



**Cambridge Assessment
Admissions Testing**



**NAZARBAYEV
UNIVERSITY**

Foundation Year Programme

Entrance Tests

MATHEMATICS

SPECIMEN PAPER

For

NUFYP SET 2019



Mathematics

SPECIMEN

60 minutes

Additional materials: Answer Sheet

Instructions to Candidates

Read this page carefully, but do not open the question paper until you are told that you may do so.

A separate answer sheet is provided for this paper. Please check you have one.

You require a soft pencil and an eraser.

Check that the title of the paper you are taking matches the title on the answer sheet.

Complete the top section of the answer sheet in soft pencil with your personal details.

There are 30 questions in this paper. Each question is worth one mark. There are no penalties for incorrect responses, only marks for correct answers, so you should attempt all 30 questions.

Answer in soft pencil on the answer sheet provided. Questions ask you to show your choice between options. Choose the **one** option you consider correct and record your choice on the separate answer sheet. If you make a mistake, erase thoroughly and try again.

You can use the question paper for rough working, but no extra paper is allowed.

Only your responses on the answer sheet will be marked.

Speed as well as accuracy is important in this paper. Work quickly, or you might not finish the paper.

Dictionaries and calculators may NOT be used.

Please wait to be told you may begin before turning this page.

This question paper consists of 19 printed pages and 5 blank pages.

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SPECIMEN for NUFYP SET 2019

- 1 The symbol $\diamond$ defines a mathematical binary operation such that $y \diamond x = \frac{y^x}{x}$ for all positive integers.

What is the value of $(2 \diamond 3) \diamond 2$?

- A 2×3^3
- B $\frac{8}{3}$
- C $\frac{32}{9}$
- D 4
- E $\frac{2^5\sqrt{2}}{9}$

- 2 Solve the inequality:

$$x^2 \geq 8 - 2x$$

- A $x \geq 4$
- B $x \leq 2$ and $x \geq -4$
- C $x \geq -2$ and $x \leq 4$
- D $x \geq 2$ and $x \leq -4$

- 3 The sum of the two values of x that satisfy the simultaneous equations $x - 3y + 1 = 0$ and $3x^2 - 7xy = 5$ is

- A -8.5
- B -7.5
- C -1.5
- D 3.5
- E 4.5
- F 5

- 4 The algebraic fraction $\frac{a}{b}$ is equal to $5 - \frac{2x}{x-1}$

Which one of the following is equivalent to $\left(\frac{a}{b}\right)^{-1}$ in terms of x ?

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

- 5 Using the formula:

$$z = xy^2$$

calculate the value of y when:

$$z = 1.2 \times 10^{13}$$

$$x = 3.0 \times 10^{-6}$$

- A** 2×10^3
- B** 4×10^3
- C** 2×10^9
- D** 4×10^9
- 6 Evaluate
- $$\left(\frac{32^{1/5} + 9^0}{81^{3/4}} \right)^{-1}$$

- A** $\frac{27}{2}$
- B** $-\frac{128}{1215}$
- C** 9
- D** $\frac{27}{11}$
- E** $\frac{1}{9}$

7 Given

$$T = 2\pi \sqrt{\frac{(k^2 + h^2)}{gh}}$$

Rearrange the formula to make k the subject.

A $k = \left(\frac{T}{2\pi}\right)^2 gh - h$

B $k = \sqrt{\left(\frac{T^2 g^2 h^2}{4\pi^2} - h^2\right)}$

C $k = \sqrt{(T - 2\pi)^2 gh - h^2}$

D $k = \sqrt{\left(\frac{T^2 gh}{4\pi^2} - h^2\right)}$

8 The sum of the roots of a quadratic equation is 7, the product of the roots is 9.

What is the equation?

A $x^2 + 7x + 9 = 0$

B $x^2 + 7x - 9 = 0$

C $x^2 - 7x + 9 = 0$

D $x^2 - 7x - 9 = 0$

- 9 The roots of the equation $2x^2 - 11x + a = 0$ differ by 2.

The value of a is

A $\frac{105}{8}$

B $\frac{113}{8}$

C $\frac{117}{8}$

D $\frac{119}{8}$

- 10 The longest side of a right-angled triangle is $6 + \sqrt{5}$ units.

One of the shorter sides is $3 + 2\sqrt{5}$ units.

What is the length of the third side?

A $2\sqrt{3}$

B $\sqrt{(70 + 24\sqrt{5})}$

C 12

D $3 - \sqrt{5}$

E $14 + 7.5\sqrt{5}$

- 11 Given that y is a solution to the simultaneous equations:

$$4x^2 + y^2 + 10y = 47$$

$$2x - y = 5$$

What is the value of y when $x \geq 0$?

- A -4
- B -1
- C 0
- D 1
- E 3
- F 7
- G 8

- 12 Five runners competed in a race: Fred, George, Hermione, Lavender, and Ron.

Fred beat George.

Hermione beat Lavender.

Lavender beat George.

Ron beat George.

Assuming there were no ties, how many possible finishing orders could there have been, given only this information?

- A 1
- B 6
- C 12
- D 18
- E 24
- F 120

- 13 Simplify:

$$4 - \frac{x^2(1-16x^2)}{(4x-1)2x^3}$$

- A $2 - \frac{1}{2x}$
- B $2 + \frac{1}{2x}$
- C $4 - \frac{1}{2x}$
- D $4 + \frac{1}{2x}$
- E $6 - \frac{1}{2x}$
- F $6 + \frac{1}{2x}$
- 14 Which of the expressions below has the largest value for $0 < x < 1$?
- A $\frac{1}{x}$
- B x^2
- C $\frac{1}{(1+x)}$
- D $\frac{1}{\sqrt{x}}$
- E $\sqrt{x}$

- 15 The diagram shows a quadrant of a circle, centre O, radius 20 cm.
The chord AB has been drawn.

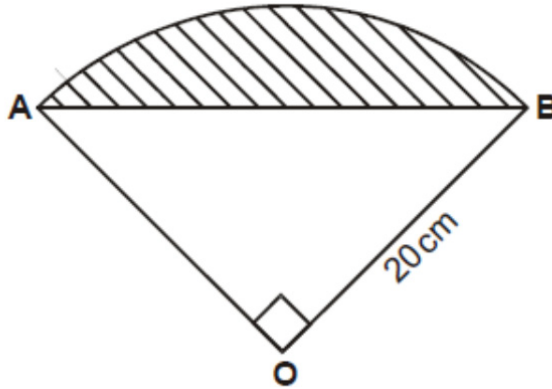


diagram not to scale

What fraction of the quadrant is shaded?

- A $\frac{\pi-1}{\pi}$
- B $\frac{2}{\pi}$
- C $\frac{\pi-2}{\pi}$
- D $\frac{2-\pi}{\pi}$

- 16 What is the equation of the straight line passing through (4, 1) which is parallel to the line given by the equation $3x + 2y = 12$?

A $3y = 14 - 2x$

B $2y = 11 - 3x$

C $2y = 14 - 3x$

D $3y = 2x - 5$

E $2y = 3x - 10$

- 17 For any real numbers a , b , and c where $a \geq b$, consider these three statements:

1. $-b \geq -a$

2. $a^2 + b^2 \geq 2ab$

3. $ac \geq bc$

Which of these statements **must** be true?

A All three statements

B Only statements 1 and 2

C Only statements 2 and 3

D Only statements 1 and 3

E Only statement 1

F Only statement 2

G Only statement 3

H None of the statements

- 18 The cross-section of a triangular prism is an equilateral triangle with side $2x$ cm. The length of the prism is d cm.

Let the total surface area of the prism be T cm². Given that the volume of the prism is T cm³, which one of the following is an expression for d in terms of x ?

A $\frac{x}{2x-3}$

B $\frac{3x}{3x-2\sqrt{3}}$

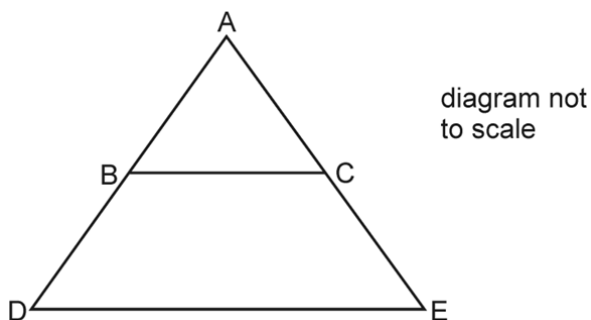
C $\frac{2x}{x-4\sqrt{3}}$

D $\frac{2x}{x-2\sqrt{3}}$

E $\frac{2x}{x-\sqrt{3}}$

- 19 A shape is formed by drawing a triangle ABC inside the triangle ADE. BC is parallel to DE.

$AB = 4$ cm $BC = x$ cm $DE = (x + 3)$ cm $DB = (x - 4)$ cm



Calculate the length of DE.

A 5 cm

B 7 cm

C 9 cm

D $4 + 2\sqrt{7}$ cm

E $7 + 2\sqrt{7}$ cm

- 20 A cube has unit length sides. What is the length of a line joining a vertex to the midpoint of one of the opposite faces (the dashed line in the diagram below)?

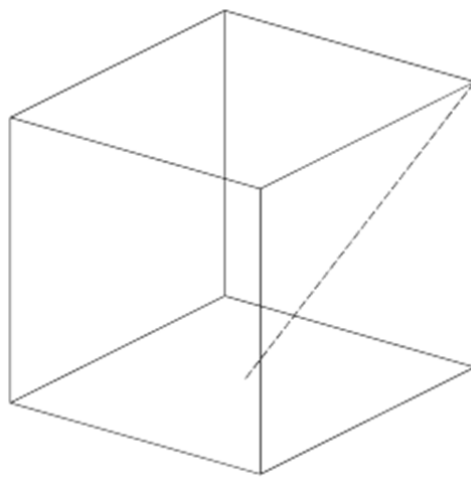


diagram not to scale

- A $\sqrt{2}$
- B $\sqrt{\frac{3}{2}}$
- C $\sqrt{\frac{5}{2}}$
- D $\sqrt{3}$
- E $\sqrt{5}$

- 21 The diagram shows three similar right-angled triangles.

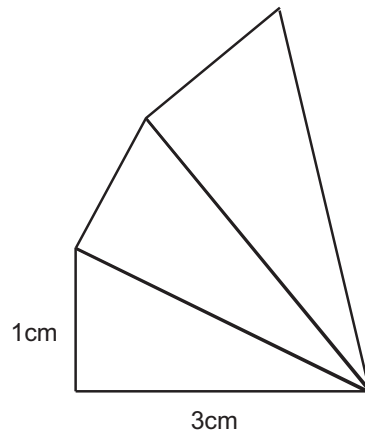


diagram not to scale

What is the area of the largest triangle?

- A $\frac{5}{3} \text{ cm}^2$
- B $\frac{50}{27} \text{ cm}^2$
- C 5 cm^2
- D 15 cm^2
- E $\frac{50}{3} \text{ cm}^2$

- 22 The n^{th} term of a sequence is $\frac{n}{n+1}$

What is an expression for the difference between the $(n + 1)^{\text{th}}$ term and the n^{th} term?

A $\frac{4n+1}{(n+2)(n+1)}$

B $\frac{1}{(n+2)(n+1)}$

C $\frac{n^2+n}{(n+2)(n+1)}$

D $\frac{1}{n^2+2}$

E $\frac{1}{n(n+1)}$

- 23 Given that c and d are non-zero integers, the expression $\frac{10^{c-2d} \times 20^{2c+d}}{8^c \times 125^{c+d}}$ is an integer if

A $c < 0$

B $d < 0$

C $c < 0$ and $d < 0$

D $c < 0$ and $d > 0$

E $c > 0$ and $d < 0$

F $c > 0$ and $d > 0$

G $d > 0$

H $c > 0$

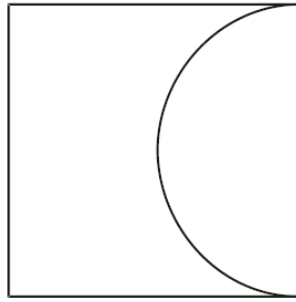
- 24 For what values of the non-zero real number a does the quadratic equation $ax^2 + (a - 2)x = 2$ have real distinct roots?

- A All values of a
- B $a = -2$
- C $a > -2$
- D $a \neq -2$

- 25 A circle has a diameter of 20 cm.
The line AC is a diameter of the circle.
B is a point on the circumference of the circle with AB=12 cm.
The point D lies on the arc AC on the opposite side to point B.
What is the sine of angle BDC?

- A 0.6
- B $\frac{16}{25}$
- C 0.8
- D $\frac{\sqrt{11}}{6}$
- E $\frac{1}{\sqrt{2}}$

- 26 A square piece of metal has a semi-circular piece cut out of it as shown. The area of the remaining metal is 100 cm^2 .



Which of the following is a correct expression of the length of the side of the square in cm?

- A $10\sqrt{\frac{1}{8-\pi}}$
- B $10\sqrt{\frac{2}{4-\pi}}$
- C $20\sqrt{\frac{2}{8+\pi}}$
- D $20\sqrt{\frac{2}{8-\pi}}$
- E $20\sqrt{\frac{1}{4-\pi}}$

- 27 Two identical copies of a right-angled triangle are placed on top of each other to make a quadrilateral ABCD as shown below.

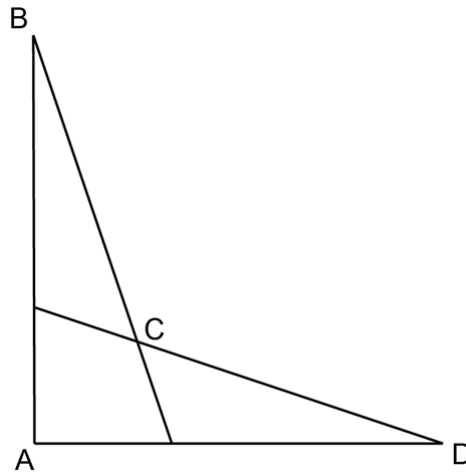


diagram not to scale

The perpendicular sides of the triangles are in the ratio 1 : 3

What fraction of the area of the quadrilateral is covered by both triangles?

- A $\frac{1}{2}$
- B $\frac{1}{3}$
- C $\frac{1}{4}$
- D $\frac{1}{5}$
- E $\frac{1}{6}$
- F $\frac{1}{7}$

- 28 Given that $a > 0$ and $1 < b < 3$ and $c = \frac{b^2+1}{a+1}$

What is the range of possible values of c ?

- A $c > 0$
- B $c > 2$
- C $0 < c < 2$
- D $0 < c < 10$
- E $2 < c < 10$

- 29 The weight of an animal increases by 50% each year for 3 years. It then declines in weight by 20% a year for 2 years and then declines by a further 25% in the next year.

What is the percentage increase in the animal's weight at the end of 6 years compared to its original weight at the start of this period?

- A 5%
- B 20%
- C 62%
- D 85%
- E 115%

- 30** If you look at a clock and the time is 9.45, what is the angle between the hour and the minute hands?
- A** 0°
 - B** 7.5°
 - C** 15°
 - D** 22.5°
 - E** 30°

END OF TEST

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