</EFOFEX>

d) <EFOFEX>
id:fxe{d2cb9f85-16e2-4394-8096-9ab586a74dd4}
FXGP:DP-AeVrWvh
FXData:

</EFOFEX>

**Notes**

2500+ variations.

**Question**

A bacterial culture is used to determine the type of bacteria causing an infection. Initially, the bacterial colony contained <EFOFEX>
id:fxe{2e92f7b3-4fe5-45d6-b6d9-dcba590a29f3}
FXGP:DP-DyYXfE9
FXData:

</EFOFEX> bacteria and the number of bacteria after *t* minutes is given by

<EFOFEX>
id:fxe{8b2f29ff-b3fa-41d4-ba3e-7534aaeaef16}
FXGP:DP-DyYXfE9
FXData:

</EFOFEX>

After <EFOFEX>
id:fxe{855ce264-b538-4747-b337-423e4dfa954d}
FXGP:DP-DyYXfE9
FXData:

</EFOFEX> minutes the colony had <EFOFEX>
id:fxe{9837e05b-f38a-418d-9a2f-6616a06ab77f}
FXGP:DP-DyYXfE9
FXData:

</EFOFEX> bacteria.

1. Show that *k* = <EFOFEX>
   id:fxe{d94f847b-800b-43e4-92d2-420116f2dee1}
   FXGP:DP-DyYXfE9
   FXData:

   </EFOFEX> to 4 decimal places.
2. How many bacteria are there when *t* = <EFOFEX>
   id:fxe{0fe7c9fc-c498-4d43-ac39-bb0ccca47f62}
   FXGP:DP-DyYXfE9
   FXData:

   </EFOFEX>?
3. How long does it take for the number of bacteria to increase from <EFOFEX>
   id:fxe{eda6fb9f-14ad-48d9-b983-ea26a748ada7}
   FXGP:DP-DyYXfE9
   FXData:

   </EFOFEX> to <EFOFEX>
   id:fxe{c993a042-3040-40ce-90c2-2e35f307681d}
   FXGP:DP-DyYXfE9
   FXData:

   </EFOFEX>?

The rate of change in a bacterial colony can be determined by the derivative.

1. What is the rate of change in the colony, in number of bacteria per minute, when *t* = <EFOFEX>
   id:fxe{fadbbef0-738b-4571-90e3-80e67b66df67}
   FXGP:DP-DyYXfE9
   FXData:

   </EFOFEX>?

**Solution**

a) <EFOFEX>
id:fxe{7616a6b7-1e26-449c-b2cb-9d9c8aa31280}
FXGP:DP-DyYXfE9
FXData:

</EFOFEX>

b) <EFOFEX>
id:fxe{3a23cf74-b71a-4977-9407-3998639e8a79}
FXGP:DP-DyYXfE9
FXData:

</EFOFEX>

c) <EFOFEX>
id:fxe{6f3817b4-30ad-4c02-8697-320cb44c7b28}
FXGP:DP-DyYXfE9
FXData:

</EFOFEX>

c) <EFOFEX>
id:fxe{33ca2e94-f57e-423b-9575-806baa888655}
FXGP:DP-DyYXfE9
FXData:

</EFOFEX>

**Notes**

100 000+ variations.

**Question**

Carbon-14 is a radioactive isotope that decays with a half-life of 5730 years, and it is often used to estimate how long ago a fossil died. An archaeologist has found an old campfire and is using Carbon-14 dating on some shells found in the campfire to estimate the age of the site.

If the amount of Carbon-14 remaining in the sample is given by the equation:

<EFOFEX>
id:fxe{8ed0d4d0-190b-405b-abcf-f566d8632ad1}

FXData:

</EFOFEX>

where *t* is the number of years,

1. Find *k*, correct to 3 significant figures.
2. The amount of Carbon-14 in the shells is <EFOFEX>
   id:fxe{e199b36c-5ae6-4452-aa91-894441c1fe60}
   FXGP:DP-JjnuNwm
   FXData:

   </EFOFEX> of the original amount. Find the number of years since the shells were cooked in the campfire.

**Solution**

1. <EFOFEX>
   id:fxe{13df3092-85cb-4ad9-b734-e7931b76c1cc}
   FXGP:DP-JjnuNwm
   FXData:

   </EFOFEX>
2. <EFOFEX>
   id:fxe{775bc48b-4c5d-44f9-a553-d8b2d762b3d1}
   FXGP:DP-JjnuNwm
   FXData:

   </EFOFEX>

**Notes**

13 variations.