هيئة جودة التعليم والتدريب
Education & Training Quality Authority

Directorate of National Examinations

Mathematical Skills – Grade 12
Test Specifications

Date Issued: 2024

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All details in this document are correct at the time of publishing, but may be subject to change as a result of ongoing efforts to ensure the quality of the examination product

1. Purpose:

The main purpose of the examinations is to measure the students' performance in Grade 12 based on the learning goals in the Secondary Education in the Kingdom of Bahrain and international level of proficiency.

Additional purposes of the National Examinations are to provide:

- a beacon of good assessment practice;
- robust information for the monitoring of standards over time..

1.1. Aims of the Grade 12 Mathematical Skills examinations

The aims of the grade 12 Mathematical Skills examinations are:

- to assess a student's ability to analyse numerical and graphical information, which is based in real life situations, and apply the right numerical techniques to find new information or derive solutions;
- to develop the use of a range of skills such as data handling, reading, logic and reasoning. Students will be assessed on these various sub-skills, which are the building blocks to successfully solving wider and more complex problems;
- to encourage the application of simple mathematics to new situations to show that students can manipulate numerical and graphical data. They need to extract and use relevant data, and find ways of drawing conclusions from information. Students need to be able to present that same data in different forms. They are expected to think critically about information, find possible reasons for unexpected variations and be able to use information for informed decision-making.

2. Definitions

2.1. Skills

In Mathematical Skill examination two major Competences will be assessed:

First: Dealing with Data:

This will be assessed through questions that measure the following skills:

- Extracting relevant and Processing data
- Identifying similar data
- Choosing and working with models

Second: Dealing with Problems:

This will be assessed through questions that measure the following skills:

- Finding procedures for solving problems
- Searching for solutions
- Making choices and decisions

Students need to be familiar with basic techniques of mathematical.

Mathematical Skills is about using logical methods of handling numerical, graphical and pictorial data.

2.2. Questions and items

A question consists of one item only.

3. Test Construct

3.1. Description of papers

There will be 1 question paper, assessing Mathematical Skills. Students answer on the question paper. Students have 150 minutes to complete 40 multiple choice questions, each made up of a stimulus, a question and 4 options – only one of which is the correct answer. Each question will have a skill focus, however, frequently, the question will involve one or more other skills, but to a lesser degree. Paper tests all major competences and their skills.

3.2. Additional materials

Students are permitted to use calculators in the exam.

4. Mathematical Skills PAPER

The questions examine the student's abilities to Deal with Data and Deal with Problems.

The questions are multiple choice with a short stimulus passage. The students select the most appropriate response from four options A to D.

Information may be presented in five categories: tables, graphs, words, pictures or diagrams.

The stimulus may include information in more than one category. The stimulus material is based on a realistic scenario. In general, students should be able to answer the question from the stimulus, rather than having to work backwards from the list of possible answers. However, there will be some questions where the options in effect form part of the stimulus. Students do not have to have knowledge specific to any subject, for example knowledge of physics or statistics; they do have to have knowledge of the basic mathematics required.

Each of the skill categories for Mathematical Skills is explained below. An example of a question that tests the sub-skill is also provided in section 5.

First: Dealing with Data:

Extracting relevant and Processing data

- Questions may give information in words, tables, or graphs. Most is quantitative but some qualitative elements may be included (e.g. colour or shape).
- This data needs to be used to answer a question
- One or more items from the data should be used correctly to give an answer. The method of using the data will be clear and will not need to be clarified. The skill is to choose and use the data correctly.

Identifying similar data

- Students will be asked to match information in one form to the same information in another form (e.g. table to graph), or in a different representation of the same form (e.g. matching a time-distance graph with the same data presented as a time-velocity graph).
- The information given and derived may be in words, tables, graphs, pictures or diagrams.
- The skill required from the student is to recognise the correct data item or data set from several others which are presented.

Choosing and working with models

- A model of a set of data may be in the form of a graph, a diagram or a written description.
- Students are given a scenario which includes information on the way in which a parameter or a process varies.
- They are then asked to choose a representation of this variation in another form which models the data presented.
- A more difficult question might expect the student to derive a mathematical model and use it to produce an answer.
- The skill is to recognise how one set of information may model either another set or a real situation.

Second: Dealing with Problems:

Finding procedures for solving problems

- Questions may give information in words, tables, graphs, pictures, or diagrams.
- Students are given a problem to solve (this will in most cases have a numerical solution, but it may also be in other forms e.g., a spatial manipulation).
- The method of solution is not immediately obvious, and the student has to choose a suitable method of using the data to come up with the answer. The skill is to work out how to use the data in a suitable way to solve the problem, and then produce a solution.

Searching for solutions

- Questions may give information in words, tables, graphs, pictures or diagrams.
- Students must solve a problem by searching for a solution.
- Searching can be in two forms. It may be necessary to search the data given to find the correct pieces of information to use. In general, it will also be necessary to consider several possible scenarios which may solve the problem, then to decide which, for example, is the best according to a given factor.
- The required skills are to identify a suitable method of searching and to carry it out correctly.

Making choices and decisions

- Questions give data in words, tables, graphs, pictures or diagrams and a set of criteria.
- Students choose from a set of options based on the given data and criteria. This involves a search of some sort.
- In the simplest sense, this would be just extracting an item from the data set be or the search may involve an amount of data handling. The skill is to be able to make an informed decision by combining a set of information and given criteria for selection.

5. Example Materials

First: Deal with Data:

Sample question (Extracting relevant and Processing data)

We had 76 people wanting orange juice at a conference. The caterers provided enough orange juice for each of 80 people to have a 400 ml cup three-quarters full. We carefully filled each cup to exactly three-quarters full as we handed them out, but failed to notice that they had given us 500 ml cups.

How many people went without?

A 0

B 4

C 8

D 12

Key D
Stimulus Type Words
Justification
The amount of orange juice provided by the caterers was 80 (people) × 400 (ml cups) × (full) = 24000 ml. The amount of orange juice in one of the larger cups is 500 (ml) × (full) = 375 ml.

The number of people that can be catered for is 24000 (the amount of orange juice provided) ÷ 375 (in each cup) = 64.
There are 76 people so 76 – 64 = 12 people will go without.

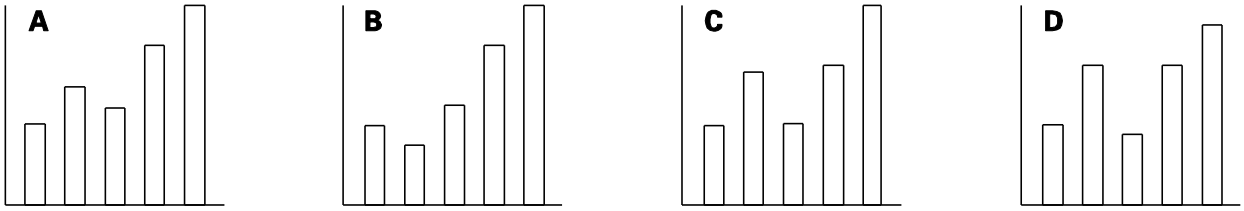
The candidate must use the data correctly (all the data is relevant so the only extraction skill is to use the correct numbers at the correct time). The skill is processing. Finding a method is a minor part of the answer, as the method of solution is straightforward

sample question (Identifying similar data)

The table shows the age distribution of the inhabitants of a small town:

Age group	0–15	16–25	26–45	46–64	65 +
Number of inhabitants	2997	4432	3761	5980	7440

Which of the following charts, if suitably labelled, could represent the data above?

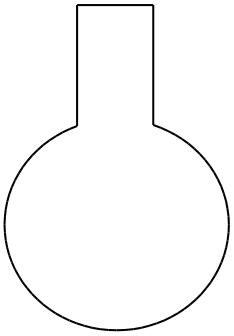


Key A
Stimulus Type Table
Justification
The second bar should be approximately 1.5 × the height of the first, the third should be in between the first and second, the fourth approximately twice the height of the first and the fifth the largest.

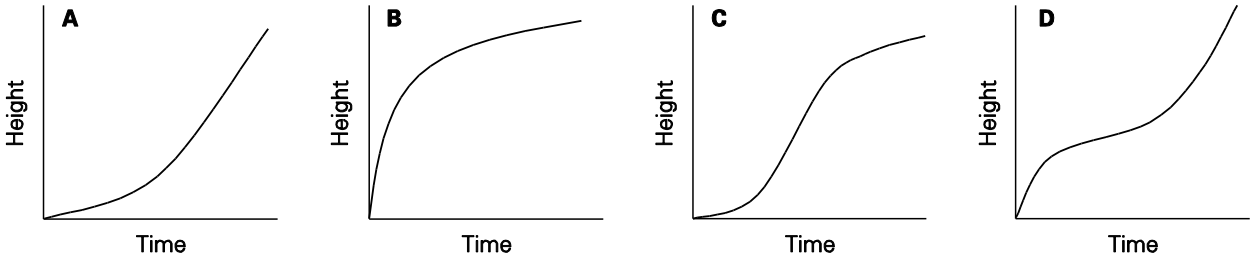
Only chart A shows this.

Sample question (Choosing and working with models)

The diagram below shows a bottle used in a laboratory. In order to determine the volume of liquid in the bottle for various heights, water is allowed to flow into the bottle at a constant rate.
An observer makes frequent notes of the height the water has reached and of the time. He draws a graph to illustrate his observations.



Which of the following graphs could be the one drawn by the observer?



Key D
Stimulus Type Words and Picture
Justification
The height will rise quickly at first (as the bottle is narrow at the bottom), it will then rise more slowly as the level reaches the wider section and more quickly again at the narrower section towards the top. All these segments will show curves as the area changes continuously. The rate of rise will then become constant in the cylindrical section at the top, giving a straight line segment. D is the only graph to show this.

Second: Deal with Problems:

Sample question (Finding procedures for solving problems)

Each of two identical cars can carry enough fuel to travel 100 km only. To make a longer journey over a deserted area, they set out together and then at some stage the first car transfers fuel to the other and returns home. The second car travels on.

What, approximately, is the furthest distance from home that the second car can travel?

A 125 km

B 133 km

C 150 km

D 167 km

Key B

Stimulus Type Words
Justification
A method must be developed to solve this problem – it cannot be done just using extraction or processing.

One way is by trial and error. For example, if the two cars travel 50 km together, it would be possible to transfer 50 km worth of fuel from one to another but then the car donating the fuel would be empty so this is clearly too far. Similarly, at 25 km only 25 km worth could be transferred so the donor car would have 25 km left when it reaches home.

It becomes clear that the donor car must divide its fuel into 3: $\frac{1}{3}$ each for the outward journey, to transfer to the other car and to return. At 33 km the car which is continuing is completely refilled and would have enough for another 100 km, making 133 km in total.

sample question (Searching for solutions)

A private mail delivery company makes the following charges for delivering letters and packages:

Weight up to 60 g	250 fils
Each extra 10 g or part thereof	50 fils

A woman wishes to use this company to send a manuscript either as a single package of weight 138 g or two or more packages with a total weight of 138 g.

What is the lowest cost of postage with this company?
A 590 fils
B 600 fils
C 640 fils
D 650 fils

Key B
Stimulus Type Words/Table
Justification
The skill is in performing a search of the options on splitting up the package to find how many pieces, and of what weights, is most effective.

As a single package it would cost 250 fils for the first 60 g and 8 × 50 fils for the remaining 78 g, or 650 fils in total.

If sent as two packages, it is most economical to have both at 60 g or more, as the first 60 g is pro rata cheaper than the remaining weight. Thus 60 g + 78 g is as effective as any other split.
This costs: 250 fils + 250 fils + (2 × 50 fils) = 600 fils.

If sent as three packages, once again it is best to keep as many as possible at 60 g or more. They would then divide as 60 g + 60 g + 18 g at 3 × 250 fils = 750 fils.

The two package option is the best at 600 fils.

sample question (Making choices and decisions)

I have none of my nephew's favourite biscuits left. My nephew visits me at least 3 times a week, though never more than five times. On each visit I know he will eat at least 6 biscuits but I won't let him have more than 8. Packets of biscuits can contain as few as 10 biscuits, or as many as 12.

How many packets of biscuits must I buy to make sure I do not run out within the next two weeks?

A 4
B 5
C 6
D 8

Key D

Stimulus Type Words

Justification

A decision on how many to buy is made by dividing my nephew's maximum requirement by the minimum number of biscuits in a pack. This is the only way of ensuring there are enough.

The most biscuits my nephew will eat in two weeks is 2 (weeks) × 5 (maximum visits per week) × 8 (maximum number of biscuits per visit) = 80. The minimum number of biscuits in a pack is 10, so 8 packets will be required. D is correct.