**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.**

## 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 |

## 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.**

## 4. Praline Packs Problem

| | | |
|---|---|---|
| 21 = 6+6+9 | 31=x | 41=20+9+6+6 |
| 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**

**THE IDEA is to find the smallest consecutive sequence of numbers of length 6 that are linear combinations of 20, 9, and 6, and such that the number preceding them is NOT such a linear combination.**

## 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 |

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

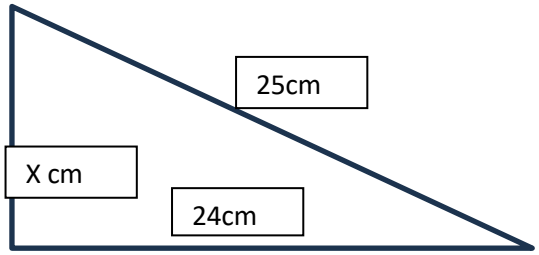
| Block | width | depth | height | contains | number | Depth so far |
|---|---|---|---|---|---|---|
| 1 | 100 | 100 | 20 | cola bottles | 40 | 20 |
| 2 | 100 | 100 | 20 | pineapple cubes | 25 | 40 |
| 3 | 100 | 100 | 20 | Coconut mushrooms | 16 | 60 |
| 4 | 100 | 75 | 20 | Foam bananas | 10 | |
| 5 | 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 |

## 6. Fancy Fondant

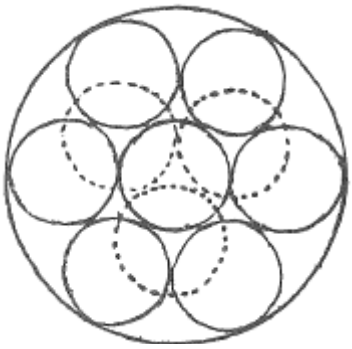
Depth required: $25^2 - 24^2 = X^2$

$$625 - 576 = X^2$$
$$49 = X^2$$
$$X = 7$$

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




## 7. Glorious Gobstoppers

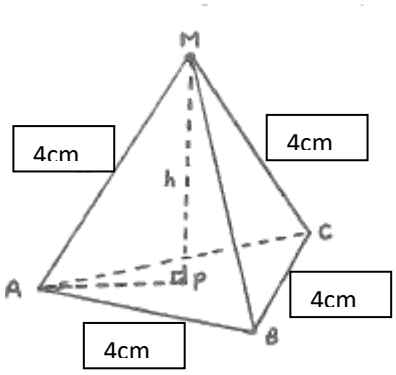


The edge length of this tetrahedron is 4cm. P in the bottom diagram is the centre of the triangle base of the tetrahedron.

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

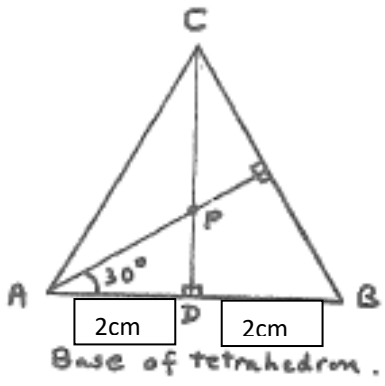
With Pythagoras on triangle MPA, we can then find the height: $h^2 = 4^2 - \left(\frac{4}{\sqrt{3}}\right)^2 = 16 - \frac{16}{3} = \frac{32}{3}$ so $h = \sqrt{\frac{32}{3}} = \frac{4\sqrt{2}}{\sqrt{3}}$

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




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

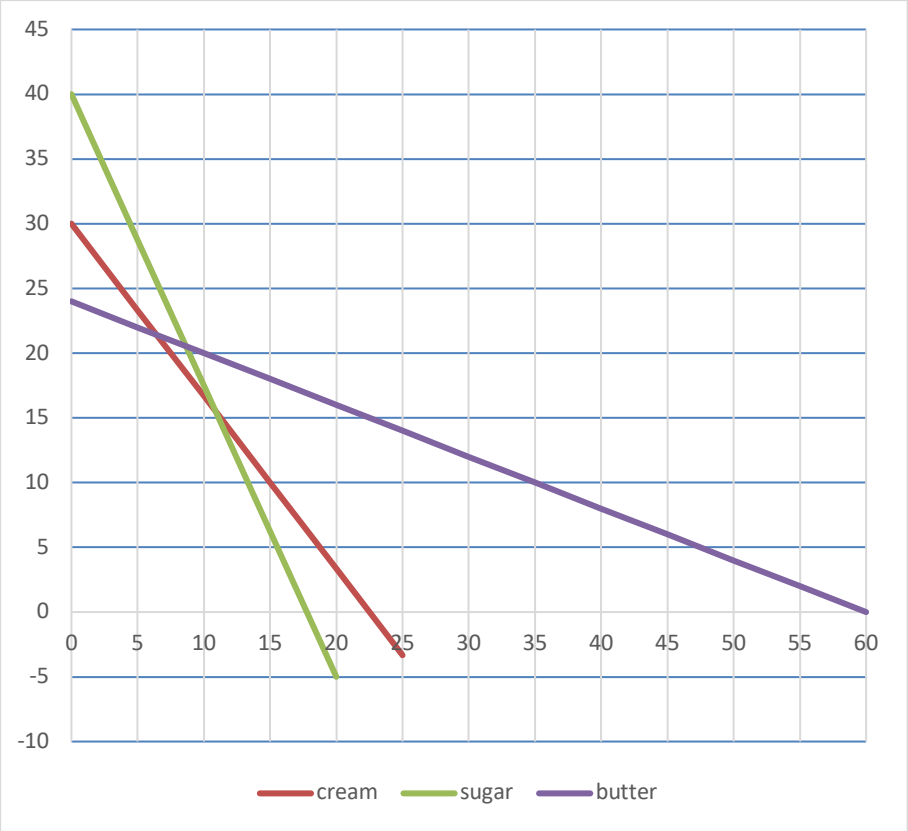
The centre of the bottom gobstopper is 2cm above the base of the cylinder. The top of the top gobstopper is 2cm above its centre, so the final height of the pyramid is $4 + 2\sqrt{\frac{32}{3}} = 4 + \frac{8\sqrt{2}}{\sqrt{3}} \approx 10.53cm$



# 8. Fab Fudge and Terrific Toffee

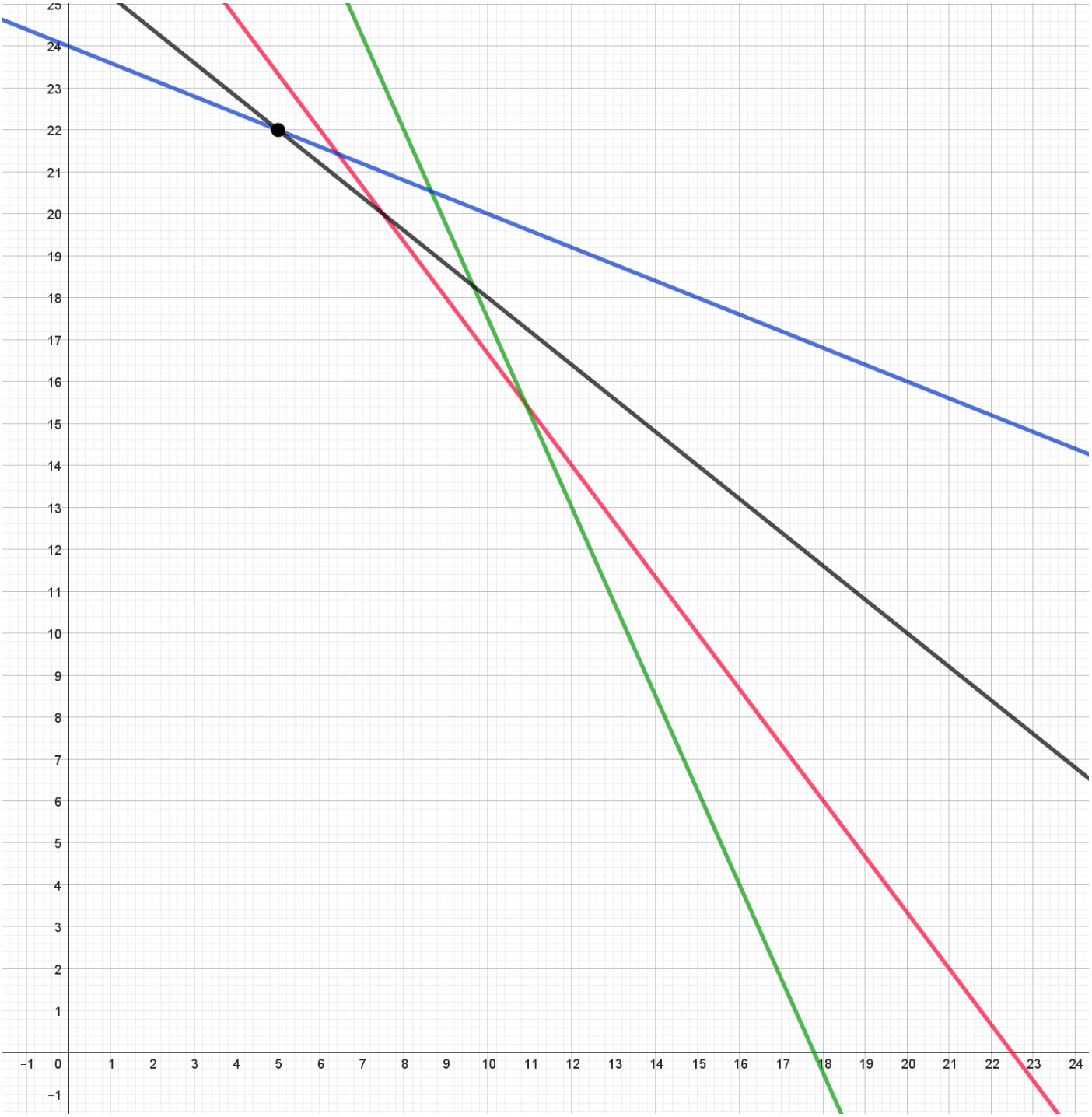
Cream: 400F+300T≤9000
Sugar: 450F+200T≤8000
Butter: 50F+125T≤3000
Want to maximise 200F+250T
Vertices of feasible region (or nearby integer points)

| 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**

# Senior Challenge ’25 Solutions



## 9. Daniella's Experiment

**1.** Since the coconut and chocolate balls start their movement in the same direction, it does not matter how many of them are chocolate or coconut balls unless their total number is 9

2. The rightmost 5 balls should be the fig balls, while the rest 9 balls are the rightmost

3. One way to explain is this: let us assume that among those 5 fig bolls there is one to whose left the ball is chocolate or coconut (i.e. starts the movement to the right), then if in the initial configuration we make just one change – by flipping these two balls and putting ***very close to each other*** – then the number of hits will increase by one compared to the previous initial configuration, as after the hit of the flipped balls, they will go in opposite directions, **which will correspond to the starting configuration of the one before the flip was done**

4. Now, assume that 5 balls move to the right and 9 balls to the left. Imagine that they are not hitting each other but going through each other. Then the number of hits will be the same as the number of encounters when balls go through each other. This gives us 5 times 9, which is 45.

FINAL ANSWER**: *45 hits***