1. (a) $P(D > 20) = P\left(Z > \frac{20-30}{8}\right)$ M1

$= P(Z > -1.25)$ A1

$=$ **0.8944** **awrt 0.894** A1 3

Note

M1 for an attempt to standardise 20 or 40 using 30 and 8.
1st A1 for $z = \pm 1.25$
2nd A1 for awrt 0.894

(b) $P(D < Q_3) = 0.75$ so $\frac{Q_3 - 30}{8} = 0.67$ M1 B1

$Q_3 =$ **awrt 35.4** A1 3

Note

M1 for $\frac{Q_3 - 30}{8}$ = to a z value

M0for 0.7734 on RHS.
B1 for (z value) between 0.67 ~ 0.675 seen.
M1B0A1 for use of $z = 0.68$ in correct expression with awrt 35.4

(c) 35.4 – 30= 5.4 so $Q_1 = 30 - 5.4$ = **awrt 24.6** B1ft 1

Note

Follow through using their of quartile values.

(d) $Q_3 - Q_1 = 10.8$ so $1.5(Q_3 - Q_1) = 16.2$ so $Q_1 - 16.2 = h$
or $Q_3 + 16.2 = k$ M1

h=**8.4 to 8.6** and k= **51.4 to 51.6** both A1 2

Note

M1 for an attempt to calculate 1.5(IQR) and attempt to add or subtract using one of the formulae given in the question – follow through their quartiles

(e) $2P(D > 51.6) = 2P(Z > 2.7)$ M1

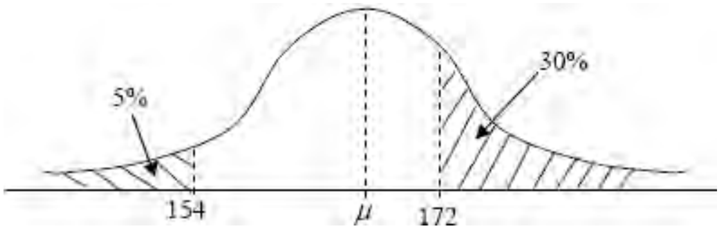
$= 2[1 - 0.9965] =$ awrt **0.007** M1 A1 3

Note

1st M1 for attempting $2P(D >$ their $k)$ or $(P(D >$their $k) + P(D <$ their $h))$
2nd M1 for standardising their h or k (may have missed the 2) so allow for standardising $P(D > 51.6)$ or $P(D < 8.4)$
Require boths Ms to award A mark.

[12]

2. (a)



bell shaped, must have inflexions	B1	
154,172 on axis	B1	
5% and 30%	B1	3

Note

2nd B1 for 154 and 172 marked but 154 must be $< \mu$ and $172 > \mu$. But μ need not be marked.

Allow for $\frac{154-\mu}{\sigma}$ and $\frac{172-\mu}{\sigma}$ marked on appropriate sides of the peak.

3rd B1 the 5% and 30% should be clearly indicated in the correct regions i.e. LH tail and RH tails.

(b) $P(X<154) = 0.05$ M1

$\frac{154-\mu}{\sigma} = -1.6449$ or $\frac{\mu-154}{\sigma} = 1.6449$ B1

$\mu = 154 + 1.6449\sigma$ * * given * * A1 cso 3

Note

M1 for $\pm\frac{(154-\mu)}{\sigma} = z$ value (z must be recognizable e.g. 1.64, 1.65, 1.96 but NOT 0.5199 etc)

B1 for $\pm$ 1.6449 seen in a line before the final answer.

A1cso for no incorrect statements (in μ, σ) equating a z value and a probability or incorrect signs e.g. $\frac{154-\mu}{\sigma}=0.05$ or $\frac{154-\mu}{\sigma}=1.6449$ or $P(Z<\frac{\mu-154}{\sigma})=1.6449$

(c) $172 - \mu = 0.5244\sigma$ or

$\frac{172-\mu}{\sigma} = 0.5244$ (allow z = 0.52 or better here but must be in an equation) B1

Solving gives $\sigma = 8.2976075$ (**awrt 8.30**) and $\mu = 167.64873$ (**awrt 168**) M1 A1 A1 4

Note

B1 for a correct 2nd equation (NB $172 - \mu = 0.525\sigma$ is B0, since z is incorrect)

M1 for solving their two linear equations leading to $\mu = \ldots$ or $\sigma = \ldots$

1st A1 for σ = awrt 8.30, 2nd A1 for μ = awrt 168
[NB the 168 can come from false working.

These A marks require use of correct equation from (b), and a z value for "0.5244" in (c)]

NB use of z = 0.52 will typically get σ =8.31 and μ = 167.67… and score B1M1A0A1

No working and both correct scores 4/4, only one correct scores 0/4

Provided the M1 is scored the A1s can be scored even with B0 (e.g. for z =0.525)

(d) P(Taller than 160cm) = $P\left(Z > \dfrac{160-\mu}{\sigma}\right)$ M1

$= P(Z < 0.9217994)$ B1

$= 0.8212$ **awrt 0.82** A1 3

Note

M1 for attempt to standardise with 160, their μ and their σ (> 0). Even allow with symbols μ and σ.

B1 for z = awrt $\pm$ 0.92

No working and a correct answer can score 3/3 provided σ and μ are correct to 2sf.

[13]

3. (a) Let the random variable X be the lifetime in hours of bulb

$P(X < 830) = P(Z < \dfrac{\pm(830-850)}{50})$ Standardising with 850 and 50 M1

$= P(Z < -0.4)$

$= 1 - P(Z < 0.4)$ Using 1-(probability >0.5) M1

$= 1 - 0.6554$

$= 0.3446$ or 0.344578 by calculator awrt 0.345 A1 3

Note

If 1-z used e.g. 1 – 0.4=0.6 then award second M0

	(b)	0.3446×500	Their (a) × 500	M1	
		$= 172.3$	Accept 172.3 or 172 or 173	A1	2
	(c)	Standardise with 860 and σ and equate to z value $\frac{\pm(818-860)}{\sigma} = z$ value		M1	
		$\frac{818-860}{\sigma} = -0.84(16)$ or $\frac{860-818}{\sigma} = 0.84(16)$ or $\frac{902-860}{\sigma} = 0.84(16)$ or equiv.		A1	
		$\sigma = 49.9$	±0.8416(2)	B1	
			50 or awrt 49.9	A1	4

Note

M1 can be implied by correct line 2

A1 for completely correct statement or equivalent.

Award B1 if 0.8416(2) seen

Do not award final A1 if any errors in solution e.g. negative sign lost.

	(d)	Company Y as the ***mean*** is greater for Y.	both	B1	
		They have (approximately) the same ***standard deviation*** or ***sd***		B1	2

Note

Must use statistical terms as underlined.

[11]

4.	(a)	$P(X < 39) = P\left(Z < \frac{39-30}{5}\right)$		M1	
		$= P(Z < 1.8) = \underline{0.9641}$	(allow awrt 0.964)	A1	2

Note

M1 for standardising with $\sigma, z = \pm\frac{39-30}{5}$ is OK

A1 for 0.9641 or awrt 0.964 but if they go on to calculate 1 – 0.9641 they get M1A0

(b)	$\text{P}(X < d) = \text{P}\left(Z < \frac{d-30}{5}\right) = 0.1151$			
	$1 - 0.1151 = 0.8849$		M1	
	$\Rightarrow \quad z = -1.2$	(allow $\pm$ 1.2)	B1	
	$\therefore \frac{d-30}{50} = -1.2$	$\underline{d = 24}$	M1A1	4

Note

1st M1 for attempting $1 - 0.1151$. Must be seen in (b) in connection with finding d

B1 for $z = \pm 1.2$. They must state $z = \pm 1.2$ or imply it is a z value by its use.
This mark is only available in part (b).

2nd M1 for $\left(\frac{d-30}{5}\right)$ = their negative z value (or equivalent)

(c)	$\text{P}(X > e) = 0.1151$ so $e = \mu + (\mu -$ their $d)$ or $\frac{e-30}{5} = 1.2$ or $-$ their z		M1	
		$e = 36$	A1	2

Note

M1 for a full method to find e. If they used $z = 1.2$ in (b) they can get M1 for $z = \pm 1.2$ here If they use symmetry about the mean $\mu +$ $(\mu -$ their $d)$ then ft their d for M1 Must explicitly <u>see</u> the method used unless the answer is correct.

(d)	$\text{P}(d < X < e) = 1 - 2 \times 0.1151$		M1	
	$= 0.7698$	AWRT $\underline{0.770}$	A1	2

Note

M1 for a complete method or use of a correct expression e.g. "their 0.8849" – 0.1151 <u>or</u> **If their *d* < their *e*** using their values with $\text{P}(X < e) - \text{P}(X < d)$ If their $d \geq$ their e then they can only score from an argument like 1 – 2x0.1151 A negative probability or probability > 1 for part (d) scores M0A0

[10]

5.	(a)	$z = \frac{53-50}{2}$	Attempt to standardise	M1	
		$P(X > 53) = 1 - P(Z < 1.5)$	1-probability required can be implied	B1	
		$= 1 - 0.9332$			
		$= 0.0668$		A1	3
		M1 for using 53,50 and 2, either way around on numerator B1 1– any probability for mark A1 0.0668 cao			
	(b)	$P(X \le x_0) = 0.01$		M1	
		$\frac{x_0 - 50}{2} = -2.3263$		M1B1	
		$x_0 = 45.3474$	awrt 45.3 or 45.4	M1A1	5
		M1 can be implied or seen in a diagram or equivalent with correct use of 0.01 or 0.99 M1 for attempt to standardise with 50 and 2 numerator either way around B1 for ± 2.3263 M1 Equate expression with 50 and 2 to a z value to form an equation with consistent signs and attempt to solve A1 awrt 45.3 or 45.4			
	(c)	P(2 weigh more than 53kg and 1 less) $= 3 \times 0.0668^2\ (1 - 0.0668)$		B1M1A1ft	
		$= 0.012492487..$	awrt 0.012	A1	4
		B1 for 3, M1 $p^2(1-p)$ for any value of p A1ft for p is their answer to part (a) without 3 A1 awrt 0.012 or 0.0125			

[12]

6.	(a)	200 or 200g		B1	1
		"mean = 200g" is B0 but "median = 200" or just "200" alone is B1			
	(b)	$P(190 < X < 210) = 0.6$ or $P(X < 210) = 0.8$ or $P(X > 210) = 0.2$ or diagram (o.e.)		M1	
			Correct use of 0.8 or 0.2	A1	
		$Z = (\pm)\frac{210-200}{\sigma}$		M1	
		$\frac{10}{\sigma} = 0.8416$	0.8416	B1	
		$\sigma = 11.882129....$	AWRT 11.9	A1	5

1st M1 for a correct probability statement (as given or eg P(200 < X < 210) = 0.3 o.e.) or shaded diagram – must have values on z-axis and probability areas shown

1st A1 for correct use of 0.8 or $p = 0.2$. Need a correct probability statement. May be implied by a suitable value for z seen (e.g. $z = 0.84$)

2nd M1 for attempting to standardise. Values for x and μ used in formula. Don't need z = for this M1 nor a z-value, just mark standardization.

B1 for $z = 0.8416$ (or better) [$z = 0.84$ usually just loses this mark in (a)]

2nd A1 for AWRT 11.9

(c)	$P(X < 180) = P\left(Z < \frac{180-200}{\sigma}\right)$	M1	
	$= P(Z < -1.6832)$		
	$= 1 - 0.9535$	M1	
	$= 0.0465$ or AWRT 0.046	A1	3

1st M1 for attempting to Standardise with 200 and their sd(>0) e.g. $(\pm)\frac{180-200}{\text{their }\sigma}$

2nd M1 **NB on epen this is an A mark ignore and treat it as 2nd M1** for 1 – a probability from tables provided compatible with their probability statement.

A1 for 0.0465 or AWRT 0.046 (Dependent on both Ms in part (c))

Standardization in (b) and (c). They must use σ not σ^2 or $\sqrt{\sigma}$.

[9]

7.	(a)	$P(X > 25) = P\left(Z > \frac{25-20}{4}\right)$	M1	
		$= P(Z > 1.25)$	M1	
		$= 1 - 0.8944$		
		$= 0.1056$	A1	3

Standardised with 20 and 4 for M1, allow numerator 20 – 25
1- probability for second M1
Anything that rounds to 0.106 for A1.
Correct answer with no working award 3/3

(b)	$P(X < 20) = 0.5$ **so** $P(X < d) = 0.5 + 0.4641 = 0.9641$		B1	
	$P(Z < z) = 0.9641$, $z = 1.80$		B1	
	$\frac{d - 20}{4} = 1.80$		M1	
	$d = 27.2$		A1	4

0.9641 seen or implied by 1.80 for B1
1.80 seen for B1
Standardised with 20 and 4 and equate to z value for M1
Z = 0.8315 is M0
Anything that rounds to 27.2 for final A1.
Correct answer with no working 4/4

[7]

8.	(a)	$P(X < 91) = P(Z < \frac{91-100}{15})$	Attempt standardisation	M1	
		$= P(Z < -0.6)$		A1	
		$= 1 - 0.7257$		M1	
		$= 0.2743$	awrt **<u>0.274</u>**	A1	4

1st M1 for attempting standardisation. $\pm\frac{(91-\mu)}{\sigma \text{ or } \sigma^2}$.
Can use of 109 instead of 91.Use of 90.5 etc is M0

1st A1 for – 0.6 (or + 0.6 if using 109)

2nd M1 for 1 – probability from tables. Probability should be > 0.5)

(b)	$1 - 0.2090 = 0.7910$	0.791	B1	
	$P(X > 100 + k) = 0.2090$ <u>or</u> $P(X < 100 + k) = 0.7910$ (May be implied)		M1	
		Use of tables to get $z = 0.81$	B1	
	$\frac{100 + k - 100}{15}$, $= 0.81$ (ft their $z = 0.81$, but must be z not prob.)		M1, A1ft	
	<u>***k* = 12**</u>		A1cao	6

1st B1 for 0.791 seen or implied.

1st M1 for a correct probability statement, but must use X or Z correctly. Shown on diagram is OK

2nd B1 for awrt 0.81 seen (or implied by correct answer – see below) (Calculator gives 0.80989…)

2nd M1 for attempting to standardise e.g. $\frac{100+k-100}{15}$ or $\frac{\text{k}}{15}$

$\frac{X-100}{15}$ scores 2nd M0 until the 100+ k is substituted to give k,

but may imply 1st M1 *if* k = 112.15 seen

1st A1ft for correct equation for k (as written or better). Can be implied by k = 12.15 (or better)

2nd A1 for k = 12 only.

<u>Answers only</u>

k = 112 or 112.15 or better scores 3/6 (on EPEN give first 3 marks)

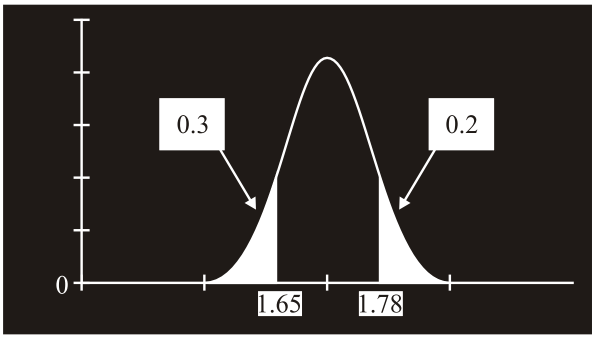
k = 12.15 or better (calculator gives 12.148438…) scores 5/6 (i.e loses last A1 only)

k = 12 (no incorrect working seen) scores 6/6

Using 0.7910 instead of 0.81 gives 11.865 which might be rounded to 12. This should score no more than B1M1B0M1A0A0.

[10]

9. (a)



2 separate sketches OK.

Bell shape	B1	
1.78 & 0.2	B1	
1.65 & 0.3	B1	3

Accept clear alternatives to 0.3; 0.7 / 0.5 / 0.2

(b)	$\frac{1.78-\mu}{\sigma}=0.8416 \Rightarrow 1.78-\mu=0.8416\sigma$		M1	
	either for method			
	0.8416		B1	
	$\frac{1.65-\mu}{\sigma}=-0.5244 \Rightarrow 1.65-\mu=-0.5244\sigma$		B1	
	(–)0.5244			
	N.B. awrt 0.84, 0.52 B1B0			
	awrt 1.7, 0.095 cao		M1 A1 A1	6
(c)	P(height ≥ 1.74) = 1 – P (height < 1.74)		M1	
	'one minus'			
	$=1-\mathrm{P}\left(Z<\frac{1.74-1.70}{0.095}\right)$		M1	
	standardise with their mu and sigma			
	$=1-P(Z<0.42)=0.3372$		A1	3
	awrt 0.337			

[12]

10.	(a)	Let H be rv height of athletes, so $H \sim \mathrm{N}(180, 5.2^2)$			
		$\mathrm{P}(H > 188) = \mathrm{P}(Z > \frac{188-180}{5.2}) = \mathrm{P}(Z > 1.54) = 0.0618$			
			± stand √, sq, awrt 0.062	M1 A1 A1	3
	(b)	Let W be rv weight of athletes, so $W \sim \mathrm{N}(85, 7.1^2)$		M1 A1	2
		$\mathrm{P}(W < 97) = \mathrm{P}(Z < 1.69) = 0.9545$	standardise, awrt 0.9545	M1 A1ft	
	(c)	$\mathrm{P}(H > 188 \ \&\ W < 97) = 0.0618(1–0.9545)$ $= 0.00281$	allow (a)×(b) for M awrt 0.0028	A1	3
	(d)	Evidence suggests height and weight are positively correlated / linked Assumption of independence is not sensible		B1	1

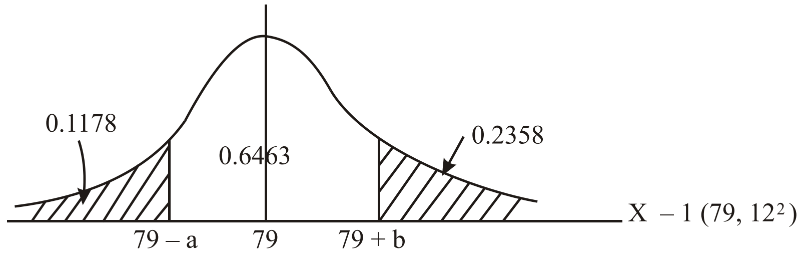
[9]

11.	(a)	$M \sim N(155, 3.5^2)$		
		$P(M > 160) = P\left(z > \frac{160-155}{3.5}\right)$	M1	
		standardising $\pm(160 - 155)$, σ, σ^2, $\sqrt{\sigma}$		
		$= P(z > 1.43)$	A1	
		$= 0.0764$	a1	3
	(b)	$P(150 \le M \le 157) = P(-1.43 \le z \le 0.57)$	B1 B1	
		awrt –1.43, 0.57		
		$= 0.7157 - (1 - 0.9236)$	M1	
		p > 0.5		
		$= 0.6393$	A1	4
		0.6393 – 0.6400 4dp		
		Special case: answer only B0 B0 M1 A1		
	(c)	$P(M \le m) = 0.3 \Rightarrow \frac{m-155}{3.5} = -0.5244$	B1 M1 A1	
		–0.5244 *att stand = z value* *for A1 may use awrt to –0.52.*		
		$m = 153.2$	cao A1	4

[11]

12.	(a)	$\mathrm{P}(X < 70) = \mathrm{P}(Z < \frac{70-79}{12})$	M1	
		standardise 79, 12 or 79, 144		
		$= \mathrm{P}(Z < -0.75) = 0.2266$	A1A1	3
		+ or -0.75, 0.2266		
	(b)	$\mathrm{P}(64 < X < 96) = \mathrm{P}(\frac{64-79}{12} < Z < \frac{96-79}{12})$	M1	
		standardise both, 79& 12 only		
		+ or –1.25 & 1.42, 0.8166	A1,A1	3
		Accept 0.8160-0.8170		

(c)



Shaded area = $\frac{1}{3}(1 - 0.6463)$ M1A1

=0.1179 cso A1 3

(d) $P(X \le 79 + b) = 0.7642$ B1 implied

0.7642

$\Rightarrow \frac{b}{12} = 0.72$ M1A1

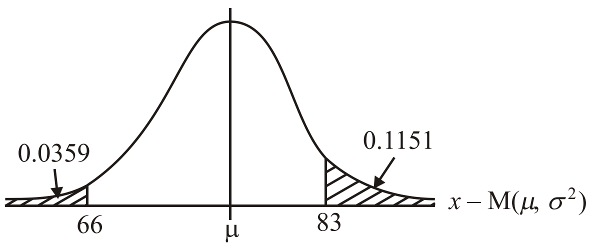
standardise LHS = z-value, all correct

$b = 8.64$ A1 4

3sf

[13]

13. (a)



Bell shaped curve & 4 values B1 1

(b) (i) $P\left(Z \le \frac{66-\mu}{\sigma}\right) = 0.0359 \Rightarrow 66 - \mu = -1.80\sigma$ –1.80 B1 seen

Clear attempt including standardization either way, or equivalentM1,A1

$81 - \mu = 1.20\sigma$ 1.20, or equivalent B1A1

Subtracting $15 = 1.20\sigma + 1.80\sigma \Rightarrow \sigma = 5$ **given answer*

Clear attempt to solve, cso M1A1

$\mu = 66 + 1.8 \times 5 = 75$ B1 8

(c) $P(69 \le X \le 83) = P\left(\frac{69-75}{5} \le Z \le \frac{83-75}{5}\right)$ standardize both either way M1

$= P(-1.20 \le Z \le 1.60)$ $-1.20, 1.60$ A1 seen

$= 0.8301$ 4 dp A1 3

[12]

14. (a) $S_{xx} = 10164 - \frac{272^2}{8} = 916$ M1,A1

Any one method, cao

$S_{yy} = 13464 - \frac{320^2}{8} = 664$ A1

cao

$S_{xy} = 11222 - \frac{272 \times 320}{8} = 342$ A1 4

cao

(**Or** 114.5,83 & 42.75)

(b) $r = \frac{342}{\sqrt{916 \times 664}} = 0.43852$ M1A1ftA1 3

formula, all correct ($\sqrt{608224}$), 0.439

(c) Slight / weak evidence, B1

students perform similarly in pressups and situps B1 2

context for +ve

(d) $\bar{x} = \frac{272}{8} = 34$ M1A1

$s = \sqrt{\frac{10164}{8} - 34^2} = \sqrt{114.5} = 10.700$ M1A1 4

method includes $\sqrt{\ }$ *, awrt 10.7*

OR *divisor (n – 1) awrt 11.4*

(e) $a = 1.96 \times 10.700\ldots = 20.9729$ (or 22.4 divisor (n – 1)) 1.96B1

$1.96 \times s$, 21.0 or 22.4 M1A1 3

	(f)	Pressups discrete, Normal continuous	B1	
		Not a very good assumption	B1 dep	2
				[18]

15. Let L represent length of visit $\therefore L \sim N(90, \sigma^2)$

(a) $P(L < 125) = 0.80$ or $P(L > 125) = 0.20$

$\therefore P\left(Z < \frac{125-90}{\sigma}\right) = 0.8 \;\therefore P\left(Z > \frac{125-90}{\sigma}\right) = 0.20$ M1

Standardising ±(125 – 90), σ/σ²/√σ

$\therefore \frac{125-90}{\sigma} = 0.8416$ B1

$\frac{\pm(125-90)}{\sigma} = z$ value M1

$\therefore \sigma = \frac{35}{0.8416} = \underline{41.587\ldots}$ A1 4

AWRT 41.6

(b) $P(L < 25) = P\left(Z < \frac{25-90}{41.587\ldots}\right)$ M1

Standardising 25, 90, their σ +ve

$= P(Z < -1.56)$

$= 1 - P(Z < 1.56)$ M1

For use of symmetry or $\Phi(-z) = 1 - \Phi(z)$; p< 0.5

$= \underline{0.0594}$ A1 3

(c) Normal is not suitable

$90 + 2\sigma = 173.\dot{3} \Rightarrow 7.07$ pm for latest arrival B1

Comment based on 2σ/3σ rule

$90 + 3\sigma = 215 \Rightarrow 6.25$ pm for latest arrival B1 2

[9]

16. (a) Symmetrical (about the mean μ)

Mode = mean = median

Horizontal axis asymptotic to curve B1;B1;B1 3

Distribution is 'bell shaped' – accept sketch

95% of data lies within 2 sd's of the mean

Any 3 sensible properties

(b) $X \sim N(27, 10^2)$

$\therefore P(26 < x < 28) = P\left(\frac{26 - 27}{10} < Z < \frac{28 - 27}{10}\right)$

Standardising with $\mu = 27$, M1

$\sigma = 10$ or $\sqrt{10}$ A1

One correct (seen)

$= P(-0.1 < Z < 0.1)$ -0.1 or 0.1 A1

$= \Phi(0.1) - \{1 - \Phi(0.1)\}$

or $2 \times \{\Phi(0.1) - 0.5\}$

$= \underline{0.0796}$ $\underline{0.0796 \text{ or } 0.0797}$ A1 4

Data is continuous	B0
Area under curve = 1	B0
Limits are $-\infty$ & ∞	B0
IQR contains 50% of data	B0
68% between $\mu \pm \sigma$	B1
Most of data within 3 s.d of mean	B1
No +ve or –ve skew	B1
Never touches axes at either side *(ie asymptotic)*	B1

17. (a) (i) Let X represent amount of sauce in a jar.

$\therefore X \sim N(505, 10^2)$

$\therefore P(X < 500) = P(Z < \frac{|500 - 505|}{10})$ M1

Standardising with 505, 10

$= P(Z < -0.5)$ A1

-0.5

$= 1 - 0.6915$

$\underline{= 0.3085}$ A1

(ii) Expected number $= 30 \times 0.3085$ M1

$30 \times$ (i)

$= \underline{9.255}$ *or* 9.26 *or* 9.3 A1 5

(b) P(X < 500) = 0.01 A1

Or clearly labelled diagram 500 & 0.01 marked.

$\therefore \frac{500-\mu}{10} = -2.3263$ M1

Standardising 500, 10, z-value

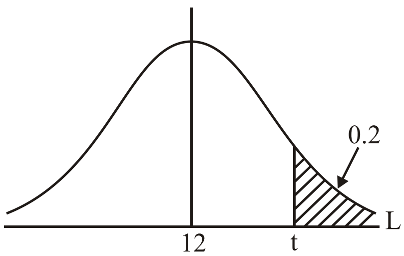
–2.3263 B1

$\underline{\therefore \mu = 523.263}$ A1 4

3 s.f. 523

[9]

18.



Let L represent lifetimes $\therefore L \sim N(12, 3^2)$

P(L > t) = 0.2 or P(Z > $\frac{t-12}{3}$) = 0.2 or diagram M1

$\therefore \frac{t-12}{3} = 0.8416$

$\therefore \underline{t = 14.5248}$

*0.8146*B1

Allow $\sigma, \sigma^2, \sqrt{\sigma}$ $\frac{t-\mu}{\sigma} = \delta$ M1

all correct A1

solving M1

14.5 A1 6

[6]

Alternative

$P(L > t) = 0.2$ M1

$\therefore\ P(L \le t) = 0.8$

$\therefore\ \dfrac{t-12}{3} = 0.84(18)$

$\therefore\ \underline{t = 14.52(14.5254)}$

0.84(18) B1

$\dfrac{t-12}{3} = 0.84(18)$ A1

solving M1

14.5 A1

19. Let X represent amount dispersed into cups

$\therefore\ X \sim N(55, \sigma)$

(a) $P(X < 50) = 0.10 \Rightarrow \dfrac{50-55}{\sigma} = -1.2816$ M1 B1

$\sigma = 3.90137$ M1 A1 4

(b) $P(X > 61) = P(Z > \dfrac{61-55}{3.90137...})$ M1

$= P(Z > 1.54)$ A1

$= 1 - 0.90382 = 0.0618$; 6.18% A1 3

(c) Let Y represent new amount dispensed.

$\therefore\ Y \sim N(\mu, 3)$

$P(Y < 50) = 0.025 \Rightarrow \dfrac{50-\mu}{3} = -1.96$ M1 B1

$\mu = 55.88$ M1 A1 4

[11]

20. Let J represent the weight of a Jar $\therefore\ J \sim N(260.00, 5.45^2)$

$\therefore\ P(J < 266) = P\left(Z < \dfrac{266-260}{5.45}\right)$ M1 A1

$= P(Z < 1.10)$

$= 0.8643$ A1

(NB: calculator gives 0.86453: accept 0.864 – 0.865)

Let C represent weight of coffee in a Jar $\therefore$ $C \sim \text{N}(101.8, 0.72^2)$

$\therefore$ $\text{P}(C < 100) = \text{P}\left(Z < \frac{100 - 101.8}{0.72}\right)$ M1 A1

$= \text{P}(Z < -2.50)$ A1

$= 0.0062$

$\therefore$ $\text{P}(J < 266 \;\&\; C < 100) = 0.8643 \times 0.0062$ M1

$= 0.0054$ A1 8

[8]