Senior Challenge '10 Solutions

Q	Solution	Marks
1	One possible sequence is: 4 5 7 6 8 1 9 2 3 Swap (16) 4 5 7 1 8 6 9 2 3 Swap (14) 1 5 7 4 8 6 9 2 3 Swap (28) 1 5 7 4 2 6 9 8 3 Swap (25) 1 2 7 4 5 6 9 8 3 Swap (39) 1 2 7 4 5 6 3 8 9 Swap (37) 1 2 3 4 5 6 7 8 9	**2** 1 for correct sequence of steps, 1 for systematic approach
2	Given that only one person lied: If A lied, so did D => A did not lie If B lied, so did D => B did not lie If D lied, so did B => D did not lie => C lie => D broke the candlestick	**3** 1 for correct culprit, 1 for correct liar, 1 for systematic approach
3	170=169+1=121+49 185=169+16=121+64 200=196+4=100+100 205=196+9=169+36 221=196+25=100+121 250=225+25=169+81 Given that the rooms are similar, but not the same, the only solution is that the conservatory is 11ft square, and the hall 10ft square.	**4** 1 for correct pair 1 for which is which 2 for systematic approach
4	See page 3	**6** 2 for all white boxes, 2 for all yellow, 2 for all blue
5	If a= length, b=width and c=height. ac= 648, bc=288 and ab=1296 $$c^2 = \frac{ac \times bc}{ab} = \frac{648 \times 288}{1296} = 144$$ Then c = 12 Then a= 648 ÷ 12 = 54 Then b= 288 ÷ 12 = 24 Then the coving = 54+54+24+24=156 feet	**5** 1 for each of a, b, c 1 for correct answer, 1 for systematic approach

6	The masses are 1, 3, 9 and 27.				6
	1=1 2=3-1 3=3 4=3+1 5=9-(3+1) 6=9-3 7=(9+1)-3 8=9-1 9=9 10=9+1	11=(9+3)-1 12=9+3 13=9+3+1 14=27-(9+3+1) 15=27-(9+3) 16=(27+1)-(9+3) 17=27-(9+1) 18=27-9 19=(27+1)-9 20=(27+3)-(9+1)	21=(27+3)-9 22=(27+3+1)-9 23=27-(3+1) 24=27-3 25=(27+1)-3 26=27-1 27=27 28=27+1 29=(27+3)-1 30=27+3	31=27+3+1 32=(27+9)-(3+1) 33=(27+9)-3 34=(27+9+1)-3 35=(27+9)-1 36=27+9 37=27+9+1 38=(27+9+3)-1 39=27+9+3 40=27+9+3+1	2 for correct masses, 4 for correct combinations
7	$108 = 500(1-x)(1-x)(1-x)$ $\dfrac{108}{500} = (1-x)^3$ $\sqrt[3]{\dfrac{108}{500}} = (1-x)$ $\sqrt[3]{\dfrac{216}{1000}} = (1-x)$ $\sqrt[3]{\dfrac{6^3}{10^3}} = (1-x)$ $\dfrac{6}{10} = (1-x)$ $\dfrac{4}{10} = x = 40\%$				**4** 1 for correct answer 3 for correct algebra
8	The first time the minutes are right is after 60 hours, when the right hand clock will have done 67 hours. At this point it is 7 hours fast, repeating every 60 hours, this discrepancy will change, until after 720 hours it is 84 hours fast, which means it will show the correct time. 720 hours is 30 days, which is therefore 6am on May 5th.				**4** 1 for correct time 1 for correct date 2 for systematic approach
9	The guilty parties are the ones not mentioned in the other questions, i.e. Mrs Peacock in the Ballroom with the Dagger				**1** 1 for all three correct

Total = 35 marks

Put 5 balls in each side

Balanced

One side heavier

Replace the balls in the heavier pan with the 5 unused balls.

Balanced

One side heavier

Discard these 10 balls, put 2 in each side from the remaining five.

Put 2 of the five balls in the lighter pan into each side.

Discard these 10 balls, put 2 in each side from the remaining five.

Balanced

One side heavier

One side heavier

Balanced

Balanced

One side heavier

Place one of the two balls from the heavier pan in each pan.

The last ball of the five is the faulty one and is lighter.

Discard 3 of these 4 balls, leaving 1 in the left hand pan. Put the last ball into the right hand pan.

One side heavier

The last ball of the five is the faulty one and is heavier.

Place one of the two balls from the lighter pan in each pan.

LHS heavier

RHS heavier

The heavier ball is the faulty one.

The lighter ball is the faulty one.

The right hand ball is the faulty one and is lighter.

Place one of the two balls from the heavier pan in each pan.

Balanced

Place one of the two balls from the lighter pan in each pan.

The right hand ball is the faulty one and is heavier.

The heavier ball is the faulty one.

The lighter ball is the faulty one.