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2014 14d At the beginning of every 8-hour period, a patient is given 10 mL of a particular drug. During each of these 8-hour periods, the patient's body partially breaks down the drug. Only $\frac{1}{3}$ of the total amount of the drug present in the patient's body at the beginning of each 8-hour period remains at the end of that period.

(i) How much of the drug is in the patient's body immediately after the second dose is given? **1**

(ii) Show that the total amount of the drug in the patient's body never exceeds 15 mL. **2**

(i) Let A_n = amt. of drug in body after n doses

$$A_2 = 10 + 10 \times \frac{1}{3}$$

$$= 10 \times 1\frac{1}{3}$$

$$= 13\frac{1}{3} \qquad \therefore 13\frac{1}{3} \text{ mL}$$

(ii) $$A_3 = 10 + 10 \times \frac{1}{3} + 10 \times \left(\frac{1}{3}\right)^2$$

$$\therefore \ A_n = 10 + 10 \times \frac{1}{3} + \ ... + 10 \times \left(\frac{1}{3}\right)^{n-1}$$

Total amount is limiting sum:

Using $a = 10$, $r = \frac{1}{3}$, limiting sum $= \frac{a}{1-r}$:

$$A = \frac{10}{1 - \frac{1}{3}}$$

$$= 10 \div \frac{2}{3}$$

$$= 15$$

$\therefore$ the maximum amount of the dose is 15 mL.

State Mean:
0.77
1.16

* These solutions have been provided by *projectmaths* and are not supplied or endorsed by BOSTES.

Board of Studies: Notes from the Marking Centre

(i) Most candidates gained full marks for this part.

(ii) Most candidates recognised that a geometric series and a limiting sum were required.

Common problems were:

- incorrectly stating the limiting sum formula;
- using an exponential growth formula.

http://www.boardofstudies.nsw.edu.au/hsc_exams/2014/pdf_doc/2014-maths.pdf

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