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ST. MARGARET'S SECONDARY SCHOOL
Preliminary Examinations 2020

CANDIDATE NAME

CLASS

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REGISTER NUMBER

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MATHEMATICS**4048/01**

Paper 1

17 August 2020

Secondary 4 Express / 5 Normal (Academic)

2 hours

Additional Materials: NIL

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

You may use a soft pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, 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. 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.

The total number of the marks for this paper is 80.

For Examiner's Use

This document consists of 20 printed pages.

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

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

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

- 1 (a) Arrange the following in ascending order.

$$0.3^2, \sqrt{2}, \frac{1}{\pi}, 1.34\%$$

Answer (a) _____ [1]

- (b) Find the difference between $\sqrt{0.25}$ and $\frac{12}{25}$. Express your answer as a fraction in its simplest form.

Answer (b) _____ [1]

- 2 (a) Simplify $\left(\frac{y^3}{6x}\right)^{-1} \times (xy^2)^2$

Answer (a) _____ [2]

- (b) Given that $2^x = 5$, find the value of

(i) 8^x ,

Answer (b)(i) _____ [1]

(ii) 2^{1-x} .

Answer (b)(ii) _____ [1]

- 3 (a) Express 198 as a product of its prime factors.

Answer (a) _____ [1]

- (b) Given that x and 198 have a lowest common multiple of 990 and highest common factor of 18, find x .

Answer (b) $x =$ _____ [2]

- 4 Factorise the following completely

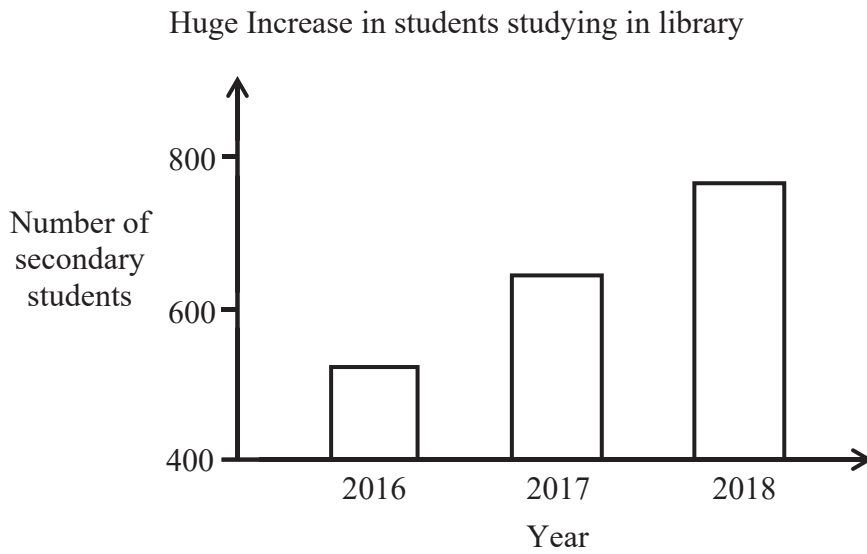
(a) $2 - x - 6x^2$,

Answer (a) _____ [1]

(b) $9x^2y - 3xy - 3x + 1$.

Answer (b) _____ [2]

- 5 The graph below shows the number of secondary school students studying in the library between 2016 and 2018.



- (a) State one way in which the graph is misleading and explain why it is misleading.

Answer _____

[1]

- (b) Do you agree that the percentage of secondary school students studying in the library has been increasing between years 2016 to 2018?

Explain your answer.

Answer _____

[2]

6 It is given that

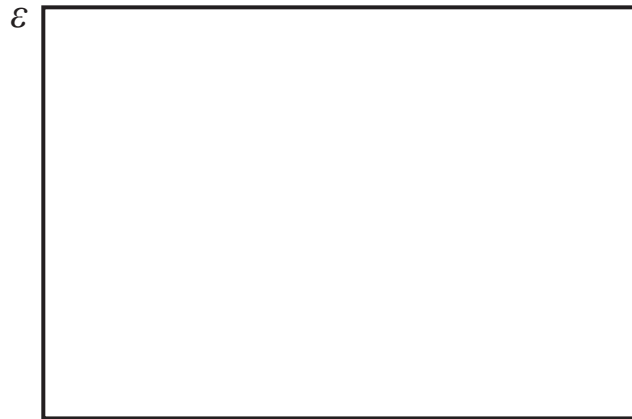
$$\varepsilon = \{x : x \text{ is an integer and } 0 < x \leq 10\},$$

$$A = \{x : x \text{ is the root of the equation } (x - 5)(x + 4) = 0\},$$

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

(a) Complete the Venn diagram below to illustrate the above information.

[2]



(b) (i) List the elements of the set B' .

Answer (b)(i) $B' =$ _____ [1]

(b) (ii) List the elements of the set $A' \cap B$.

Answer (b)(ii) $A' \cap B =$ _____ [1]

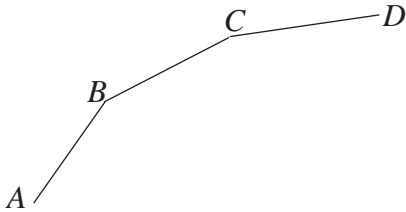
- 7 Given that p is directly proportional to $(x + 2)$ and $p = 15$ when $x = 1$.
- (a) Express p in terms of x .

Answer (a) $p =$ _____ [2]

- (b) Find the range of values of x for which $5 \leq p \leq 25$.

Answer (b) _____ [2]

- 8 AB , BC and CD are adjacent sides of a regular 18-sided polygon.



Find

- (a) angle ABC ,

Answer (a) _____[°] [1]

- (b) angle ACB .

Answer (b) _____[°] [1]

- 9 The scale of a map is 8 cm : 2 km.
(a) Write this scale in the form 1 : n .

Answer (a) 1 : _____ [1]

- (b) A sports complex is represented by an area of 58cm^2 on the map. Calculate the actual area of the sports complex in square kilometres.

Answer (b) _____ km^2 [2]

- 10 $\sqrt{4x^2 - y} = 2x - 3$
Rearrange the formula to make x the subject.

Answer $x =$ _____ [3]

- 11** The graph of the function $y = ax^2 + bx + c$ passes through the points (2, 4) and (1, 0). The y -intercept of the graph is -2 .
- (a)** Find the values of a , b and c .

Answer (a) $a = \underline{\hspace{2cm}}$, $b = \underline{\hspace{2cm}}$, $c = \underline{\hspace{2cm}}$ [4]

- (b)** Find the coordinates of the turning point of the graph by completing the square.

Answer (b) ($\underline{\hspace{2cm}}$, $\underline{\hspace{2cm}}$) [2]

- 12 (a) Given that $1.8 : x = \frac{1}{8} : \frac{8}{9}$, find the value of x .

Answer (a) $x =$ _____ [1]

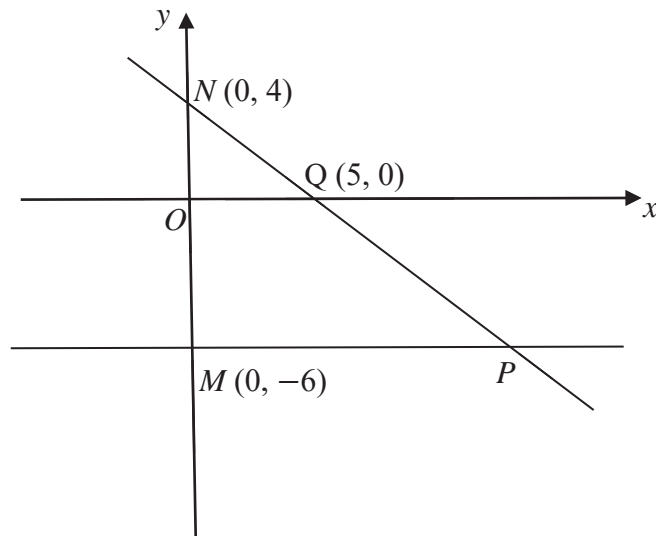
- (b) Bacteria in a petri dish multiply at a rate of 9.5 % per hour. At 1 pm, the population of bacteria in the petri dish was 3800.
Find the population of bacteria at 2 pm.

Answer (b) _____ [2]

- (c) The marked price of a watch is \$8000. If the watch is sold at the marked price, the retailer gains a profit of 60%. Find the retailer's profit if he sells it at a discount of 20% of the marked price.

Answer (c) \$ _____ [2]

- 13 In the diagram, M is the point $(0, -6)$ and N is the point $(0, 4)$.
The line MP is parallel to the x -axis and line NP cuts the x -axis at $Q(5, 0)$.



- (a) State the equation of line MP .

Answer (a) _____ [1]

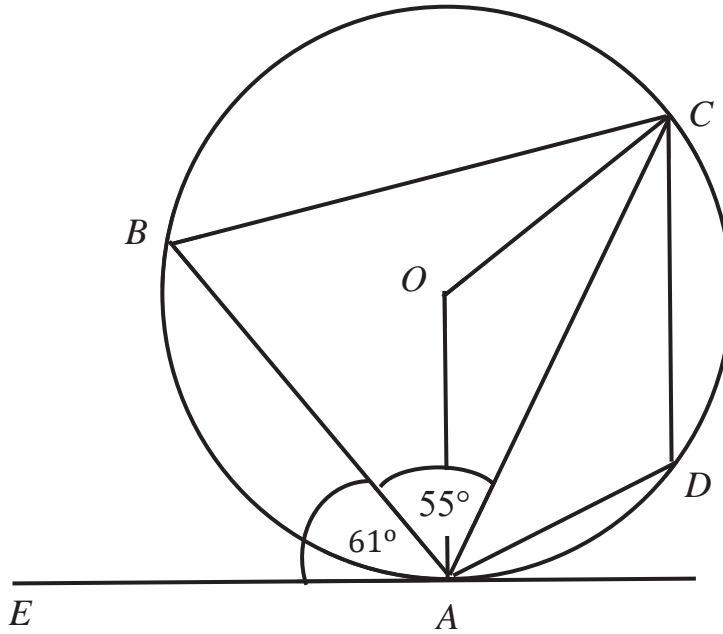
- (b) Find the equation of line NP .

Answer (b) _____ [2]

- (c) Find the coordinates of P .

Answer (c) (_____, _____) [2]

- 14 The diagram shows a circle, $ABCD$, with centre O . EA is a tangent to the circle. Angle $BAE = 61^\circ$ and angle $BAC = 55^\circ$.



Find,

(a) angle BAO ,

Answer (a) _____ $^\circ$ [1]

(b) angle AOC ,

Answer (b) _____ $^\circ$ [2]

(c) angle ABC ,

Answer (c) _____° [1]

(d) angle CDA .

Answer (d) _____° [1]

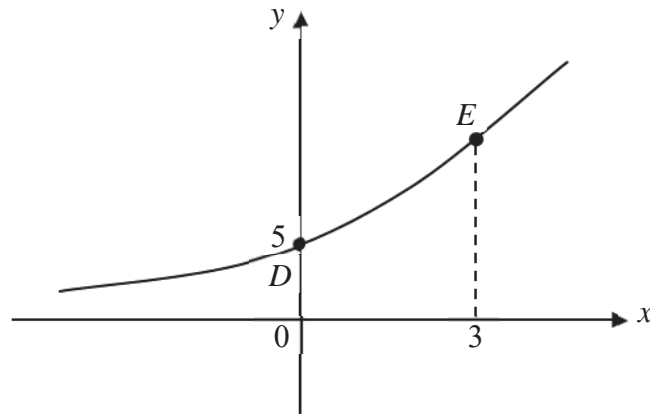
- 15** Two similar solid cones made of the same material have volumes 216 cm^3 and 343 cm^3 .
Given that the base radius of the larger cone is 14 cm, find
- (a) the base radius of the smaller cone,

Answer (a) _____ cm [2]

- 15 (b) the ratio surface area of the smaller cone : surface area of the larger cone, giving your answer to the lowest term.

Answer (b) _____ : _____ [1]

- 16 The sketch shows the graph of $y = 2^x + h$. The graph cuts the y-axis at D , and E is on the graph where $x = 3$.



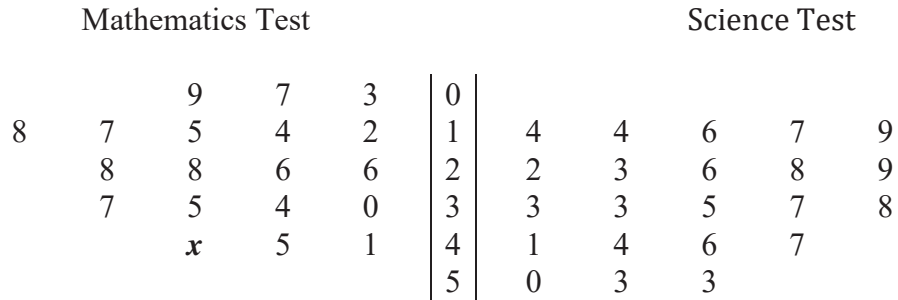
- (a) Find the value of h .

Answer (a) $h =$ _____ [1]

- (b) Find the y-coordinate of point E .

Answer (b) _____ [1]

- 17 The results of 19 students in a Mathematics test and 22 students in a Science test are shown in the stem-and leaf diagram.



Key : 2 | 1 | 4 means a mark of 12 for Mathematics test and a mark of 14 for Science test.

- (a) Write down the median mark for the Science test.

Answer (a) _____ [1]

- (b) The range of the marks for Mathematics test is 43. Find the value of *x*.

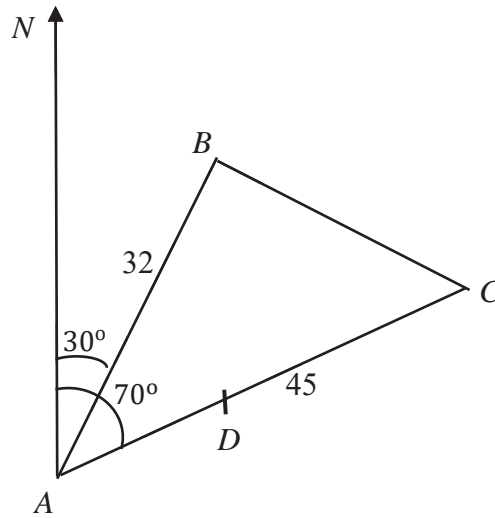
Answer (b) _____ [1]

- (c) The two statements below compare the Mathematics test and the Science test. For each statement, write whether you agree or disagree, giving a reason for each answer.

Statement	Agree/Disagree	Reason
The students performed better in the Mathematics test than in the Science test.		
The students' performance is more consistent in the Mathematics test than in the Science test.		

[2]

- 18 In the diagram, A , B and C represent three buildings. B is 32 km from A on a bearing of 030° and C is 45 km from A on a bearing of 070° .



- (a) Calculate the bearing of A from B .

Answer (a) _____ $^\circ$ [1]

- (b) Calculate the distance of C from B .

Answer (b) _____ km [3]

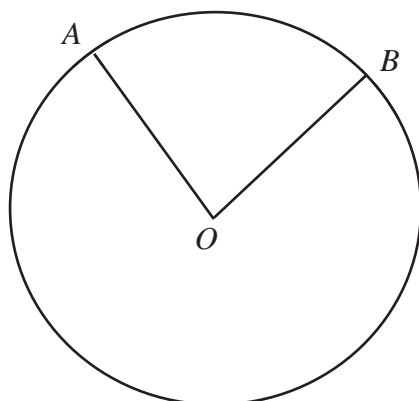
- (c) A cyclist leaves A at 12.40 pm and cycled directly to D at a steady speed of 10 km/h.
- (i) When the cyclist is at D which is due south of B , calculate the distance AD .

Answer (c)(i) _____ km [2]

- (ii) Hence, find the time, to the nearest minute, at which the cyclist reaches D .

Answer (c)(ii) _____ [2]

- 19 In the figure, the area of the minor sector AOB is $\frac{11}{48}$ of the area of the circle.



- (a) Show that angle $AOB = 1.4399$ radians.

[1]

- (b) Given that the area of the minor sector OAB is 39 cm^2 , find the radius of the circle.

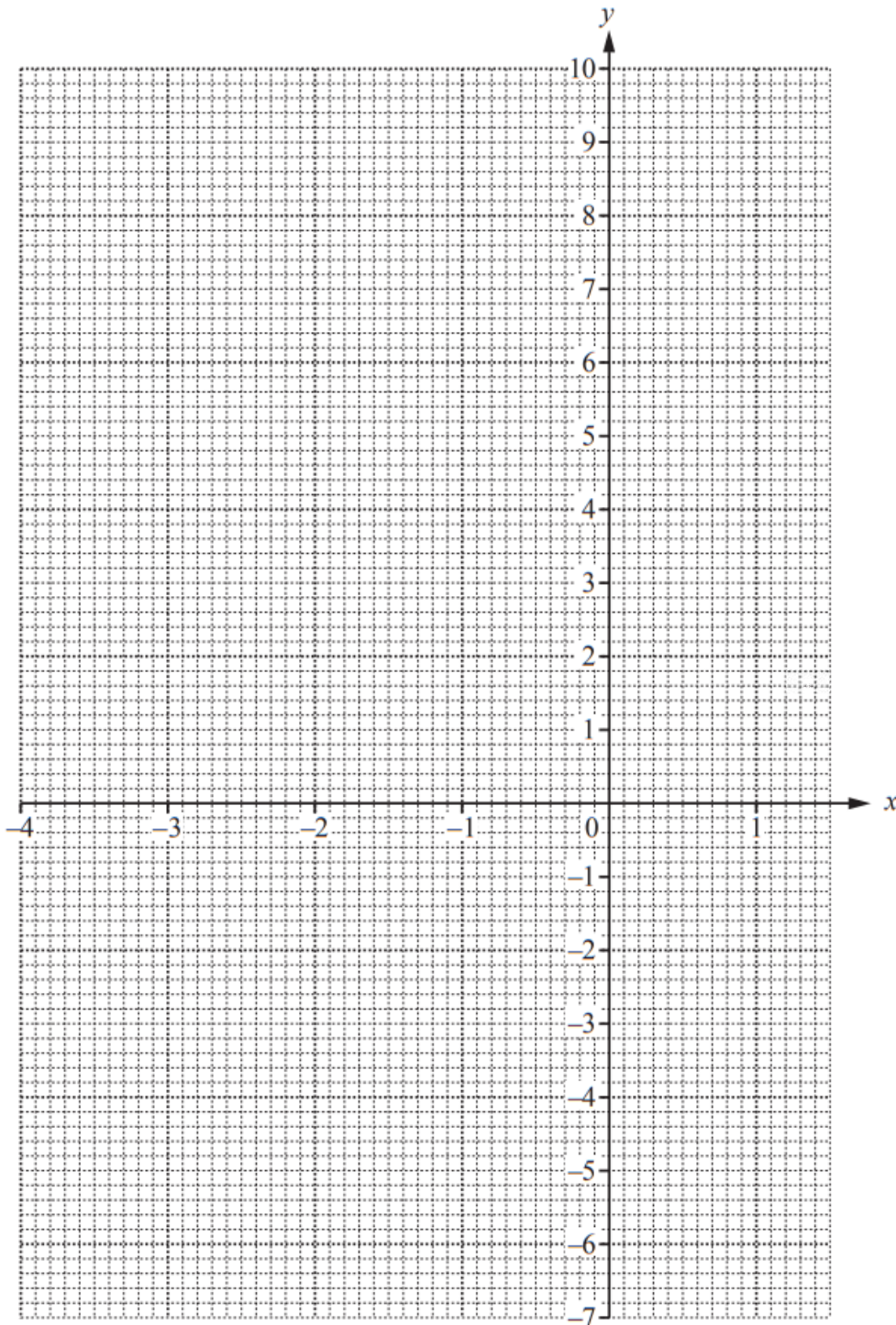
Answer (b) _____ cm [2]

20 The table shows some values of $y = 2x^2 + 5x - 3$ for $-4 \leq x \leq 1.5$.

x	-4	-3	-2	-1	0	1	1.5
y	9	0	-5		-3	4	9

(a) Complete the table. [1]

(b) On the grid, draw the graph of $y = 2x^2 + 5x - 3$ for $-4 \leq x \leq 1.5$. [2]



- (c) Explain why the equation $2x^2 + 5x - 3 = k$ does not have solutions for some values of k .

[1]

- (d) The equation $2x^2 + 3x - 7 = 0$ can be solved by drawing a suitable straight line on the grid.

- (i) Find the equation of the straight line.

Answer (d)(i) _____ [1]

- (ii) By drawing this straight line, solve the equation $2x^2 + 3x - 7 = 0$

Answer (d)(ii) $x =$ _____ or _____ [3]



ST. MARGARET'S SECONDARY SCHOOL

Preliminary Examinations 2020

CANDIDATE NAME

CLASS

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REGISTER NUMBER

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MATHEMATICS

4048/02

Paper 2

19 August 2020

Secondary 4 Express / 5 Normal (Academic)

2 hours 30 minutes

Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

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Write in dark blue or black pen.

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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 100.

This question paper consists of **28 printed pages** including 1 graph paper & 2 black pages.

Mathematical Formulae

Compound Interest

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

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Statistics

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

Answer **all** the questions.

1 (a) Solve the equation $\frac{2}{8+a} = \frac{3}{4-5a}$.

Answer: _____ [2]

(b) Simplify $\frac{9x^2-1}{9x} \times \frac{xy}{3xy-y}$.

Answer: _____ [3]

- 1 (c) Make y the subject of the formula $r = \frac{x(y^2 + 5)}{3}$.

Answer: _____ [3]

- (d) Given that $q - \frac{p}{q} = 47$, find the value of $\sqrt{\frac{q^2 - p + 2q}{q}}$.

Answer: _____ [3]

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,

Answer: \$ _____ [1]

(ii) the hire purchase price,

Answer: \$ _____ [2]

(iii) the amount of each monthly instalment.

Answer: \$ _____ [1]

- 2 (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 three years. He computed the amount he has at the end of three years using the computation below.

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

Identify and explain the mistakes in his computation.

[2]

- (ii) Write down the correct computation of the total amount he has in the bank at the end three years in term of x .

Answer: _____ [1]

- (iii) Given that Roland has \$12 533 in the bank at the end of three years, find the amount he invested. Give your answer correct to the nearest dollar.

Answer: \$ _____ [1]

- (iv) Roland is wondering if he should have chosen to invest the same amount for three 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]

- 3 Three brands of tennis shoes, Ace, Niks and Wils, are sold at two stores, Joe Sporting House and Mikasa Sports.

The following table shows the price of each brand at the two stores.

Brand	Price of one pair of shoes (\$)	
	Joe Sporting House	Mikasa Sports
Ace	159	175
Niks	230	215
Wils	205	223

- (a) Represent the information in the above table by a 3×2 matrix **A**.

Answer: _____ [1]

A tennis club manager plans to order 8, 25 and 12 pairs of shoes of brands Ace, Niks and Wils respectively. She can enjoy free delivery of the shoes if she orders from the same store.

- (b) Write down a 1×3 matrix **P** to represent the orders.

Answer: _____ [1]

- (c) Evaluate the matrix **C**, where $\mathbf{C} = \mathbf{PA}$.

Answer: _____ [1]

(d) Explain what the elements in **C** represent.

[1]

(e) Both stores, Joe Sporting House and Mikasa Sports are offering a discount of 10% and 15% discounts respectively.

(i) Write down a 2×2 matrix **Q** such that the matrix multiplication **AQ** give the discounted price of each brand of shoes from each store.

Answer: _____ [2]

(ii) Hence, using matrix multiplication, determine which store the manager should buy the tennis shoes from.

Answer: _____ [4]

- 4 (a) These are the first four terms in a sequence.

23 31 39 47

- (i) Find an expression, in terms of n , for the n th term of the sequence.

Answer: _____ [1]

- (ii) Explain why it is not possible for a term in the sequence to be a multiple of 4.

Answer: _____ [1]

- (b) The n th term of a different sequence is given by $T_n = \frac{3n+8}{108-2n}$.

- (i) Find T_4 .

Give your answer as a fraction.

Answer: _____ [1]

- (ii) The value of T_k can be simplified to $\frac{7}{18}$.
Find the value of k .

Answer: _____ [2]

- (iii) Find the least value of n for which $T_n > 1$.

Answer: _____ [2]

- 5 The variables x and y are connected by the equation $y = \frac{3}{2}x^2 - \frac{1}{2}x^3$.

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

x	-2	-1	0	1	2	2.5	3	4
y	10	p	0	1	q	1.56	0	-8

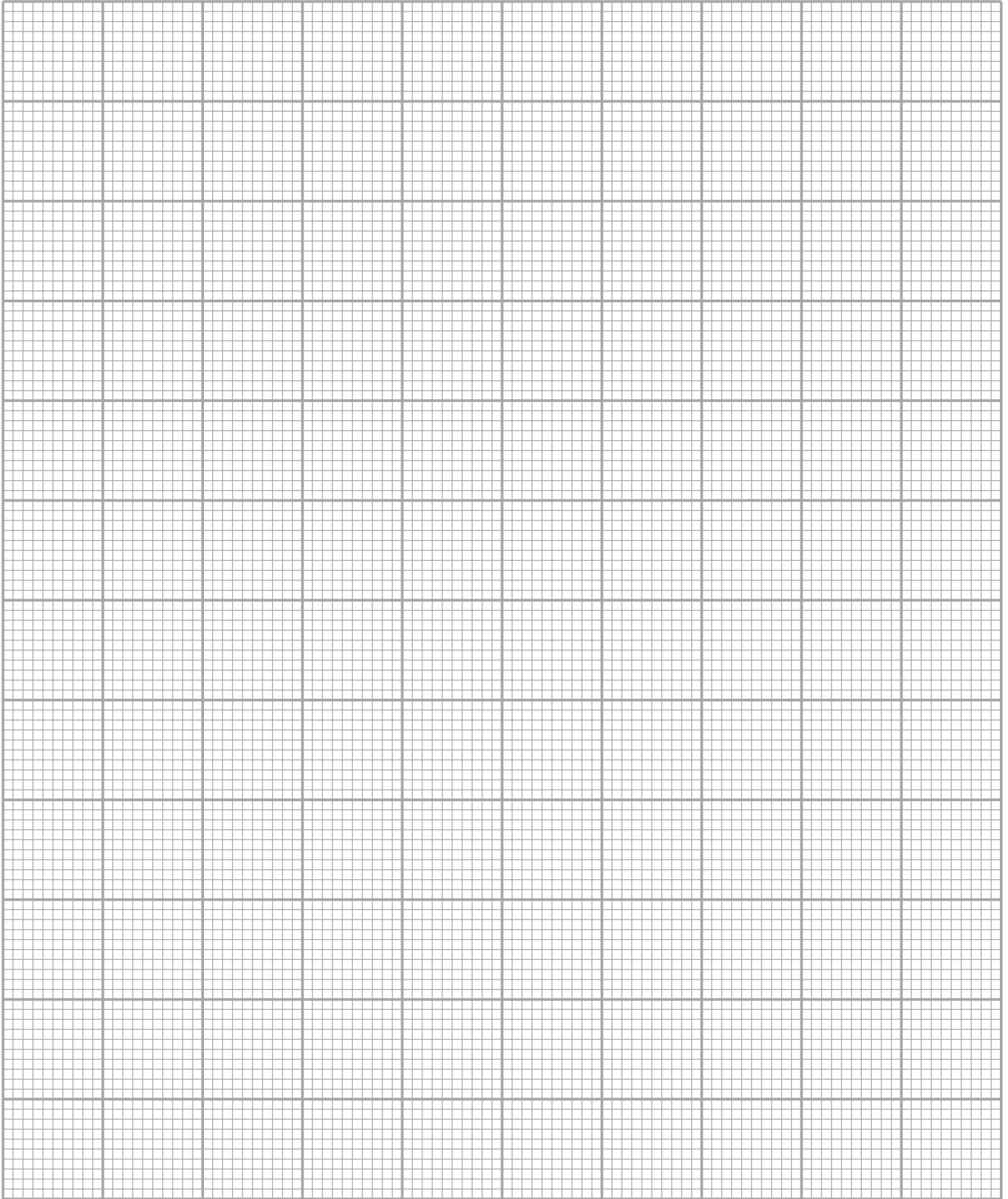
- (a) Find the value of p and of q .

Answer: $p =$ _____, $q =$ _____ [2]

- (b) On the graph paper provided on the next page, draw the graph of $y = \frac{3}{2}x^2 - \frac{1}{2}x^3$ using a scale of 2 cm to represent 1 unit for the x -axis, for $-2 \leq x \leq 4$ and a scale of 1 cm to represent 1 unit for the y -axis. [3]

- (c) By drawing a tangent, find the gradient of the curve at $x = 2.5$.

Answer: _____ [2]



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- 5 (d) (i) On the same axes, draw the line with gradient 2 that passes through the point (3, 4). [1]

- (ii) Write down the equation of this line.

Answer: _____ [1]

- (iii) The x -coordinate of the point where this line intersects the curve is the solution of the equation $x^3 + Ax^2 + Bx - 4 = 0$.
Find the value of A and of B .

Answer: $A =$ _____ , $B =$ _____ [2]

- 6 Issac travelled by bicycle from Town A to Town B . He travelled a distance of 100 km at an average speed of x km/h on his journey from Town A to Town B .
- (a) Write down an expression for the time taken in hours, in terms of x .

Answer: _____ h [1]

- (b) On the return journey, his average speed was reduced by 10 km/h.
Write down an expression for the time taken in hours, in terms of x .

Answer: _____ h [1]

- (c) Given that he took 30 minutes more for his return journey than his journey from Town A to Town B , form an equation in x and show that it reduces to $x^2 - 10x - 2000 = 0$. [3]

6 (d) Solve the equation $x^2 - 10x - 2000 = 0$.

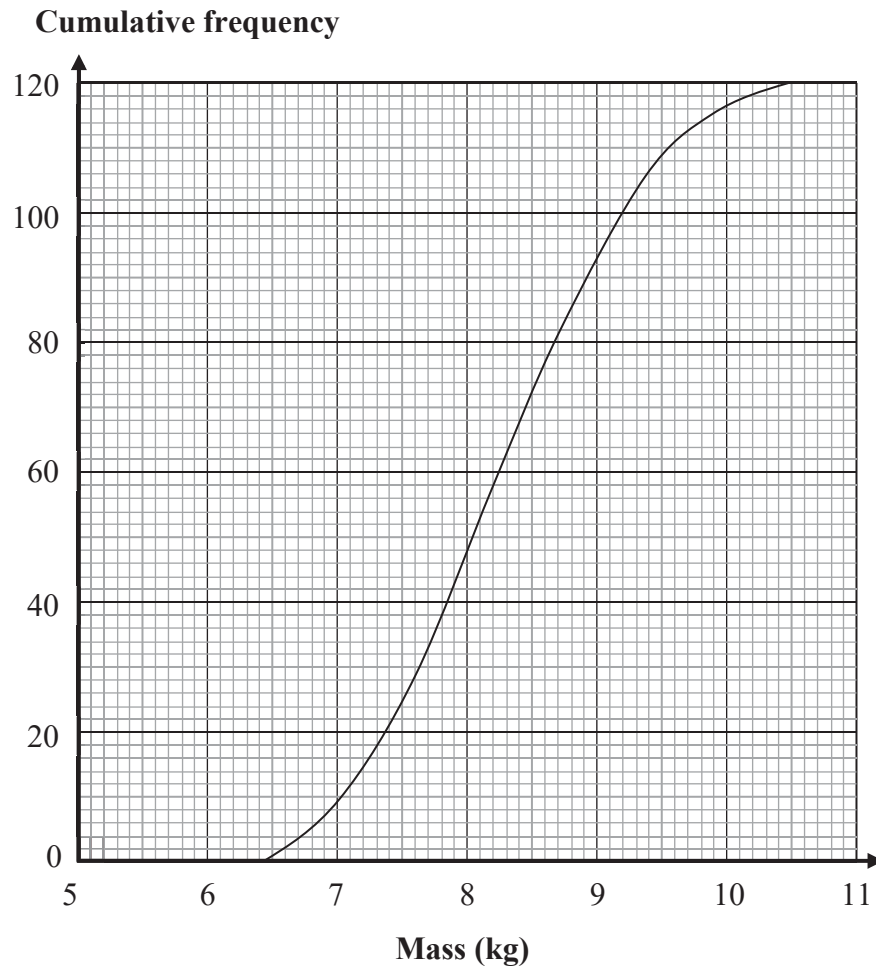
Answer: $x =$ _____ [2]

(e) Hence or otherwise, find the time taken in hours for the return journey.

Answer: _____ h [2]

- 7 The mass of 120 9-month old infants are recorded.

The cumulative frequency curve below shows the distribution of the masses.



- (a) (i) Complete the following grouped frequency table for the masses of the infants.

Mass (m kg)	$6 \leq m < 7$	$7 \leq m < 8$	$8 \leq m < 9$	$9 \leq m < 10$	$10 \leq m < 11$
Frequency	9			23	4

[2]

- (ii) Calculate an estimate of the mean mass.

Answer: _____ kg [1]

- (iii) Calculate an estimate of the standard deviation.

Answer: _____ kg [1]

(iv) Explain why the mean and standard deviation are estimates. [1]

(v) A 9-month old infant is considered obese if the infant's mass is above 9.2kg. Daniel claims that his 9-month old infant's mass is at the 90th percentile. Determine if Daniel's infant is obese. [2]

(b) The table below shows information of a group of 9-month old infants and the brand of milk powder they were fed.

	<i>Brand A</i>	<i>Brand B</i>
Not Obese	10	15
Obese	8	14

(i) One of these infants is selected at random. Find, as a fraction in its lowest terms, the probability that the infant is not obese.

Answer: _____ [1]

(ii) Two of the infants are selected at random.

Find the probability that,

(a) they both consume milk powder from *Brand A*,

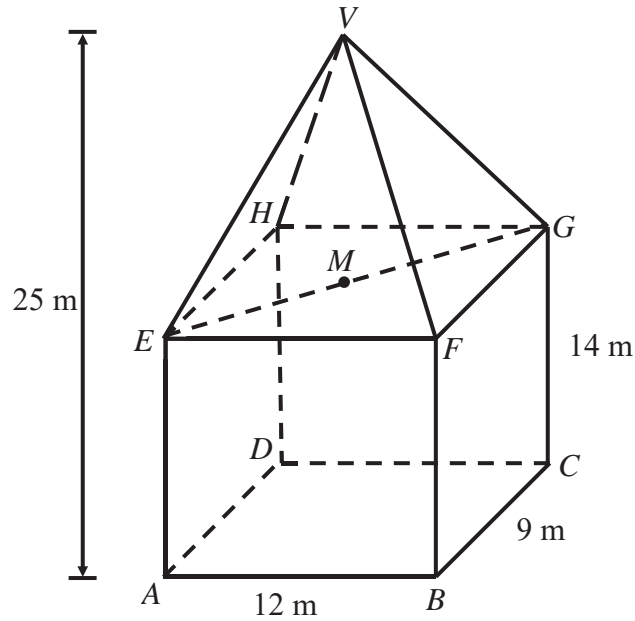
Answer: _____ [2]

(b) they are both obese, but only one consume milk powder from *Brand B*.

Answer: _____ [2]

- 8 The diagram of a building is shown below. It is 25 m tall. $ABCD$ represents the rectangular floor of the building. E, F, G and H are vertically above A, B, C and D respectively. V represents the vertex of the roof in the shape of a pyramid. M is the midpoint of EG and V is vertically above M .

It is given that $AB = 12$ m, $BC = 9$ m and $CG = 14$ m.



- (a) Show that $VG = 13.3$ m, correct to 3 significant figures.

[3]

(b) Calculate angle EVF .

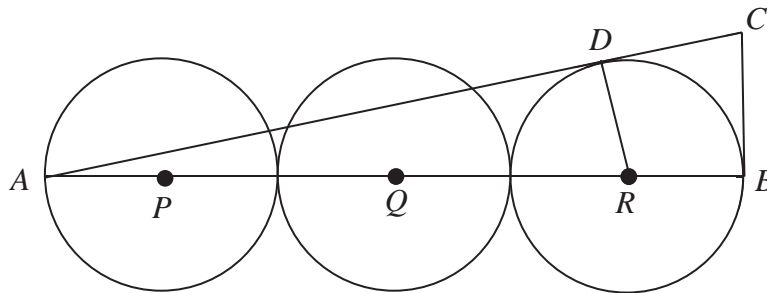
Answer: _____ ° [3]

(c) Calculate the total surface area of the building.

Answer: _____ m² [4]

- 9 Three congruent circles with centre P , Q and R are arranged such that they are just touching each other, as shown in the diagram.

The lines AC and BC are tangent to the circle with centre R .



- (a) Explain why triangle ABC is a right-angled triangle. [1]

- (b) State the size of angle ADR .

Answer: _____° [1]

- (c) Show that triangle ADR is similar to triangle ABC . [2]

- (d) Given that the length of AR is 24 cm, find the area of the quadrilateral $RBCD$.

Answer: _____ cm^2 [5]

10 Howard runs a small online business which prints customized corporate polo tee-shirts.

A cotton polo tee-short weights approximately 150 grams and a dri-fit polo tee-shirt weighs approximately 135grams.

A customer can choose to print the customized corporate polo tee-shirt in colour or in black and white.

Each polo tee-shirt is sealed in a plastic packaging before it is being delivered by a courier service.

Information regarding the cost and printing of the polo tee-shirts and courier service can be found below.

Courier Services (inclusive of 7% GST)			
Weight	Standard Delivery (1 – 3 days)	Express Delivery (The next day)	Time-Slot Delivery (9am-12pm, 12pm – 3pm, 3pm – 6pm, *6pm – 10pm)
0 – 4 kg	\$5	\$7	\$10
4.1 – 10 kg	\$9	\$11	\$14
10.1 – 20 kg	\$14	\$16	\$19
20.1 – 30 kg	\$20	\$22	\$25
30.1 – 40 kg	\$28	\$32	\$40
*Additional \$5 applies for time-slot delivery between 6pm – 10pm			

Polo tee-shirt supplies (costs excluding 7% GST)		
Item	Description	Unit cost
Polo tee-shirt	Cotton	\$8
	Bulk price (100 pieces)	\$740
	Dry-Fit	\$11
	Bulk price (100 pieces)	\$1030
Fabric printing Cartridge	Black and White printing Average yield 70 tee-shirts	\$150
	Colour printing Average yield 50 tee-shirts	\$240
Packaging	Plastic Sheet Cover	\$0.25
	Bulk price (50 pieces)	\$11

- (a) How much is the courier service for 20 cotton polo tee-shirts if the order was to be delivered the next day?

Answer: \$ _____ [2]

- (b) There is an order for 100 cotton polo tee-shirts with black and white printing that is to be delivered at a timing between 6pm – 10pm specifically.
Find the total cost price of producing, packaging and delivering the polo tee-shirts to the customer.

Answer: \$ _____ [3]

- (c) There is a quotation request for an order of 280 dry-fit polo tee-shirts with coloured printing. This order is to be delivered any time after the polo tee-shirts are ready.

Howard needs to decide how much he should charge the customer in order to make sure that he cover all the costs. As Howard has decided to stop printing dry-fit polo tee-shirts, he needs to ensure that there are no excess dry-fit polo tee-shirts left.

Suggest a sensible amount for Howard to charge each dry-fit polo tee-shirt.

Justify the decision you make and show your calculations clearly.

[6]

