The NBT Mathematics (MAT) test: Exemplar questions

Questions in the section *Functions and their Graphs* will determine whether a test writer understands the properties of parabolas. Questions 1 and 2 are examples.

1. The function f defined by $y = f(x) = -x^2 + 6x - 5$ has
   (A) A minimum y value and a negative y-intercept.
   (B) A maximum y value and a positive y-intercept.
   (C) A minimum y value and a positive y-intercept.
   (D) A maximum y value and a negative y-intercept.

Under the heading Algebraic Processes one of the topics listed is *Algebraic Manipulation*. Question 2 is an example of a question where the answer cannot be deduced by substituting into the given options to rule out those that are correct.

2. The sum of the roots of the equation $-x^2 + 6x - 5 = 0$ is

   (A) -5 (B) -4 (C) 3 (D) 6

Another topic listed under the heading Algebraic Processes is *Number Sense.* The following question depends on *Number Sense* (the bigger a number, the bigger its square root) as well as the concepts tested in the first two questions above.

3. The expression $\sqrt{-x^2 + 6x - 5}$ has a

   (A) maximum value of 2 (B) minimum value of 2

   (C) maximum value of 3 (D) minimum value of 3

Question 4 is an example of the category *Transformations* and related concepts.

4. If the graph of $y = -x^2 + 6x - 5$ is reflected in the x-axis and the resulting graph is then reflected in the y-axis, the new equation is

   (A) $y = -(x-3)^2 + 4$ (B) $y = -x^2 - 6x - 5$

   (C) $y = (x+3)^2 + 4$ (D) $y = x^2 + 6x + 5$

One of the categories listed is *Competent use of logical skills in making deductions and determining the validity of given assertions.* Question 5 (which is also an example *Number Sense)* illustrates what this means. Writers need to assess the various options and make deductions about their validity.

5. For any real number x, which one of the following statements is **always** true?

(A) $-x < 0$ (B) $\frac{1}{x}$ is rational

(C) $\frac{x}{x+1} < 1$ (D) $\frac{1}{x} > 1$ if $0 < x < 1$

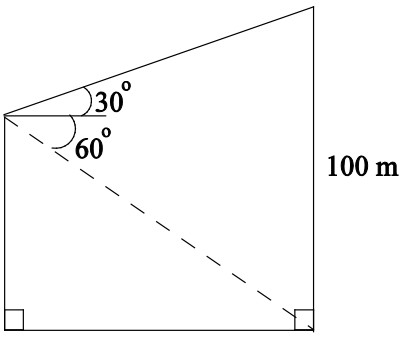
The next two questions are in the *Trigonometry* category. Question 6 depends on an understanding of *compound angles*, and question 7 involves an application of *trigonometric ratios* in a two-dimensional situation.

6. $\sin 43^\circ \cos 23^\circ - \cos 43^\circ \sin 23^\circ$ is equal to

(A) $\cos 66^\circ$ (B) $\cos 20^\circ$

(C) $\sin 66^\circ$ (D) $\sin 20^\circ$

7.



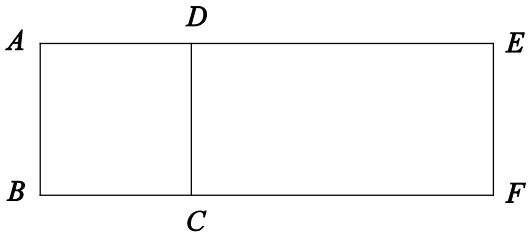
cell phone tower A cell phone tower B

The angle of elevation of the top of cell phone tower B from the top of cell phone tower A is 30°. The angle of depression of the foot of cell phone tower B from the top of cell phone tower A is 60°. The height of cell phone tower B is 100m. The foot of cell phone tower A and the foot of cell phone tower B are in the same horizontal plane. The height of cell phone tower A is

(A) 60 m (B) 65 m (C) 70 m (D) 75 m

Question 8 combines an understanding of *Algebraic Manipulation* (in this case quadratics) and *Spatial Awareness* (rectangles) and Question 9 tests understanding of the *Properties of two- and three-dimensional objects,* as well as *surface area*.

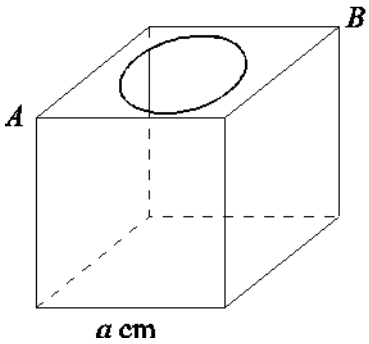
8.



Suppose ABCD is a square with side length $(x-1)$ cm. If the area of rectangle ABFE is (x^2+x-2) cm², then the length of FC, in cm, is

(A) 2 (B) 3 (C) 4 (D) 5

Question 9 is also an example of *Spatial Awareness*.



9. The figure represents an empty cube with a circular opening at the top. The diameter of the opening is half the length of the diagonal AB. The outer surface area of the cube (in square centimetres) is:

(A) $6a^2-\frac{\pi a^2}{4}$ (B) $6a^2-2\pi a^2$

(C) $6a^2-\frac{\pi a^2}{8}$ (D) $6a^2-\frac{\pi a^2}{2}$

Question 10 (from the *Algebraic Processes* subcategory *Financial Calculations*) shows what we mean when we say that calculators are unnecessary.

10. An amount of R1 000 is invested at an annual interest rate of 6%. Interest is compounded **every three months** (quarterly). After 5 years the investment, in rands, will be worth

(A) $1\,000\,(1{,}015)^{20}$ (B) $1\,000\,(1{,}02)^{15}$

(C) $1\,000\,(1{,}03)^{20}$ (D) $1\,000\,(1{,}06)^{5}$

The options given above show that we are interested in the *expression* you would use to carry out the calculation, and not in the final answer.