

**Question 1**

**10 marks**

All Sams sell six shells. All Sarahs seek seven shells.

What is the smallest positive number of Sams and Sarahs required so that no S-named person is left unsatisfied?

**Question 1**

**10 marks**

All Sams sell six shells. All Sarahs seek seven shells.

What is the smallest positive number of Sams and Sarahs required so that no S-named person is left unsatisfied?

**Question 2****10 marks**

Peter has a box of lego. The box contains lots of white 2 by 4 lego bricks as well as a single blue 2 by 4 brick. What is the maximum number of white bricks which Peter can attach to his blue brick at the same time?

**Question 2****10 marks**

Peter has a box of lego. The box contains lots of white 2 by 4 lego bricks as well as a single blue 2 by 4 brick. What is the maximum number of white bricks which Peter can attach to his blue brick at the same time?

**Question 3**

**10 marks**

How many distinct positive prime factors does 2014 have?

**Question 3**

**10 marks**

How many distinct positive prime factors does 2014 have?

**Question 4****10 marks**

Pam is picking bok choy leaves from her garden for dinner. From each plant she picks either 2 or 3 leaves. If she picks 19 leaves, what is the smallest possible number of plants she is growing?

**Question 4****10 marks**

Pam is picking bok choy leaves from her garden for dinner. From each plant she picks either 2 or 3 leaves. If she picks 19 leaves, what is the smallest possible number of plants she is growing?

**Question 5****CHANGE RUNNER NOW****10 marks**

It takes one mathematician and two physicists to write a physics book, and it takes two mathematicians to write a maths book. What's the most number of books that ten mathematicians and ten physicists can write together, assuming each person only works on one book?

**Question 5****CHANGE RUNNER NOW****10 marks**

It takes one mathematician and two physicists to write a physics book, and it takes two mathematicians to write a maths book. What's the most number of books that ten mathematicians and ten physicists can write together, assuming each person only works on one book?

**Question 6****10 marks**

Mel decides to start a new student club called SMUG (Super Melbourne University Gentlemen). At first, Mel is the only member. On Monday, Mel tricks two students into joining SMUG. On Tuesday, each member tricks two new members into joining. Continuing in this manner, how many members are in SMUG by the end of Friday?

**Question 6****10 marks**

Mel decides to start a new student club called SMUG (Super Melbourne University Gentlemen). At first, Mel is the only member. On Monday, Mel tricks two students into joining SMUG. On Tuesday, each member tricks two new members into joining. Continuing in this manner, how many members are in SMUG by the end of Friday?

**Question 7****10 marks**

Samantha is waiting to catch a Belgrave train, which is arriving after a Lilydale train. Right now, the time until the Belgrave train arrives is 1.5 times the time until the Lilydale train arrives. In 4 minutes, the time until the Belgrave train arrives will be twice the time until the Lilydale train arrives. Assume that all trains are punctual. How long is it until the Belgrave train arrives?

**Question 7****10 marks**

Samantha is waiting to catch a Belgrave train, which is arriving after a Lilydale train. Right now, the time until the Belgrave train arrives is 1.5 times the time until the Lilydale train arrives. In 4 minutes, the time until the Belgrave train arrives will be twice the time until the Lilydale train arrives. Assume that all trains are punctual. How long is it until the Belgrave train arrives?

**Question 8****10 marks**

Adrian is planning on travelling by plane to Berlin, Paris, Los Angeles, Boston, and Tokyo. He is about to plan the order in which he visits the cities and has two conditions that must both be satisfied:

1. either he visits Paris immediately after visiting Berlin or visits Paris immediately before visiting Berlin, and
2. either he visits Boston immediately after visiting Los Angeles or visits Boston immediately before visiting Los Angeles.

How many different ways are there in which Adrian can visit the cities while satisfying both conditions?

eg. Berlin, Paris, Los Angeles, Boston, Tokyo (in order) is allowed but Berlin, Tokyo, Paris, Boston, Los Angeles (in order) is not allowed as this would violate condition 1.

**Question 8****10 marks**

Adrian is planning on travelling by plane to Berlin, Paris, Los Angeles, Boston, and Tokyo. He is about to plan the order in which he visits the cities and has two conditions that must both be satisfied:

1. either he visits Paris immediately after visiting Berlin or visits Paris immediately before visiting Berlin, and
2. either he visits Boston immediately after visiting Los Angeles or visits Boston immediately before visiting Los Angeles.

How many different ways are there in which Adrian can visit the cities while satisfying both conditions?

eg. Berlin, Paris, Los Angeles, Boston, Tokyo (in order) is allowed but Berlin, Tokyo, Paris, Boston, Los Angeles (in order) is not allowed as this would violate condition 1.



**Question 9****10 marks**

What is the maximum number of pieces of a round pizza that you can make with 5 straight cuts? (Note: No horizontal cuts, i.e. cutting the pizza into layers.)

**Question 9****10 marks**

What is the maximum number of pieces of a round pizza that you can make with 5 straight cuts? (Note: No horizontal cuts, i.e. cutting the pizza into layers.)

**Question 10**

**CHANGE RUNNER NOW**

**10 marks**

Han, Sam, and Yi are professional cake eaters. Han eats cakes two times as quickly as Yi, while Sam eats three times as quickly as Han. If they eat 20 cakes in 5 minutes between the three of them, how many cakes does Han eat per minute?

**Question 10**

**CHANGE RUNNER NOW**

**10 marks**

Han, Sam, and Yi are professional cake eaters. Han eats cakes two times as quickly as Yi, while Sam eats three times as quickly as Han. If they eat 20 cakes in 5 minutes between the three of them, how many cakes does Han eat per minute?

**Question 11****20 marks**

Find the smallest 4 digit number  $abcd$  where  $a, b, c,$  and  $d$  are distinct non-zero digits such that the two-digit numbers  $ab, ac, ad, bc, bd$  and  $cd$  are all prime numbers.

**Question 11****20 marks**

Find the smallest 4 digit number  $abcd$  where  $a, b, c,$  and  $d$  are distinct non-zero digits such that the two-digit numbers  $ab, ac, ad, bc, bd$  and  $cd$  are all prime numbers.

**Question 12****20 marks**

Consider two radius 1 circles arranged so that the boundary of each circle goes through the centre of the other circle. What is the perimeter of the overlapping region?

**Question 12****20 marks**

Consider two radius 1 circles arranged so that the boundary of each circle goes through the centre of the other circle. What is the perimeter of the overlapping region?

**Question 13****20 marks**

A dart board has four regions worth 3, 4, 5 and 6 points (missing the board counts as 0 points). Trithang throws four darts and writes down, in order, how much each dart scores. How many different ways are there to score 11 in total?

**Question 13****20 marks**

A dart board has four regions worth 3, 4, 5 and 6 points (missing the board counts as 0 points). Trithang throws four darts and writes down, in order, how much each dart scores. How many different ways are there to score 11 in total?

**Question 14****20 marks**

Suppose a cube with side length 1 is rolled across a table without slipping. Consider the path traced out by one corner as the cube rolls through one revolution. How far along this path does the corner move in each revolution?

**Question 14****20 marks**

Suppose a cube with side length 1 is rolled across a table without slipping. Consider the path traced out by one corner as the cube rolls through one revolution. How far along this path does the corner move in each revolution?

**Question 15**

**CHANGE RUNNER NOW**

**20 marks**

Andrew has a bag of red, green, and blue juggling balls, with two of each colour. If Andrew draws 3 balls from the bag at random, what is the probability that each ball is of a different colour?

**Question 15**

**CHANGE RUNNER NOW**

**20 marks**

Andrew has a bag of red, green, and blue juggling balls, with two of each colour. If Andrew draws 3 balls from the bag at random, what is the probability that each ball is of a different colour?

**Question 16****20 marks**

What is the smallest positive integer divisible by 0.8, 1.75 and 5.5? (i.e. it is a whole number multiple of 0.8, 1.75 and 5.5)

**Question 16****20 marks**

What is the smallest positive integer divisible by 0.8, 1.75 and 5.5? (i.e. it is a whole number multiple of 0.8, 1.75 and 5.5)



**Question 17****20 marks**

Mel is thinking of two numbers. The sum of Mel's numbers is 99 and their product is 1800. What is the sum of the squares of Mel's numbers?

**Question 17****20 marks**

Mel is thinking of two numbers. The sum of Mel's numbers is 99 and their product is 1800. What is the sum of the squares of Mel's numbers?

**Question 18****20 marks**

Jenny decides to go for a 60 step walk, which ends at the same point that it starts at. Each step is exactly one metre and is either North, South, East or West. Jenny never goes to a place on the walk that she has been to before.

At the end of the walk Jenny decides to calculate the area enclosed by the walk. How many possible values are there for this area?

**Question 18****20 marks**

Jenny decides to go for a 60 step walk, which ends at the same point that it starts at. Each step is exactly one metre and is either North, South, East or West. Jenny never goes to a place on the walk that she has been to before.

At the end of the walk Jenny decides to calculate the area enclosed by the walk. How many possible values are there for this area?

**Question 19**

**20 marks**

Find the four digit number  $abcd$  such that  $4 \times abcd = dcba$ .

**Question 19**

**20 marks**

Find the four digit number  $abcd$  such that  $4 \times abcd = dcba$ .

**Question 20****CHANGE RUNNER NOW****20 marks**

Matt and Tom are having a race. Matt slides 33m down a vertical pole at 6m/s, then runs along the flat ground for 56m at 8m/s, to the finish line. Tom gives Matt a 5 second head start, then takes a zip line running diagonally from the start to the finish, travelling at 10m/s. If we start timing from when Matt first heads off, how long does the winner take to get to the finish?

**Question 20****CHANGE RUNNER NOW****20 marks**

Matt and Tom are having a race. Matt slides 33m down a vertical pole at 6m/s, then runs along the flat ground for 56m at 8m/s, to the finish line. Tom gives Matt a 5 second head start, then takes a zip line running diagonally from the start to the finish, travelling at 10m/s. If we start timing from when Matt first heads off, how long does the winner take to get to the finish?

**Question 21**

**30 marks**

Find the three last digits of  $7^{9999}$ .

**Question 21**

**30 marks**

Find the three last digits of  $7^{9999}$ .

**Question 22**

**30 marks**

Find the smallest positive integer ending in 1986 which is divisible by 1987.

**Question 22**

**30 marks**

Find the smallest positive integer ending in 1986 which is divisible by 1987.

**Question 23****30 marks**

Suppose there is a 5-person marching band. Four of the musicians march forward at  $2\text{m/s}$  so that they always form the corners of a square with side length  $2\text{m}$ . The fifth musician marches at  $4\text{m/s}$  and walks along the edges of this moving square. How long does it take for the fifth musician to do a full lap of the square?

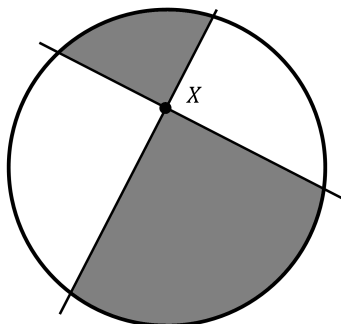
**Question 23****30 marks**

Suppose there is a 5-person marching band. Four of the musicians march forward at  $2\text{m/s}$  so that they always form the corners of a square with side length  $2\text{m}$ . The fifth musician marches at  $4\text{m/s}$  and walks along the edges of this moving square. How long does it take for the fifth musician to do a full lap of the square?

**Question 24**

**30 marks**

A point X is distance 1 from the centre of a circle of radius 4. Damian decides to draw two lines which are perpendicular to each other through X which break the circle into 4 regions. Damian then shades two opposite regions as shown.

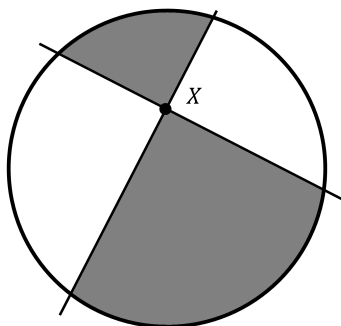


What is the maximum possible area of the two shaded regions combined?

**Question 24**

**30 marks**

A point X is distance 1 from the centre of a circle of radius 4. Damian decides to draw two lines which are perpendicular to each other through X which break the circle into 4 regions. Damian then shades two opposite regions as shown.



What is the maximum possible area of the two shaded regions combined?



**Question 25****30 marks**

Paul buys a poster which fits in a cylinder with height 80 cm and radius 5 cm. He then wants to fit this cylinder in a square box (i.e. a cube). What is the side length of the smallest square box which would fit the cylinder?

**Question 25****30 marks**

Paul buys a poster which fits in a cylinder with height 80 cm and radius 5 cm. He then wants to fit this cylinder in a square box (i.e. a cube). What is the side length of the smallest square box which would fit the cylinder?