3. (a) Show that for $r \geqslant 1$

$$\frac{r}{\sqrt{r(r+1)}+\sqrt{r(r-1)}} \equiv A\left(\sqrt{r(r+1)}-\sqrt{r(r-1)}\right)$$

where A is a constant to be determined.

(2)

(b) Hence use the method of differences to determine a simplified expression for

$$\sum_{r=1}^{n} \frac{r}{\sqrt{r(r+1)}+\sqrt{r(r-1)}}$$

(3)

(c) Determine, as a surd in simplest form, the constant k such that

$$\sum_{r=1}^{n} \frac{kr}{\sqrt{r(r+1)}+\sqrt{r(r-1)}} = \sqrt{\sum_{r=1}^{n} r}$$

(2)

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(Total for Question 3 is 7 marks)

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