

Senior Challenge '25 Solutions

1. Strawberry Laces

$$108 = 500(1-x)(1-x)(1-x),$$

$$\frac{108}{500} = (1-x)^3$$

$$\sqrt[3]{\frac{108}{500}} = (1-x)$$

$$\sqrt[3]{\frac{216}{1000}} = (1-x)$$

$$\sqrt[3]{\frac{6^3}{10^3}} = (1-x)$$

$$\frac{6}{10} = (1-x)$$

$$\frac{4}{10} = x = 40\%$$

Abby gets 200cm, Brenda gets 120cm and Charlie gets 76cm.

5 marks:
(1 mark for each length,
2 marks for reasoning)

2. Selection Box

3 pear drops and 2 of each of the others.

A third of nine is 3, leaving 6. Two must be eclairs, leaving 4, one fifth is 1.8 which rounds to 2, so 2 each of truffles and mints.

10 ways.

P	E	T	M
7	2	4	7
7	3	4	6
7	4	4	5
7	5	4	4
10	2	4	4

P	E	T	M
8	2	4	6
8	3	4	5
8	4	4	4
9	2	4	5
9	3	4	4

6 marks:
(1 mark for 3 pear drops,
1 mark for 2 eclairs,
1 mark for 2 each of truffles and mints,
1 mark for 10 ways,
2 marks for listing combinations)

The marks for listing combinations can be assumed if a good enough explanation of why there are 10 is provided.

3. Skittle Scenarios

On each turn:

either 2 yellows are removed and one green is added,

one green (eats 2 adds 1) is removed,

or none are removed (eats 1 green adds 1 green).

If there is an odd number of yellow skittles in the bag, the last one will be yellow.

If there is an even number of yellow skittles, the last one will be green as there will never be an odd yellow one to be the last.

5 marks:
(1 for each scenario of how many are removed,
1 for explanation for odd,
1 for explanation for even)

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4. Praline Packs Problem			
21 = 6+6+9	31=x	41=20+9+6+6	6 marks: (1 mark for list of impossible quantities, 1 mark for 43, 1 mark for showing that 44 – 49 are all possible, 2 marks for explaining why this allows all other quantities, 1 mark for 86)
22=x	32=20+6+6	42=7*6	
23=x	33=6+6+6+6+9	43=x	
24=6+6+6+6	34=x	44=20+4*6	
25=x	35=20+9+6	45=5*9	
26=20+6	36= 6*6	46=20+20+6	
27=9+9+9	37=x	47=20+9+9+9	
28=x	38=20+3*6	48=8*6	
29=20+9	39=5*6+9	49=20+20+9	
30=6+6+6+6+6	40=20+20	50=20+5*6	
So 43*2=86 free sweets			

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5. Guess the Sweets in the Jar

378 sweets

Sweet	Dimensions (mm)			Volume each	Number for 10%	Volume of 10%	Total sweets
Fruit salads	10	20	30	6000	34	204000	34
Pink shrimps	30	20	15	9000	23	207000	23
Coconut mushrooms	25	25	20	12500	16	200000	16
Pineapple cubes	20	20	20	8000	25	200000	25
Foam bananas	75	20	10	15000	14	210000	14
White mice	40	20	15	12000	17	204000	17
Dew drops	15	15	15	3375	60	202500	60
Cola bottles	10	10	50	5000	40	200000	40
Jellybeans	25	10	10	2500	80	200000	149
					309	1827500	
							378

8 marks:
(1 mark for 378,
1 mark for 10% of each,
1 mark for remainder,
1 mark for filling with jellybeans as smallest,
4 marks for packing method)

Remaining volume after 10% of each 172500, so 69 extra Jellybeans

Block	width	depth	height	contains	number	Depth so far
1	100	100	20	cola bottles	40	20
2	100	100	20	pineapple cubes	25	40
				Coconut		
3	100	100	20	mushrooms	16	60
4	100	75	20	Foam bananas	10	
5	80	75	10	Foam bananas	4	
6	20	75	10	Jellybeans	6	
7	100	25	30	Jellybeans	30	90
8	100	60	30	Pink shrimps	20	
9	100	40	30	White mice	10	120
10	60	60	30	Dew drops	32	
11	60	40	30	White mice	6	
12	100	40	30	Fruit salads	20	150
13	60	15	30	Pink shrimps	3	
14	60	45	30	Dew drops	24	
15	60	40	30	Fruit salads	12	
16	15	30	30	Dew drops	4	
17	25	30	30	Jellybeans	9	
18	40	30	10	Fruit salads	2	
19	40	20	15	White mice	1	
20	40	20	25	Jellybeans	8	
21	40	50	40	Jellybeans	32	
22	60	100	10	Jellybeans	24	190
23	100	100	10	Jellybeans	40	200

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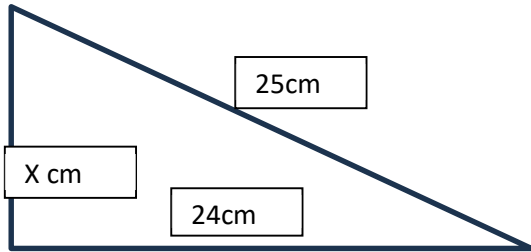
6. Fancy Fondant

Depth required: $25^2 - 24^2 = X^2$

$$625 - 576 = X^2$$

$$49 = X^2$$

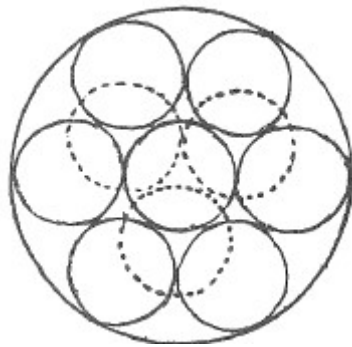
$$X = 7$$



$$\begin{aligned} \text{Volume} = V &= \pi r^2 h = \\ \pi 12^2 \times 7 &= 1008\pi \approx \\ \mathbf{3166.73\text{cm}^3} \end{aligned}$$

4 marks:
(2 marks for use of Pythagoras,
1 mark for $x=7$,
2 marks for volume with correct units)

7. Glorious Gobstoppers



The edge length of this tetrahedron is 4cm. P in the bottom diagram is the centre of the triangle base of the tetrahedron.

The length of AP is calculated from triangle APD, as $\frac{4}{\sqrt{3}}\text{cm}$

With Pythagoras on triangle MPA, we can then find the height: $h^2 = 4^2 - \left(\frac{4}{\sqrt{3}}\right)^2 =$

$$16 - \frac{16}{3} = \frac{32}{3} \text{ so } h = \sqrt{\frac{32}{3}} = \frac{4\sqrt{2}}{\sqrt{3}}$$

This is repeated for the tetrahedron formed from one of the gobstoppers in the middle layer and the 3 upon which it is sat.

$$\text{This gives us } 2\sqrt{\frac{32}{3}} = \frac{8\sqrt{2}}{\sqrt{3}}$$

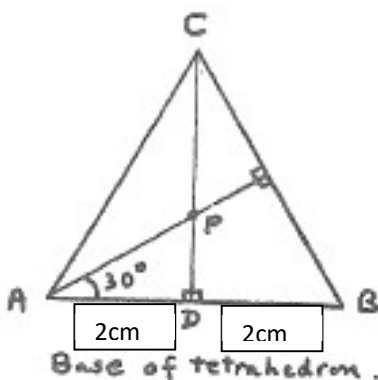
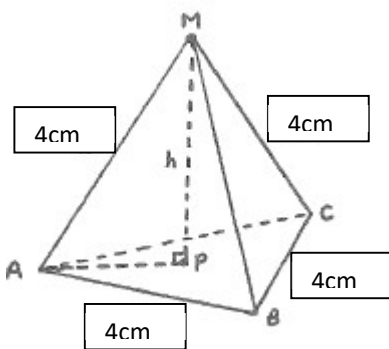
The centre of the bottom gobstopper is 2cm above the base of the cylinder. The top of the top gobstopper is 2cm above its centre, so the final height of the pyramid

$$\text{is } 4 + 2\sqrt{\frac{32}{3}} = 4 + \frac{8\sqrt{2}}{\sqrt{3}} \approx 10.53\text{cm}$$

8 marks:
(1 mark for 7 gobstoppers,
1 mark for 2cm apart,
1 mark for the length of AP,
1 mark for the height MP,
1 mark for second tetrahedron,
1 mark for adding the extra two cm,
2 marks for some reasoning)

Special cases:

Allow 5.266 (decimal approximation) or $\frac{6+4\sqrt{6}}{3}$



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8. Fab Fudge and Terrific Toffee

Cream: $400F + 300T \leq 9000$

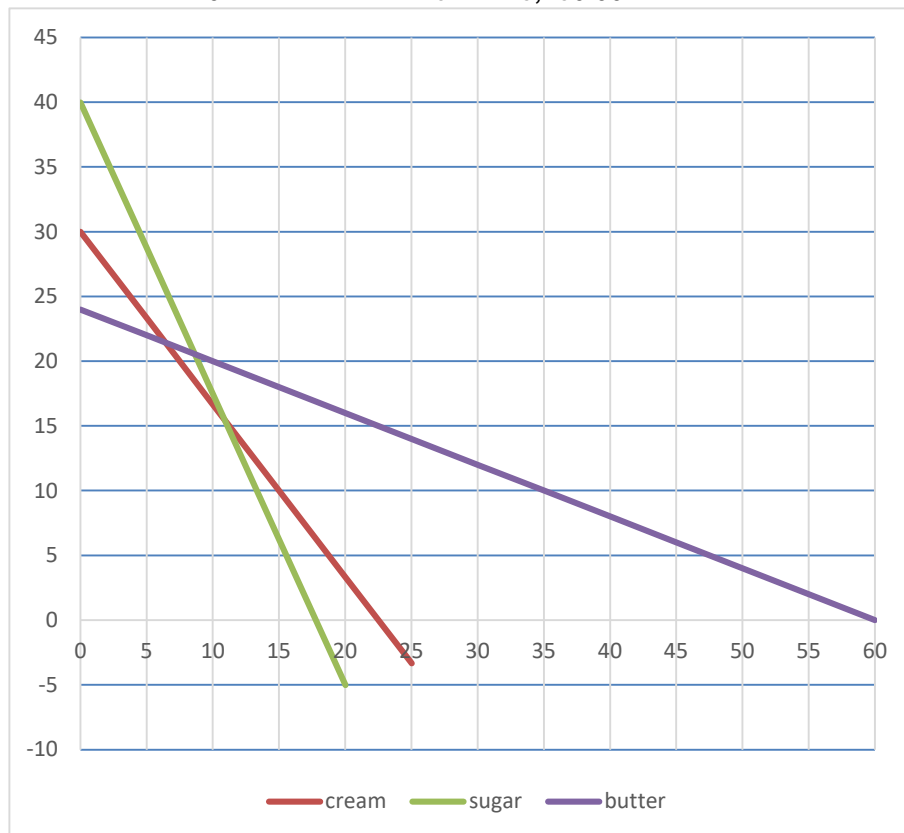
Sugar: $450F + 200T \leq 8000$

Butter: $50F + 125T \leq 3000$

Want to maximise $200F + 250T$

Vertices of feasible region (or nearby integer points)

F	T	Total
0	0	£ -
0	24	£ 6,000.00
17	0	£ 3,400.00
5	22	£ 6,500.00
6	21	£ 6,450.00
7	20	£ 6,400.00
10	15	£ 5,750.00



Optimum profit is £6500, with 5 batches of fudge and 22 of toffee

8 marks:

(3 marks: 1 mark for each of the three graphs,
1 mark for checking vertices,
1 mark for stating correct vertex,
1 mark for recognition of integer problem,
1 mark for fudge and toffee,
1 mark for profit)

Special case:

Give 6 marks for solution as (6,21) (i.e. don't give last two marks)

Special case:

Allow full marks for brute force approach of trying all integer values (this can be used to differentiate between very top entries later)

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