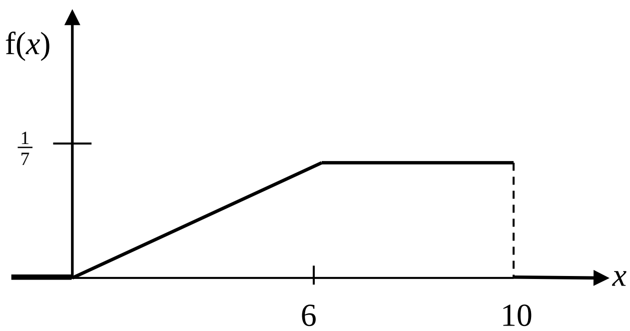
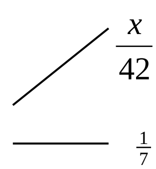
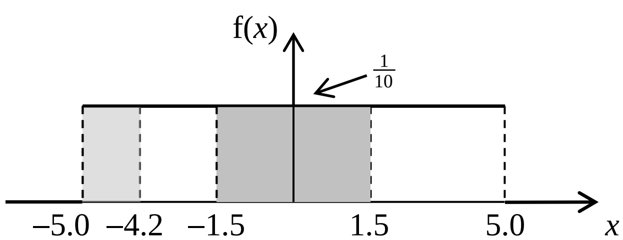
Mock Paper Mark Scheme

Advanced Subsidiary/Advanced GCE
General Certificate of Education

Question number	Scheme		Marks		
1. (*a*)			B1 B1		
		Labelled axes and < 0, > 10	B1		
		$\frac{1}{7}$, 6, 10	B1	(4)	
(*b*)	$P(X \geq 5) = 1 - P(X < 5)$	5 and $\int$ or area Δ	M1		
	$= 1 - \frac{5}{42} \times \frac{1}{2} \times 5$ (area of Δ)	full method	M1		
	$= 1 - \frac{25}{84} = \frac{59}{84}$		A1	(3)	
(*c*)	Probability it does *not* break down is $\left(\frac{59}{84}\right)^2$		M1		
	$\therefore$ probability it does break down is $1 - \left(\frac{59}{84}\right)^2 =$ (awrt) 0.507		A1	(2)	**(9)**
2.					
(*a*)	$P(X < -4.2) = \frac{0.8}{10} = 0.08$		B1	(1)	
(*b*)	$P(\lvert X \rvert < 1.5) = \frac{3}{10} = 0.3$		M1 A1	(2)	

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(*c*)	Y = no. of lengths with $\lvert X \rvert < 1.5$ $\quad\therefore\ Y \sim \mathrm{B}(10, 0.3)$	M1
	$\mathrm{P}(Y > 5) = 1 - \mathrm{P}(Y \le 5)$	M1
	$= 1 - 0.9527 \quad = \quad 0.0473$	A1 (3)
(*d*)	R = no. of lengths of piping rejected	
	$R \sim \mathrm{B}(60, 0.08) \Rightarrow R \approx \sim\mathrm{Po}(4.8)$ $\quad$ 4.8 or 60 × (*a*)	B1√
	$\mathrm{P}(R \le 2) = \mathrm{e}^{-4.8}\left[1 + 4.8 + \frac{(4.8)^2}{2!}\right]$ $\quad$ Po and ≤ 2, formula	M1, M1 A1√ (ft for their λ if full expression seen)
	$= 17.32 \times \mathrm{e}^{-4.8} = 0.1425\ldots$ $\quad$ (accept awrt 0.143)	A1 cao (5) **(11)**
3. (*a*)	D is continuous	B1 (1)
(*b*)	Sampling Frame is the list of competitors or their results, e.g. label the results 1—200 and randomly select 36 of them	B1 B1 (2)
(*c*)	X = no. of competitors with $A = 2$ $\quad X \sim \mathrm{B}(36, \frac{1}{3})$	
	$X \approx \sim\mathrm{N}(12, 8)$	M1 A1
	$\mathrm{P}(X \ge 20) \approx \mathrm{P}\left(Z \ge \frac{19.5 - 12}{\sqrt{8}}\right)$ $\quad \pm\frac{1}{2}$, ‘z’	M1, M1
	$= \mathrm{P}(Z \ge 2.65\ldots)$	A1
	$= 1 - 0.9960 \quad = \quad 0.004$	A1 (6)
(*d*)	Probability is very low, so assumption of $\mathrm{P}(A = 2) = \frac{1}{3}$ is unlikely. (Suggests $\mathrm{P}(A = 2)$ might be higher.)	B1, B1 (2) **(11)**

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4. (*a*)	X = no. of vases with defects $\quad X \sim B(20, 0.15)$	B1
	$P(X \leq 0) = 0.0388$ Use of tables to	M1
	$P(X \leq 6) = 0.9781 \quad \therefore P(X \geq 7) = 0.0219$ find each tail	M1
	$\therefore$ critical region is $X \leq 0$, or $X \geq 7$	A1, A1 (5)
(*b*)	Significance level = $P(X \leq 0) + P(X \geq 7) = 0.0388 + 0.0219 = 0.0607$	B1 (1)
(*c*)	$H_0: \lambda = 2.5, \quad H_1: \lambda > 2.5 \quad$ [or $H_0: \lambda = 10, \quad H_1: \lambda > 10$]	B1, B1
	Y = no. sold in 4 weeks. Under H_0 $Y \sim Po(10)$	M1
	$P(Y \geq 15) = 1 - P(Y \leq 14) = , \; 1 - 0.9165 = 0.0835$	M1, A1
	More than 5% so not significant. Insufficient evidence of an increase in the rate of sales.	A1 (6) **(12)**

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5. (*a*)	$F(1.5) = 1 \Rightarrow k(2 \times (1.5)^3 - (1.5)^4) = 1$	M1
	i.e. $k\left[2 \times \frac{27}{8} - \frac{81}{16}\right] = 1$	
	i.e. $k\left(\frac{108-81}{16}\right) = 1$ $\therefore k = \frac{16}{27}$ (*)	A1 cso (2)
(*b*)	$P(T > 1) = 1 - F(1)$, $= 1 - \frac{16}{27}(2-1) = \frac{11}{27}$	M1, A1 (2)
(*c*)	$f(t) = F'(t) =$, $\frac{16}{27}(6t^2 - 4t^3)$	M1, A1
	i.e. $f(t) = \begin{cases} \frac{32}{27}(3t^2 - 2t^3) & 0 \le t \le 1.5 \\ 0 & \text{otherwise} \end{cases}$ Full definition	B1 (3)
(*d*)	$E(T) = \int_0^{1.5} t\,f(t)\,dt = \frac{32}{27}\int_0^{1.5}(3t^3 - 2t^4)\,dt$ $\int t\,f(t)$	M1
	$= \frac{32}{27}\left[\frac{3t^4}{4} - \frac{2t^5}{5}\right]_0^{\frac{3}{2}}$	A1
	$= \frac{32}{27}\left[\left(\frac{243}{64} - \frac{2}{5} \times \frac{243}{32}\right) - (0)\right]$	
	$= \frac{9}{2} - \frac{18}{5} = 0.9$ (*)	A1 cso (3)
(*e*)	$F(E(T)) = \frac{16}{27}(2 \times 0.9^3 - 0.9^4) = 0.4752$ evidence seen	B1
(*f*)	$P(T > 1 \mid T > 0.9) = \dfrac{P(T>1)}{P(T>0.9)}$, $= \dfrac{\text{part }(b)}{1 - \text{part }(e)}$, $= 0.7763\ldots$	M1, M1,
	accept awrt 0.776	A1 (3)
		(14)

Question number	Scheme	Marks
6. (*a*)	X = no. of customers arriving in 10 minute period	
	$X \sim \text{Po}(3)$ $\quad$ $P(X \geq 4) = 1 - P(X \leq 3) =$, $\quad 1 - 0.6472 = 0.3528$	M1 A1 (2)
(*b*)	Y = no. of customers in 30 minute period $\quad Y \sim \text{Po}(9)$	B1
	$P(Y \leq 7) = 0.3239$	M1 A1 (3)
(*c*)	p = probability of no customers in 5 minute period = $e^{-1.5}$	B1
	C = number of 5 minute periods with no customers	
	$C \sim B(6, p)$	M1
	$P(C \leq 1)$, $= (1-p)^6 + 6(1-p)^5 p$	M1, M1 A1
	$= 0.59866\ldots$ (accept awrt 0.599)	A1 (6)
(*d*)	W = no. of customers on Wednesday morning	
	$3\frac{1}{2}$ hours = 210 minutes $\quad \therefore W \sim \text{Po}(63)$ ‘63’	B1
	Normal approximation $\quad W \approx \sim N(63, (\sqrt{63})^2)$	M1 A1
	$P(W > 49) \approx P(W \geq 49.5)$ $\quad \pm\frac{1}{2}$	M1
	$= P\left(Z \geq \frac{49.5 - 63}{\sqrt{63}}\right)$ standardising	M1
	$= P(Z \geq -1.7008)$	A1
	$= 0.9554$ (tables) (accept awrt 0.955 or 0.956)	A1 (7)