



2021 Wits Mathematics Competition
Qualifying Round
Grade 6 and 7

Instructions

This exam consists of 20 multiple choice questions. There is one correct answer to each question. There is no penalty for incorrect answers. The mark allocation is as follows:

Questions 1-5 are each worth 3 points,
Questions 6-10 are each worth 4 points,
Questions 11-15 are each worth 5 points,
Questions 16-20 are each worth 6 points.
The total number of points available is 90.

The time limit on this exam is 75 minutes, calculators and geometric implements may NOT be used. If you are using the computer-friendly answer sheet you should fill it in in BLACK pen (other colours do not scan well). Time may be given for filling in name, school and other personal details.

“Always try the problems that matter most to you”. — Andrew Wiles

A. 3 point questions

1. Find $\frac{3}{4} + \frac{5}{6}$

A. $\frac{19}{12}$

B. $\frac{20}{12}$

C. $\frac{21}{12}$

D. $\frac{22}{12}$

E. $\frac{23}{12}$

A. $\frac{3}{4} + \frac{5}{6} = \frac{9}{12} + \frac{10}{12} = \frac{19}{12}$

2. A fence is 40 m long. The fence has posts 5 m apart. Four strands of wire run the length of the fence. Without counting the wire used to tie the ends of the wire, what are the materials needed to build this fence?

A. 8 posts, 40 m wire

B. 8 post, 160 m wire

C. 9 posts, 40 m wire

D. 9 posts, 160 m wire

E. Unknowable

D. 9 posts (there are 8 spaces between the posts) and a total of 160 m of wire (4 times the 40 meters)

3. Seven people were in the doctor's waiting room at the times shown.

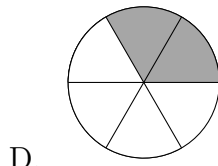
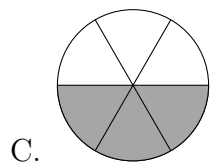
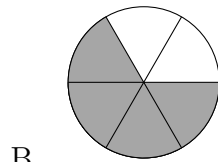
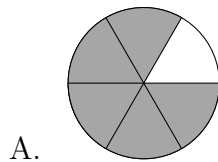
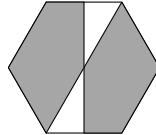
	Arrived in waiting room	Went in to see doctor
Ann	9:20	9:55
Bob	9:40	10:20
Carl	10:05	10:50
David	10:05	11:15
Eric	10:10	11:35
Fatima	10:10	11:50
Gaye	10:55	12:05

How many people were in the waiting room at 10 o'clock?

A. 1

- B. 2
 - C. 3
 - D. 5
 - E. 7
- A. Only Bob.

4. Which circle has the same fraction shaded as the regular hexagon?



- E. None of the above
- A. Both have five sixths of the total area shaded.

5. This is a magic square. All of its rows, columns and diagonals have the same total.

		5
8	7	
9		

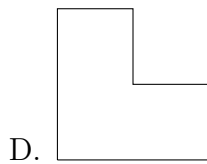
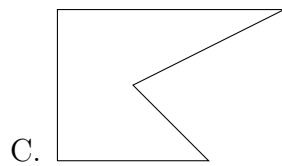
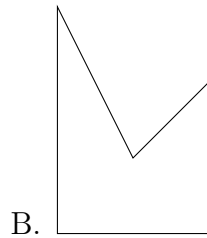
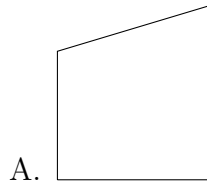
Which number belongs in the shaded square?

- A. 2
- B. 4
- C. 6
- D. 10
- E. 12

A. First observe that the sum (per row, column or diagonal) is 21. This allows us to fill in individual squares.

B. 4 point questions

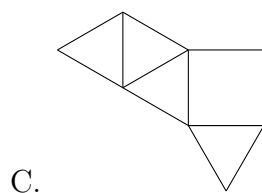
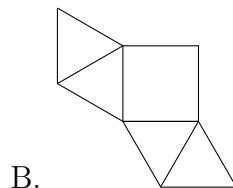
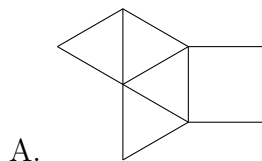
6. Using one straight line, which of these shapes can be divided into two identical pieces?

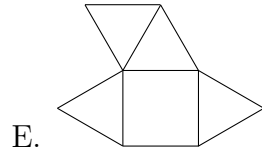
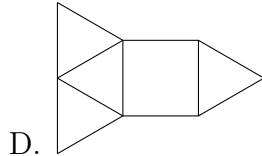


E. None of these

D. This is the only option which can be split in this manner

7. Which of these nets will **NOT** fold to make a square pyramid?





E. The two leftmost triangles would overlap leaving another side of the square uncovered.

8. A rectangular paddock has perimeter of 60 m. If the area of this paddock is $200m^2$ what is the longest side of this paddock?

- A. No such paddock could exist
- B. 10 m
- C. 20 m
- D. 25 m
- E. 30 m

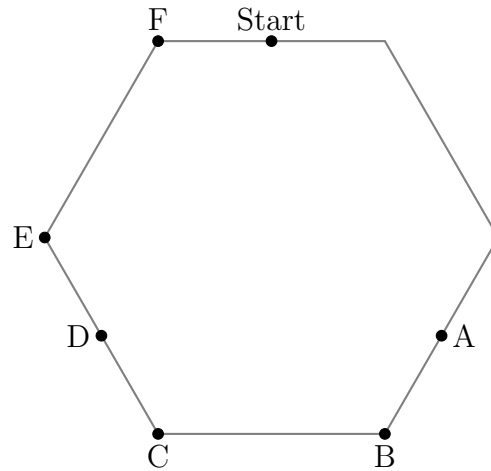
C. The only solution here is a 10 meter by 20 meter paddock.

9. Terri's birthday is on 3 December. On 1 August 2012 she was 11-years-old. In which year will she have her 21st birthday?

- A. 2020
- B. 2021
- C. 2022
- D. 2023
- E. 2024

B. 2021. She turned 12 in 2012

10. A running track is in the shape of a hexagon with equal sides. Kerri started running from the start flag. She ran an anti-clockwise direction (that is towards F) and stopped one-third of the way around the track.



At which point (A,B,C or D) did she stop?

- A. A
- B. B
- C. C
- D. D
- E. E

D. Break the hexagon into 12 pieces, consisting of each half of each side. Count out 4 of these.

C. 5 point questions

11. The average age of the 40 members of a computer science camp is 17 years. There are 20 girls, 15 boys, and 5 adults. If the average age of the girls is 15 and the average age of the boys is 16, what is the average age of the adults?

- A. 26
- B. 27
- C. 28
- D. 29
- E. 30

C. As the average age is 17 years the sum of all 40 ages is $40 \times 17 = 680$ years. The boys ages sum to 240 and the girls to 300. This leaves 140 years shared amongst five adults for an average age of 28/

12. At a party, if each kid took one apple from the fruit bucket, then 7 apples would still remain in the bucket. However, if each kid had an appetite for two apples, the supply would be 16 apples short. How many kids were at the party?

- A. 7
- B. 14
- C. 16
- D. 23
- E. 37

D. 23. If each kid tries to take a second apple seven of them take one and sixteen don't get (or are still owed one). This means 23 kids at the party.

13. Find the greatest three-digit number such that.
- 1. It leaves a remainder of 1 when divided by 2
 - 2. It leaves a remainder of 2 when divided by 3
 - 3. It leaves a remainder of 3 when divided by 4
 - 4. It leaves a remainder of 4 when divided by 5
- A. 947
 - B. 959
 - C. 964
 - D. 987
 - E. 999

B. 959. The conditions imply that the number leaves a remainder of 59 when divided by 60 and 959 is the largest such three digit number. This is because 60 is the least common multiple of 2,3,4 and 5 and the number is 1 short of a whole multiple all each of them. A useful generalisation of this idea (not needed for this question) is called the Chinese Remainder Theorem which interested readers may enjoy reading up on (the wikipedia article is excellent). An alternative method is simply to test each of the given options given.

14. Define $a \oplus b$ as $\frac{a+b}{a \times b}$ compute $(3 \oplus 2) \oplus 4$

A. $\frac{24}{42}$

B. $\frac{9}{24}$

C. $\frac{14}{234}$

D. 1

E. $\frac{29}{20}$

E.

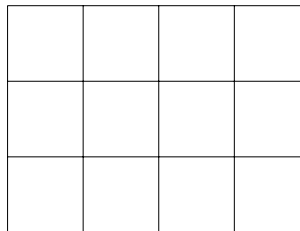
$$(3 \oplus 2) \oplus 4 =$$

$$\frac{5}{6} \oplus 4 =$$

$$\frac{\frac{5}{6} + 4}{\frac{5}{6} \times 4} =$$

$$\frac{29}{20}$$

15. How many rectangles are in the below shape?



A. 40

B. 50

C. 60

D. 70

E. 80

C. 60. This can be done by enumeration. The cleanest way however is to choose two horizontal lines (6 ways to do this) and two vertical lines (10 ways to do this) for a total of 60 ways.

D. 6 point questions

16. Assume that you have an analogue clock where the hour and minute hands continuously. How many times will the hour and minute hands be co-linear from 5 am to 7 pm. (The hour and minute hands are co-linear if the point in the same direction or in opposite directions.)

- A. 13
- B. 14
- C. 25
- D. 26
- E. 27

C.

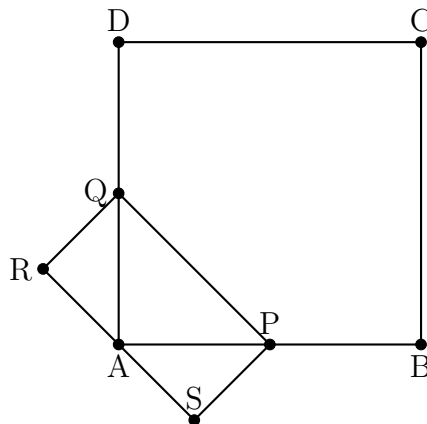
17. A donkey is tied to the corner of an $8m \times 10m$ rectangular barn with a 12 m length of rope. What is the gazing area of the donkey?

(Note that the donkey is unable to enter the barn.)

- A. 64π
- B. 72π
- C. 108π
- D. 113π
- E. 144π

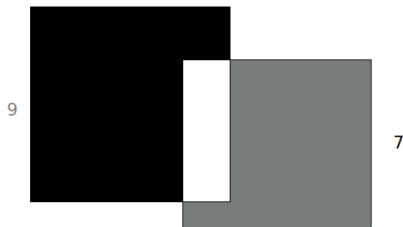
D.

18. In the figure, ABCD is a square. P and Q are mid-points of AB and AD respectively. PQRS is a rectangle. Find the ratio of the area of the square to the area of the rectangle.



- A. 4
- B. 8

- C. 12
D. 16
E. None of these
- A.
19. An ant starts at the bottom left corner of a ten meter by ten meter square field. It walks for seven meters in a straight line towards the top right corner then walks two meters directly upwards and stops. From the ant's final location, find the sum of the four shortest distances to the top, right, bottom and left boundaries of the field.
- A. $10m$
B. $16m$
C. $18m$
D. $20m$
E. $26m$
- D. At any point in the field the distances to the top and bottom add up to ten meters. The same is true for the left and right sides.
20. Two squares with side lengths seven and nine are pictured below. How much greater is the larger (darker) shaded region than the smaller shaded region?



- A. 16
B. 32
C. 49
D. 81
E. Impossible to tell
- D. 32 The darkly shaded region has area 81 minus the intersection. The lightly shaded region has area 49 minus the intersection. Thus the difference is $81 - 49 = 32$.