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OUTRAM SECONDARY SCHOOL PRELIMINARY EXAMINATION 2024

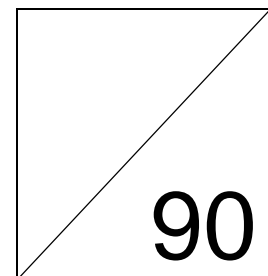
Subject : **Mathematics**
Level (Stream) : **Secondary Four Express
& Five Normal Academic**
Paper : **4052/01**
Date : **21 August 2024**
Duration : **2 hours 15 mins**
Marks : **90**

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, highlighters, glue or correction fluid.

Answer **all** questions on the Question Paper.
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 number of marks is given in brackets [] at the end of each question or part question.



Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

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

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 running route is 42.2 km long and a runner took 4 hours 45 minutes to finish the route. Calculate the speed of the runner in metres per second.

Answer m/s [2]

2 (a) Simplify $\left(\frac{g^{12}}{256f^6}\right)^{-\frac{1}{4}}$.

Answer [2]

(b) $5 \times 9^{k-1} = 15 \times 81$
Find the value of k .

Answer $k =$ [3]

- 3** Given that $\sin \theta = 0.8211$, find the two possible values of θ , where $0^\circ \leq \theta \leq 180^\circ$.

Answer $\theta = \dots\dots\dots$ [2]

- 4** The number $A = 2^7 \times 5^{11} \times 7^8$.

- (a) Prove that A is divisible by 245.

Answer $\dots\dots\dots$
 $\dots\dots\dots$ [2]

- (b) The number $A \times k$ is a perfect square.
 Find the smallest possible integer value of k .

Answer $k = \dots\dots\dots$ [1]

- (c) The number $B = 2^5 \times 3^6 \times 7^3$.
 Find the highest common factor (HCF) and lowest common multiple (LCM) of A and B as a product of its prime factors.

Answer HCF = $\dots\dots\dots$ [1]

LCM = $\dots\dots\dots$ [1]

- 5** Zen invests \$42000 at a rate of 1.6% per annum compounded monthly.
Calculate the value of the investment at the end of 3 years.

Answer \$ [2]

- 6 (a)** Express $x^2 + 6x + 10$ in the form of $(x + h)^2 + k$.

Answer [2]

- (b)** Using your answer in **(a)**,

- (i)** write down the equation of the line of symmetry of the curve $y = x^2 + 6x + 10$.

Answer [1]

- (ii)** Explain why the equation $x^2 + 6x + 10 = 0$ does not have any solutions.

Answer

..... [1]

- 7 (a) Paul is 25% heavier than Mike. Mike is 25% lighter than Oscar.
Find the ratio of the weight of Paul to that of Oscar.

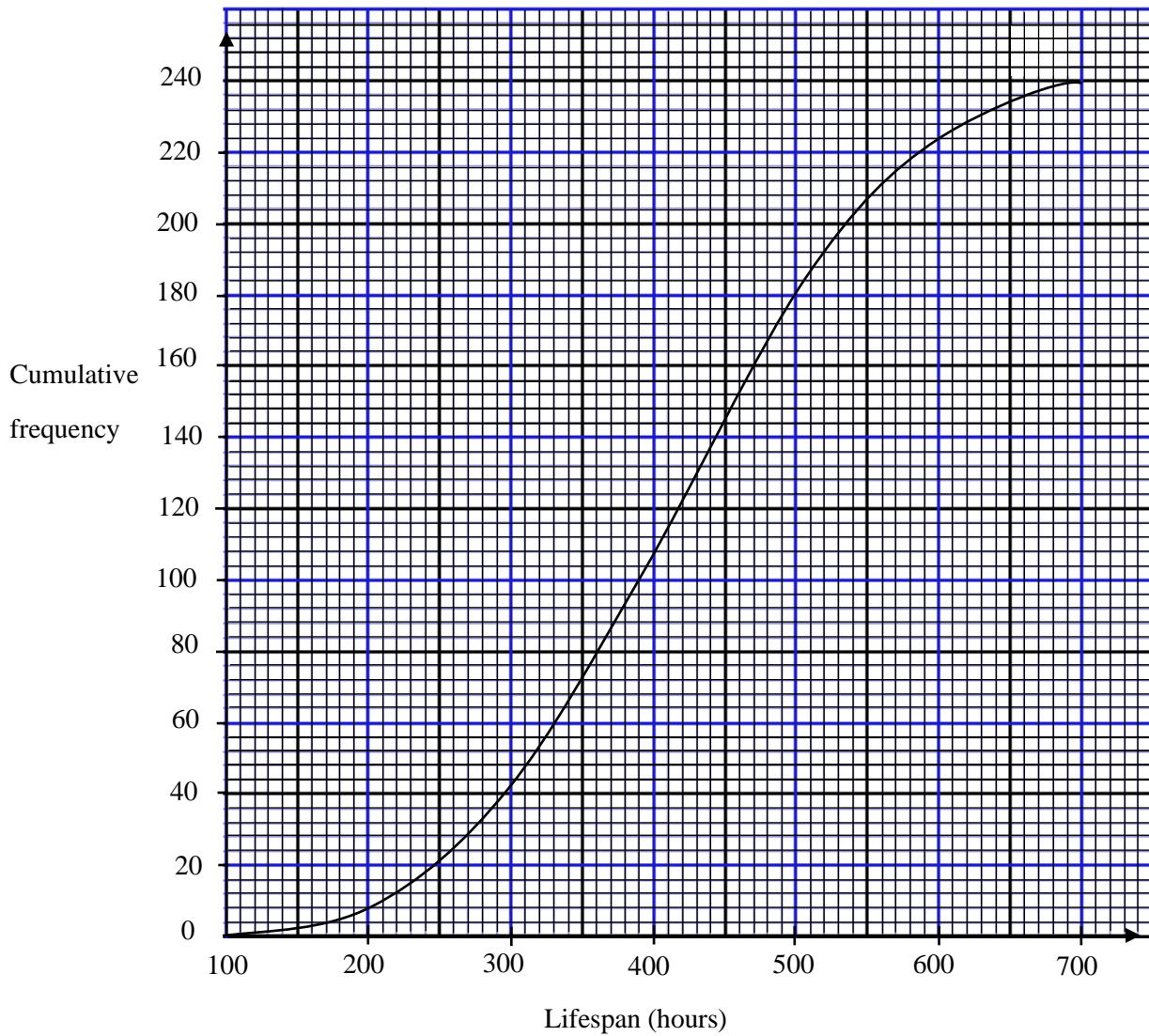
Answer [2]

- (b) Rachel bought 8 watches for \$900 each. She sold 4 watches at a profit of 80%,
and 3 watches at a loss of 50%. She kept one watch for herself.

Calculate Rachel's net profit.

Answer \$ [3]

- 8 A company produces light bulbs. The lifespan, in hours, of 240 light bulbs is tested. The cumulative frequency curve shows the distribution of lifespan of the light bulbs.



(a) Use the diagram to estimate

(i) the median lifespan of the light bulbs

Answer h [1]

(ii) the interquartile range of the lifespan of the light bulbs.

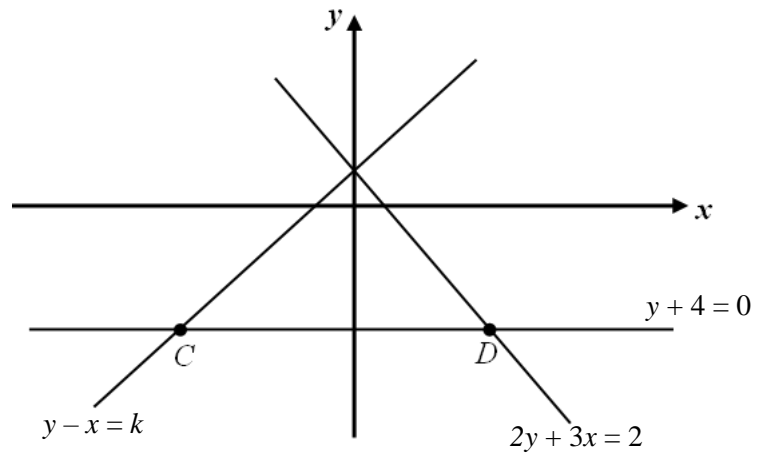
Answer h [2]

(b) Light bulbs with a lifespan of over x hours can be sold. Only 80 of the light bulbs tested meet this requirement.

Find the value of x .

Answer $x =$ [1]

- 9 The diagram, which is not drawn to scale, shows the three lines.



- (a) Show that $k = 1$.

Answer:

[1]

- (b) Find the coordinates of point D .

Answer D (..... ,) [1]

- 10** Write as a single fraction in its simplest form $\frac{7y}{y+3} - \frac{y+9}{3-y}$.

Answer [2]

- 11 (a)** Factorise completely.

(i) $33x^2y + 11xy$.

Answer [1]

(ii) $x^3 + x^2 - 9x - 9$.

Answer [3]

- (b) Expand and simplify $(x + 3y)(4x - 3y)$.

Answer [1]

- 12** A bag contains blue, green and red marbles. There are 3 more green marbles than blue marbles. Half of the marbles in the bag are red.

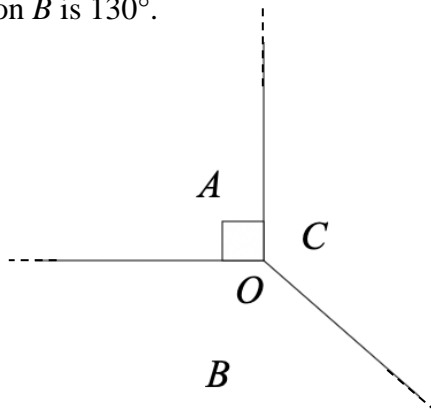
Given that the probability of choosing a blue marble is $\frac{6}{25}$, find the number of green marbles in the bag.

Answer [3]

- 13** Show that $x^2(3x-10) + 2(x^3 + 10x - 8) - 4$ is divisible by 5 for any integer x .

Answer

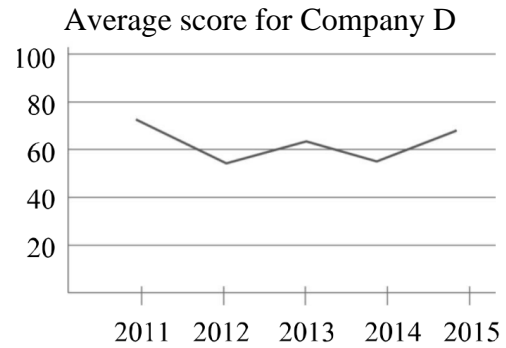
- 14** The diagram shows one interior angle of each of the three polygons, A , B and C .
The polygons fit together at the point O .
The interior angle of polygon A is 90° .
The interior angle of polygon B is 130° .



Explain why polygon C can be a regular polygon.

Answer

- 15 The graph shows the average performance score of two companies from year 2011 to 2015.



State one aspect of the graphs which may be misleading and explain how this may lead to a misinterpretation.

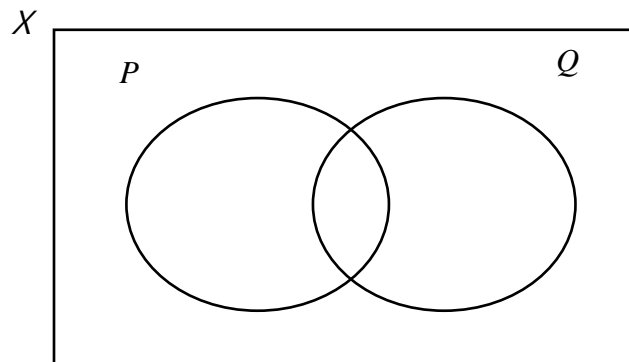
Answer

.....

..... [2]

- 16 (a) On the Venn diagram, shade the region that represents $P' \cup Q$.

Answer



[1]

(b) It is given that

$$\mathcal{E} = \{x : x \text{ is an integer and } 10 \leq 3x + 5 < 40\},$$

$$A = \{x : x \text{ is divisible by 4}\} \text{ and}$$

$$B = \{x : x \text{ is a prime number}\}.$$

(i) List the elements in A .

Answer [2]

(ii) Use one of the symbols below to complete each statement.

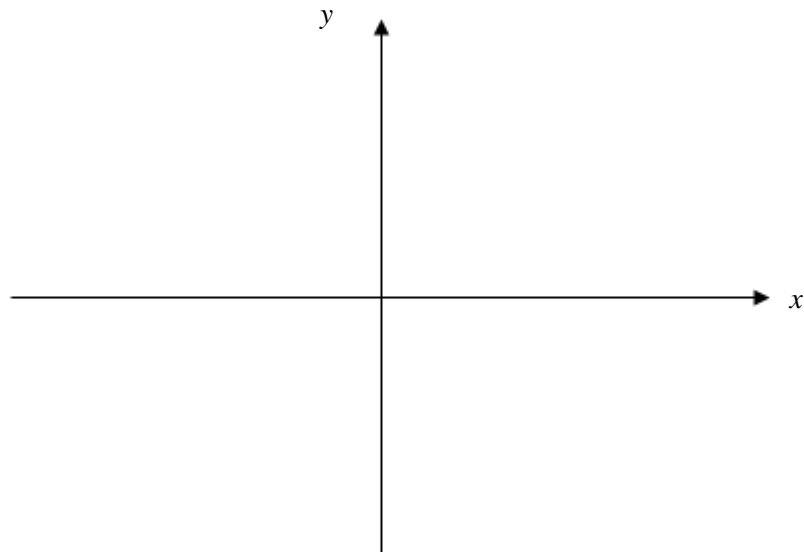
$$\in \quad \notin \quad \emptyset \quad \subset \quad \not\subset$$

$$A \dots\dots B$$

Answer [1]

17 Sketch the graph of $y = -(2x + 3)(x - 8)$ on the axes below.

Indicate clearly the points where the graph crosses the axes and its turning point.



[3]

18 Simplify $\frac{6x^2 - 7xy - 5y^2}{18x^2 - 50y^2}$.

Answer [3]

- 19** y is proportional to the square root of x .
If the value of x is increased by 300%, the value of y will be increased by r %.
Find the value r .

Answer [2]

- 20** A concert was held over a particular weekend. The matrix \mathbf{M} shows the number of tickets sold on Saturday and Sunday respectively.

$$\mathbf{M} = \begin{matrix} & \begin{matrix} \text{Saturday} & \text{Sunday} \end{matrix} \\ \begin{pmatrix} 84 & 51 \\ 135 & 160 \\ 72 & 87 \end{pmatrix} & \begin{matrix} \text{Children} \\ \text{Adults} \\ \text{Senior Citizens} \end{matrix} \end{matrix}$$

- (a) The concert tickets were priced at \$6 for a child, \$15 for an adult and \$8 for a senior citizen.
Represent this information in a 1×3 matrix \mathbf{P} .

Answer $\mathbf{P} = \dots\dots\dots$ [1]

- (b) Evaluate the matrix $\mathbf{T} = \mathbf{PM}$.

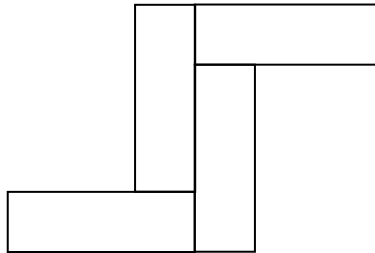
Answer $\mathbf{T} = \dots\dots\dots$ [2]

- (c) State what each of the elements in matrix \mathbf{T} represents.

Answer $\dots\dots\dots$
 $\dots\dots\dots$ [1]

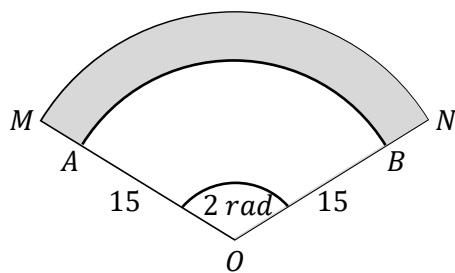
- (d) The elements of the matrix \mathbf{N} , where $\mathbf{N} = \mathbf{QM}$, represents the number of tickets sold on each day of the concert.
Write down the matrix \mathbf{Q} .

Answer $\mathbf{Q} = \dots\dots\dots$ [1]



Answer cm² [3]

- 22** In the diagram, OAB and OMN are sectors of two concentric circles with the same centre at O . $OA = OB = 15$ cm and angle $AOB = 2$ radians. The area of the shaded region is 136 cm².



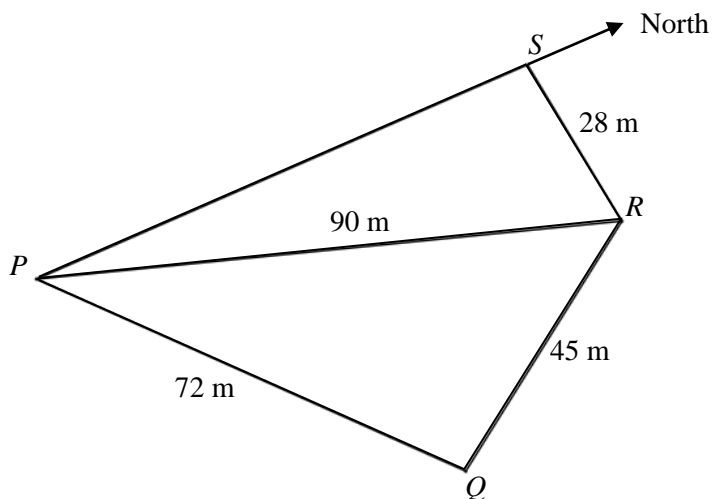
Find the length of AM .

Answer cm [3]

- 23** The diagram shows a park $PQRS$ and a path PR .

S is due north of P and the bearing of R from P is 018° .

It is also given that $PQ = 72$ m, $QR = 45$ m, $RS = 28$ m and $PR = 90$ m.



- (a)** Calculate

- (i)** angle PSR ,

Answer $^\circ$ [2]

- (ii)** the bearing of P from R .

Answer $^\circ$ [2]

(b) Show that angle PQR is 97.903° , correct to three decimal places.

Answer

[3]

(c) Find

(i) area of triangle PQR ,

Answerm² [2]

(ii) the shortest distance from Q to PR .

Answer m [1]

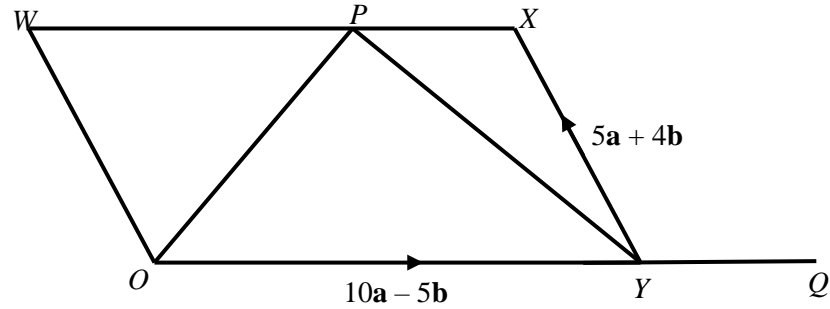
(d) A lamp post stands vertically at point Q .

The greatest angle of elevation of the top of the lamp post when viewed from a point along PR is 8° .

Calculate the height of the lamp post.

Answer m [2]

- 24 $OWXY$ is a parallelogram. P is a point on WX such that $\overrightarrow{WP} = \frac{3}{5}\overrightarrow{WX}$.
 $\overrightarrow{YX} = 5\mathbf{a} + 4\mathbf{b}$ and $\overrightarrow{OY} = 10\mathbf{a} - 5\mathbf{b}$.



- (a) Find \overrightarrow{YP} in terms of \mathbf{a} and \mathbf{b} .

Answer [2]

- (b) Q is on OY produced such that $OY : YQ$ is $5 : 2$.
 Show that \overrightarrow{QX} and \overrightarrow{YP} are equal vectors.

- (c) Find the value of $\frac{\text{area of triangle } PXY}{\text{area of triangle } OPY}$.

Answer [1]

End of Paper