Question	Answer	Marks	Guidance
1	$\lambda = 4.4$	**B1**	
	$P(X<4) = e^{-4.4}(1 + 4.4 + \frac{4.4^2}{2} + \frac{4.4^3}{3!})$	**M1**	Allow any λ allow one end error
	$= 0.359$	**A1**	
		3	

Question	Answer	Marks	Guidance
2	A: N(6, 4.8)	**B1 B1**	B1 for N(6, ..) for either A or B. B1 for 4.8 (or 2.19^2) (or SD=2.19)
	B: N(6, 2.4)	**B1**	B1 For 2.4 (or 1.55^2) (or SD=1.55) (SR 3/3 but error seen withhold B1 so 2/3 scored)
		3	

Question	Answer	Marks	Guidance
3(i)	$52 \pm z \times \frac{6.5}{\sqrt{15}}$	**M1**	Expression of the correct form. Any z
	$z = 1.96$	**B1**	Seen or used
	48.7 to 55.3 (3 sf)	**A1**	Must be an interval
		3	

Question	Answer	Marks	Guidance
3(ii)	Narrower because more information or because $\frac{\sigma}{\sqrt{n}}$ smaller	**B1**	oe Accept 'sample size is larger' 'more employees' 'width inversely proportional to sq root of n' 'if n increases width decreases' '95% CI is 49.7 to 54.3' or similar. No contradictions
		1	

Question	Answer	Marks	Guidance
4(i)	Est(μ) = 495.9	**B1**	Accept 496
	Est(σ^2) = $\frac{10}{9}(\frac{2459283}{10} - "495.9"^2)$	**M1**	Attempt Σx^2 and subst in correct formula (1/9("2459283" – "4959"^{2}/10)). May be implied by correct answer
	= 12.8 (3 sf) or 383/30	**A1**	(Note: Biased var "11.49" scores M0 A0)
		3	
4(ii)	H_0: $\mu = 505$ H_1: $\mu < 505$ $\frac{\frac{75660}{150} - 505}{3.6 \div \sqrt{150}}$	**B1**	Allow 'Pop mean' but not just 'mean'
	= –2.04	**M1**	Correct stand'n; must have √150. No sd/var mixes. Condone sample SD (3.58/3.39) Accept standardisation of totals ((75660-75750)/44.091) Accept CV method
		A1	Accept +2.04 (Note: if valid area comparison done 0.0207/0.0206 or 0.979 needed for A1)
	comp z = –2.054	**M1**	Valid comparison of z's or area (0.0207/6>0.02; 0.979(3)<0.98)
	No evidence (at 2%) that machine pkts mean mass < 505	**A1ft**	oe No contradictions. SC Two tail test can score B0 M1 A1 M1 for comparison with 2.326 A0 (max 3/5)
		5	

Question	Answer	Marks	Guidance
4(iii)	Large sample, so sample mean approx normally distr'd	**B1**	Allow just 'Sample is large' or 'n is large' n>30
		1	

Question	Answer	Marks	Guidance
5(i)	$\frac{1}{2} \times a \times b = 1$	**M1**	Attempt Δ area = 1 or $\int(b – bx/a)\, dx = 1$ with correct limits
	$b = \frac{2}{a}$	**A1**	
		2	
5(ii)	grad = $-\frac{2}{a^2}$ or $-\frac{b}{a}$	**B1**	allow without '–' sign (could be implied or seen in **(i)**)
	$y - (\frac{2}{a}) =$ grad $\times x$ or $y =$ grad $\times (x – a)$	**M1**	correct use of $y = mx + c$ or $y - y_1 = m(x – x_1)$ with (0,b) or (a,0) including attempt at substitution of their b
	$y - (\frac{2}{a}) = -\frac{2}{a^2}x$ or $y = -\frac{2}{a^2}(x – a)$ and $y = \frac{2}{a} - \frac{2}{a^2}x$ **AG**	**A1**	No errors seen
		3	

Question	Answer	Marks	Guidance
5(iii)	$\int_0^a (\frac{2}{a}x - \frac{2}{a^2}x^2)\mathrm{d}x$	**M1**	Attempt int $xf(x)$ ignore limits
	$= [\frac{1}{a}x^2 - \frac{2}{3a^2}x^3]_0^a$	**A1**	Correct integration ignore limits
	$a - \frac{2}{3}a = 0.5$	**M1**	Sub correct limits into their integral and = 0.5
	$a = 1.5$	**A1**	
		4	

Question	Answer	Marks	Guidance
6(i)	Accidents occur independently or randomly	**B1**	In context. Allow 'singly'.
		1	
6(ii)	$e^{-2.5} \times \frac{2.5^4}{4!}$	**M1**	Poisson P(4), allow any λ
	= 0.134 (3 sfs)	**A1**	
		2	

Question	Answer	Marks	Guidance
6(iii)	$\lambda = \frac{25}{12}$ or 2.08(333)	**B1**	
	$1 - e^{-\frac{25}{12}}(1 + \frac{25}{12} + \frac{\frac{25}{12}^2}{2!} + \frac{\frac{25}{12}^3}{3!})$	**M1**	1 – Poisson P(0, 1, 2, 3), allow any λ allow one end error
	= 0.158 (3 sfs)	**A1**	As final answer
		3	
6(iv)	$N(\frac{1825}{84}, \frac{1825}{84})$ or N(21.7(26), 21.7(26))	**B1**	Stated or implied
	$\frac{29.5-\frac{1825}{84}}{\sqrt{\frac{1825}{84}}}$	**M1**	Allow with wrong or no cc with their mean/sd
	Φ("1.668")	**M1**	Correct area consistent with their working
	= 0.952 (3 sfs)	**A1**	
		4	

Question	Answer	Marks	Guidance
7(i)	H_0: P(10) = 0.1 H_1: P(10) > 0.1	**B1**	Both. Allow '*p*' for P(10)
	B(9,0.1) P($X \geqslant 3$) = $1 - (0.9^9 + 9\times0.9^8 \times 0.1 + {}^9C_2 \times 0.9^7 \times 0.1^2)$	**M1**	Allow one extra term in bracket
	= 0.05297... or 0.053(0)	**A1**	
	comp 0.01	**M1**	Valid comparison. (comparison with 0.99 can recover previous M1 A1 for 0.9470)
	No evidence (at 1% level) to reject H_0 Claim not justified	**A1ft**	No contradictions
		5	
7(ii)	H_0 not rejected oe	**B1**	
		1	
7(iii)	P($X \geqslant 4$) = "0.05297" – ${}^9C_3\times0.9^6\times0.1^3$	**M1**	or $1-(0.9^9 + 9 \times 0.9^8 \times 0.1 + {}^9C_2 \times 0.9^7 \times 0.1^2 + {}^9C_3 \times 0.9^6 \times 0.1^3)$
	= 0.00833	**A1**	Note: 0.05297 and 0.00833 both needed in **(i)** or **(iii)** to justify CV
	Hence crit value is 4	**B1**	Allow without working. Or in **(i)** May be implied by attempt at P($X < 4$) below
	B(9,0.5) P($X < 4$)	**M1**	stated or implied
	$= 0.5^9 + 9 \times 0.5^8 \times 0.5 + {}^9C_2 \times 0.5^7 \times 0.5^2 + {}^9C_3\times0.5^6\times0.5^3$	**M1**	Attempt P($X < 4$) with $p = 0.5$
	P(Type II) = 0.254 (3 sf)	**A1**	
		6	