| **Question** | **Scheme** | | | **Marks** |
| --- | --- | --- | --- | --- |
| **1(a)** | awrt + 1.40 | | | B1 |
| (o.e) | | | M1A1ft |
| (or awrt 16.0) | | | A1 |
|  |  | | | **(4)** |
| **1(b)** | 0.4192 | | | B1 |
|  |  | | | **(1)** |
|  |  | | | **(5 marks)** |
| **2(a)** |  | | | M1 |
| P(*Z* < -0.70) = 1 - 0.7580 | | | M1 |
| = 0.2420 **(awrt 0.242)** | | | A1 |
|  |  | | | **(3)** |
| **2(b)** | [P(*T* < *t* )=0.30 implies] *z* = | | | M1 A1 |
|  | | | M1 |
| *t* = awrt 15.28 (allow awrt 15.28/9) | | | A1 |
|  |  | | | **(4)** |
|  |  | | | **(7 marks)** |
| **3(a)** |  | | | M1 |
|  | | | A1 |
| = **awrt 0.309** | | | A1 |
|  |  | | | **(3)** |
| **3(b)** | (Calc gives 1.036433...) | | | M1B1A1 |
| ***d =* 14.5**  (Calc gives 14.4727...) | | | A1 |
|  |  | | | **(4)** |
| **3(c)** | [P(*X* > *μ*  + 15 | *X* > *μ* – 15) = ] | | | M1 |
| = | | | A1 |
| = or **awrt 0.538** | | | A1 |
|  |  | | | **(3)** |
|  |  | | | **(10 marks)** |
| **4(a)** |  | | | M1 A1 |
| *k* = *n* + 1 | | | A1 |
|  |  | | | **(3)** |
| **4(b)** |  | | | M1 A1 |
| = | | | A1cao |
|  |  | | | **(3)** |
| **4(c)** |  | | | M1 |
| = | | | A1cao |
|  |  | | | **(2)** |
| **4(d)** | Var (*X*) =  = | | | M1 |
| Var (3*X*) = 9 Var (*X*) | | | M1 |
| = oe or 0.3375 or 0.338 | | | A1cso |
|  |  | | | **(3)** |
|  |  | | | **(11 marks)** |
| **5(a)** | 24 and 28 (above the mean)  For 0.80 and 0.05 (clearly indicated)  28  24  0.05  0.80 | | | B1  B1 |
|  |  | | | **(2)** |
| **5(b)** | 15% | | | B1 |
|  |  | | | **(1)** |
| **5(c)** | or | | | M1 |
| 0.8416 and 1.6449 seen | | | B1 |
| , | | | A1 A1 |
| eliminating  or | | | M1 |
| **awrt** 4.98 | | | A1 |
| **awrt** 19.8 | | | A1 |
|  |  | | | **(7)** |
| **5(d)** | *z =* | | | M1 |
| = | | | dM1 |
| 1  0.9418 = 0.0582 **awrt** 0.06 | | | A1 |
|  |  | | | **(3)** |
|  |  | | | **(13 marks)** |
| **6(a)** | [Let *X* be the amount of beans in a tin. P(*X* < 200) = 0.1] | | |  |
| [calc gives 1.28155156…] | | | M1 B1 |
| = 209.996…. awrt 210 | | | A1 |
|  |  | | | **(3)** |
| **6(b)** | P(*X* > 225) = | | | M1 |
| =  or 1 – P(*Z* < 1.92) (allow 1.93) | | | A1 |
| = 1 – 0.9726 = 0.0274 (or better) [calc gives 0.0272037…] | | |  |
| = 0.0274 | | |  |
| = awrt **2.7%** allow **0.027** | | | A1 |
|  |  | | | **(3)** |
| **6(c)** | [Let *Y* be the new amount of beans in a tin] | | |  |
| or  [calc gives 2.3263478…] | | | M1 B1 |
|  | | | dM1 |
| (2.14933…) | | | A1 |
|  |  | | | **(4)** |
|  |  | | | **(10 marks)** |
| **7(a)** | The random variable *H* ~ height of females  [] | | | M1 |
|  | | | M1 |
| = 0.1056 (calc 0.1056498…) **awrt 0.106** (accept 10.6%) | | | A1 |
|  |  | | | **(3)** |
| **7(b)** | [] | | | M1 |
| = 0.0062 (calc 0.006209…) awrt 0.0062 or | | | A1 |
| [P( *H* >180| *H* >170)] = | | | M1 |
| = 0.0587 (calc 0.0587760…) **awrt 0.0587 or 0.0588** | | | A1 |
|  |  | | | **(4)** |
| **7(c)** | P(*H* > *h* |*H* >170) (= 0.5) or | | | M1 |
| [P(*H* > *h*)] =  = 0.0528 (calc 0.0528249…)  or [P(*H* < *h*)] = 0.9472 | | | A1ft |
| (calc 1.6180592…) | | | M1 B1 |
| *h* = awrt 173 cm **awrt 173** | | | A1 |
|  |  | | | **(5)** |
|  |  | | | **(12 marks)** |
| **8(a)** | P(*W <* 224) = P | | | M1 |
| = P (*z* < -1.6) | | |  |
| = 1 – 0.9452 | | | M1 |
| = 0.0548 awrt 0.0548 | | | A1 |
|  |  | | | **(3)** |
| **8(b)** | 0.5 – 0.2 = 0.3 0.3 or 0.7 seen | | | M1 |
| 0.5244 seen; any *z* | | | B1 M1 |
| *w* = 234.622 awrt 235 | | | A1 |
|  |  | | | **(4)** |
| **8(c)** |  | | | M1 |
|  | | | M1 A1 |
|  |  | | | **(3)** |
|  |  | | | **(10 marks)** |
| **9** | N (0.2*n*, 0.16*n*) | Mean = 0.2*n* and Var = 0.16*n* oe  This may be awarded if they appear in the standardisation as 0.2*n* and either 0.16*n* or | | B1 |
| P= 0.0401 | Using a continuity correction either 55.5 or 54.5 | | M1 |
| = 1.75 | B1: Using a *z* = awrt ± 1.75  M1: Standardising using either 55.5, 54.5 or 55 and equal to a *z* value. Follow through their mean and variance. If they have not given the mean and Var earlier then they must be correct.  A1: A correct equation. May be awarded for = 1.75  Condone use of inequality sign rather than equals sign. | | B1M1A1 |
| 0.2*n* + 0.7 – 55 = 0 | This is dependent on the previous method mark being awarded. Using either the quadratic formula or completing the square or factorising or any correct method to solve **their 3 equations**. If they write the formula written down then it must be correct for their equation. May be implied by correct answer of = 15 or 342.25  **NB** you may award this mark if they use  54.5 for awrt 14.9, – 18.4, 221 or 337  55 for awrt – 18.4, 223, or – 117  If the answer is not one of these then the method for solving their 3 term equation must be seen. | |  |
| = 15 | Allow 15 or – 18.5 do not need to see *n*  or  Condone *n* = 15 or *n* = – 18.5 | | A1 |
| *n* = 225 | Cao 225 do not need to see see *n*  or | | A1 |
|  |  | | | **(8 marks)** |
|  | Alternative method for last 3 marks  (0.2*n* – 55)2 = (– 0.7)2  0.04 *n*2 – 22.69*n* + 3080.25 = 0  *n* = 225 or 1369/4  *n* = 225 | | M1 solving 3 term quadratic in *n* as above  A1 either 225 or 1369/4 or 342.25  A1 must select 225 |  |
| **10(a)** | P(*M* < 10) = P = 0.1 | | |  |
| ⇒ =, – 1.2816 | | | M1  B1 |
|  | | | A1 |
|  |  | | | **(3)** |
| **10(b)** | *T* represents number less than 12 minutes. *T* ~ B(15, 0.1) | | | B1 |
| P(*T* ≤ 1) | | | M1 |
| = 0.549 | | | A1 |
|  |  | | | **(3)** |
| **10(c)** | [ *T* ~ number of people who take less than 12 mins to complete the test]*T*~ B(*n*, 0.1) | | |  |
| *T* can be approximated by N( 0.1*n*, 0.09*n*) | | | B1 |
| = 0.3085 | | | M1 |
| or | | | B1 |
| M1 |
| A1 |
|  | | | M1A1 |
| *n* = 100 | | | A1cso |
|  |  | | | **(8)** |
|  |  | | | **(14 marks)** |

|  |  |  |  |  |  |
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|  | **Source paper** | **Question number** | **New spec references** | **Question description** | **New AOs** |
| 1 | S1 2011 | 2 | A 4.2 | Normal distribution | 1.1b, 3.1a |
| 2 | S1 2011 | 4 | A 4.2 | Normal distribution | 1.1b, 3.3, 3.4 |
| 3 | S1 2013R | 4 | A 3.2, 4.2 | Normal distribution, Conditional probability | 1.1b, 3.1a, 3.1b, 3.4 |
| 4 | S1 2015 | 6 | A 3.2, 4.2 | Normal distribution | 1.1b, 2.1, 3.1a, 3.4 |
| 5 | S1 2014R | 6 | A 4.2 | Normal distribution | 1.1b, 3.1b, 3.4 |
| 6 | S1 2013 | 6 | A 4.3 | Normal distribution | 1.1b, 2.1, 3.1b, 3.4 |
| 7 | S1 2014 | 7 | A 3.2, 4.2 | Normal distribution | 1.1b, 2.1, 3.1b, 3.3, 3.4 |
| 8 | S1 Jan 2012 | 7 | A 4.2 | Normal distribution, Probability | 1.1b, 3.1b, 3.3, 3.4 |
| 9 | S2 2016 | 5 | A 4.2 | Binomial distribution, Normal distribution | 1.1b, 1.2, 3.1b, 3.3, 3.4 |
| 10 | S2 2017 | 5 | A 4.1, 4.2 | Binomial distribution, Normal distribution | 1.1b, 3.1b, 3.3, 3.4 |