Sec 4.5 Applications

In 1970 the US population was 203.3 million. By 2010, it had grown to 308.7 million. Write a model to represent this pattern and use it to determine when the population will reach 335 million.

Looks like "pert"

$Q = Q_o e^{kt}$

-determine "k"

-then determine when will reach 335 mil.

$308.7 = 203.3 e^{k(40)}$

$1.518 = e^{40k}$

$40k$

$\ln 1.518 = \ln e^{40k}$

$\ln 1.518 = 40k$

$.417 = 40k$

$k \approx .01044$

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$Q = 203.3e^{.01044t}$

$335 = 203.3e^{.01044t}$

$1.6478 = e^{.01044t}$

$\ln 1.6 = \ln e^{.01044t}$

$\ln 1.6 = .01044t$

$.499 \approx .01044t$

$t \approx 47.8$ years

1970
+47.8
during 2017

The half-life for carbon-14 is 5714 years. Write a model to represent this pattern. In 1947, jars containing the Dead Sea Scrolls (biblical scriptures of the Jewish sect the Essenes) were found by an Arab Bedouin herdsman. Analysis indicated that the scroll wrappings contained 76% of their original carbon-14. Estimate the age of the scrolls.

$$Q = Q_0 e^{-.000121t}$$

$$.76Q_0 = Q_0 e^{-.000121t}$$

$$.76 = e^{-.000121t}$$

$$\ln .76 = \ln e^{-.000121t}$$

$$\ln .76 = -.000121t$$

$$t \approx 2268 \text{ years}$$

1947
-2268
-321 BC

The function

$$f(t) = \frac{30{,}000}{1+20e^{-1.5t}}$$

initially ≈ 1428

describes the number of people, f(t), who have become ill with influenza t weeks after its initial outbreak in a town with 30,000 people. How many were ill at the initial outbreak? How many people were ill by the end of the fourth week?

$t = 4$

$$f(t) = \frac{30000}{1+20e^{-1.5(4)}}$$

$$\frac{30000}{1.049}$$

$\approx 28{,}583$

Suggested Practice
Sec 4.5 page 504-506

1-23 odds
27,29,31,37ab,41,43,45

1. 127.3 million
3. Iraq; 1.9%
5. 2030
7. a. $A = 6.04e^{.01t}$
   b. 2040
9. 146.1 million
11. .0088
13. -.0039
15. about 8 grams
17. 8 grams after 10 seconds; 4 after 20; 2 after 30; 1 after 40; .5 after 50
19. about 15,679
21. 12.6 years
23. -.000428
   (or, .0428% yearly)
27. a. -.52912
   b. about 106,900,000 years old
   or, .1069 billion
29. 7.1 years
31. 5.5 hours
37a. about 20 people
   b. about 1080 people
41. 2025
43. about 3.7%
45. about 48 years old