Jason has three biased coins. For each coin the probability of obtaining a head when it is thrown is  $\frac{2}{3}$ . Jason throws all three coins. The number of heads obtained is denoted by X.

(a) Find the probability generating function 
$$G_X(t)$$
 of  $X$ .

Jason also has two unbiased coins. He throws all five coins. The number of heads obtained from the two unbiased coins is denoted by Y. It is given that  $G_Y(t) = \frac{1}{4} + \frac{1}{2}t + \frac{1}{4}t^2$ . The random variable Z is the total number of heads obtained when Jason throws all five coins.

(b) Find the probability generating function of 
$$Z$$
, expressing your answer as a polynomial. [3]

(c) Find 
$$E(Z)$$
.