

## 5. CARLY'S POP-UP CAKE SHOP

Carly has opened a new cake shop. She has 22.5kg of flour, 24kg of butter and 21kg of sugar available. The best selling items are melting moments and chocolate chunk cookies. Melting moments require 120g of flour, 96g of butter and 132g of sugar for 16. Chocolate cookies require 240g of flour, 300g of butter and 180g of sugar for 24. (She has plenty of the other ingredients needed.)



Melting moments sell for £1.75 a pack of 4 and Cookies for £1.95 a pack of 4. All are sold by the end of each day. Recommend the number of melting moments and cookies that should be baked and state the expected income.

## 6. THE TOXTETH TORTE



The latest frozen gateau to reach the market is the 'Toxteth Torte'. It consists of a cuboid of crunchy carrot crumble (whose sides measured in centimetres are all integers), topped by a 4cm layer of piquant prune puree.

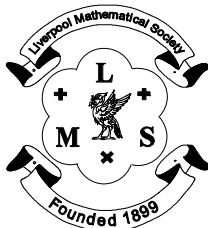
The whole is encased in a 1cm layer of silky strawberry sorbet, forming a gateau which is longer than it is high. The sorbet represents one-half of the gateau by volume, while the puree is one-fifth of the gateau by volume. What are the dimensions of the 'Toxteth Torte'?

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The competition is promoted by Liverpool Mathematical Society (LivMS)

[www.maths.liv.ac.uk/lms.html](http://www.maths.liv.ac.uk/lms.html)

The Liverpool Mathematical Society incorporates the Liverpool Branches of the MA and the ATM.  
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(INCORPORATING THE LIVERPOOL BRANCHES OF THE MA AND THE ATM)

# Open Challenge '18 For Year 13 or below

## Rules

- 1) It should be attempted at home during February half term.
- 2) Your entry must be your own work.
- 3) For individual entries only. You should attempt all six questions.
- 4) Entries without any working out at all or written on this sheet will not be marked.
- 5) It is possible to win a prize even if you have not completed all of the questions, so hand in your entry even if it is not quite finished.
- 6) **You must print your name, date of birth and school in neat, legible writing on the front sheet.**
- 7) Pupils under 15 years of age should only attempt this in exceptional circumstances.

Either you or your maths teacher needs to return your entry by 9 March to this address:

### Open Challenge '18 Entries,

Mrs A. Carter,  
Danes Court,  
Mudhouse Lane,  
Burton,  
Neston.  
CH64 5TS.

All of the prizes and certificates will be awarded at an evening of mathematical recreation at the University of Liverpool on 2 May. Solutions will be posted on

[www.maths.liv.ac.uk/lms.html](http://www.maths.liv.ac.uk/lms.html) shortly afterwards. We hope that you enjoy the questions.

## 1. THE JOURNEY OF ADAM ANT



There are several circular cylindrical non-touching caps and two small bread crumbs on the table. The crumbs are at a distance  $d$  from each other. Adam Ant is planning to travel from one bread crumb to the other along the table avoiding the caps. Explain why he can always make his journey such that the length of the trip is less than  $1.6d$ .

## 2. RYAN'S RESTAURANT

Ryan's Restaurant is very popular and offers two-course and three-course fixed-price 'meal deals'.

The menu consists of

### Starter

Aubergine tagine, Bruschetta, Chillied prawns, Drizzled trout, Egg California, Falafel with hummus

### Main

Grilled steak, Half a rotisserie chicken, King prawn curry, Linguine with prawns in a white sauce, Meatballs with spaghetti

### Dessert

New York Cheesecake, Pecan pie, Queen of puddings, Trifle, and Waffle with ice cream and fruit.

In how many different ways can a three-course 'meal deal' consisting of a starter, main and dessert be chosen?

A two-course 'meal deal' consists of a starter and main or a main and dessert.

In how many ways can a two-course 'meal deal' be chosen?

If you have prawn or trout for a starter you are recommended not to have king prawn curry or the linguine for your main course. In how many ways can a three-course meal now be chosen?

Side orders consist of roast potatoes, salad, vegetables, onion rings and zucchini. If you have a three-course meal you can choose up to 2 side orders. In how many ways can a three-course meal now be chosen?



### 3. APPLE D - CIDER

The catering manager in a restaurant buys apples in large quantities for making apples pies. Whilst wishing to ensure that the apples are of good quality, her main concern is to minimise purchasing costs.



There are two grades of apples to choose from: grade 1 apples of average size 6cm across and grade 2 apples of average size 4cm across. There are approximately 8 grade 1 apples per kilogram. The grade 1 apples cost 80p per kilogram and the grade 2 apples cost 70p per kilogram. A cylindrical corer of diameter 1cm is used in the preparation of the apples.

The cook prefers grade 1 apples because he claims the relative amount of waste is less and the overall preparation time is shorter. However, the catering manager wishes to purchase the apples which are most economical.

What would you advise?

### 4. CARTER'S CLAIMS

Carter's Cordial comes in two varieties: standard and extra concentrated.

Their marketing material makes the following two claims:

1. Our Extra Concentrated Cordial is twice as strong by volume as our Standard Cordial.
2. You only need to use half as much Extra Concentrated Cordial compared to our Standard Cordial for the same volume of drink.



Assume that Claim 1 is true, and consider the validity of Claim 2.

Assume that Claim 2 is true, and consider the validity of Claim 1.

As an independent analyst, you are asked to comment on the consistency or otherwise of the validity of these two claims taken together, be as technically thorough as you are able, as well as providing a plausible interpretation of your reasoning.