Name:	Level/Subject: **4048 Sec 4 E-Math**
Material: **March Practice Questions 2022**	Centre: **Overmugged**

Instructions

- 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
- You are expected to use a scientific calculator to evaluate explicit numerical expressions
- 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 of 3.142, unless the question requires the answer in terms of π
- A copy of the formula list is provided for you on the next page

Copyright

Question Source

All questions are sourced and selected based on the known abilities of students sitting for the 'O' Level E-Math Examination. All questions compiled here are from **2009 - 2021 School Mid-Year / Prelim Papers**. Questions are categorised into the various topics and range in varying difficulties. If questions are sourced from respective sources, credit will be given when appropriate.

How to read:

[S4 ABCSS P1/2011 PRELIM Qn 1]

Secondary 4, ABC Secondary School, Paper 1, 2011, Prelim, Question 1

Prepared by: **Kaiwen :)**

This question paper consists of 52 printed pages including the cover page

Contents

List of Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

1 Numbers & their Operations

1. One astronomical unit (1 au) is a unit of length defined as 149597870700 metres, which is roughly the average distance between the Earth and the Sun

   (a) Express one astronomical unit in metres, correct to 3 significant figures in standard form [1]

   (b) The speed of sound is 343 m/s. How long, in seconds, does sound take to travel a distance of 1 au? Give your answer in standard form, correct to 3 significant figures [2]

   (c) The average distance between the Earth and Moon is 384400 km. Express this distance as a percentage of 1 au [2]

   (d) A rocket travels a distance of one metre in 8000 nanoseconds (ns). How long, in seconds, does the rocket take to travel 1 au. Give your answer in standard form, correct to 3 significant figures [2]

   Credit: **S4 CWSS P2/2019 MYE Qn 2**

2. (a) Simplify the following, giving your answer in positive indices [2]

$$\left(\frac{x^6}{25y^4}\right)^{-\frac{1}{2}}$$

   (b) Solve the equation [3]

$$9\left(\sqrt[3]{3^{3x}}\right) = \frac{1}{3^{3(2-x)}}$$

   (c) Given that $a > 0$ and n is an even numbers, deduce the number of solutions for the equation. Explain your answer clearly [3]

$$ax^n - x = 0$$

   Credit: **S4 ANDSS P1/2020 PRELIM Qn 6**

3. (a) Consider the following numbers:

$$27^{\frac{1}{3}} \qquad \pi \qquad \frac{22}{7} \qquad 3.\dot{1} \qquad 3.33 \qquad \sqrt{10}$$

   (i) Write the above numbers in order of size, smaller first [1]

   (ii) State which of the above numbers are irrational [1]

   (b) (i) Evaluate the following, in radians, giving your answer correct to 3 siginificant figures [1]

$$\sqrt{\frac{1-\sin 12.3}{e^5}}$$

   (ii) At room temperature, an oxygen atom in the air travels 500 metres per second. Find the time taken, in minutes, for an oxygen atom to travel 750 megametres in room temperature. Give your answer in standard form [1]

   Credit: **S4 ANDSS P1/2015 PRELIM Qn 1 & 2**

2 Ratio & Proportion

1. (a) 5 men takes 9 days to build a house. How many days would 3 men take to build the house [1]

   (b) The volume of water, V m^3 flowing through a cylindrical pipe is directly proportional to the square of its cross-sectional radius, R m. If the radius of the pipe is increased by 150%, find the percentage increase of the volume [2]

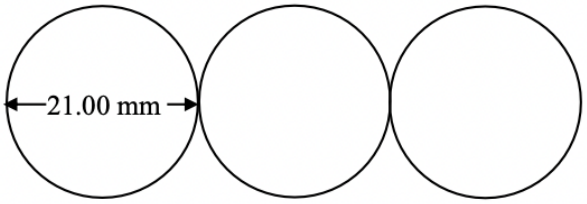
   Credit: **S4 YISS P1/2020 PRELIM Qn 12**

2. (a) Eng bought a mobile phone at \$2020. A week later, he decided to sell it in an online platform where every customer is entitled for 5% discount. Eng would like to earn a profit of 10% of the cost. Calculate the selling price of the mobile phone in the online platform. Give your answer correct to the nearest dollar [2]

   (b) Forty-five staff needs to work for 8 hours a day to complete a project in a week. Five workers were transferred to another department before the project begins. Find the number of extra hours the remaining staff need to work in a day to complete the project in a week [2]

   (c) Gina wishes to exchange her Singapore dollars (SGD) into Australia dollars (AUD). At a money changer, the exchange rate SGD 1 = AUD 0.987. However, the exchange rate in a bank is AUD 1 = SGD 1.12. Where should Gina exchange her SGD 1200 into AUD? Support your answer with suitable justifications [2]

   (d) A hospital is raising money by collecting 20-cent coins. The target is to collect sufficient coins so that they would be one kilometre long when they are placed edge-to-edge in a straight line [3]

   A 20-cent coin is 21.00 mm in diameter. The hospital meets their target of one kilometre. The local bank charges 12 cents per coin deposited into the savings account. Calculate the amount of money raised after the deposit into the bank. Give your answer in dollars

   Credit: **S4 ZHSS P2/2020 PRELIM Qn 3**

3 Percentage

1. (a) The number of people involved in community development activities in 2018 and 2019 are summarised on the table. In 2019, 12% were children and the number of adults was 28% more than that in 2018 [4]

	Number of participants	
	2018	2019
Children	2336	**(i)**
Youth	4216	3714
Adults	**(ii)**	8096
Seniors	6810	6516

Find the missing numbers in the table

(b) (i) In May 2019, there were 1.49 million visitors to Singapore. In May 2020, there were 878 visitors to Singapore. The ratio number of visitors in May 2020 : number of visitors in May 2019 can be written in the form $1 : k$. Find k, giving your answer in standard form, correct to 3 significant figures [1]

(ii) The total number of days spent by the visitors in May 2019 is 5.08 million days. Calculate the mean number of days spent by a visitor in May 2019 [1]

(c) Alan invested 9600 US dollars (US$) in an account paying compound interest at 2.4% per year. After 6 years, he withdraws the total amount and converts it to Singapore dollars ($) at the exchange rate of $1 = US$0.72. The bank charges an administrative fee of 1.5% for the currency conversion. Calculate the total amount Alan receives [4]

Credit: **S4 CHIJ Sec P2/2020 PRELIM Qn 2**

2. (a) Roland bought a sofa set priced at \$5200 on hire purchase. He paid a deposit of 20% and the rest was paid over 36 equal monthly instalments. The interest was charged at a flat rate of 3.6% per annum. Find,
   (i) amount of deposit [1]
   (ii) the hire purchase price [2]
   (iii) the amount of each monthly instalment [1]

   (b) Roland has also chosen to invest \$$x$ in R&K bank that pays a compound interest at a rate of 1.45% per annum, compounded every 3 months
   (i) Roland intends to make the investment for 3 years. He computed the amount he has at the end of the three years using the following computation [2]

$$\text{Total amount} = \$x\left(1+\frac{1.45\div 12}{100}\right)^3$$

   Identify and explain the mistake in his computation
   (ii) Write down the correct computation of the total amount he has in the bank at the end of 3 years in terms of x [1]
   (iii) Given that Roland has \$12533 in the bank at the end of 3 years, find the amount he invested. Give your answer correct to the nearest dollar [1]
   (iv) Roland is wondering if he should have chosen to invest the same amount for 3 years compounded on a yearly basis, given that the interest rate is 1.7% per annum. Suggest if he should have done so, justifying your answer with working [2]

Credit: **S4 SMSS P2/2020 PRELIM Qn 2**

3. Shops A and B are having sales on a particular jacket. Shop A offers a 35% discount on the original price p, while Shop B offers a 20% discount on the same original price, with a further reduction of x% on the discounted price

   (a) Given that Ali holds a membership on Shop B, the total amount of discount offered to him from Shop B can be written as the following expression. Find the value of a [1]

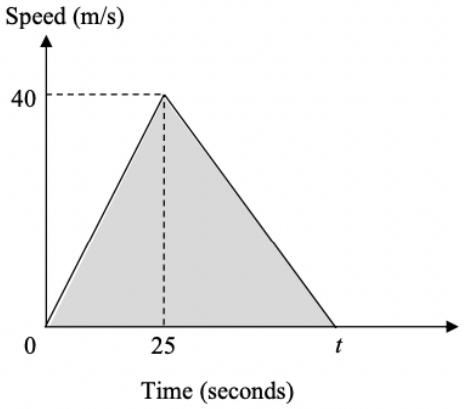
$$\frac{p}{125}(a+x)$$

   (b) Given that Ali is offered a higher discount from Shop B, form an inequality in x and show that it reduces to $x > k$, where k is a constant to be determined [2]

Credit: **S4 VS P1/2015 PRELIM Qn 14**

4 Rate & Speed

1. The diagram shows the speed-time graph of a car's journey.



The shaded area represents the distance travelled. The distance travelled to its destination is 1140 m

(a) Calculate the value of t [1]

(b) Calculate the acceleration of the car for the second part of the journey (after the first 25 seconds) [1]

(c) A second car starts off from the same point as the first car and travels at a constant speed of 60 km/h. Express 60 km/h in metres per second [1]

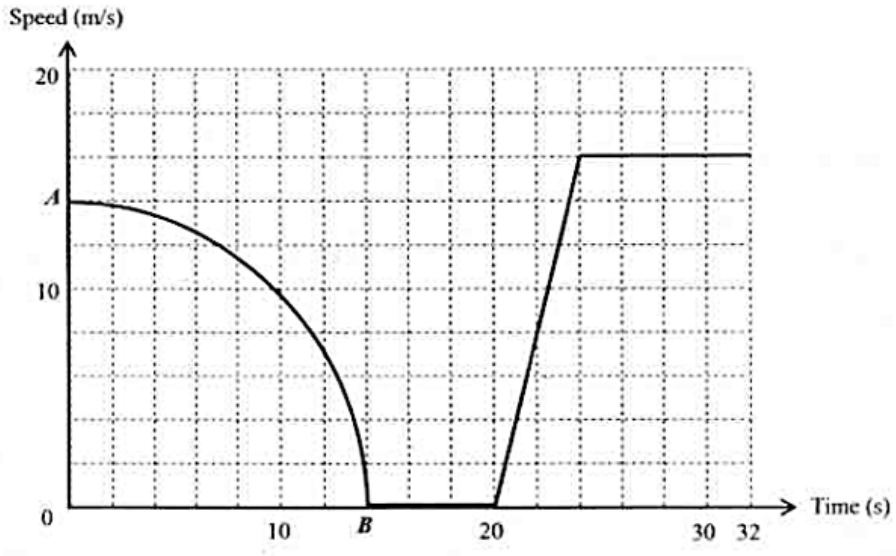
(d) Ben claims that the second car will arrive at the destination earlier. Explain whether you agree with him [2]

Credit: **S4 HYSS P1/2020 PRELIM Qn 2**

2. Jane can varnish 3 jars in 5 hours. Jim can varnish 2 jars in 3 hours. Jane and Jim work together to varnish a total of 20 jars. If they continue to varnish at the same rate, how long will it take them to varnish the 20 jars? Give your answer in hours and minutes, to the nearest minute [3]

Credit: **S4 CWSS P1/2018 PRELIM Qn 13**

3. The diagram below shows the speed-time graph of a car for a journey

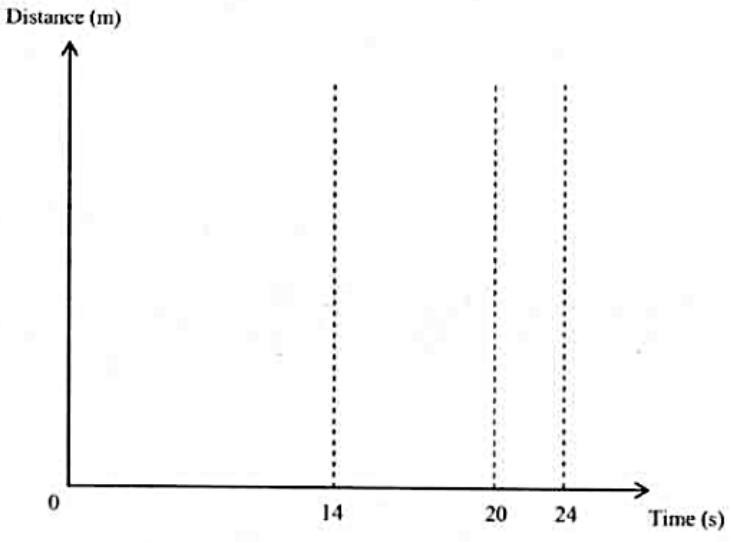


The car decelerates from an initial speed of 14 m/s for the first 14 seconds and remained at rest for the next 6 seconds. It then accelerates uniformly for the next 4 seconds and remained at a constant speed of 16 m/s thereafter. AB is an arc of a quadrant

(a) Find the acceleration at $t = 23$ s [1]

(b) Taking π to be $\frac{22}{7}$, find the total distance travelled for the entire journey [2]

(c) Copy the following axes into your answer script and sketch the distance-time graph of the vehicle for the first 24 seconds of the journey, indicating the distances travelled after $t = 14$ s, $t = 20$ s and $t = 24$ s on the vertical axis clearly [2]



Credit: **S4 CHS P1/2015 PRELIM Qn 21**

5 Algebraic Expressions & Formulae

1. (a) A number pattern is shown below. The difference between every consecutive term is equal

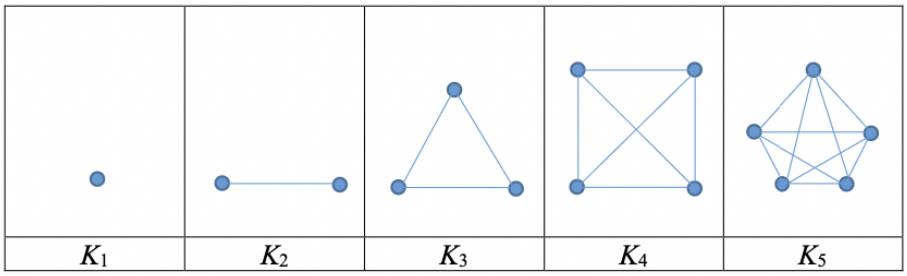
$$x \quad 7 \quad y \quad z \quad 19$$

(i) Find the values of x, y and z [2]

(ii) Find an expression for the nth term [2]

(iii) Find the 109th term of the sequence [1]

(b) Every pair of the dots in a sequence are connected by lines between them as shown in the diagram below



(i) State the number of lines connected to every dot in K_6 [1]

(ii) State the number of lines in K_6 [1]

(iii) Find the number of lines, in terms of n, connecting each dot in K_n [1]

(iv) Find the number of lines in K_{256} [1]

(v) Explain why the sequence can never contain 71 lines [1]

Credit: **S4 TSS P2/2020 PRELIM Qn 2**

2. The sum of a series of numbers is given below

$$S_n = 1 + 2 + 3 + ... + n = \frac{n(n+1)}{2}$$

(a) Find the value of S_{35} [1]

(b) Find the value of n given that [2]

$$S_n = 1378$$

(c) Find the value of T given that [2]

$$T = 101 + 102 + 103 + ... + 199$$

(d) Find the value of P given that [2]

$$P = 2 + 4 + 6 + ... + 100$$

(e) Using part (d), find the sum of all odd integers from 0 to 100 [1]

Credit: **S4 AMKSS P1/2019 MYE Qn 16**

3. The first 4 terms in a sequence of numbers are given below

$$T_1 = 6 + (1-2)^2 - 2 = 5$$

$$T_2 = 6 + (2-2)^2 - 4 = 2$$

$$T_3 = 6 + (3-2)^2 - 6 = 1$$

$$T_4 = 6 + (4-2)^2 - 8 = 2$$

(a) Find T_5 [1]

(b) Show that the nth term of the sequence is given by [2]

$$T_n = n^2 = 6n + 10$$

(c) T_k and T_{3k} are terms in the sequence. It is given that [3]

$$\frac{T_{3k}}{T_k} = 17$$

Show that this equation simplifies to

$$2k^2 - 21k + 40 = 0$$

(d) Solve the equation [3]

$$2k^2 - 21k + 40 = 0$$

(e) Explain why one of the solutions in part (d) must be rejected as the position of T_k in the sequence [1]

Credit: **S4 CHIJ KC P2/2018 PRELIM Qn 4**

4. (a) It is given that

$$S = \frac{a}{2}\sqrt{n^2 - b}$$

(i) Find S when $a = 8$, $b = -7$ and $n = 3$ [1]

(ii) Express n in terms of a, b and S [3]

(b) Solve the equation [2]

$$\frac{5}{\sqrt[3]{5}} = 5^{x-1}$$

(c) Factorise [2]

$$9x^2 - 25 + 12xy - 20y$$

(d) Simplify [3]

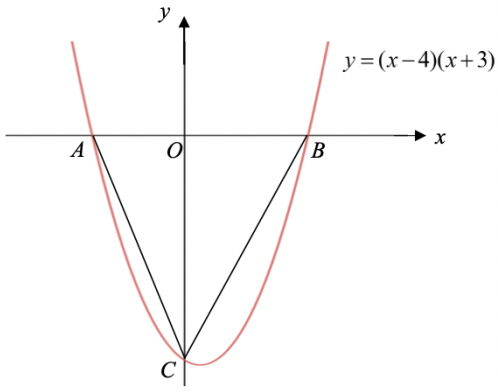
$$\frac{x^2 + 3x - 7}{x - 4} + \frac{9 + 3x}{4 - x}$$

Credit: **S4 CCHS(Y) P2/2017 MYE Qn 1**

6 Functions & Graphs

1. The diagram below shows the graph which cuts the x-axis at A and B and the y-axis at C

$$y = (x-4)(x+3)$$



(a) Find the coordinates of the points A, B and C [2]

(b) Find the length of the line AC [1]

(c) Find the equation of the line BC [1]

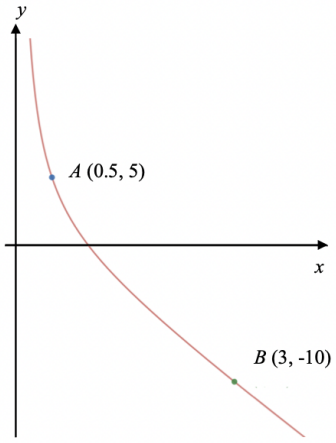
(d) Find the coordinates of the minimum point [1]

(e) Explain why the equation $(x-4)(x+3) = k$ does not have solutions for some values of k [1]

Credit: **S4 MGS P1/2020 PRELIM Qn 16**

2. The sketch below shows the graph of

$$y = \frac{p}{x} + qx + 1$$



The points $A(0.5, 5)$ and $B(3, -10)$ lie on the graph. Find the values of p and q

Credit: **S4 SST P1/2020 PRELIM Qn 7**

3. **Answer the whole of this question on a sheet of a graph paper**

The variables x and y are connected by the equation

$$y = \frac{x}{10}\left(15 - x^2\right)$$

Some corresponding values of x and of y are given in the table below

x	-3	-2	-1	0	1	2	2.5	3	4	5
y	-1.8	-2.2	-1.4	0	1.4	2.2	2.2	q	-0.4	-5

(a) Calculate the value of q

(b) Using a scale of 2 cm to represent 1 unit on each axis, draw a horizontal x-axis for $-3 \leq x \leq 5$ and a vertical y-axis for $-5 \leq y \leq 3$. On your axes, plot the points given in the table and join them with a smooth curve

(c) Use your graph to find the solutions of, for $-3 \leq x \leq 5$

$$\frac{x}{10}\left(15 - x^2\right) = -1$$

(d) By drawing a tangent, find the gradient of the curve at $x = 3.5$

(e) (i) On the same axes, draw the line with gradient $\frac{1}{2}$ that passes through the coordinates $(-3, -1)$ [1]

(ii) Write down the equation of the line [1]

(iii) Write down the coordinates of the points where the line intersects the curve [2]

Credit: **S4 YYSS P2/2019 PRELIM Qn 3**

4. **Answer the whole of this question on a sheet of graph paper**

A population of flies increases according to the formula

$$N = 30 \times 2^t$$

where N is the population of flies after t days. The table shows some corresponding values of variables N and t

t	1	1.5	2	2.5	3	3.5	4
N	60	84.9	120	k	240	339	480

(a) Find the value of k [1]

(b) Determine the initial number of flies [1]

(c) Using a scale of 2 cm to represent 1 unit on each axis, draw a horizontal x-axis for $0 \leq x \leq 4$. Using a scale of 2 cm to represent 100 units on each axis, draw a vertical y-axis for $0 \leq N \leq 500$. On your axes, plot the points given in the table and join them with a smooth curve [3]

(d) Use your graph to determine the time when the population reaches 250 [1]

(e) By drawing a tangent, find the gradient of the curve at $t = 2$. Explain what this gradient represents [2]

(f) Use your graph to determine the time when the population is increasing at 200 flies per day [2]

Credit: **S4 AHS P2/2018 PRELIM Qn 4**

7 Equations & Inequalities

1. Jenny bought some jars of cookies for \$900. She paid \$$n$ for each jar of cookies
   (a) Write down an expression, in terms of n, for the number of jars of cookies she bought [1]
   (b) Jenny found that 2 jars of cookies were spoilt and could not be sold. Jenny sold each remaining jar of cookies for \$3 more than she paid for it. Write down an expression, in terms of n, for the total sum of money she received from the sale of the jars of cookies [1]
   (c) Given that she made a profit of \$92 from the sale of the jars of cookies, form an equation in n and show that it reduces to [2]

$$n^2 + 49n - 1350 = 0$$

   (d) Solve the equation in part(c), giving your solutions correct to 3 decimal places [2]
   (e) Hence, find the selling price of each jar of cookies sold by Jenny, giving your solution correct to the nearest cent [2]

Credit: **S4 SST P2/2018 PRELIM Qn 2**

2. (a) Solve the equations
   (i) [2]

$$3x^2 - 507 = 0$$

   (ii) [3]

$$\frac{x-2}{x+3} - \frac{x-3}{12+4x} = 5$$

   (b) Simplify the following expressions, leaving your answers in positive index
   (i) [2]

$$\frac{1}{9c^{-2}} \times \frac{(3d)^{-1}}{c^3}$$

   (ii) [2]

$$\frac{5f^2g^3}{21gh} \div \frac{40f^5g^2}{7h^3}$$

   (c) Given that x and y are integers such that $-7 \leq x < 3$ and $-2 \leq y \leq 3$, calculate
   (i) the greatest value of $x + y$ [1]
   (ii) the least value of xy [1]
   (iii) the greatest value of $x^2 - y^2$ [1]

Credit: **S3 AMKSS P2/2016 PRELIM Qn 1(a) & 2**

3. A helicopter makes a trip to a destination 500 km away. The average speed of the helicopter is x km/h

   (a) Write down an expression, in terms of x, for the time taken for the helicopter to reach its destination in hours [1]

   (b) On the return trip, the helicopter reduced its average speed by 25 km/h. The return trip took 15 minutes longer than the outbound trip

      (i) Write down an expression, in terms of x for the time taken by the helicopter to make the return trip in hours [1]

      (ii) Form an equation in x and show that it can be reduced to [3]

$$x^2 - 25x - 50000 = 0$$

      (iii) Solve the equation in part (b)(ii), giving both answers correct to 2 decimal places [3]

      (iv) Calculate the time taken, in hours and minutes, for the helicopter to complete only the return trip. Give your answer correct to the nearest minute [2]

Credit: **S3 KSS P2/2018 EOY Qn 3**

8 Set Language & Notation

1. (a) Given that

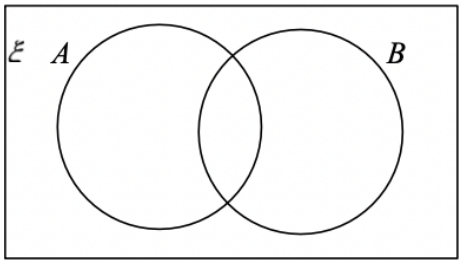
$$\mathscr{E} = \{\text{integers } x : 2 \leq x < 15\}$$
$$E = \{\text{prime numbers}\}$$
$$F = \{\text{factors of } 18\}$$
$$G = \{\text{multiples of } 3\}$$

(i) List the elements of $E \cap F$ [1]

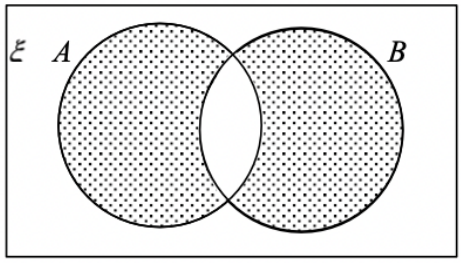
(ii) Underline the correct statement(s) from the list below [1]

$$E \cup F = \{0\} \qquad F \subset G \qquad 11 \in E \qquad F \cap G = \{3, 6, 9\}$$

(b) On the Venn diagram, shade the region which represents $A \cup B'$



(c) Express in set notation, the shaded region represented in the Venn diagram below



Credit: **S4 HIHS P1/2020 PRELIM Qn 17**

2. Given that

$$\mathscr{E} = \{\text{integers } x : 0 < x \leq 16\}$$
$$A = \{\text{multiples of } 3\}$$
$$B = \{\text{perfect squares}\}$$
$$C = \left\{\text{integers } x : x > \sqrt{90}\right\}$$

List the elements in

(a) A' [1]

(b) $A \cap B$ [1]

(c) $(A \cup B \cup C)'$ [1]

Credit: **S4 SCSS P1/2015 PRELIM Qn 8**

9 Matrices

1. Aldrick and Bryan are two salespersons for a fitness programme. The new subscription that they obtained in May and June for packages F, G and H are shown in the table

Months	May		June	
Names	Aldrick	Bryan	Aldrick	Bryan
Packages F	18	15	20	21
Packages G	32	37	30	34
Packages H	11	14	16	15

The information is represented by the matrices $\mathbf{A}$ and $\mathbf{B}$

$$\mathbf{A} = \begin{pmatrix} 18 & 15 \\ 32 & 37 \\ 11 & 14 \end{pmatrix} \qquad \mathbf{B} = \begin{pmatrix} 20 & 21 \\ 30 & 34 \\ 16 & 15 \end{pmatrix}$$

(a) (i) Find $\mathbf{B} - \mathbf{A}$ [1]

(ii) Describe what the elements in $\mathbf{B} - \mathbf{A}$ represent [1]

(b) The sales commissions for packages F, G and H are \$30, \$45 and \$60 respectively

(i) Represent the information in a 1×3 matrix $\mathbf{C}$ [1]

(ii) Find $\mathbf{CA}$ [1]

(iii) Describe what the elements in $\mathbf{CA}$ represent [1]

Credit: **S4 BGSS P1/2020 PRELIM Qn 23**

2. As part of a Values in Action project, three Secondary 4 classes from Brightgrove Secondary School collected old newspapers and clothes to raise funds for charity. The collection was done over 2 weeks. The following table shows the weight of the collections made in kilograms (kg), by the three classes, 4E, 4F and 4G in Week 1

	Week 1		
	4E	4F	4G
Newspaper (kg)	390	300	350
Clothes (kg)	150	200	180

(a) Represent the weights of the newspapers and clothes collected in Week 1 in a 2×3 matrix **A** [1]

(b) 1 kg of newspaper is sold at \$0.15 and 1 kg of clothes is sold at \$0.45. Represent this information in a 1×2 row matrix **H** [1]

(c) The collection is done by the same classes in Week 2 is given by the matrix **B**

$$\mathbf{B} = \begin{pmatrix} 220 & 250 & 200 \\ 260 & 230 & 170 \end{pmatrix}$$

(i) Evaluate the matrix $\mathbf{R} = \mathbf{A} + \mathbf{B}$ [1]

(ii) Given that $\mathbf{L} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$, evaluate the matrix $\mathbf{M} = \mathbf{RL}$ [2]

(iii) State what the elements of **M** represent [1]

(iv) Evaluate the matrix **MH** [1]

(v) Hence, state the total amount of money raised by the 3 classes [1]

Credit: **S4 CCHS(M) P2/2020 PRELIM Qn 3**

3. A group of volunteers pack goodie bags for the residents of a nursing home. The table shows the contents of one of each type of goodie bag

	Bag Type		
	P	Q	R
Number of buns	5	3	4
Number of toothbrushes	2	1	2
Number of packets of Milo	2	3	2
Number of packets of coffee	1	2	3

This information can be represented by the matrix

$$\mathbf{A} = \begin{pmatrix} 5 & 3 & 4 \\ 2 & 1 & 2 \\ 2 & 3 & 2 \\ 1 & 2 & 3 \end{pmatrix}$$

There are 20 bags of type P, 30 bags of type Q and 10 bags of type R

(a) (i) Represent the numbers of the three type of goodie bags in a 3×1 column matrix $\mathbf{B}$ [1]

(ii) Evaluate the matrix $\mathbf{C} = \mathbf{AB}$ [2]

(iii) State what the elements of $\mathbf{C}$ represent [1]

(b) A bun cost \$1. A toothbrush costs \$1.50. A packet of Milo costs \$6.40. A packet of coffee costs \$5.60. The elements of the matrix $\mathbf{E}$, where $\mathbf{E} = \mathbf{DA}$, represent the costs, in dollars, of each bag of P, of Q and of R respectively

(i) Write down the matrix $\mathbf{D}$ [1]

(ii) Evaluate the matrix $\mathbf{E}$ [1]

(c) Evaluate the matrix $\mathbf{F} = \mathbf{EB}$ [1]

(d) State what the element(s) of $\mathbf{F}$ represent [1]

Credit: **S4 CHIJ SNGS P2/2018 PRELIM Qn 3**

4. A shop sells two flavoures of ice-cream, Rum Raisin and Super Chunkies. Each flavour is sold in cups of three different sizes, small, medium and large, and of different prices. The sales in two successive days are given in the table below

	Saturday			Sunday		
Size	Small	Medium	Large	Small	Medium	Large
Cost	\$2.50	\$3.20	\$4.50	\$2.50	\$3.20	\$4.50
Rum Raisin	12	17	8	14	12	10
Super Chunkies	18	15	11	13	21	16

The information for Saturday's sales can be represented by the matrix

$$\mathbf{M} = \begin{pmatrix} 12 & 17 & 8 \\ 18 & 15 & 11 \end{pmatrix}$$

The cost of each flavour for each size can be represented by the matrix

$$\mathbf{C} = \begin{pmatrix} 2.5 \\ 3.2 \\ 4.5 \end{pmatrix}$$

The information for the Sunday's sales can be represented by a 2×3 matrix $\mathbf{N}$

(a) Write down the matrix $\mathbf{N}$ [1]

(b) Calculate [1]

$$\mathbf{P} = (\mathbf{M} + \mathbf{N})$$

(c) Describe what is represented by the elements in $\mathbf{P}$ [1]

(d) Calculate [2]

$$\mathbf{Q} = \frac{1}{2}\mathbf{PC}$$

(e) Describe what is represented by the elements of $\mathbf{Q}$ [1]

(f) Calculate and describe what is represented by the elements of [2]

$$\mathbf{R} = \begin{pmatrix} 1 & 1 \end{pmatrix} \mathbf{PC}$$

Credit: **S4 CGS P2/2018 PRELIM Qn 2**

10 Problems in Real-World Context

1. Mr Wong is thinking of applying for a credit card that gives the most savings in terms of dining, grocery and petrol. His gross monthly expenses (before any discounts) are listed in the table [9]

Type of Expenses	Amount
Petrol	350
Grocery	100
Dining	400

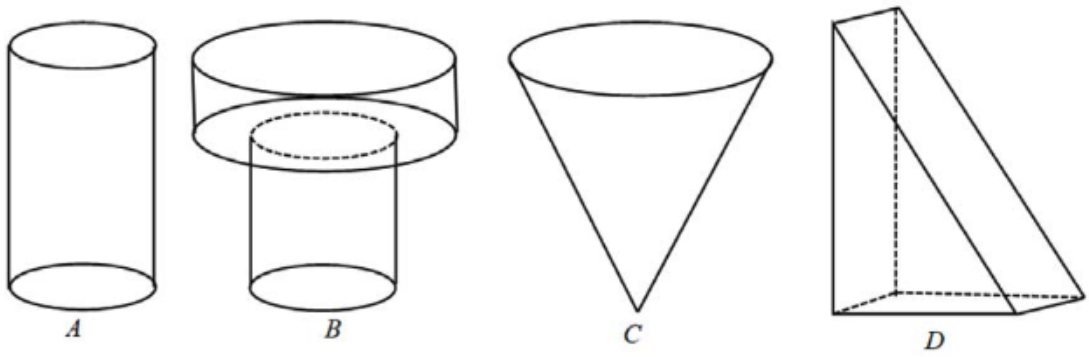
After doing some research, he decided to narrow his option to the 3 cards listed below

Credit Card	**Savings on Petrol**	**Savings on Dining**	**Savings on Grocery**
CBSH Card	• 14% upfront discount plus 5% cash rebate (on monthly petrol expenses) with monthly minimum spending of $600 on the CBSH card	• 5% cash rebate on dining expenses with monthly minimum spending of $600 on the CBSH card	• 5% cash rebate on grocery expenses with monthly minimum spending of $600 on the CBSH card
BSOP Card	• 15% upfront discount plus 6% cash rebate (on monthly petrol expenses) with minimum spending of $1000 on BSOP Card	• 5% cash rebate on all dining expenses with minimum monthly spending of $1000 on the BSOP Card	• 5% cash rebate on grocery expenses
CBCO Card	• 14% upfront discount plus 4.3% cash rebate (on monthly petrol expenses) with monthly minimum spending of $800 on the CBCO Card plus 2.1% cash rebate (on monthly petrol expenses) with monthly minimum spending of $400 on petrol	• 5% cash rebate on all dining expenses with monthly minimum spending of $800 on the CBCO Card	• 5% cash rebate on grocery expenses with monthly minimum spending of $800 on the CBCO Card

Which credit card should Mr Wong apply for so as to maximise his savings, given that he can only apply for one card and this card is to be used only for these 3 types of expenses? Show your working clearly

Credit: **S4 CHIJ STC P1/2019 PRELIM Qn 10**

2. The diagrams below show four container (not drawn to scale), A, B, C and D each with a height h cm.



The containers are initially empty. It takes t seconds to fill each container with water at a constant rate

(a) Sketch the graph of the depth of water against time for each of the 4 containers. Sketch the graphs separately [2]

(b) It takes 12 seconds to fill container D to the brim. Find the time it takes to fill container D to half its height [2]

Credit: **S4 CGS P1/2018 PRELIM Qn 19**

3. **Application Question**

(a) Meg writes down how long she would use the air conditioner in the following table [2]

Days	Number of hours
Monday to Thursday	6 hours
Friday	7 hours 15 minutes
Saturday and Sunday	8 hours

Find the mean length of time that she would use the air conditioner each day

(b) Meg is deciding between two models of air conditioner. The table below shows information that she needs, including the electricity consumptions of two models

Residential Air Conditioners

	Model S (Standard)	Model E (Energy efficient)
Price	\$650	\$1300
Electricity consumption	2080 kWh	1264 kWh

Notes:

- Price include GST
- Electricity consumptions are based on 8 hours of use each day

Service Contracts

Frequency	Price per service before 7% GST
1 service every 2 months	\$25
1 service every 3 months	\$30
1 service every 4 months	\$35

Offer: **40%** discount on service contract with purchase of Model S

(i) Based on her usage, Meg estimates that the electricity consumptions in 1 year will be 1755 kWh for Model S and 1066.5 kWh for Model E. Explain how she found these estimates [1]

(ii) The total cost of an air conditioner includes its price, the cost of the electricity it consumes and the cost of servicing it. Electricity costs 25.3 cents per kWh, including GST. Meg would lke the air conditioner to be serviced once every 4 months. Based on her usage, which model will have a lower total cost after 7 years of use? Justify your decision with calculations. [7]
(You should assume that the costs of electricity and servicing remain the same)

Credit: **S4 CHIJ KC P2/2018 PRELIM Qn 10**

4. **Application Question**

(a) **Diagram 1** shows a figure made up of 3 congruent circles enclosed by a perimeter.

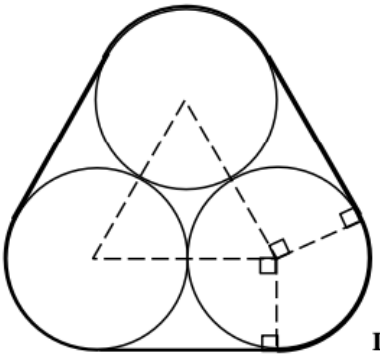


Diagram 1

The circles touch each other and the radius of each circle is 3 cm

(i) Show that the length of the perimeter is 36.85 cm, correct to 2 decimal places [2]

(ii) Show that the area of the figure is 97.86 cm^2, correct to 2 decimal places [3]

(b) Mr Tan imports tennis balls and repackages them for sale. He wants to use eco-friendly packaging plastic containers as they do less harm to the environment and to improve the "Brand Image" of his product. [5]

However eco-friendly plastic containers are more expensive than traditional plastic containers. Mr Tan is searching for a container design that uses the least amount of eco-friendly packaging material

He narrows his search to the two designs shown in **Diagram 2** and **Diagram 3**

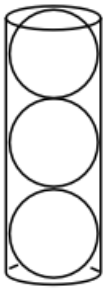


Diagram 2

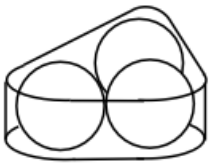


Diagram 3

Diagram 2 shows a closed cylinder. The balls touch each ends and the sides of the cylinder.

Diagram 3 is a closed triangular box where the corners are curved. Each ball touches the top, the bottom and the sides of the box. Each ball also touches the other two balls. **Diagram 1** is the plan view of this design

Which container design should Mr Tan adopt? Explain your decision with clear working. In your investigation, model a tennis ball as a sphere of radius 3 cm

Credit: **S4 CHIJ Sec P2/2020 PRELIM Qn 10**

11 Angles, Triangles & Polygons

1. The exterior angle of a regular n-sided polygon is 14° more than the exterior angle of a regular $(2n+6)$-sided polygon

   (a) Write down and simplify an expression, in terms of n, each exterior angle of the $(2n+6)$-sided polygon [1]

   (b) Write down an equation in n and show that it reduces to [3]

   $$14n^2 - 138n - 1080 = 0$$

   (c) Solve the equation in part (b) [2]

   (d) Explain why one of the solutions above is rejected [1]

   (e) Hence, find the value of each interior angle of the n-sided polygon [2]

   Credit: **S4 BPGHS P2/2020 PRELIM Qn 5**

2. There is a playground P. A basketball court B is 350 m away from P. The bearing of B from P is 110°. The scale is 1 cm : 50 m. Assume that North is pointing to the top of the paper

   (i) Find and label the position of basketball court B [1]

   (ii) A community centre C is 450 m away from P and 300 m from B. Given that the bearing of C from P is between 000° and 090°, find the position of C [1]

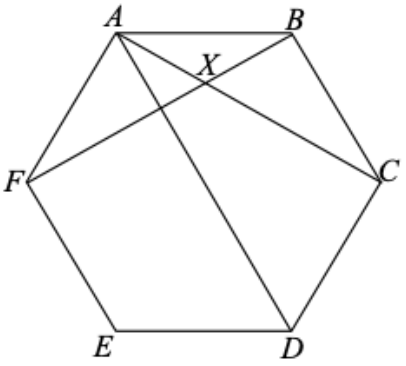
   (iii) Construct the perpendicular bisector of PB [1]

   (iv) Construct the angle bisector of $\angle BCP$ [1]

   Credit: **S4 NHHS P1/2020 PRELIM Qn 22**

3. (a) Name a quadrilateral with four equal sides and unequal diagonals [1]

   (b) The diagram shows a regular hexagon $ABCDEF$. The diagonals FB and AC intersect at point X

   (i) Find the interior angle of the regular hexagon $ABCDEF$ [1]

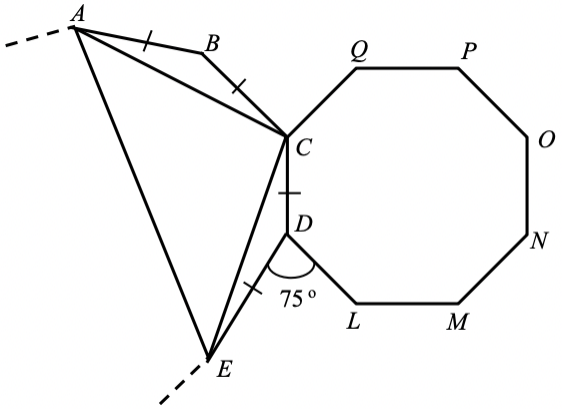
   (ii) Explain why $\triangle FAB$ and $\triangle CBA$ are congruent [2]

   (iii) Find obtuse $\angle FXC$ [2]

   (iv) Given that diagonal AD bisects $\angle FAB$, determine if FE and AD are parallel [2]

   Credit: **S4 YTSS P2/2018 PRELIM Qn 3**

4. The diagram shows regular octagon $CDLMNOPQ$ and part of a regular n-sided polygon, $ABCDE$....



(a) Find

(i) $\angle CDL$ [1]

(ii) the number of sides in the regular polygon $ABCDE$ [2]

(iii) $\angle BAC$ [1]

(iv) $\angle CAE$ [2]

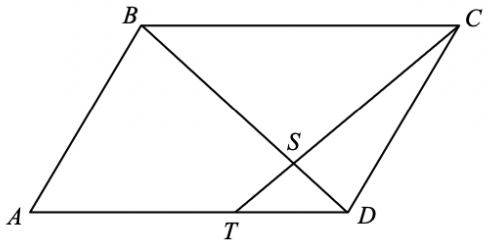
(b) Explain why $\triangle ABC$ and $\triangle CDE$ are congruent [2]

(c) Is it possible to have a circle with diameter AE and point C on its circumference? Explain [1]

Credit: **S4 HYSS P1/2020 PRELIM Qn 12**

12 Congruency & Similarity

1. $ABCD$ is a parallelogram, S is a point on BD and $BS = 3SD$



(a) Name a triangle that is similar to $\triangle DST$ [1]

(b) Find

(i) [1]

$$\frac{\text{Area of } \triangle BCS}{\text{Area of } \triangle BCD}$$

(ii) [1]

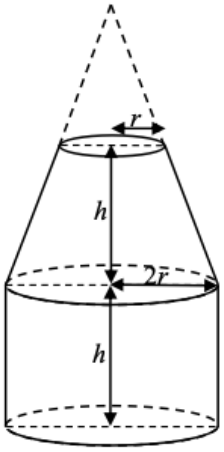
$$\frac{\text{Area of } \triangle DST}{\text{Area of } \triangle BCS}$$

(iii) [1]

$$\frac{\text{Area of } \triangle DST}{\text{Area of } \triangle BCD}$$

Credit: **S4 NGHS P1/2020 PRELIM Qn 12**

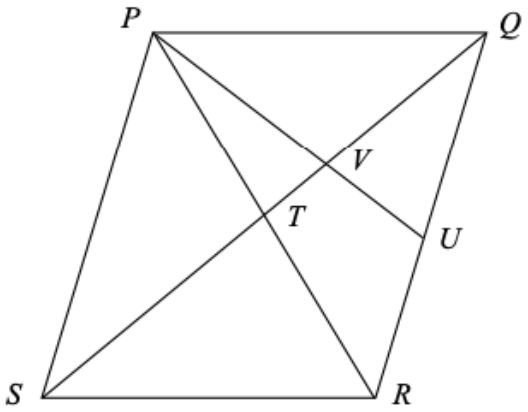
2. The diagram shows a milk container which is made up of a frustum and a cylinder [3]



The height, h cm, of the cylinder is the same as the height of the frustum. The radius of the cylinder base is twice the radius of the top circular surface of the frustum, r cm. Given that the **curved** surface areas of the frustum and cylinder are equal, find an expression for h, in terms of r

Credit: **S4 NCHS P1/2018 PRELIM Qn 10**

3. The diagram shows a parallelogram $PQRS$ with diagonals PR and QS intersecting at T.



The point U is the mid-point of QR and the line PU cuts QS at V

(a) Name a triangle that is congruent to triangle PTQ [1]

(b) Prove that

(i) $\triangle PVS$ and $\triangle UVQ$ are similar [2]

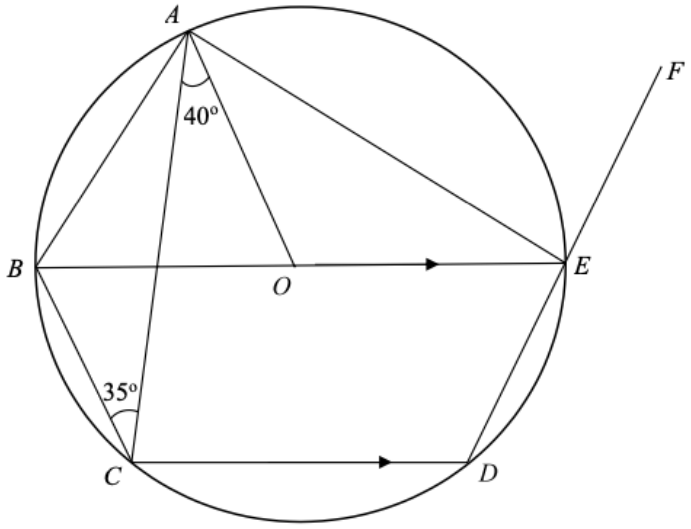
(ii) $QV = 2VT$ [2]

(c) Find the ratio of the area of $\triangle QVU$ to the area of the trapezium [2]

Credit: **S4 SCGS P2/2018 PRELIM Qn 3**

13 Properties of Circles

1. A, B, C, D and E are points on the circle, with centre O



The diameter of the circle, BE, is parallel to CD. $\angle OAC = 40°$ and $\angle ACB = 35°$. DEF is a straight line. Find, giving reasons for each answer,

(a) $\angle OEA$ [1]

(b) Reflex $\angle AOB$ [2]

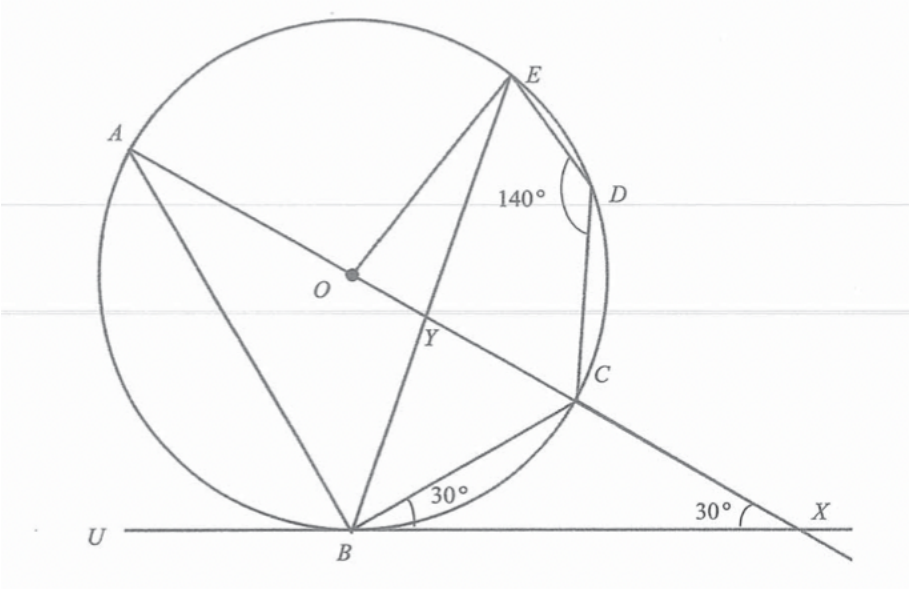
(c) $\angle BAC$ [2]

(d) $\angle FEB$ [2]

(e) $\angle DOE$ [2]

Credit: **S4 ANDSS P2/2020 PRELIM Qn 8**

2. O is the centre of the circle passing through A, B, C, D and E.



UBX is the tangent to the circle at B. ACX is a straight line which passes through O. $\angle CBX = \angle CXB = 30^\circ$ and $\angle EDC = 140^\circ$

(a) Stating your reasons clearly, find,

(i) $\angle BAC$ [2]

(ii) $\angle CEB$ [1]

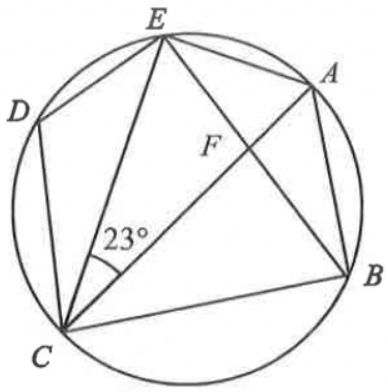
(iii) $\angle CBE$ [1]

(iv) $\angle OBY$ [2]

(b) T is a point such that $\angle ATE$ is 60° and on the same side as point B. State whether point T lies in the circle. Explain your answer

Credit: **S4 HGSS P2/2019 PRELIM Qn 5**

3. (a) In the diagram, A, B, C, D and E are points on the circle.



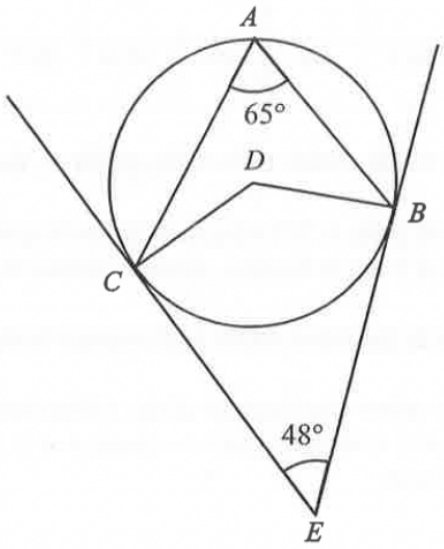
AC is the diameter and $\angle ACE = 23°$. Calculate, giving reasons for each answer,

(i) $\angle EBA$ [1]

(ii) $\angle EBC$ [1]

(iii) $\angle CDE$ [1]

(b) The diagram below shows a circle with points A, B and C on its circumference. [4]

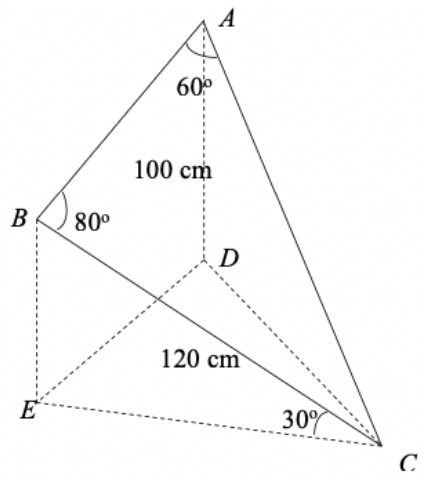


The lines EC and EB are tangents to the circle. The point D is inside the circle. $\angle CAB = 65°$ and $\angle CEB = 48°$. Determine if the point D is the centre of the circle. Give reasons for your answer

Credit: **S4 PCSS P2/2020 PRELIM Qn 14**

14 Trigonometry

1. (a) In the diagram, a thin triangular board ABC is held to the horizontal ground at the vertex C



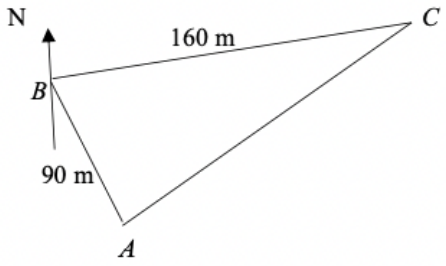
D and E are points on the ground vertically below A and B respectively. BC is inclined at an angle of $30°$ with the horizontal. It is given that $AD = 100$ cm, $BC = 120$ cm, $\angle CAB = 60°$ and $\angle ABC = 80°$

(i) Calculate the length of AB [2]

(ii) Find the area of $\triangle ABC$ [2]

(iii) Find the angle of depression of B from A [3]

(b) In the diagram, A, B and C are three points on level ground.



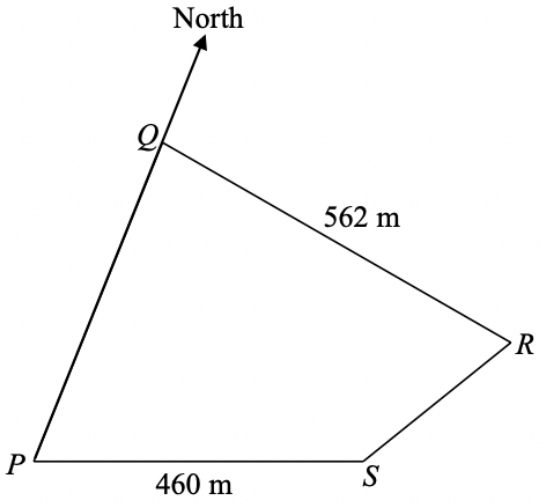
The bearing of A from B is $150°$ and the bearing of B from C is $245°$. The distance of A from B is 90 m and C from B is 160 m

(i) Calculate the distance AC [3]

(ii) A coconut tree of height 28 m is located at C. Ahmad walks along AC and stops at X where he spotted a monkey $\frac{1}{3}$ up the tree. Given his angle of elevation of the monkey is $15°$, find the distance he walked [3]

Credit: **S4 HSS P2/2020 PRELIM Qn 10**

2. The diagram shows four points P, Q, R and S which lie on level ground in a garden.



P is due south of Q. The bearing of S from P and Q are 068° and 126° respectively. $PS = 460$ m and $QR = 562$ m

(a) Find QS [2]

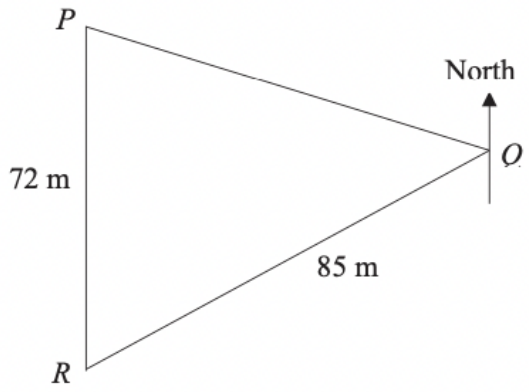
It is given that the bearing of R from Q is 098°

(b) Find RS [3]

(c) Joseph walks from P to Q, how far is he away from Q when he is west of R? [2]

Credit: **S4 TKSS P2/2020 PRELIM Qn 8**

3. Two school teams, Novotel and Temasek, are participating in an Amazing Race in Bishan Park.



The diagram shows the paths in the park. The teams assemble at P before heading to Q to start the race. P is due North of R. The bearing of R from Q is 241°. The distance PR is 72 metres and the distance RQ is 85 metres

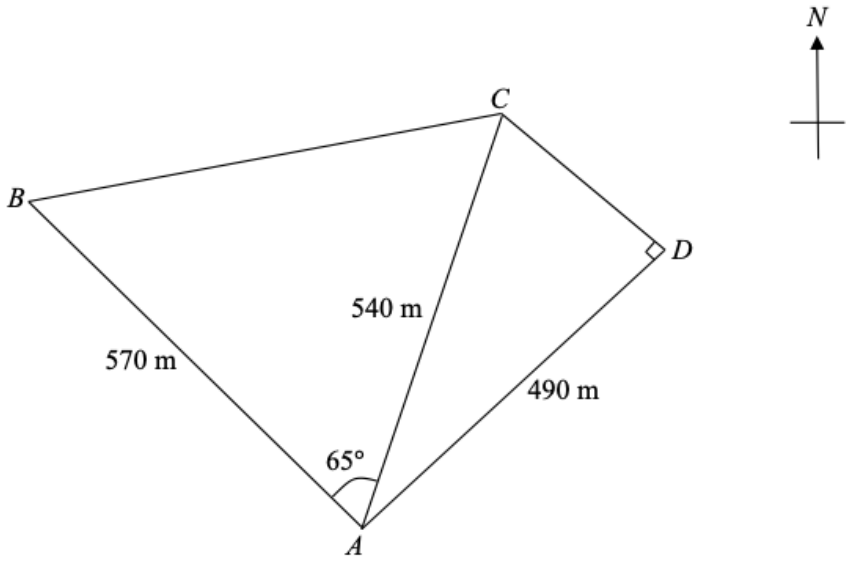
(i) Find the distance PQ [3]

(ii) The final station of the race is at R, each team is required to find a clue that is hidden at point S before completing the race at R. The bearing of S from R is 099° and QS is 54 metres. Given that there are 2 possible locations, find the two possible values of $\angle RSQ$ [3]

(iii) Both teams managed to find the clue at the same time and team Novotel is closer to R than team Temasek. Team Novotel claims that they are the winner. Given that the speed of team Novotel is 30% less than the speed of team Temasek when they travel from S to R. Do you agree with team Novotel that they will win the race? Justify your answer with clear working in your calculations [5]

Credit: **S4 BWSS P2/2019 PRELIM Qn 9**

4. The diagram shows a field $ABCD$ on horizontal ground, crossed by a path AC.



$AB = 570$ m, $AC = 540$ m and $AD = 490$ m. $\angle BAC = 65°$, $\angle CDA = 90°$ and the bearing of C from B is 079°

(a) Find

(i) BC [3]

(ii) $\angle BCA$ [2]

(iii) the bearing of A from C [2]

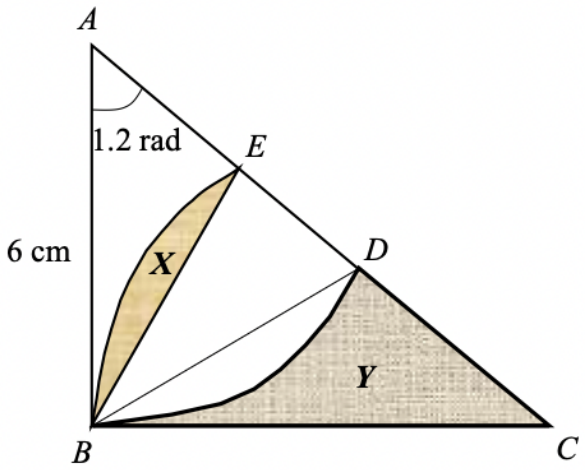
(b) A drone is hovering vertically above point D. The angle of depression of A from the drone is 2.6°. Find the angle of depression of C from the drone [4]

(c) The land is valued at \$45000 per hectare. Given that 1 hectare = 10000 square metres, calculate the value of the field [3]

Credit: **S4 TKSS P2/2018 PRELIM Qn 8**

15 Mensuration

1. ABC is a right-angled triangle.



ABD is a sector of a circle of radius 6 cm with centre A. CBE is a sector of another circle with centre C. $\angle BAC = 1.2$ radians. Find

(a) the length of arc BD [1]

(b) the length of BC [1]

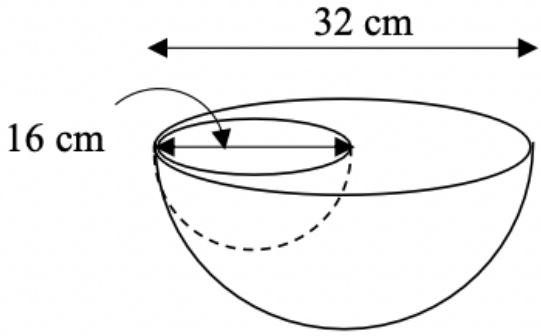
(c) the perimeter of the shaded region Y [2]

(d) the area of the shaded region X [3]

(e) the area of the shaded region Y [3]

Credit: **S4 MSS P2/2020 PRELIM Qn 6**

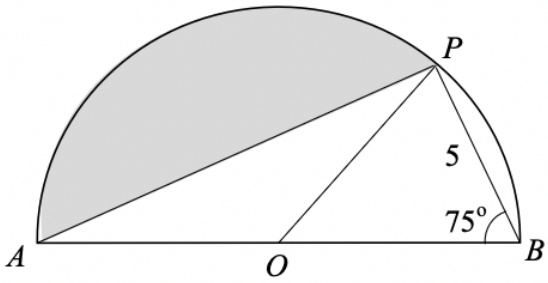
2. (a) The diagram shows an ornament made up of a hemispherical block of wood diameter 32 cm, that has a smaller hemispherical block of diameter 16 cm, carved out of it



(i) Calculate the surface ares of the ornament, leaving your answer in terms of π [3]

(ii) Calculate the volume of the ornament [2]

(b) The figure shows a semicircle with centre O.



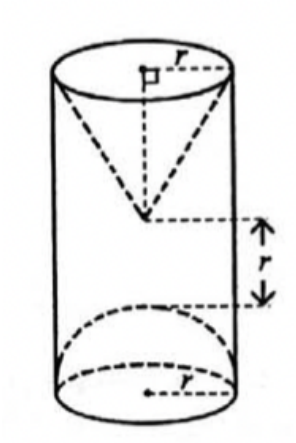
AB is the diameter and point P is on the circumference of the circle. $\angle OBP = 75°$ and $BP = 5$ cm

(i) Show that $OA = 9.66$ cm, correct to 3 significant figures [2]

(ii) Calculate the area of the shaded region [3]

Credit: **S4 CHIJ SNGS P2/2020 PRELIM Qn 6**

3. A carpenter wants to create a wooden toy for his son.



He removed a right-angled cone and a hemisphere from a uniform cylindrical wood. The radius of the base of the cone and hemisphere are r cm. The distance between the top of the hemisphere and the vertex of the cone is also r cm. Given that the curved surface area of the cone is equal to the curved surface area of the hemisphere, work out the volume of the toy, in terms of r

Credit: **S4 NCHS P1/2019 MYE Qn 22**

4. The diagram (Figure 1) shows a conical bottle of height h and radius R that is filled with water.

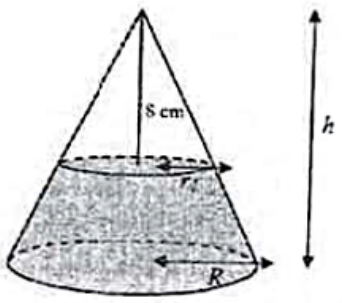


Figure 1

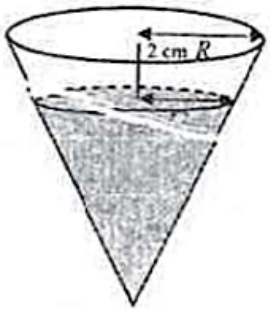


Figure 2

When rests on its base, the water in the bottle is 8 cm from its vertex

(a) (i) Express r in terms of R and h [1]

(ii) Hence, show that the volume of the water can be expressed as [2]

$$V = \frac{1}{3}\pi R^2 \left(h - \frac{512}{h^2}\right)$$

When the same conical bottle is turned upside down (Figure 2), the water level is 2 cm from its base

(b) Show that the volume of water is [2]

$$\frac{1}{3}\pi R^2 \frac{(h-2)^3}{h^2}$$

(c) Using your answers from part (a) and (b), or otherwise, write down an equation in h and show that it reduces to [2]

$$h^2 - 2h - 84 = 0$$

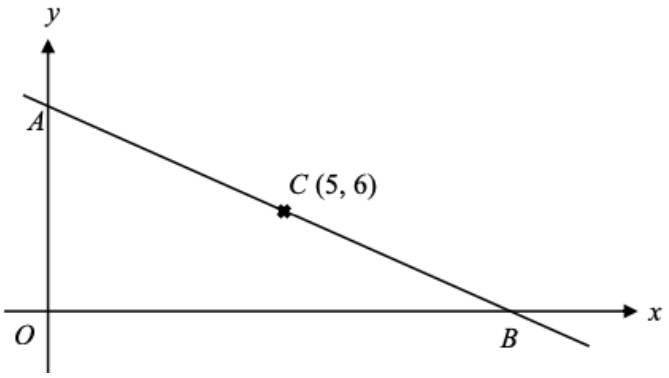
(d) Solve the equation in part (c), giving your answer correct to 1 decimal place [2]

(e) Calculate the volume of water in the conical bottle if $R = 7$ cm [2]

Credit: **S4 WSSS P2/2019 PRELIM Qn 8**

16 Coordinate Geometry

1. In the diagram not drawn to scale, point A lies on the y-axis and point B lies on the x-axis.



The coordinates of C is $(5, 6)$

(a) Given that C lies on the line AB and that $5OA = 3OB$, show that the y-intercept of the line AB is 9 [3]

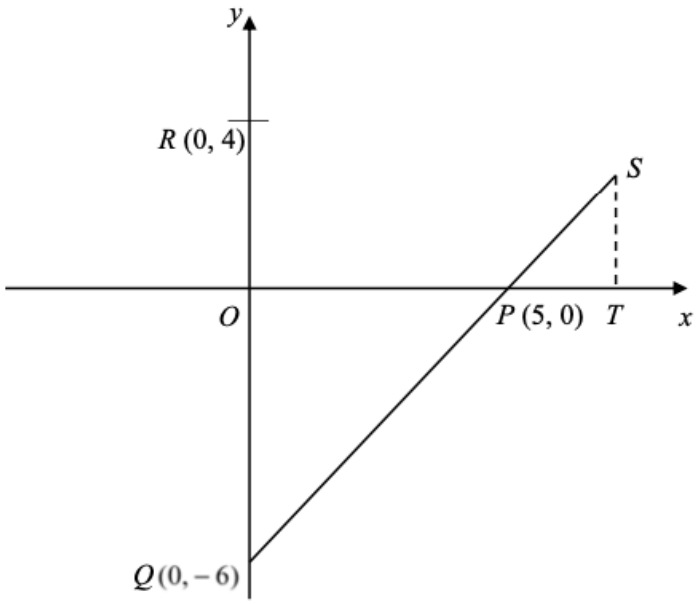
(b) Given that point D lies on the y-axis, state the coordinates of D such that $\triangle ACD$ is an isosceles triangle [1]

(c) Given further that $OCEA$ is a parallelogram, state the coordinates of the point E [1]

(d) Find the area of the parallelogram, $OCEA$ [2]

Credit: **S4 AHS P2/2020 PRELIM Qn 3**

2. In the diagram, P, Q and R are the points $(5, 0)$, $(0, -6)$ and $(0, 4)$ respectively



(a) Find the equation of the line PQ [1]

S is a point on QP produced such that the x-coordinate of S is k and T lies vertically below S on the x-axis

(b) Given that the area of $\triangle RQS$ is 40 units^2, show that $k = 8$ [2]

(c) (i) Calculate the lengths of PQ and PS respectively [3]

(ii) Hence, using your answers in (c)(i) and stating your reasons clearly, show that $\triangle PQO$ is similar to $\triangle PST$ [3]

Credit: **S4 MGS P2/2018 PRELIM Qn 9**

3. A is the point $(5, -8)$ and B is the point $(-10, 4)$

(a) Find the equation of the line AB [2]

(b) The equation of the line l is

$$4x + 5y = 10$$

(i) Does the line l intersect the line AB? Justify your working [2]

(ii) Does the point $C(10, -10)$ lie on the line l? Justify your working [2]

(iii) Line l intersects at the following curve at the point D [2]

$$y = \frac{x^3}{5} - x^2 - 2$$

The x-coordinate of point D is a real solution of the following equation, where p and q are constants

$$x^3 + px^2 + qx - 20 = 0$$

Find the values of p and q

Credit: **S4 BGSS P2/2020 PRELIM Qn 10**

17 Vectors in 2 Dimensions

1. (a) Given that

$$\mathbf{u} = \begin{pmatrix} 8 \\ -2 \end{pmatrix} \qquad \mathbf{v} = \begin{pmatrix} 2 \\ 6 \end{pmatrix} \qquad \mathbf{w} = \begin{pmatrix} 16 \\ p \end{pmatrix}$$

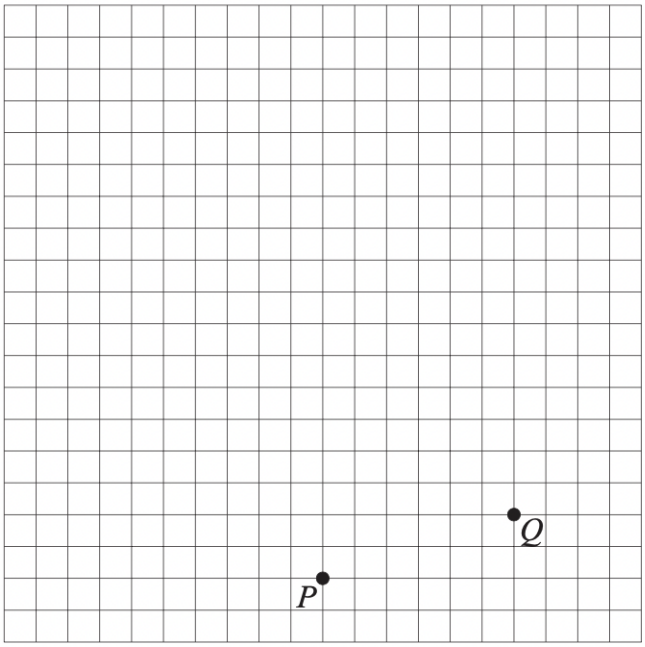
(i) Find [2]

$$|\mathbf{u} - \mathbf{v}|$$

(ii) Find [1]

$$2\mathbf{v} + \mathbf{u}$$

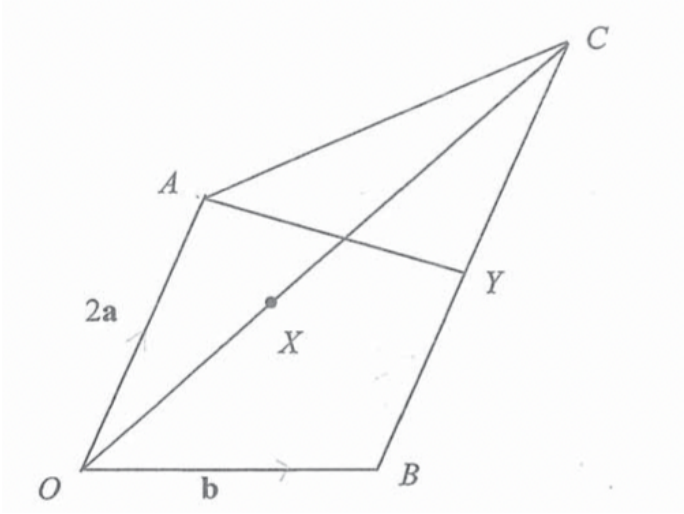
(b) The point R is such that $\overrightarrow{QR} = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$. It is given that $\overrightarrow{RS} = \begin{pmatrix} -12 \\ h \end{pmatrix}$ [2]



Find the 2 possible values of h which will make $PQRS$ a trapezium

Credit: **S4 SMSS P1/2020 MYE Qn 17 & 19**

2. In the diagram, $\overrightarrow{OA} = 2\mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$. BC is parallel to OA and $BC = \frac{3}{2}OA$. X is a point on OC such that $OX = \frac{2}{3}XC$. Y is the midpoint of BC



(a) Express in terms of **a** and/or **b**, as simply as possible

(i) $\overrightarrow{AB}$ [1]

(ii) $\overrightarrow{OC}$ [1]

(iii) $\overrightarrow{OX}$ [1]

(iv) $\overrightarrow{AX}$ [1]

(b) What can you deduce about the points A, X and B? Justify your answer [2]

(c) (i) AY produced meets OB produced at a point Z. Given that $\overrightarrow{AZ} = h\overrightarrow{AY}$, express $\overrightarrow{AZ}$ in terms of **a**, **b** and h [3]

(ii) Given also that $\overrightarrow{OZ} = k\overrightarrow{OB}$, express $\overrightarrow{AZ}$ in terms of **a**, **b** and k [1]

(iii) Hence, show that $h = 4$ and $k = 4$ [2]

(d) Find the value of

(i) [1]

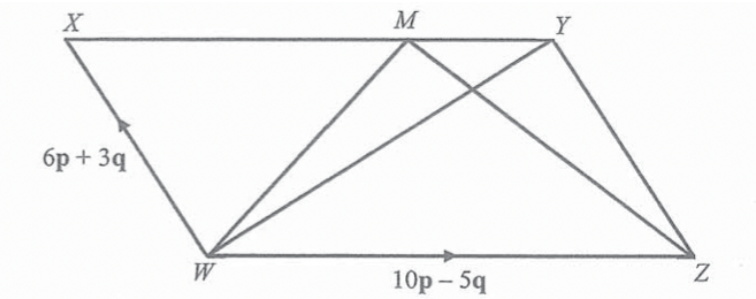
$$\frac{\text{Area of } \triangle OAX}{\text{Area of } \triangle OAC}$$

(ii) [1]

$$\frac{\text{Area of } \triangle OBX}{\text{Area of } \triangle ABC}$$

Credit: **S4 BSS P2/2020 PRELIM Qn 5**

3. (a) In the diagram, $WXYZ$ is a parallelogram.



M is a point on XY such that $XM : MY = 3 : 2$, $\overrightarrow{WX} = 6\mathbf{p} + 3\mathbf{q}$ and $\overrightarrow{WZ} = 10\mathbf{p} - 5\mathbf{q}$

(i) Find in terms of $\mathbf{p}$ and/or $\mathbf{q}$

(a) $\overrightarrow{WM}$ [1]

(b) $\overrightarrow{ZM}$ [1]

(ii) (a) Find the ratio Area of $\triangle WMX$: Area of $WXYZ$ [1]

(b) The area of $\triangle WMX$ is 8 units^2. Hence, calculate the area of $WXYZ$ [1]

(iii) Given that N is on WX produced such that ZMN is a straight line. Express $\overrightarrow{WN}$ in terms of $\mathbf{p}$ and $\mathbf{q}$ [1]

(b) Coordinates of A and B are $(-3, 3)$ and $(7, -13)$ respectively

(i) Write $\overrightarrow{AB}$ as a column vector [1]

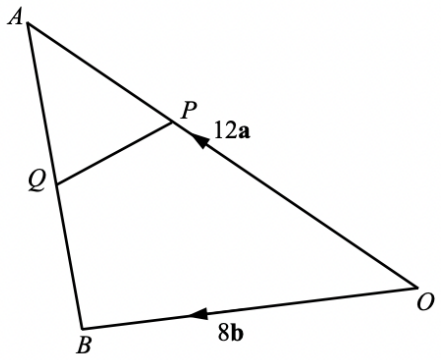
(ii) Find the acute angle formed by the line AB with the horizontal axis [2]

(iii) If the gradient of $AB = -\dfrac{2m}{n}$, express $\overrightarrow{AB}$ in terms of m and n [1]

(iv) Another vector $\overrightarrow{CD}$ is parallel to $\overrightarrow{AB}$ and has the magnitude thrice that of $\overrightarrow{AB}$. Write down the possible vectors of $\overrightarrow{CD}$ [2]

Credit: **S4 FMS(S) P2/2019 PRELIM Qn 8**

4. The position vectors of A and B, relative to O, are $12\mathbf{a}$ and $8\mathbf{b}$ respectively.



$\overrightarrow{OP} = 2\overrightarrow{PA}$ and $\overrightarrow{AQ} = \overrightarrow{QB}$

(a) Express each of the following in terms of $\mathbf{a}$ and $\mathbf{b}$

(i) $\overrightarrow{AQ}$ [1]

(ii) $\overrightarrow{BP}$ [1]

(iii) $\overrightarrow{QP}$ [1]

(b) Find the position vector of R such that $\overrightarrow{PR} = 4\overrightarrow{PQ}$ [1]

(c) Make 2 statements about the points O, B and R [1]

(d) Find the position vector of S such that $PQBS$ is a parallelogram [1]

(e) Find [1]

$$\frac{\text{Area of } \triangle OBP}{\text{Area of } \triangle ORA}$$

(f) Given that [2]

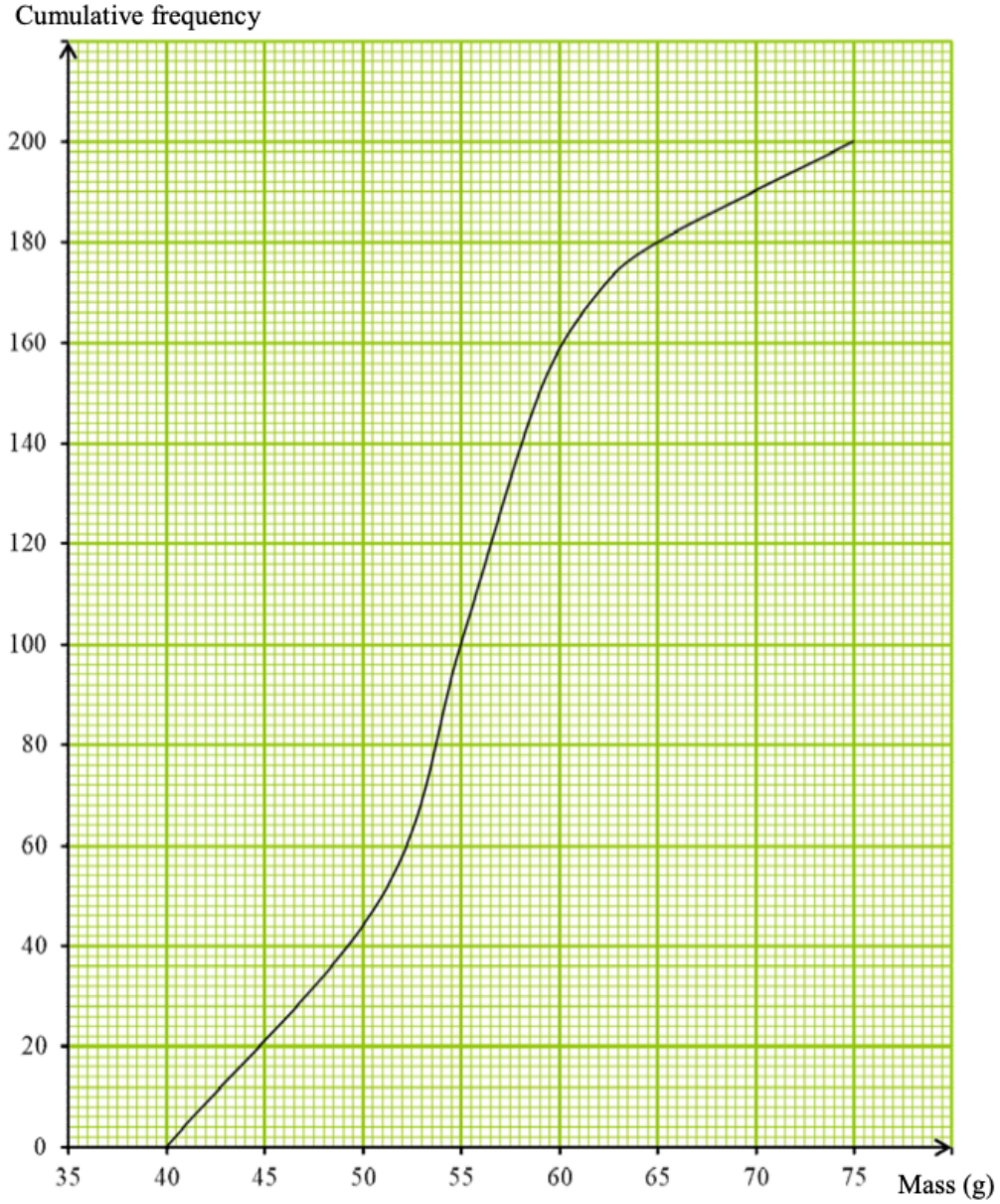
$$\mathbf{a} = \begin{pmatrix} -1 \\ 1 \end{pmatrix} \qquad \mathbf{b} = \begin{pmatrix} -1 \\ -1 \end{pmatrix}$$

find $\left|\overrightarrow{AB}\right|$

Credit: **S4 CGSS P2/2018 PRELIM Qn 9**

18 Data Analysis & Handling

1. (a) A cumulative frequency graph represents the masses of 200 eggs from Sunny Farm



The eggs are grouped according to their masses:

- Grade 1: $62\text{g} < \text{mass} \leq 75\text{g}$
- Grade 2: $51\text{g} < \text{mass} \leq 62\text{g}$
- Grade 3: $40\text{g} < \text{mass} \leq 51\text{g}$

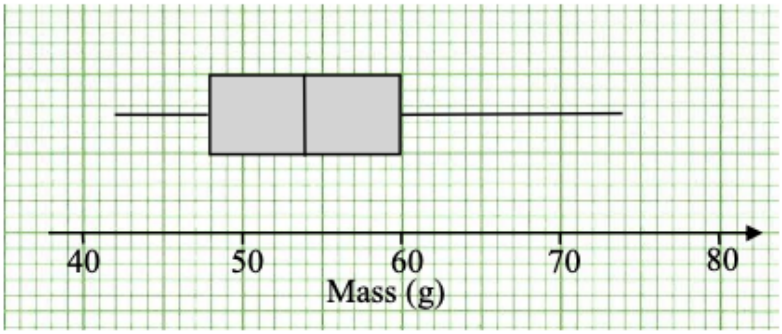
Use the graph to find

(i) the median mass [1]

(ii) the percentage of eggs which are in Grade 2 category [2]

(iii) their interquartile range [1]

(b) The box and whisker plot shows the masses of 200 eggs from Happy Farm



Fiego made two comparisons between the masses of eggs from Happy Farm and Sunny Farm. State whether you agree with Fiego's statements. Provide statistical evidence to support your answer

(i) Statement 1: Generally, eggs from Sunny Farm have more consistent masses than eggs from Happy Farm [1]

(ii) Statement 2: Happy Farm has a higher percentage of eggs in Grade 1 category than Sunny Farm [1]

(c) Thirty employees in Happy Farm work in either Administrative Department or Farming and Outdoors Department. The table below shows the the breakdown of males and females employees in the department

	Administrative	Farming and Outdoors
Males	1	20
Females	3	6

Two employees are selected randomly from the 30 employees to be the Chairperson and Deputy Chairperson of the Staff Well-being Committee. Find, as a fraction in its simplest form, the probability that

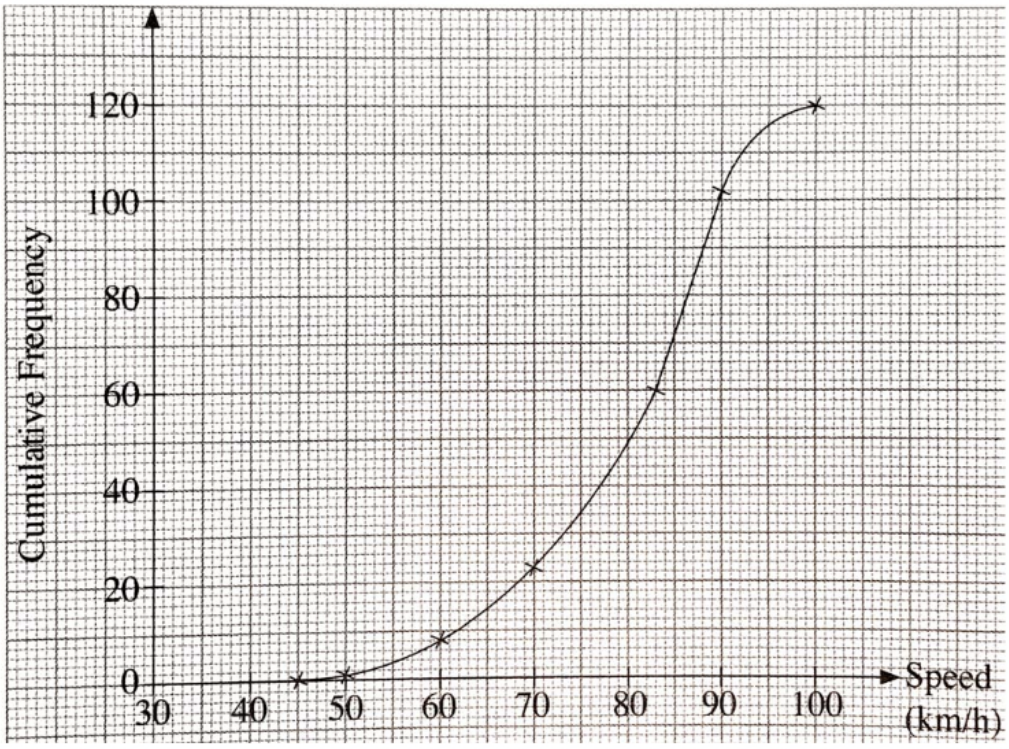
(i) both of them are from the Administrative Department [1]

(ii) at least one of them is from the Administrative Department [2]

(iii) one of them is a male employee from Farming and Outdoors Department and the other person is a female employee from Farming and Outdoors Department [2]

Credit: **S4 BGSS P2/2020 PRELIM Qn 4**

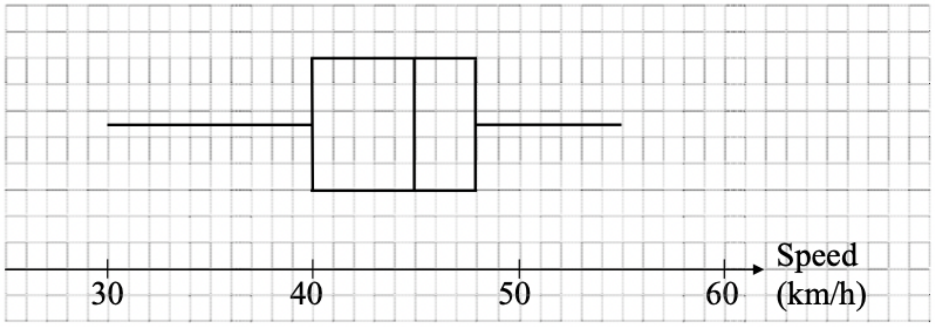
2. The diagram below shows the cumulative frequency curve of the speed of 120 cars passing through a certain point along an expressway at 11 am



(a) Use your graph to find
  (i) the median speed [1]
  (ii) the interquartile range [2]

(b) A speed camera is located at the point. Calculate the percentage of cars that will be fined for speeding if the speed limit is 90 km/h

The box-and-whisker plot below shows the speed of another 100 cars along the same point of the expressway at 6.30pm

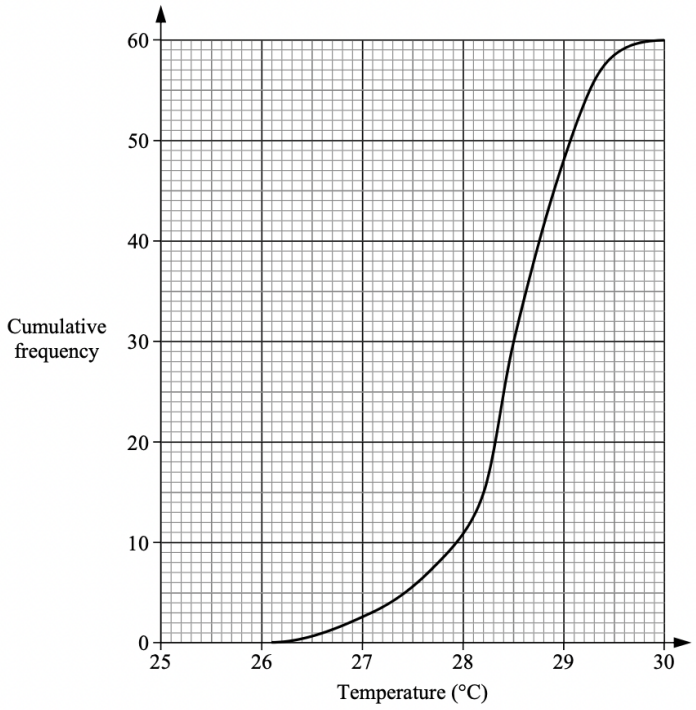


(c) Make 2 comparisons between the speeds of the cars at 11 am and 6.30pm [2]

(d) Suggest a reason for the difference in the speed of the cars measured along the same point of the expressway at 11am and 6.30pm [1]

Credit: **S4 BPGHS P2/2018 PRELIM Qn 7**

3. The temperature at Simei was recorded every day for 60 days. The cumulative frequency curve below shows the distribution of the temperatures



(a) Use the curves to estimate
  (i) the median temperature [1]
  (ii) the interquartile range of the temperatures [2]

(b) Estimate the number of days that had temperatures above 29°C [1]

The temperature at Jurong was recorded every day for the same period. The interquartile range of the temperatures at Jurong is 1.5°C

(c) Make a comment comparing the temperatures at Simei and Jurong [1]

(d) The temperatures at Jurong are converted to degrees Fahenheit °F using the formula [1]

$$\text{temperature in } °\text{F} = 1.8 \times (\text{temperature in } °\text{C}) + 32$$

Find the interquartile range, in °F, of the converted temperatures

Credit: **S4 CHIJ KC P2/2018 PRELIM Qn 9(a)**

4. The table below summarises the heights of 200 trees in Rainforest A

Height h metres	$0 \leq h < 10$	$10 \leq h < 20$	$20 \leq h < 30$	$30 \leq h < 40$	$40 \leq h < 50$
Frequency	10	25	80	65	20

(a) Calculate an estimate of

(i) the mean height [1]

(ii) the standard deviation [1]

(b) The mean height of another 200 trees in Tropical Forest B was 20.1 metres and the standard deviation was 4.53 metres. Use this information to comment on two differences between the heights of the trees in the two forests [2]

(c) A tree was selected at random from Rainforest A. Find, as a fraction in its lowest terms, the probability that its height is

(i) 40 metres and above [1]

(ii) below 30 metres [1]

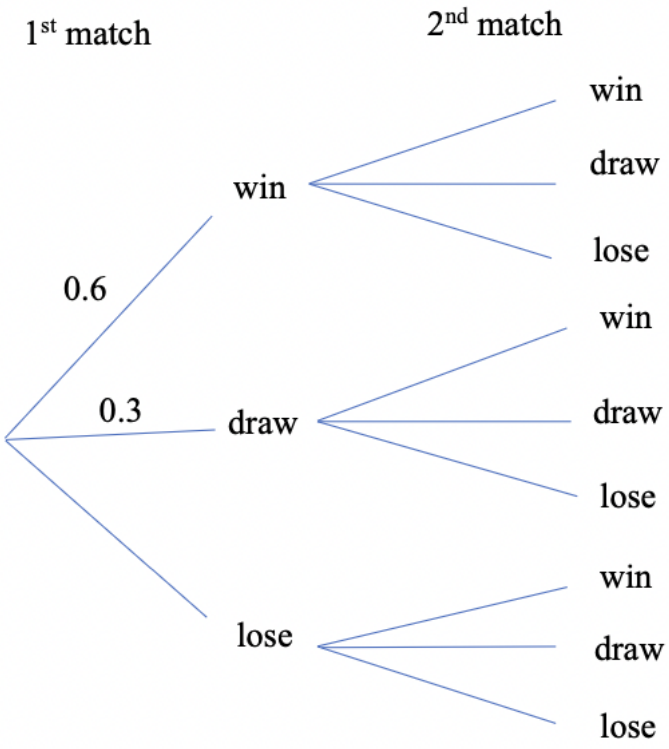
(d) Two trees are selected at random. Find the probability that **both** trees will be less than 20 metres. Give your answer as a decimal correct to 3 significant figures [2]

Credit: **S4 CCHS(M) P2/2018 PRELIM Qn 9**

19 Probability

1. (a) A football team takes part in 2 matches to qualify for the next round. The probability that the team wins is 0.6. The probability that the team draws is 0.3

(i) Complete the tree diagram below [2]



(ii) To qualify for the next round, the team needs at least a win and a draw. Find the probability that the team will qualify for the next round [2]

(b) A bag contains 2 red buttons and x yellow buttons. Two buttons are chosen at random, one after another, without replacement. The probability that both buttons chosen are red is $\frac{1}{10}$. Find x [4]

Credit: **S4 QSS P2/2020 PRELIM Qn 5**

2. A drawer contains 2 blue socks and 6 white socks. Two socks are taken from the drawer at random without replacement. If the two socks are different colours, then a third sock is taken from the drawer. Otherwise, no third sock is taken

(a) Draw a tree diagram to show the probabilities of the possible outcomes [3]

(b) Find, as a fraction in its simplest form, the probability that

(i) the first 2 socks taken are white [1]

(ii) a third sock is taken and it is the same colour as the first sock [2]

Credit: **S4 CHIJ KC P2/2018 PRELIM Qn 9(b)**

3. A bag contains four balls, numbered 2, 3, 6 and 9. Two balls are picked from the bag at random, one after another, without replacement
   (a) Draw a possibility diagram to represent the outcomes [2]
   (b) Find, in its simplest form, the probability that
      (i) both balls have numbers less than 6 [1]
      (ii) both balls are odd numbers [1]
      (iii) the product of the numbers is more than 10 [1]
   (c) The two balls are now picked from the bag, one after another, with replacement. Ken claims that "the probability that the product of the numbers is more than 10 has increased because there are more favourable outcomes." [2]
   Do you agree? Justify by showing your calculations

   Credit: **S4 HIHS P2/2020 PRELIM Qn 1**

4. A driving theory test is set every month. John takes the test each month until he passes. Each time he takes the test, the probability he passes is 0.9. Find the probability that John
   (a) passes on his second attempt [1]
   (b) takes at least 2 attempts to pass the test [1]
   (c) fails the first n test [1]
   (d) passes the test in one of the first n months [1]

   Credit: **S4 CWSS P1/2018 PRELIM Qn 15**

