The continuous random variable X has cumulative distribution function F given by

$$\mathrm{F}(x) = \begin{cases} 0 & x < 2, \\ \frac{1}{60}x^2 - \frac{1}{15} & 2 \leqslant x \leqslant 8, \\ 1 & x > 8. \end{cases}$$

(a) Find $\mathrm{P}(3 \leqslant X \leqslant 6)$. [1]

(b) Find $\mathrm{E}\left(\sqrt{X}\right)$. [3]

(c) Find $\mathrm{Var}\left(\sqrt{X}\right)$. [2]

(d) The random variable Y is defined by $Y = X^3$. Find the probability density function of Y. [3]