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## Senior Division

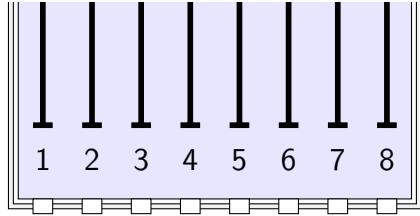
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### Questions 1 to 10, 3 marks each

1. Eight children in a swimming race are John, Iain, Hans, Ivan, Giovanni, Beth, Liz and Elisa. They are put in lanes 1 to 8 randomly. What is the probability that Beth, Liz or Elisa is in lane 1?

(A)  $\frac{3}{8}$       (B)  $\frac{1}{2}$       (C)  $\frac{3}{5}$       (D)  $\frac{5}{3}$       (E)  $\frac{1}{3}$

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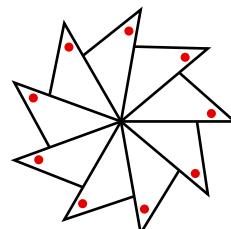


2. What is the value of  $17a + 20b$  when  $a = 20$  and  $b = 17$ ?
- (A) 680      (B) 689      (C) 1720      (D) 2017      (E) 3737
- 

3. 1000% of 1 is
- (A) 0.1      (B) 1      (C) 10      (D) 100      (E) 1000
- 

4.  $4^2 + 3^3 + 2^4 =$
- (A) 29      (B) 33      (C) 43      (D) 59      (E) 73
- 

5. This pinwheel star is formed by rotating a right-angled triangle around one of its corners. What is the angle at each of the nine tips that are marked with dots?
- (A)  $30^\circ$       (B)  $40^\circ$       (C)  $45^\circ$   
(D)  $50^\circ$       (E)  $60^\circ$
- 



7.  $200 - 199 + 198 - 197 + 196 - \cdots + 2 - 1$  is equal to  
(A) 1                    (B) 99                    (C) 100                    (D) 101                    (E) 200






$\times$	1	2	3	4	5
1					
2					
3					
4					
5					



**Questions 11 to 20, 4 marks each**

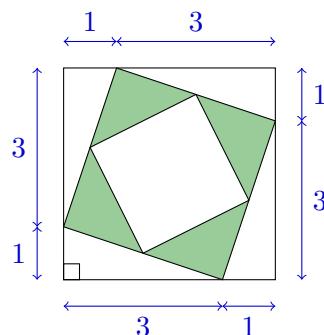
- 11.** Each row, column and diagonal of this grid should add up to 30. What number goes in the bottom-right corner?

(A) 3              (B) 15              (C) 5              (D) 13              (E) 4

	2	
8		12
		?

- 12.** The vertices of the innermost white square bisect the sides of the shaded square.

What is the area of the innermost white square?



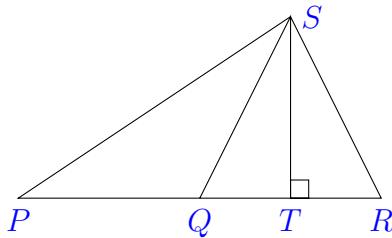
- 13.** Two cars leaving Sale for Melbourne are travelling at 60 km/h and are 240 m apart travelling west on the Princes Highway. When each car reaches the 80 km/h sign it starts travelling at 80 km/h. How far apart are they once they are both past the sign?

- (A) 180 m      (B) 240 m      (C) 360 m      (D) 300 m      (E) 320 m

- 14.** In the triangle shown,  $PQ = SQ = SR = QR$  and  $\angle STR = 90^\circ$ .

The ratio  $TR : PS$  is equal to

- (A)  $1 : \sqrt{3}$       (B)  $1 : 2\sqrt{3}$       (C)  $1 : 2$   
 (D)  $1 : \sqrt{2}$       (E)  $1 : (3\sqrt{3})/2$

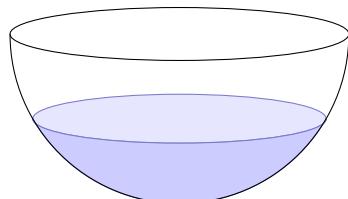


- 15.** The solution to the equation  $2017x^2 - 2017^{2017} = 0$  is



- 16.** A hemispherical bowl is filled to half its depth. The maximum angle through which the bowl may be tilted from horizontal without spilling is

- (A)  $22\frac{1}{2}^\circ$       (B)  $30^\circ$       (C)  $45^\circ$   
 (D)  $60^\circ$       (E)  $67\frac{1}{2}^\circ$



- 17.** I spent exactly \$4000 on books which cost \$25 and \$26 each. I bought at least one book at each price. What is the maximum number of books I could have bought?

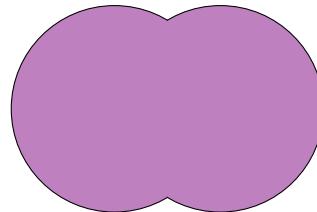
- (A) 153                  (B) 157                  (C) 155                  (D) 159                  (E) 161

- 18.** All of the digits from 0 to 9 are used to form two 5-digit numbers. What is the smallest possible difference between these two numbers?

- 19.** Two circles of diameter 12 cm overlap, forming the shape shown with perimeter  $14\pi$  cm.

What is the area of the shape, in cm<sup>2</sup>?

(A)  $42\pi + 18$       (B)  $42\pi + 9\sqrt{3}$       (C)  $72\pi - 18$   
 (D)  $72\pi - 9\sqrt{3}$       (E)  $24\pi\sqrt{3}$



- 20.** Five spherical balls of diameter 10 cm fit inside a closed cylindrical tin with internal diameter 16 cm.

What is the smallest height the tin can be?

(A) 39 cm      (B) 42 cm      (C) 45 cm      (D) 48 cm      (E) 50 cm

**Questions 21 to 25, 5 marks each**

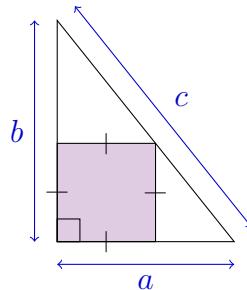
- 21.** A square is drawn in the corner of a right-angled triangle with side lengths  $a$ ,  $b$  and  $c$ , as shown.

Which expression gives the ratio of the unshaded area to the shaded area in all cases?

(A)  $1 : 1$       (B)  $c : (a + b)$       (C)  $ab : c^2$

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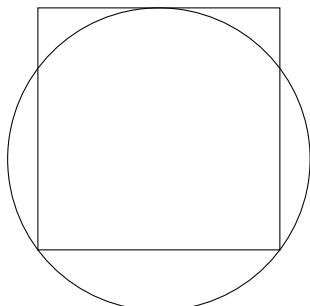


- 22.** Andy and Brandy have decided to share a cake in an unusual way. Andy will take some fraction of the cake first. From then on, Brandy and Andy will alternate taking half of what remains each time. Eventually there is so little left they decide they are finished. What fraction of the cake should Andy take first to ensure that they end up with half each?

(A)  $\frac{1}{6}$       (B)  $\frac{1}{4}$       (C)  $\frac{2}{5}$       (D)  $\frac{1}{3}$       (E)  $\frac{1}{2}$

- 24.** A circle touches one side of a square and passes through the end vertices of the opposite side. The circle has circumference  $c$  and the square has perimeter  $s$ . Which of the following is true to the nearest one percent?

- (A)  $c$  is approximately 5% larger than  $s$ .
- (B)  $c$  is approximately 2% larger than  $s$ .
- (C)  $c$  and  $s$  are equal.
- (D)  $c$  is approximately 2% smaller than  $s$ .
- (E)  $c$  is approximately 5% smaller than  $s$ .



- 25.** I have two blue socks, two red socks, and two yellow socks in a drawer. On Monday, I randomly pick two of the socks to wear. On Tuesday, I randomly pick two of the remaining socks to wear. On Wednesday, I wear the two remaining socks from the drawer.

What is the probability that I didn't wear a matching pair of socks on any of the three days?

**For questions 26 to 30, shade the answer as an integer from 0 to 999  
in the space provided on the answer sheet.**

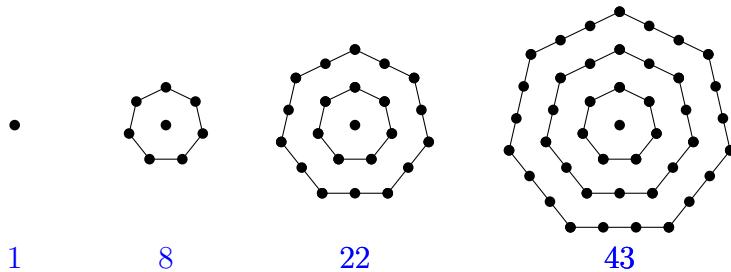
**Question 26 is 6 marks, question 27 is 7 marks, question 28 is 8 marks,  
question 29 is 9 marks and question 30 is 10 marks.**

- 26.** A river runs from west to east. Colin's hat has fallen in 28 metres upstream from the waterfall. Pepper the wonder dog is admiring the view 36 metres directly south of the waterfall. Pepper can run exactly three times as fast as the hat is being carried downstream. What is the minimum distance in metres that Colin's hat must travel before Pepper can retrieve it?

- 27.** Mike multiplied at least two consecutive integers together. He obtained a six-digit number  $N$ . The first two digits of  $N$  are 47 and the last two digits of  $N$  are 74. What is the sum of the integers that Mike multiplied together?
- 

- 28.** For  $n \geq 3$ , the sequence of *centred  $n$ -gon numbers* is found by starting with a central dot, then adding layers consisting of  $n$ -gons of dots around this centre, where the number of dots on each side increases by 1 for each layer.

For instance, the sequence of centred 7-gon numbers starts 1, 8, 22, 43, ... as shown.



What is the smallest  $n$  for which 2017 is in the sequence of centred  $n$ -gon numbers?

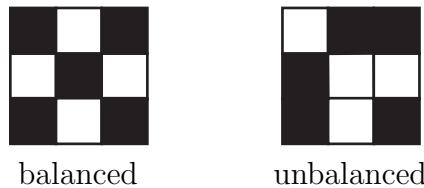
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- 29.** A friend and I play a game. We each start with two coins. We take it in turns to toss a coin; if it comes down heads, we keep it, if tails, we give it to the other. I always go first, and the game ends when one of us wins by having all four coins.

If we play this game 840 times, what is the expected number of games that I would win?

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- 30.** The squares of an  $8 \times 8$  grid are coloured black or white. A colouring is called *balanced* if each  $2 \times 2$  subgrid contains exactly two squares of each colour. An example of a balanced colouring of a  $3 \times 3$  grid is shown on the left. The *unbalanced* colouring on the right fails this requirement since the  $2 \times 2$  subgrid on the bottom right contains three white squares.



Counting rotations and reflections of a pattern as different, how many balanced colourings of the  $8 \times 8$  grid are there?

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