

NORTH VISTA SECONDARY SCHOOL Preliminary Examination 2024 Secondary 4 Express/ 5 Normal Academic



CANDIDATE NAME		
CLASS	INDEX NUMBER	

MATHEMATICS

Paper 2

4052/02

20 August 2024

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

Answer **all** the questions.

If working is needed for any question it must be shown with the answer.

Omission of essential working will result in loss of marks.

The use of an approved scientific calculator is expected, where appropriate.

If the degree of accuracy is not specified in the question and if the answer is not exact, give the answer to three significant figures. Gives answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question. The total of the marks for this paper is **90**.

For Examiner's Use				
Category	Question			
Accuracy				
Brackets				
Fractions				
Units				
Others				
Marks Deducted				

This document consists of 23 printed pages.

Mathematical Formulae

Compound Interest

Total amount =
$$P(1 + \frac{r}{100})^n$$

Mensuration

Curved surface area of a cone = $\pi r l$

Surface area of a sphere = $4\pi r^2$

Volume of a cone =
$$\frac{1}{3}\pi r^2 h$$

Volume of a sphere =
$$\frac{4}{3}\pi r^3$$

Area of triangle
$$ABC = \frac{1}{2}ab\sin C$$

Arc length = $r\theta$, where θ is in radians

Sector area =
$$\frac{1}{2}r^2\theta$$
, where θ is in radians

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$
$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

$$Mean = \frac{\sum fx}{\sum f}$$

Standard Deviation =
$$\sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

1 (a) Solve the inequality -5 < 3x - 2 < 13.

(b) Solve these simultaneous equations.

$$\frac{1}{2}x + y = 5$$
$$2x - 3y = 13$$

You must show your working.

Answer $x = \dots y = \dots [3]$

1 (c)
$$p = \sqrt[3]{\frac{r+q}{4r-1}}$$

(i) Find p when $r = 7$ and $q = -15$.

Answer p = [1]

(ii) Rearrange the formula to make *r* the subject.

1 (d) Solve
$$\frac{15}{2x-1} = x+3$$
.

Answer $x = \dots$ [3]

(a) The table shows the amount of 'Food Waste Output' and 'Food Waste Recycled' in Singapore from 2008 to 2010.

Year	2008	2009	2010	
Food Waste Output	565 000	605 000	640 000	
(*Tonnes)				
Food Waste Recycled	65 000	75 000	99 000	
(*Tonnes)				

*1 tonne = 1000 kg

2

(i) Write the total amount of Food Waste Output from 2008 to 2010 in standard form.

Answer tonnes [1]

(ii) Given that the percentage increase in Food Waste Recycled from 2009 to 2010 is the same as the percentage increase from 2010 to 2011, calculate the amount of Food Waste Recycled in 2011.

Answer tonnes [2]

(iii) Per capita food waste is defined as the amount of Food Waste Output generated by each person. Given that the population in 2008 is 4.84 million, calculate the per capital food waste in kilograms per day.

(a) (iv) It is given that

2

Food Waste Output = Food Waste Disposed + Food Waste Recycled

The recycling rate is given by the formula

Recycling Rate = $\frac{\text{Food Waste Recycled}}{\text{Food Waste Output}}$

In 2007, 509 000 tonnes of food waste was disposed, and the recycling rate was 8.6%. Calculate the Food Waste Output in 2007.

Answer tonnes [2]

(b) A river of length 612 m is represented by 9 cm on Map A.

(i) The actual perimeter of a lake is 1700 m.Find the perimeter of the lake on Map A.

(ii) The area of the lake on Map A is 36 cm².Calculate the area of the lake on Map B which has a scale of 1: 5100.

7

[Turn over

(a) Show that the radius of the circle, *r* is given by $\frac{60-2x}{\pi}$ cm. Answer

[2]

(b) If the area of the square is equal to the area of the circle, form an equation in x and show that it reduces to

$$(4-\pi)x^2 - 240x + 3600 = 0.$$

Answer

3 (c) Solve the equation $(4-\pi)x^2 - 240x + 3600 = 0$, giving your solutions correct to two decimal places.

Answer x = or [4]

(d)	Explain why one of the solutions has to be rejected.		
	Answer	Rejectbecause	
		[1]	

(a) The heights of 12 students from Group A were recorded. The results are shown in the stem-and-leaf diagram.

Key: 15 0 means 150 cm

(i) Find the mean height.

Answer cm [1]

(ii) Find the standard deviation of the heights.

10

4

4 (b) The table shows the subjects studied by a group of 40 students.

	Geography	History
Biology	9	12
Physics	8	11

(i) One of the students is chosen at random from students who study Biology. Find the probability that this student also studies History.

(ii) Two of the students are chosen at random from students who study Geography. Find the probability that both students study Biology but not Physics.

(iii) Three of the students are chosen at random from the whole group. Find the probability only one of them studies History.

> > [Turn over

5 (a) Complete the table of values for $y = \frac{1}{4}x^3 + \frac{3}{2}x^2 - 4$.

X	-6	-5	-4	-3	-2	-1	0	1	2	
у		2.25	4	2.75	0	-2.75	-4	-2.25	4	
		•				•				[

(b) On the grid opposite, draw the graph of $y = \frac{1}{4}x^3 + \frac{3}{2}x^2 - 4$ for $-6 \le x \le 2$. [3]

(c) The equation $\frac{1}{4}x^3 + \frac{3}{2}x^2 - 4 = k$ has no solution. Use your graph to find 2 possible integer values of k.

Answer k = or [2]

(d) By drawing a suitable line on the grid, solve the equation $x^3 + 6x^2 - 2x - 16 = 0$.

Answer $x = \dots$ [3]

(e) By drawing a tangent, find the gradient of the curve at (1, -2.25).

4 3 -2-1 0 -1 1 -3 -2 -4 _ ΗĒ + -1 -2



y

5

[Turn over

x

6

(a) The first four terms in a sequence of numbers are given below.

- $T_1 = 2^2$ $T_2 = 2^4$ $T_3 = 2^6$ $T_4 = 2^8$
- (i) Find an expression for T_n .

Answer $T_n = \dots$ [1]

(ii) The first four terms in second sequence of numbers are given below.

$$R_1 = 4^4$$

 $R_2 = 4^7$
 $R_3 = 4^{10}$
 $R_4 = 4^{13}$

Find an expression for R_n .

Answer $R_n = \dots$ [1]

(iii) The *n*th term of the third sequence of numbers is given by $Q_n = \frac{R_n}{T_n}$.

(a) Show that $Q_n = 2^{4n+2}$.

Answer

[1]

(b) Explain, with working, why 128 is not a term in the sequence Q_n .

 6 (b) A is the point (4, 12) and B is the point (10, 4).

(i) Find $|\overrightarrow{AB}|$.

(ii) Given that $\overrightarrow{AC} = \frac{1}{2}\overrightarrow{BA}$, find the coordinates of *C*.

Answer (.....) [2]



The diagram shows a section of a playground, *ABC*, bounded by three footpaths *AB*, *AC* and *BC*. AB = 30 m, BC = 38 m and angle $BAC = 95^{\circ}$.

(a) Find angle *ABC*.

Answer Angle $ABC = \dots$ [3]

7

(c) Ken runs from B to C at a speed of 4 m/s.
3 seconds after Ken left point B, Ali started to run from A towards C.
Determine the speed that Ali needs to run in order to reach point C at the same time as Ken.

[4]



In the diagram, *A*, *B*, *C*, and *D* are points on a circle, centre *O*. *TA* and *TB* are tangents to the circle at *A* and *B* respectively. Angle $COA = 92^{\circ}$ and angle $BTA = 38^{\circ}$.

(a) Find angle *CDA*.Give reasons for each step of your working.

8

Answer Angle *CDA* = [2]

(b) Find angle *BCO*.Give reasons for each step of your working.

8 (c) The radius of the circle is 7 cm. Find the area enclosed by *TA*, *TB* and major arc *BCDA*.

[Turn over

A pottery artist in Singapore makes a clay sculpture consisting of two identical solid hemispheres and a solid cylinder as shown in the diagram below.
 The hemisphere has a radius of 14 cm.
 The cylinder has a radius of 2.5 cm and height of 6 cm.



The artist made another **geometrically similar** clay sculpture. The radius of the hemisphere of the second sculpture is 7 cm.

(a) Given that the clay used has a density of 1.5 g/cm^3 , show that the total mass of the two sculptures is 19.59 kg correct to 4 significant figures.

Answer

Destinations (Zones)	Air (Delive	rmail Rate ry in 2-9 days)	Surface Mail Rate (Delivery in 15-30 days)	
	1 st 5 kg	Additional 1 kg or part thereof	1 st 5 kg	Additional 1 kg or part thereof
Zone A Malaysia	\$16	\$3	-	-
Zone B Brunei, Hong Kong, Indonesia, Philippines, Taiwan and Thailand	\$30	\$5	\$18	\$2
<i>Zone C</i> China, India, South Korea, rest of Asia	\$30	\$5	\$18	\$2
Zone D Australia, Japan and New Zealand	\$40	\$7	\$20	\$2

After completing the **two** sculptures, he has to deliver them to Australia within **2 weeks** via postage. The following tables show the mailing prices and other costs at the post office.

Carton Size	Dimension (cm)	Price
XS	$20 \times 15 \times 9$	\$3.90
S	$30 \times 25 \times 15$	\$4.90
Μ	$35 \times 25 \times 15$	\$5.90
L	$40 \times 22 \times 22$	\$6.90
XL	$45 \times 30 \times 30$	\$7.90
XXL	$55 \times 32 \times 32$	\$8.90

Items	Dimensions	Price
Packaging foam peanut	Small bag - 1500 cm^3	\$2
(to fill empty space in the carton)	Medium bag - 7500 cm^3	\$5
,	Large bag - 60000 cm ³	\$39

How to Pack and Seal Packages

- 1. Items may be packed in *one carton or two separate cartons*.
- 2. *Fill all empty space with foam peanuts* to protect the contents.
- 3. The weight of the carton box and foam peanuts is *negligible*.

9 (b) The cost of the clay he uses is \$41.50 per pack. Each pack contains 5 kg of clay. Given that the **cost of delivery** should be kept **as low as possible**, decide on the carton size(s) and suggest a sensible selling price of the sculptures.

Justify any decisions you make and show your calculations clearly. [6]

Answer

Working space for Qn 9

23

End of Paper