1	mean = 18.2 sd $= \sqrt{876/50}$ $= 4.19$	B1 M1 A1 [3]	 Correct unsimplified expression seen Correct answer
2	mean = 200 × 2/15 (= 26.67) (80/3) variance = 200 × 2/15 × 13/15 (= 23.11)(208/9) $P(21 < X < 35) =$ $P\left(\frac{21.5-26.67}{\sqrt{23.11}}\right) < z < \frac{34.5-26.67}{\sqrt{23.11}}$ $= P(-1.075 < z < 1.629)$ $= 0.8589 + 0.9483 - 1$ $= 0.807$	B1 M1 M1 M1 A1 [5]	mean and variance correct standardising, ±, with or without cc, must have sq rts continuity corrections 20.5 or 21.5, 34.5 or 35.5 $\Phi_1 + \Phi_2 - 1$ answer rounding to 0.807
3	**(i)** $P(X > 20) = P(z > -6.4/3.7)$ $= P(z > -1.730)$ $= 0.9582$ Number of students = 335 or 336	M1 A1 A1ft [3]	Standardising no cc no sq rt Prob rounding to 0.958 Correct answer ft their prob, must be integer
	(ii) P(very slow) = 0.05 P(0, 1, 2) = $(0.95)^8 + {}^8C_1(0.05)^1(0.95)^7 + {}^8C_2(0.05)^2(0.95)^6$ $= 0.6634 + 0.2793 + 0.0515$ $= 0.994$	B1 M1 M1 A1 [4]	0.05 or 0.95 seen Binomial term with ${}^8C_r p^r (1-p)^{8-r}$ seen any p Correct expression for P(0, 1, 2), p close to 0.05 Answer rounding to 0.994
4	**(i)** $3 = 2x / 10$ $x = 15$ height = freq / class width $= x / 20 = 0.75$ cm	M1 A1 M1 A1 [4]	Attempt at using freq density = freq / cw Correct answer Attempt at using fd = freq / cw with different cw from above Correct answer
	(ii) mean wt = (5.5 × 30 + 15.5 × 60 + 23 × 45 + 28 × 75 + 40.5 × 60 + 60.5 × 15) / 285 = 26.6 grams	M1 M1 A1 [3]	Using freqs or frequency ratios and mid-points, attempt not ucb, not cw (can do it without x) Correct unsimplified answer can have fr ratios Correct answer

5 (i)

	A	*B*	*C*	*D*
Rick	1/3	2/9	2/9	2/9
Brenda	1/4	1/4	1/4	1/4
Ali	2/35	2/35	2/7	3/5

M1 Obtaining probs of each person for each entrance (can be implied or awarded in part **(i)** or part **(ii)**)

P(Rick *B*, Brenda *B*, Ali not *B*)
+ P(Rick *B*, Brenda not *B*, Ali *B*)
+ P(Rick not *B,* Brenda *B*, Ali *B*)
= 11/210 + 2/210 + 1/90 = 23/315

M1 Considering options 2 meet 1 doesn't, must have at least two 3-factor terms

P(Rick *B*, Brenda *B*, Ali *B*) = 1/315

M1 Adding option all three meet, must be added to a prob

Prob(at least 2 at entrance *B*)
= 24/315 (8/105) (0.0762)

A1 Correct answer

[4]

(ii) P(entrance *A*) = 1/210 (0.00476)
P(entrance *B*) = 1/315 (0.00317)
P(entrance *C*) = 1/63 (0.0159)
P(entrance *D*) = 1/30 (0.0333)

M1 Obtaining a three-factor prob for any entrance

M1 Adding four three-factor probabilities for the 4 entrances

A1 Two or more correct entrance probabilities

P(same entrance) = 2/35 (0.0571)

A1 Correct answer

[4]

6 (i) ${}^6P_4 = 6!/2!$
= 360

B1 Correct answer

[1]

(ii) 4!/2! = 12

B1 Correct answer

[1]

(iii) $4! \times {}^6C_4 = 360$ or ${}^6P_4$

B1 Correct final answer

[1]

(iv) e.g. 2R 1B 1G, 1R 2B 1G, 1R 1B 2G

M1 4!/2! seen

$= \frac{4!}{2!} + \frac{4!}{2!} + \frac{4!}{2!} = 36$, mult by ${}^6C_3$

M1 Mult by ${}^6C_3$

total = 720

A1 Correct answer

[3]

(v) 2R 2B = 4!/2!2! = 6

M1 Considering 2 colours e.g. RRBB or RBBR or...

Mult by ${}^6C_2$, total = 90

A1 mult by ${}^6C_2$

Answer = 360 + 720 + 90 = 1170

A1ft Ft their **(iii)** + **(iv)** + **(v)**

[3]

7	**(i)** If y = P(odd number) then P(even number) = $2y$ $3y + 6y = 1$ so $y = 1/9$ oe. OR prob = 1/3	M1 A1 [2]	2P(Odd) shown = P(Even) and summed to 1 correct answer accept either
	(ii) Score of 8 means throwing a 6 6 is even so P(8) = 2/9 (AG)	B1 B1 [2]	 legit justification of use of 2/9
	(iii) Var(X) = $(48 + 36 + 98 + 128 + 100)/9 - (58/9)^2$ = 4.02 accept 4.025 (326/81)	M1 A1 [2]	Correct method no dividings, 6.44 squared subt numerically Correct answer
	(iv) P(score 6,10) + P(score 10,6) + P(score 8,8) = 1/81 + 1/81 + 4/81 = 6/81 (2/27) (0.0741)	M1 A1 [2]	Summing two different 2-factor probabilities Correct answer
	(v) P(score 6, 10) = 1/81 P(1st score 6 given total 16) = (1/81) ÷ (6/81) = 1/6	B1 M1 A1 [3]	1/81 seen in numerator Dividing by their **(iv)** Correct answer