Question 1

[Maximum mark: 5]

Jurgen is a scientist working for NASA.

He maintains a telescope that is in orbit around the Earth.

To test the accuracy of the telescope he uses it to measure the radius of the Earth.

The radius of the Earth is known to be 6 378 137 metres.

(a) Jurgen measures the radius of the Earth to be 6 432 400 metres. What is the percentage error in his measurement? [2]

Jurgen uses **his** measurement to calculate the circumference of the Earth. He assumes the Earth is spherical.

(b) (i) What value for the circumference of the Earth does Jurgen obtain? Round your answer to 4 significant figures.

(ii) Write down the answer to part (b)(i) in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [3]

Question 2

[Maximum mark: 6]

After solving a problem, John has an **exact** answer of $z = 0.1475$.

(a) Write down the **exact** value of z in the form $a \times 10^k$, where $1 \leq a < 10, k \in \mathbb{Z}$. [2]

(b) State the value of z given correct to 2 significant figures. [1]

(c) Calculate the percentage error if z is given correct to 2 significant figures. [3]

Question 3

[Maximum mark: 6]

Given that $z = \dfrac{10\sin\alpha}{3x+y}$, where $\alpha = 30^\circ$, $x = 6$ and $y = 46$.

(a) Find the **exact** value of z. [2]

(b) Write your answer to part (a)

(i) correct to 2 decimal places;

(ii) correct to 3 significant figures;

(iii) in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [4]

Question 4

[Maximum mark: 6]

Let $A = \sqrt{\dfrac{\sin\alpha - \sin\beta}{x^2 + 2y}}$, where $\alpha = 54^\circ$, $\beta = 18^\circ$, $x = 24$ and $y = 18.25$.

(a) Find the value of A. Write down your full calculator display. [2]

(b) Give your answer to **part (a)** correct to

(i) three significant figures;

(ii) three decimal places. [2]

(c) Give the answer to **part (b) (i)** in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$. [2]

Question 5

[Maximum mark: 6]

Let $Q = \dfrac{(\sin 2x + b)(2\sin x - 1)}{a^2 - 4\tan x}$, where $x = 45^\circ$, $a = 18$ and $b = \sqrt{2}$.

(a) Find the **exact** value of Q. [2]

(b) Give your answer to **part (a)** correct to

(i) three decimal places;

(ii) three significant figures. [2]

(c) Calculate the percentage error if Q is given to three decimal places. [2]

Question 6

[Maximum mark: 6]

The volume of a hemisphere, V, is given by the formula

$$V = \sqrt{\frac{4S^3}{243\pi}},$$

where S is the total surface area.

The total surface area of a given hemisphere is 529 cm^2.

(a) Calculate the volume of this hemisphere in cm^3. Give your answer correct to **one decimal place**. [3]

(b) Write down your answer to part (a) correct to **the nearest integer**. [1]

(c) Write down your answer to **part (b)** in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]

Question 7

[Maximum mark: 6]

Four cement bags labelled, "5 kg", were delivered to a customer. The customer measured each bag to check their weights and recorded the following:

$$4.92,\ 4.95,\ 5.02,\ 4.95$$

(a) (i) Find the mean of the customer's measurements.

(ii) Calculate the percentage error between the mean and the stated, approximate weight of 5 kg. [3]

(b) Calculate $\sqrt{2.15^8 - 5.12^{-0.8}}$, giving your answer

(i) correct to the nearest integer;

(ii) in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [3]

Question 8

[Maximum mark: 6]

The distance between two points with coordinates (x_1, y_1) and (x_2, y_2) is equal to $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.

(a) Calculate the distance between points A$(40, -100)$ and B$(1, -2)$. Give your answer correct to three significant figures. [3]

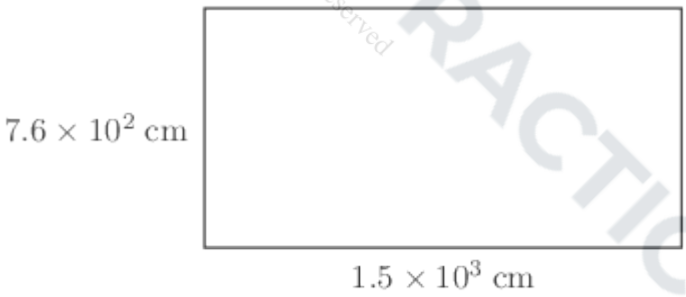
(b) Give your answer from **part (a)** correct to one decimal place. [1]

(c) Write the answer to **part (b)** in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$. [2]

Question 9

[Maximum mark: 6]

The following diagram shows a rectangle with sides of length 7.6×10^2 cm and 1.5×10^3 cm.



(a) Write down the area of the rectangle in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [3]

Natalie estimates the area of the rectangle to be $1\,200\,000$ cm^2.

(b) Find the percentage error in Natalie's estimate. [3]

Question 10

[Maximum mark: 8]

A cuboid has the following dimensions: length $= 9.6$ cm, width $= 7.4$ cm, and height $= 5.2$ cm, measured correct to the **nearest millimetre**.

(a) Using these measurements, calculate the volume of the cuboid, in cm^3. Give your answer to two decimal places. [2]

The lower and upper bounds for the length of the cuboid can be expressed as $9.55 \leq l < 9.65$.

(b) Write similar expressions for

(i) the width;

(ii) the height. [2]

(c) Hence, calculate the **minimum** volume of the cuboid. Give your answer to three significant figures. [2]

(d) Write your answer to **part (c)** in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]

Question 11

[Maximum mark: 6]

Let $F = \dfrac{(4\sin 2z - 1)(2\tan 3z + 1)}{x^2 - y^2}$, where $x = 12$, $y = 8$ and $z = 15^\circ$.

(a) Calculate the **exact** value of F. [2]

(b) Give your answer to F correct to

(i) two significant figures;

(ii) two decimal places. [2]

Sasha estimates the value of F to be 0.03.

(c) Calculate the percentage error in Sasha's estimate. [2]

Question 12

[Maximum mark: 6]

Given $r = 2a - \frac{\sqrt{b}}{c}$, $a = 0.975$, $b = 4.41$ and $c = 35$,

(a) calculate the value of r. [2]

Albert first writes a, b and c correct to one significant figure and then uses these values to estimate the value of r.

(b) (i) Write down a, b and c each correct to one significant figure.

(ii) Find Albert's estimate of the value of r. [2]

(c) Calculate the percentage error in Albert's estimate of the value of r. [2]