M/39

M1 - Jan 10.

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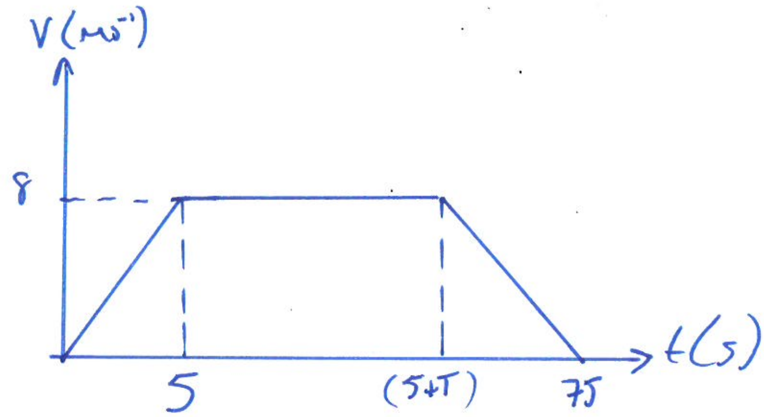
2. An athlete runs along a straight road. She starts from rest and moves with constant acceleration for 5 seconds, reaching a speed of $8\,\mathrm{m\,s^{-1}}$. This speed is then maintained for T seconds. She then decelerates at a constant rate until she stops. She has run a total of 500 m in 75 s.

(a) In the space below, sketch a speed-time graph to illustrate the motion of the athlete.
(3)

(b) Calculate the value of T.
(5)

(a)



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B1 \
B1 8, 75

(b) Total Area = 500

$\frac{1}{2}(75+T)\times 8 = 500$ M1 A2

$(75+T)\times 4 = 500$

$75+T = 125$

$T = 125-75$ M1

$T = 50$ sec. A1

M/8

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C2 June 09

2. (a) Find the first 3 terms, in ascending powers of x, of the binomial expansion of

$$(2+kx)^7$$

where k is a constant. Give each term in its simplest form.

(4)

Given that the coefficient of x^2 is 6 times the coefficient of x,

(b) find the value of k.

(2)

(a) $(2+kx)^7 = \left[2\left(1+\frac{k}{2}x\right)\right]^7 = 2^7\left(1+\frac{kx}{2}\right)^7$

$= 2^7\left[1 + 7\left(\frac{kx}{2}\right) + \frac{7\times 6}{2!}\left(\frac{kx}{2}\right)^2 + \cancel{7} \dots\right]$ M1

$= 128\left[1 + \frac{7}{2}kx + \frac{21}{4}k^2x^2 + \dots\right]$

$= 128 + 448kx + 672k^2x^2 + \dots$ B1 A1 A1

(b) $6 \times 448k = 672k^2$ M1

$k = \frac{6\times 448}{672} = 4.$ A1

M/6

4

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Alt

(a) $(2+kx)^7 = 2^7 + 2^6 \times 7(kx)^1 + 2^5 \times {}^7C_2\,(kx)^2 + \dots$ M1

CL - June 08

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3. (a) Find the first 4 terms, in ascending powers of x, of the binomial expansion of $(1 + ax)^{10}$, where a is a non-zero constant. Give each term in its simplest form.

(4)

Given that, in this expansion, the coefficient of x^3 is double the coefficient of x^2,

(b) find the value of a.

(2)

(a) $1 + 10ax + \frac{10\times9\times(ax)^2}{2!} + \frac{10\times9\times8\times(ax)^3}{3!} + \ldots$ B1 (1st 2 terms) M1

$1 + 10ax + 45a^2x^2 + 120a^3x^3 + \ldots$ A1 A1

(b) $2\times(45a^2) = 120a^3$ M1

$a = \frac{90}{120} = \frac{3}{4}$ A1

M/6

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9. The first three terms of a geometric series are $(k + 4)$, k and $(2k - 15)$ respectively, where k is a positive constant.

(a) Show that $k^2 - 7k - 60 = 0$.

(4)

(b) Hence show that $k = 12$.

(2)

(c) Find the common ratio of this series.

(2)

(d) Find the sum to infinity of this series.

(2)

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(a) $(k+4), k, (2k-15), \ldots$

Common Ratio $\therefore$

$\frac{k}{k+4} = \frac{2k-15}{k}$ M1

$k^2 = (2k-15)(k+4)$ M1 A1

$k^2 = 2k^2 + 8k - 15k - 60$

$k^2 - 7k - 60 = 0$ As required A1

(b) $(k+5)(k-12) = 0$ M1

$k > 0 \therefore k = 12$ As required A1

(c) $r = \frac{12}{12+4} = \frac{12}{16} = \frac{3}{4}$ M1 A1

(d) $S_\infty = \frac{a}{1-r} = \frac{16}{1-\frac{3}{4}} = \frac{16}{\frac{1}{4}} = 16 \times 4 = 64$ M1 A1

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6. A geometric series has first term 5 and common ratio $\frac{4}{5}$.

Calculate

(a) the 20th term of the series, to 3 decimal places, **(2)**

(b) the sum to infinity of the series. **(2)**

Given that the sum to k terms of the series is greater than 24.95,

(c) show that $k > \dfrac{\log 0.002}{\log 0.8}$, **(4)**

(d) find the smallest possible value of k. **(1)**

(a) $a = 5 \quad r = \frac{4}{5} \quad n = 20$

20^{n} term $= 5 \times \left(\frac{4}{5}\right)^{19} = \cancel{\ldots} = \cancel{\ldots}$ (3dp) 0.072 (3dp). M1 A1

(b) $S_\infty = \dfrac{5}{1 - \frac{4}{5}} = \dfrac{5}{\frac{1}{5}} = 25$ M1 A1

(c) $S_k = \dfrac{5\left(\left(\frac{4}{5}\right)^k - 1\right)}{\frac{4}{5} - 1} > 24.95$ M1

$-25\left(\left(\frac{4}{5}\right)^k - 1\right) > 24.95$

$\left(\frac{4}{5}\right)^k - 1 < \dfrac{24.95}{-25}$ A1

$\left(\frac{4}{5}\right)^k < \cancel{\ldots}\ 0.002$

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$\log\left(\frac{4}{5}\right)^k < \log(\cancel{0.002})$

$\cancel{k < \frac{\log(0.002)}{\log 0.8}}$ $\quad k\log(0.8) < \log(0.002)$ M1

$k > \dfrac{\log(0.002)}{\log(0.8)}$ A1 $\therefore k > 27.85\ldots$

-ve

$\therefore k_{min} = 28.$ B1

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