STADIRA
TRAINING INSTITUTE

Mathematics – Applications and Interpretation

Standard Level

Paper 1

Marks: 80

1 hour 30 minutes

DP MOCK EXAMINATION – SET 1

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Instructions to candidates

- Write your name in the box above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper (e.g. TI-Nspire CX II).
- Answer all questions. Answers must be written within the answer boxes provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the mathematics: applications and interpretation formula booklet is required for this paper.
- The maximum mark for this examination paper is [80 marks].

Information

- This question paper has 16 pages.
- The number of marks for each question or part question is shown in brackets [ ].

Answer all questions. Answers must be written within the answer boxes provided. Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. Solutions found from a graphic display calculator should be supported by suitable working. For example, if graphs are used to find a solution, you should sketch these as part of your answer. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

1. [Maximum mark: 4]

At its closest approach, the distance from Earth to Mars is approximately 54 600 000 km.

(a) Write down this distance in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [1]

A radio signal travels through space at a speed of 3.00×10^5 km s^{-1}.

(b) Calculate the time, in seconds, for a radio signal to travel from Earth to Mars. [2]

(c) Give your answer to part (b) in minutes. [1]

2. [Maximum mark: 5]

An engineering student in Tokyo estimates the height of the Tokyo Skytree to be 630 m. The actual height is 634 m.

(a) Calculate the percentage error in the student's estimate. [2]

A walkway near the tower is 380 m long, correct to the nearest 10 m.

(b) Write down the lower bound and the upper bound of the length of the walkway. [2]

(c) Five identical walkways are laid end to end. Write down the minimum possible total length. [1]

3. [Maximum mark: 5]

The Teatro Colón concert hall in Buenos Aires has 30 rows of seats. The first row has 22 seats, and each successive row has 4 more seats than the row in front of it.

(a) Find the number of seats in row 30. [2]

(b) Find the total number of seats in the concert hall. [2]

(c) For a sold-out concert, each ticket costs 150 pesos. Calculate the total ticket revenue. [1]

4. [Maximum mark: 5]

A music video is posted online in Seoul. On the first day it receives 800 views. The number of views on each following day is 1.35 times the number of views on the previous day.

(a) Find the number of views on day 8. [2]

(b) Find the total number of views during the first 8 days. [2]

(c) Find the first day on which the number of views in a single day exceeds 20 000. [1]

5. [Maximum mark: 6]

Amina invests 12 000 pula (BWP) in a savings account in Gaborone. The account pays a nominal annual interest rate of 4.5 %, compounded monthly. She leaves the money in the account for 6 years.

(a) Calculate the value of Amina's investment after 6 years. [3]

During the same period, the average annual rate of inflation is 2.8 %.

(b) Calculate the real value of the investment after 6 years, taking inflation into account. [2]

(c) State, with a reason, whether the purchasing power of Amina's money has increased. [1]

6. [Maximum mark: 5]

The cost, C, in Kenyan shillings (KES), of a taxi journey of d kilometres in Nairobi is modelled by

$$C = 200 + 65d.$$

(a) Write down what the value 65 represents in this model. [1]

(b) Find the cost of a journey of 12 km. [2]

(c) Wanjiru pays 1500 KES for a journey. Find the distance she travelled. [2]

7. [Maximum mark: 6]

A water jet at the Dubai Fountain is modelled by

$$h(x) = -0.24x^2 + 1.68x + 1.2, \quad x \geq 0 \ ,$$

where h is the height of the water above the pool surface, in metres, and x is the horizontal distance from the nozzle, in metres.

(a) Write down the height of the nozzle above the pool surface. [1]

(b) Using your graphic display calculator, find the maximum height reached by the water jet. [2]

(c) Find the horizontal distance from the nozzle to the point where the water lands on the pool surface. [2]

(d) Hence write down the domain of h for this model. [1]

8. [Maximum mark: 5]

A cup of coffee is served in a café in Oslo. Its temperature, T, in °C, after t minutes is modelled by

$$T(t) = 21 + 69 \times (0.94)^t.$$

(a) Write down the temperature of the coffee when it is served. [1]

(b) Find the temperature of the coffee after 10 minutes. [2]

(c) Find the time taken for the coffee to cool to 40 °C. [2]

9. [Maximum mark: 5]

From a point A on level ground, 80 m from the base of the Burj Khalifa, the angle of elevation of the top of the tower is 84.5°.

(a) Find the height of the tower. Give your answer to the nearest metre. [2]

An observer walks 40 m directly away from the tower, from A to point B.

(b) Find the angle of elevation of the top of the tower from B. [3]

10. [Maximum mark: 6]

A triangular park in Cape Town has vertices A, B and C, where AB = 140 m, AC = 95 m and angle BAC = 68°.

(a) Find the length of BC. [3]

(b) Find the area of the park. [2]

(c) Find the size of angle ABC. [1]

11. [Maximum mark: 5]

A grain silo in Saskatchewan, Canada, is made of a cylinder of radius 4.5 m and height 11 m, with a hemispherical roof of the same radius on top.

(a) Calculate the total volume of the silo. [3]

(b) Grain fills 85 % of the total volume. Calculate the volume of grain in the silo. [2]

12. [Maximum mark: 5]

The monthly rainfall, in mm, recorded in Mumbai during one year was:

2, 1, 3, 14, 92, 485, 617, 340, 264, 64, 13, 3

(a) Write down the median monthly rainfall. [1]

(b) Find the lower quartile and the upper quartile. [2]

(c) Determine, using calculations, whether the value 617 is an outlier for this data. [2]

13. [Maximum mark: 6]

The masses of apples harvested in a Chilean orchard are normally distributed with mean 168 g and standard deviation 12 g. An apple is selected at random.

(a) Find the probability that the apple has a mass greater than 180 g. [2]

(b) Find the probability that the apple has a mass between 150 g and 180 g. [2]

The heaviest 5 % of apples are sold as premium fruit.

(c) Find the minimum mass of a premium apple. [2]

14. [Maximum mark: 6]

A phone factory in Vietnam has two assembly lines. Line A produces 60 % of the phones and Line B produces the remaining 40 %. On average, 3 % of phones from Line A and 8 % of phones from Line B are defective. A phone is chosen at random from a day's production.

(a) Using a tree diagram or otherwise, find the probability that the phone is defective. [3]

(b) Given that the phone is defective, find the probability that it was produced by Line A. [2]

(c) The factory produces 2000 phones in one day. Find the expected number of defective phones. [1]

15. [Maximum mark: 6]

Consider the curve $y = x^3 - 9x^2 + 24x - 10$.

(a) Find $\frac{dy}{dx}$. [2]

(b) Find the gradient of the curve at the point where x = 1. [1]

(c) Find the values of x at the points where the tangent to the curve is horizontal. [2]

(d) Hence write down the interval of values of x for which the curve is decreasing. [1]