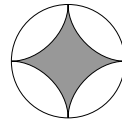


19. The shaded region shown in the diagram is bounded by four arcs, each of the same radius as that of the surrounding circle. What fraction of the surrounding circle is shaded?

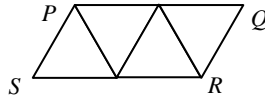


- A  $\frac{4}{\pi} - 1$  B  $1 - \frac{\pi}{4}$  C  $\frac{1}{2}$  D  $\frac{1}{3}$  E it depends on the radius of the circle

20. A rectangle with area  $125 \text{ cm}^2$  has sides in the ratio 4:5. What is the perimeter of the rectangle?

- A 18 cm B 22.5 cm C 36 cm D 45 cm E 54 cm

21. The parallelogram  $PQRS$  is formed by joining together four equilateral triangles of side 1 unit, as shown. What is the length of the diagonal  $SQ$ ?

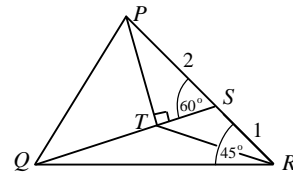


- A  $\sqrt{7}$  B  $\sqrt{8}$  C 3 D  $\sqrt{6}$  E  $\sqrt{5}$

22. What is the maximum possible value of the median number of cups of coffee bought per customer on a day when Sundollars Coffee Shop sells 477 cups of coffee to 190 customers, and every customer buys at least one cup of coffee?

- A 1.5 B 2 C 2.5 D 3 E 3.5

23. In triangle  $PQR$ ,  $PS = 2$ ;  $SR = 1$ ;  $\angle PRQ = 45^\circ$ ;  $T$  is the foot of the perpendicular from  $P$  to  $QR$  and  $\angle PST = 60^\circ$ . What is the size of  $\angle QPR$ ?



- A  $45^\circ$  B  $60^\circ$  C  $75^\circ$  D  $90^\circ$  E  $105^\circ$

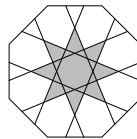
24. All the positive integers are written in the cells of a square grid. Starting from 1, the numbers spiral anticlockwise. The first part of the spiral is shown in the diagram.

				...	32	31	
	17	16	15	14	13	30	
	18	5	4	3	12	29	
	19	6	1	2	11	28	
	20	7	8	9	10	27	
	21	22	23	24	25	26	

What number will be immediately below 2012?

- A 1837 B 2011 C 2013 D 2195 E 2210

25. The diagram shows a ceramic design by the Catalan architect Antoni Gaudi. It is formed by drawing eight lines connecting points which divide the edges of the outer regular octagon into three equal parts, as shown. What fraction of the octagon is shaded?



- A  $\frac{1}{5}$  B  $\frac{2}{9}$  C  $\frac{1}{4}$  D  $\frac{3}{10}$  E  $\frac{5}{16}$



## UK INTERMEDIATE MATHEMATICAL CHALLENGE

THURSDAY 2ND FEBRUARY 2012

Organised by the **United Kingdom Mathematics Trust**  
and supported by

**The Actuarial Profession**  
making financial sense of the future

### RULES AND GUIDELINES (to be read before starting)

- Do not open the paper until the Invigilator tells you to do so.
- Time allowed: **1 hour**.  
No answers, or personal details, may be entered after the allowed hour is over.
- The use of rough paper is allowed; **calculators** and measuring instruments are **forbidden**.
- Candidates in England and Wales must be in School Year 11 or below.  
Candidates in Scotland must be in S4 or below.  
Candidates in Northern Ireland must be in School Year 12 or below.
- Use B or HB pencil only.** Mark *at most one* of the options A, B, C, D, E on the Answer Sheet for each question. Do not mark more than one option.
- Do not expect to finish the whole paper in 1 hour.* Concentrate first on Questions 1-15. When you have checked your answers to these, have a go at some of the later questions.
- Five marks are awarded for each correct answer to Questions 1-15.  
Six marks are awarded for each correct answer to Questions 16-25.  
**Each incorrect answer to Questions 16-20 loses 1 mark.**  
**Each incorrect answer to Questions 21-25 loses 2 marks.**
- Your Answer Sheet will be read only by a *dumb machine*. **Do not write or doodle on the sheet except to mark your chosen options.** The machine 'sees' all black pencil markings even if they are in the wrong places. If you mark the sheet in the wrong place, or leave bits of rubber stuck to the page, the machine will 'see' a mark and interpret this mark in its own way.
- The questions on this paper challenge you to **think**, not to guess. You get more marks, and more satisfaction, by doing one question carefully than by guessing lots of answers. The UK IMC is about solving interesting problems, not about lucky guessing.

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