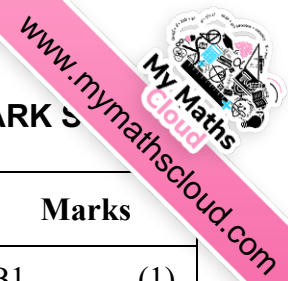
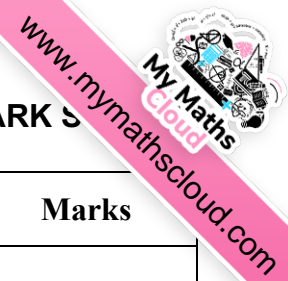


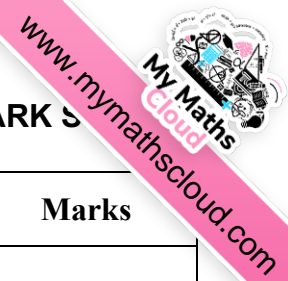
Question Number	Scheme	Marks
<p>1. (a)</p> <p>(b)</p> <p>(c)</p>	$P(B) = P(B \cap D) + P(B \cap F) + P(B \cap R)$ $= 0.3 \times 0.8 + 0.6 \times 0.6 + 0.1 \times 0.1$ $= 0.61$ $P(R B) = \frac{P(R \cap B)}{P(B)} = \frac{0.01}{0.61} = \frac{1}{61}$ <p style="text-align: right;">(accept 0.016 or 0.0164)</p> $\frac{1}{61} + \frac{1}{61} - \frac{1}{61}^2 \text{ or } 1 - \left(1 - \frac{1}{61}\right)^2$ $= 0.0325$ <p style="text-align: right;">awrt 0.0325</p>	<p>M1 A1 (2)</p> <p>M1, A1 (2)</p> <p>M1 M1 A1 (7 marks)</p>
<p>2. (a)</p> <p>(b)</p> <p>(c)</p>	$f(x) = \begin{cases} \frac{3}{7} e^{-\frac{3}{7}x} & [x \geq 0] \\ [0 & \text{otherwise}] \end{cases}$ $P(2 < X < 3) = \int_2^3 \frac{3}{7} e^{-\frac{3}{7}x} dx$ $= \left[-e^{-\frac{3}{7}x} \right]_2^3$ $= e^{-\frac{6}{7}} - e^{-\frac{9}{7}} = 0.14791$ <p style="text-align: right;">awrt 0.148</p> $P(X \geq 7) = \left[-e^{-\frac{3}{7}x} \right]_7^\infty$ $= e^{-3} = 0.049787$ <p style="text-align: right;">awrt 0.050</p>	<p>M1 A1 (2)</p> <p>M1 A1 A1 (3)</p> <p>M1 A1 (2) (7 marks)</p>



Question Number	Scheme	Marks
<p>3. (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	<p>Geometric</p> <p>$p = \frac{1}{8}$</p> <p>$P(S = 5) = \left(\frac{7}{8}\right)^4 \times \left(\frac{1}{8}\right)$ $= 0.073$</p> <p>$P(S \geq 3) = (1 - p)^2$ $= \left(\frac{7}{8}\right)^2 = \frac{49}{64}$ awrt 0.766</p> <p>Assume shots are <i>independent</i> and <i>probability</i> of hits is <i>constant</i></p>	<p>B1 (1)</p> <p>B1</p> <p>M1</p> <p>A1 (3)</p> <p>M1 A1 ft</p> <p>A1 (3)</p> <p>B1 B1 (2)</p> <p>(9 marks)</p>
<p>4. (a)</p> <p>(b)</p> <p>(c)</p>	<p>$M_X(t) = E(e^{tx}) = \int_0^a e^{tx} \frac{1}{a} dx$</p> <p>$= \left[\frac{1}{at} e^{tx} \right]_0^a$</p> <p>$= \left(\frac{e^{at}}{at} \right) - \left(\frac{1}{at} \right)$</p> <p>$= \frac{e^{at} - 1}{at}$</p> <p>$M_Y(0) - 1 \Rightarrow 1 = \frac{1}{4}(1 + A + B)$ or $A + B = 3$ (1)</p> <p>$M'_Y(t) = \frac{1}{4}(Ae^t + 2Be^{2t})$</p> <p>$E(Y) = M'_Y(0) \Rightarrow \frac{5}{4} = \frac{A}{8} + \frac{2B}{4}$ or $A + 2B = 5$ (2)</p> <p>$(2) - (1) \Rightarrow B = 2$ and $A = 1$</p> <p>$M_Z(t) = M_X(t) \times M_Y(t) = \frac{e^{at} - 1}{at} \times \frac{1 + e^t + 2e^{2t}}{4}$</p>	<p>M1</p> <p>M1</p> <p>M1</p> <p>A1 cso (4)</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>M1 A1 A1 (6)</p> <p>B1 ft (1)</p> <p>(11 marks)</p>



Question Number	Scheme	Marks
<p>5. (a)</p> <p>(b)</p> <p>(c)</p>	$60 = \frac{3(1-p)}{p^2}$ $20p = 1 - p$ $(5p - 1)(4p + 1) = 0$ $p = \frac{1}{5}$ $P(Y = 8) = \binom{7}{2} p^2 (1-p)^5 \times p$ $= \binom{7}{2} \times \left(\frac{1}{5}\right)^3 \times \left(\frac{4}{5}\right)^5 = 0.05505$ $P(Y \leq 10 \dots) = 1 - P(Y \geq 11 \text{1st head on 2nd toss})$ $= 1 - P(0 \text{ heads in 8 tosses}) - P(1 \text{ head in 8 tosses})$ $= 1 - 0.8^8 - 8 \times 0.2 \times (0.8)^7$ $= 0.49688$	<p>M1 A1</p> <p>M1</p> <p>M1</p> <p>A1 (5)</p> <p>M1</p> <p>awrt 0.055 A1 (2)</p> <p>M1</p> <p>M1</p> <p>A1 A1</p> <p>awrt 0.497 A1 (5)</p> <p>(12 marks)</p>
<p>6. (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)(i)</p> <p>(ii)</p> <p>(e)</p>	$P(\text{Accept}) = P(X \leq 1 X \sim B(20, p))$ $= (1-p)^{20} + 20(1-p)^{19}p$ $= (1-p)^{19} (1 + 19p) \quad (*)$ $j = 0.880, k = 0.587$ <p>Graph</p> $p = 0.015 \Rightarrow P = 0.96 \Rightarrow P(\text{Reject}) = 0.04$ $p = 0.065 \Rightarrow P = 0.62 \Rightarrow P(\text{Reject}) = 0.38$ <p>High probability of acceptance for low p is OK but not very efficient since negative gradient is not steep enough</p>	<p>M1</p> <p>M1</p> <p>A1 cso (3)</p> <p>B1, B1 (2)</p> <p>axes and scales B1</p> <p>points B1</p> <p>OC curve B1 (3)</p> <p>B1</p> <p>M1 A1 (3)</p> <p>B1 B1 (2)</p> <p>(13 marks)</p>



Question Number	Scheme	Marks												
7. (a)(i)	$P(X = 2) = \frac{e^{-3} \times 3^2}{2!} = 4.5e^{-3}$	M1 A1												
(ii)	$P(X \geq 4) = 1 - P(X \leq 3), \quad = 1 - e^{-3} \left(1 + 3 + \frac{3^2}{2!} + \frac{3^3}{3!} \right)$ $= 1 - 13e^{-3}$	M1, A1 A1 (5)												
(b)	<table style="margin-left: 20px;"> <tr> <td>y:</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> <tr> <td>x:</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>≥4</td> </tr> </table> $P(Y = y): \quad e^{-3} \quad 3e^{-3} \quad 4.5e^{-3} \quad 4.5e^{-3} \quad 1 - 13e^{-3}$ $G_Y(t) = e^{-3}(t^0 + 3t + 4.5t^2 + 4.5t^3) + (1 - 13e^{-3})t^4$ $= e^{-3}(1 + 3t + 4.5t^2 + 4.5t^3 - 13t^4) \quad (*)$	y:	0	1	2	3	4	x:	0	1	2	3	≥4	B1 M1 A1 cso (3)
y:	0	1	2	3	4									
x:	0	1	2	3	≥4									
(c)	$G'_Y(t) = e^{-3}(3 + 9t + 13.5t^2 - 52t^3 + 4t^4)$ $\mu = E(Y) = G'_Y(1) = 4 - 26.5e^{-3} \text{ or } 2.68$ $G''_Y(t) = e^{-3}(9 + 27t - 156t^2) + 12t^2$ $G''_Y(1) = e^{-3}(-120) + 12 = 12 - 120e^{-3}$ $\sigma^2 = G''_Y(1) + G'_Y(1) - [G'_Y(1)]^2 \quad (= 1.52\dots)$ $\sigma = \sqrt{\sigma^2} = 1.23$	M1 A1 A1 M1 A1 A1 M1 A1(8) (15 marks)												