10 **(a)** The first 3 terms of an arithmetic progression are $3\sin 2x$, $5\sin 2x$, $7\sin 2x$.

(i) Show that the sum to n terms of this arithmetic progression can be written in the form $n(n+a)\sin 2x$, where a is a constant. [3]

(ii) Given that $x = \frac{2\pi}{3}$, find the exact sum of the first 20 terms. [2]

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(b) The first 3 terms of a geometric progression are $\ln 2y$, $\ln 4y^2$, $\ln 16y^4$.

(i) Find the nth term of this geometric progression. [2]

(ii) Find the sum to n terms of this geometric progression, giving your answer in its simplest form. [2]

(c) The first 3 terms of a different geometric progression are $\left(2w-\frac{1}{4}\right)$, $\left(2w-\frac{1}{4}\right)^2$, $\left(2w-\frac{1}{4}\right)^3$.

Find the values of w for which this geometric progression has a sum to infinity. [3]

Question 11 is printed on the next page.

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11 **(a)** Given that $y = x^2 \ln x$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$. [2]

(b) Hence find $\int x \ln x \, \mathrm{d}x$. [3]

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