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DEYI SECONDARY SCHOOL

Preliminary Examination 2024
Secondary 4 Express

Name:	
Class:	**Index No.:**

MATHEMATICS **4052/02**

Paper 2 05 Aug 2024

0810 – 1025h

2 hours 15 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class, index number and calculator model in the spaces at the top of this page.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid / tape.

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

For Examiner's Use
90

Mathematical Formulae

Compound interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

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

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

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

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

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

Answer **all** the questions.

1 **(a)** Factorise completely $3x^3 - 12xy^2$.

Answer …… [2]

(b) Express $\frac{x}{(1-3x)^2} - \frac{1}{3x-1}$ as a single fraction in its simplest form.

Answer ……..…….. [2]

(c) Given that $R = \sqrt{q^2 + \frac{2a}{v}}$, express a in terms of R, v and q.

Answer $a =$ ……..…….. [2]

(d) Given that $\frac{y}{x} = 10$ and $\frac{z}{y} = 5$, where $x \neq 0$ and $y \neq 0$.

Find the value of $\frac{y+z}{2x+y}$.

Answer ……..…….. [2]

2 A store sold a laptop at $1530 after offering a discount of 15%.
Despite the discount, the store is still able to make a profit of 11%.
Calculate

(a) **(i)** the selling price of the laptop before the discount,

Answer $ …… [2]

(ii) the cost price of the laptop, giving your answer to the nearest dollar.

Answer $ …… [2]

(b) Richard bought an HDB flat for $720 000.
He took a home loan of 80% of this amount from a bank.

(i) Calculate the amount of the loan.

Answer $ …… [1]

(ii) At the end of each month, the bank charges a 2.88% per annum compound interest compounded monthly. If Richard pays $5000 at the end of each month, calculate the amount of loan left at the beginning of the third month.

Answer $ …… [4]

3 A company has two types of robot vacuum.
Model *Q* takes 5 minutes more then Model *P* to clean a particular floor surface area of 450 m^2.
The speed of Model *P* is 8 m^2 per minute faster than Model *Q*.

(a) Taking x to be the rate, in m^2 per minute, at which Model *Q* cleans, write down an expression, in terms of x for the time taken to clean the floor area of 450 m^2 with Model *P* and Model *Q* respectively.

Answer Model *P* ……..…… minutes [1]

Model *Q* ……..…… minutes [1]

(b) Form an equation in x and show that it reduces to $x^2 + 8x - 720 = 0$.

[3]

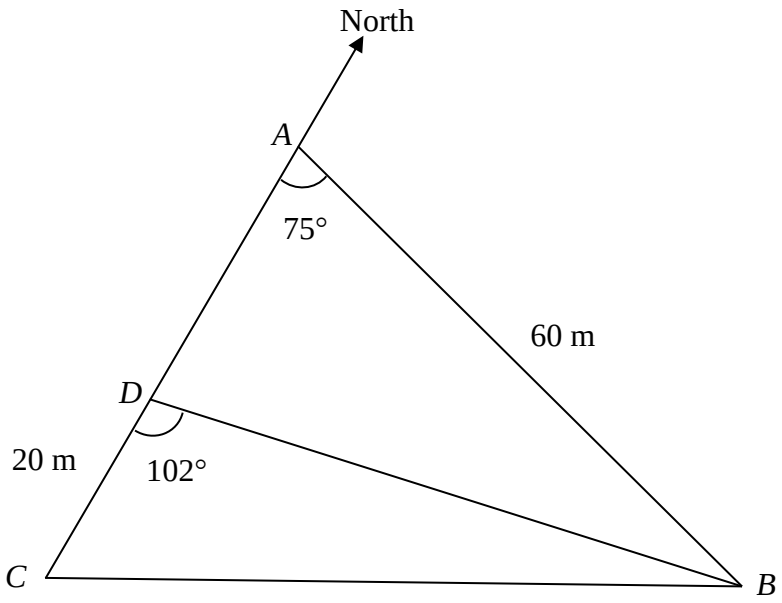
(c) Solve the equation $x^2 + 8x - 720 = 0$, giving your answers to 2 decimal places.

Answer ……..…or …….. [3]

(d) Hence, determine the time required to clean the floor area of 450 m^2 with both Model *P* and Model *Q* operating together, leaving your answer in minutes and seconds, accurate to the nearest second.

Answer ……..… minutes …… seconds [2]

4 *A*, *B*, *C* and *D* are points on level ground with *A* due north of *C* and *D*.
$\angle BAD = 75°$, $\angle BDC = 102°$, *AB* = 60 m and *CD* = 20 m.



Calculate

(a) (i) the bearing of *D* from *B*,

°

Answer …… [2]

(ii) the length of *BD*,

Answer ……m [2]

(iii) the length of *BC*.

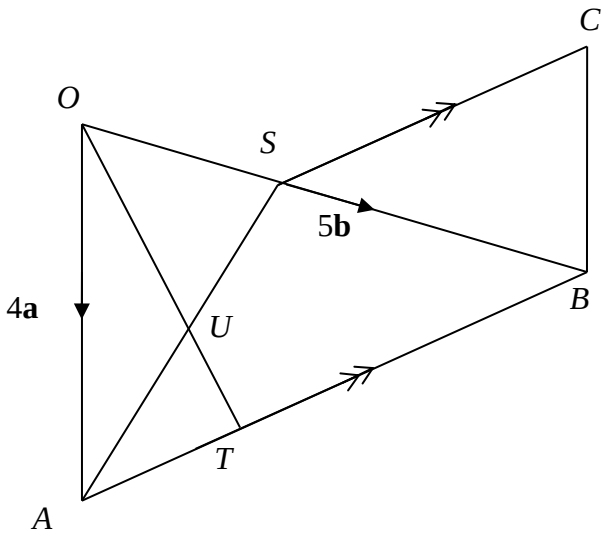
Answer ……m [2]

(b) A tree is spotted at point *B*.
The largest angle of elevation from *AC* to the top of the tree is 40°.
Find the height of the tree.

Answer ……..……..m [3]

5 In the diagram, the position vectors of A and B relative to O are $4\mathbf{a}$ and $5\mathbf{b}$ respectively.

OA is parallel to CB and SC is parallel to AB. It is given that $OS : SB = 2:3$ and $\overrightarrow{AT} = \frac{1}{3}\overrightarrow{TB}$.



(a) Find, in terms of **a** and **b**, the vectors

(i) $\overrightarrow{OS}$,

Answer …… [1]

(ii) $\overrightarrow{AS}$,

Answer …… [1]

(iii) $\overrightarrow{OT}$.

Answer …… [2]

(b) U is a point on OT such that $OU : UT = 8 : 3$.

(i) Express $\overrightarrow{AU}$ in terms of **a** and **b**.

Answer …… [2]

(ii) Hence, explain why A, U and S lie on a straight line.

Answer ……

……

……

……

……

……[2]

(c) Given that ΔSBC is similar to ΔBOA, find

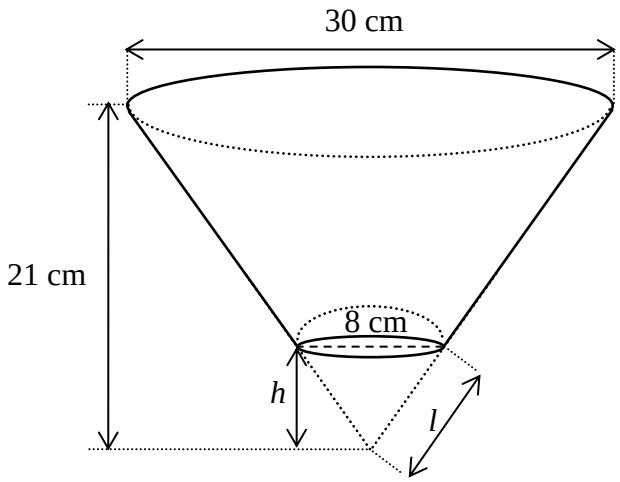
(i) $\dfrac{\text{Area of } \Delta SBC}{\text{Area of } \Delta BOA}$,

Answer …… [1]

(ii) $\dfrac{\text{Area of } \Delta OTA}{\text{Area of } \Delta OBA}$.

Answer …… [1]

6 A model is made out of a solid inverted right circular cone with diameter 30 cm and a vertical height 21 cm. A smaller right circular cone of diameter 8 cm, vertical height h cm and slant height l cm and a hemisphere of diameter 8 cm are removed from the bigger cone.



(a) **(i)** Show that $h = 5.6$ cm.

[2]

(ii) Hence, find the value of l.

Answer …… [2]

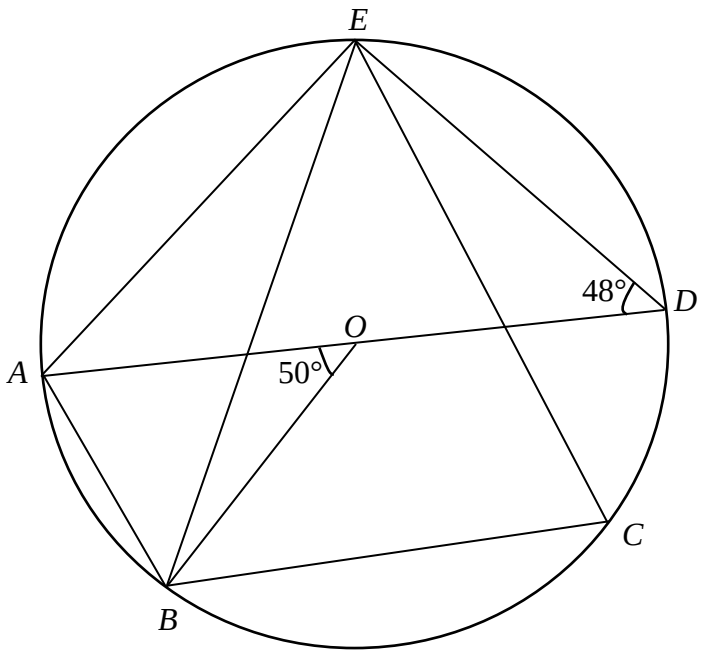
(b) Calculate the volume of the model.

Answer ……..……..cm^3 [3]

(c) Another geometrically similar model is 30% smaller.
Calculate the top circular surface area of the new model.

Answer ……..…….. cm^2[4]

7



The diagram shows a circle *ABCDE* with centre *O*. *AOD* is the diameter of the circle.

$\angle AOB = 50°$ and $\angle ADE = 48°$. Find

(a) (i) $\angle AEB$,

Answer ……° [1]

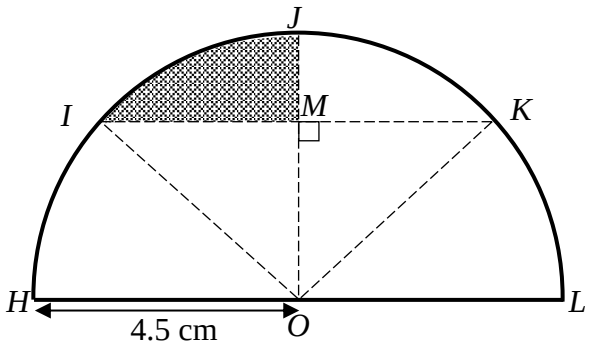
(ii) $\angle DAE$,

Answer ……..……..° [2]

(iii) $\angle BCE$.

Answer ……..……..° [2]

(b)



A semi circle *OHIJKL*, centre *O*, has a radius 4.5 cm.
The length of chord *IK* is 6 cm.

(i) Show that angle *IOK* = 1.46 radians correct to 3 significant figures.

[3]

(ii) Find the area of the shaded region.

Answer ……..……..cm^2 [3]

8 **(a)** Complete the table of values for $y = \frac{1}{6}x^2(x-5)$. [1]

x	-2	-1	0	1	2	3	4	5	6
y		-1	0	-0.67	-2	-3	-2.67	0	6

(b) On the grid opposite, draw the graph of $y = \frac{1}{6}x^2(x-5)$ for $-2 \leq x \leq 6$. [3]

(c) Use your graph to find the solutions of $\frac{1}{6}x(x-5) = -\frac{2}{x}$.

Answer $x =$ ……, $x =$ ……, $x =$ …… [2]

(d) By drawing a tangent, find the gradient of the curve at $x = 4$.

Answer …… [2]

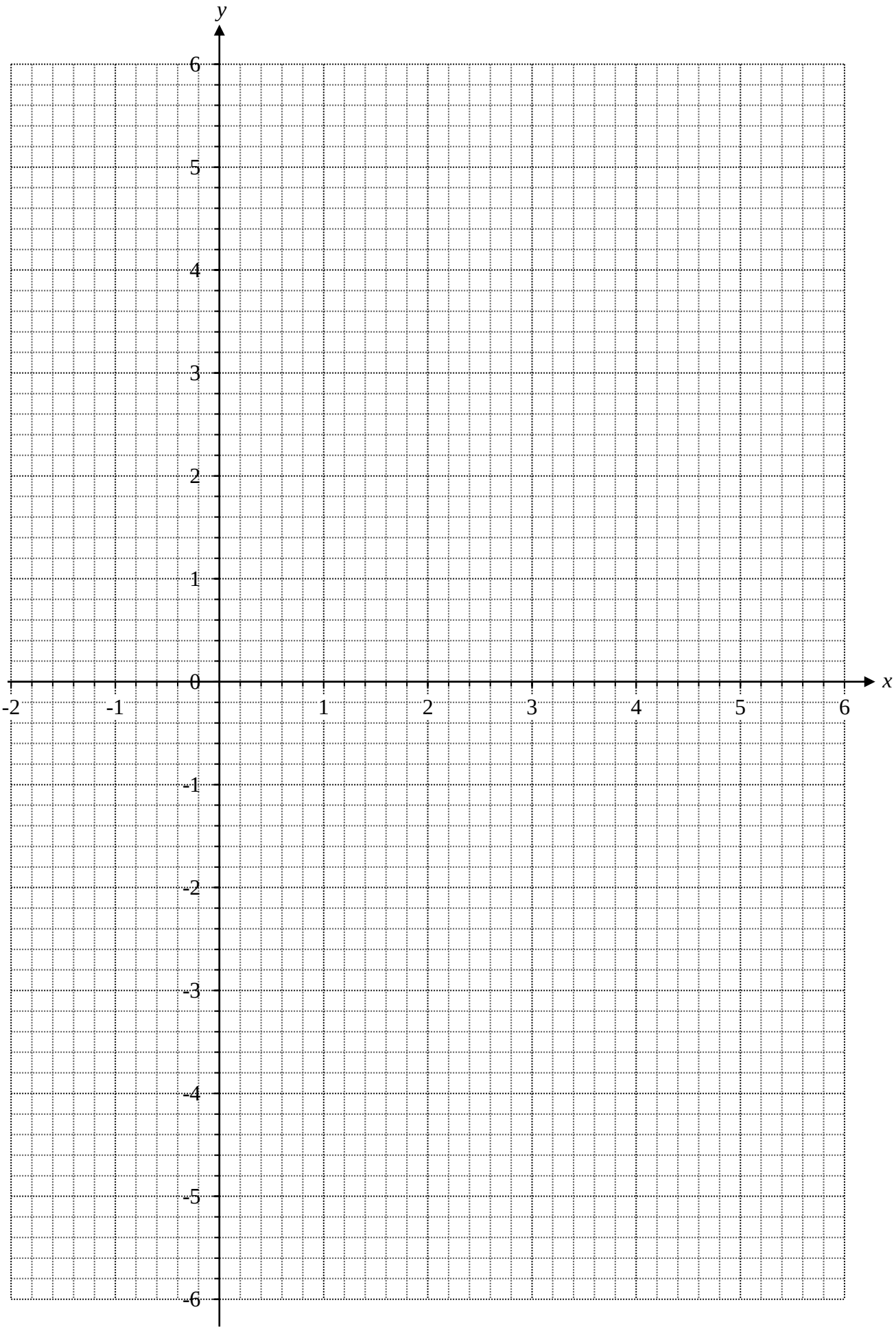
(e) **(i)** On the same grid, draw the line $2y = 8 - x$ for $-2 \leq x \leq 6$. [1]

(ii) Write down the x-coordinate of the point where this line intersects the curve.

Answer $x =$ …… [1]

(iii) This value of x is a solution of the equation $x^3 - 5x^2 + 3x = Q$.
Find the value of Q.

Answer $Q =$ …… [2]


y
x
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-2
-1
1
2
3
4
5
6

9 Le Xuan lives in a small city and decides to buy a car for daily commute.
She has narrowed down her choices to the following two cars.
Tesla Electric is powered by electricity and Honda Fit is fuelled by petrol.
The following information is useful in helping Le Xuan decide which car to buy.

	Types of Car	
	Tesla Electric	Honda Fit
Cost with 10 years Certificate of Entitlement (COE)	$194 890	$131 388
Hire Purchase Agreement	- 30% down payment - Simple interest chargeable at 3.2 % per annum over loan period of 3 years	
Insurance	$1500 per year First year: 15% discount	First year: $1000 2nd year onwards: $50 rebate
Road Tax	$100 yearly	$400 yearly
Vehicular Emissions Scheme Rebate	One- time 6% rebate off the cost for electric cars given after one year of ownership	

(a) Show that the total cost of the Tesla Electric car under the Hire Purchase agreement is $207986.61, correct to the nearest cents.

Answer

[2]

Other important information		
Type of Car	Tesla Electric	Honda Fit
Battery/ Fuel Capacity	54 Kilowatts (kW) for every 400 km	7 litres for every 100 km
Average cost to Charge/ Refuel the Car	$ 0. 573 per kW	$3.45/ litre
Time to Charge/ Refuel the Car	Normal charge: 2 – 3 hours Fast charge: 30 minutes	3 minutes

(b) Le Xuan possesses a good driving record and she estimates that she will drive 850 km per month and intends to own the car for at least 3 years.
She has $60 000 in savings for the down payment and owns a credit card that entitles her to 7% discount at any petrol station.
If the costs and expenditures of owning a car is the deciding factor, suggest which car should Le Xuan buy?
Justify the decision you make and show all your calculations clearly.

Answer

Le Xuan should buy the ……..

……..

……..

…….. [8]

--- The End ---