AHMAD IBRAHIM SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2022

SECONDARY 3 NORMAL (ACADEMIC)

Name:	Class:	Register No.:

MATHEMATICS SYLLABUS A **4045/01**
Paper 1 **28 September 2022**
2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

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

If working is needed for any questions it must be shown with the answer.
Omission of essential working will result in loss of marks.
The total number of marks for this paper is 70.

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.

For Examiner's Use
/ 70

Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone $= \pi rl$

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

1 By writing each value correct to 1 significant figure, **estimate** the value of

$$\frac{\sqrt{0.98\times109.12}}{3.695}.$$

Show your working.

Answer ..... [2]

---

2 Find the largest integer x satisfying $4x<13$.

Answer $x=$..... [2]

---

3 Two schools are 4.5 km apart.

The distance between the two schools on the map is 1.2 cm.

The map is drawn to a scale of $1:n$.

Find n.

Answer $n=$..... [2]

---

4 16 men can complete a project in 36 days.

If a project must be completed in 12 days, how many more men are needed?

Answer ..... [2]

---

5 In 2021, Andy's income was 4% more than his income in 2020.

His income in 2021 was \$15 600.

What was his income in 2020?

Answer \$ ..... [2]

---

6 Find the obtuse angle such that

(a) $\sin A^\circ = 0.9$,

Answer $A =$ .....[1]

(b) $\cos B^\circ = -0.5$.

Answer $B =$ ..... [1]

---

7 y is directly proportional to the cube of x.

(a) Given that $y = 54$ when $x = 6$, write a formula for y in terms of x.

Answer $y =$ ..... [2]

(b) Find y when $x = 2$.

Answer $y =$ ..... [1]

---

8 $b = \dfrac{2a}{w + a}$

(a) Find the value of b when $w = 3.15$ and $a = 0.45$.

Answer $b =$ ..... [1]

(b) Rearrange the formula to make a the subject.

Answer $a =$ ..... [2]

---

9 Write $\dfrac{3x-1}{2x^2-7x-15}-\dfrac{1}{x-5}$ as a single fraction in its simplest form.

Answer ..... [3]

---

10 **(a)** Simplify $\dfrac{27x^2y^3z}{81xy^3z^3}$.

Answer .....[1]

(b) Simplify $\dfrac{3m^2}{m^2-49}\div\dfrac{8m}{m+7}$.

Give your answer as a single fraction in its simplest form.

Answer ..... [2]

---

11 **(a)** Expand and simplify $2x(x-2y)-x(7y+x)$.

Answer ..... [2]

(b) Solve $2x^2+5x=0$.

Answer $x =$ ..... or $x =$ ..... [2]

---

12 **(a)** Evaluate $\left(\frac{64}{27}\right)^{-\frac{2}{3}}$.

Give your answer as a fraction.

Answer ..... [2]

(b) $32^{\frac{4}{5}} = 2^n$

Find the value of n.

Answer $n =$ ..... [2]

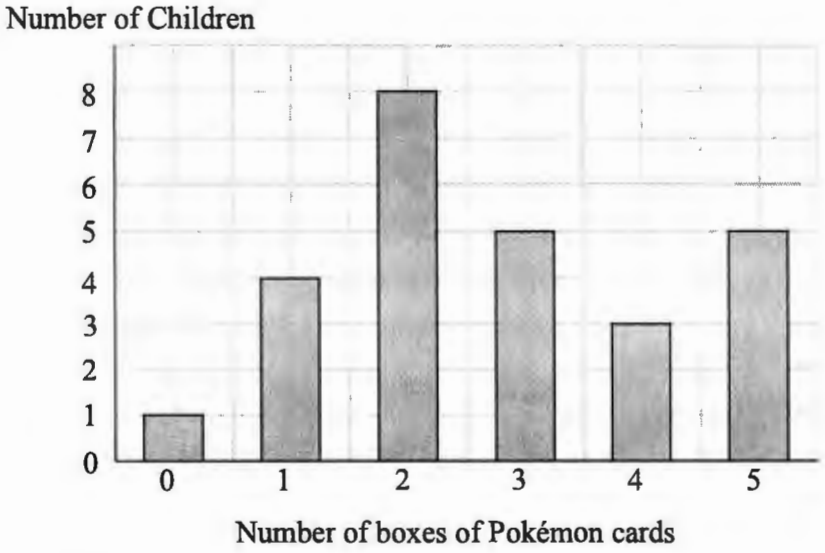
---

13 A is a point $(11,4)$ and B is the point $(2t,t)$. The gradient of AB is $\frac{1}{5}$.

Form an equation in t and solve for t to find the coordinates of B.

Answer (....., ...) [3]

14 The graph shows the number of boxes of Pokémon cards each child brings to school.



(a) What is the total number of children surveyed?

Answer ..... [1]

(b) What is the mean of number of boxes of Pokémon cards brought to school?

Answer ..... [2]

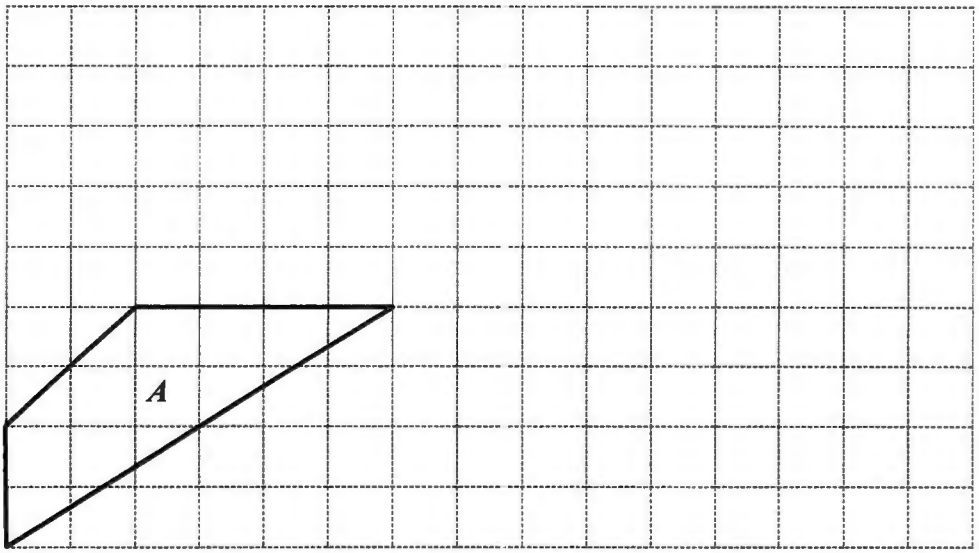
(c) Suggest another statistical diagram to represent the data.
Explain the advantage of the suggested statistical diagram.

Answer: .....

.....

..... [1]

15 **(a)** On the grid, draw an enlargement of the quadrilateral using a scale factor of $\frac{3}{2}$.



[2]

(b) Quadrilateral ***P*** is a reduction of quadrilateral ***A*** using a scale factor of x.
The longest side of quadrilateral ***P*** has length of 2.6 cm.
Write down the value of x?

Answer $x =$ ..... [1]

16 **(a)** Express 693 as a product of its prime factors.

Answer ..... [2]

(b) Given that $693n$ is a perfect square, find the smallest positive integer value of n.

Answer $n =$ ..... [1]

(c) $588 = 2^2 \times 3 \times 7^2$

Write down the lowest common multiple (LCM) of 588 and 693.
Give your answer as a product of its prime factors.

Answer ..... [1]

17 **(a)** These are first five terms of a sequence.

47 40 33 26 19

(i) Find the first negative term of this sequence.

Answer ..... [1]

(ii) Write an expression, in terms of n, for the nth term of this sequence.

Answer ..... [1]

(b) The nth term of another sequence is $2n^2 - 13n - 7$.

Determine if -25 is a term in this sequence.

Explain your answer clearly. [2]

Answer

18 **(a)** The point E has coordinates $(2,6)$.

The point F has the same y-coordinates as E and an x-coordinate 4 less than that of E.

(i) Find the coordinates of F.

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

(ii) State the equation of the line EF.

Answer ..... [1]

(b) The line l has equation $y=-2x+5$.

The point R lies on the line l.

Given that the x-coordinate of R is twice its y-coordinate, find the coordinate of R.

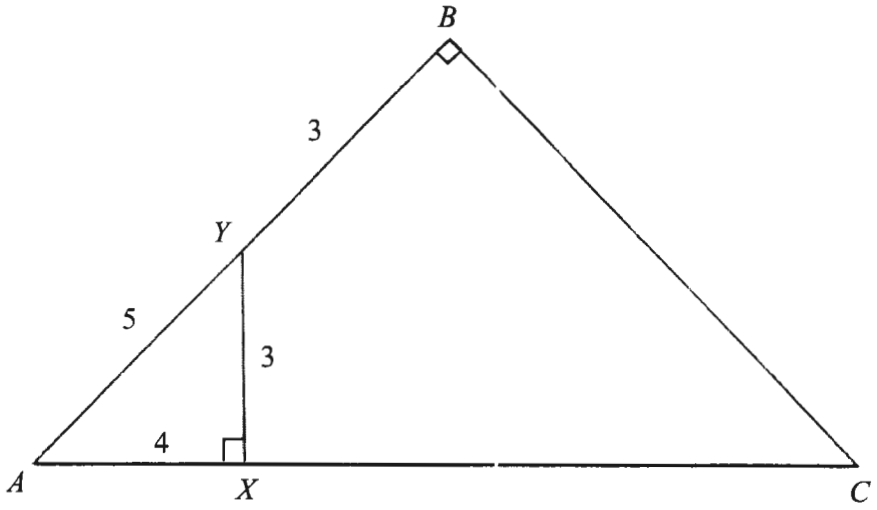
Answer (....., ...) [3]

(c) The equation of line p is $2y+4x=7$.

Show how you can tell that the line p does not intersect the line l. [2]

Answer

19



Triangle ABC is similar to triangle AXY.

$AX = 4$ cm, $XY = 3$ cm, $AY = 5$ cm and $YB = 3$ cm.

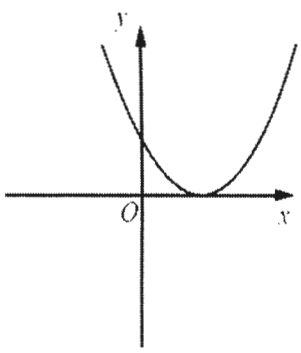
(a) Calculate the length of CX.

Answer $CX =$ ..... cm [2]

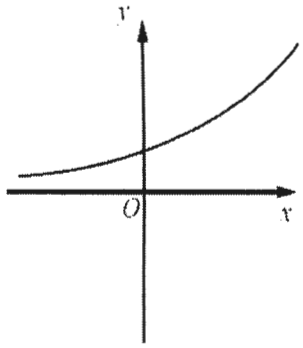
(b) Find the angle of ACB.

Answer Angle $ACB =$ ..... [2]

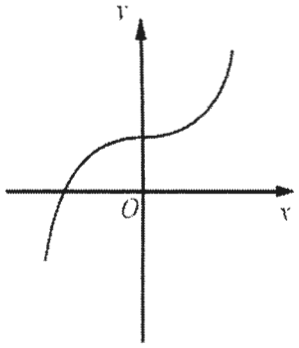
20



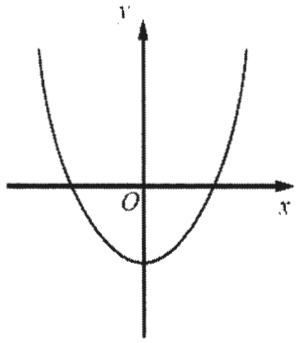
Graph 1



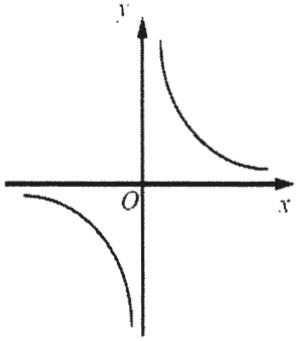
Graph 2



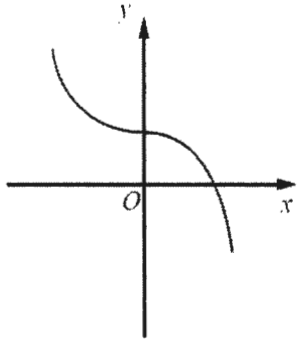
Graph 3



Graph 4



Graph 5



Graph 6

(a) Sketches of the graphs of some equations are drawn above.
State which of the graphs could be the graph of

(i) $y = \frac{1}{x}$,

Answer Graph ..... [1]

(ii) $y = 3^x$,

Answer Graph ..... [1]

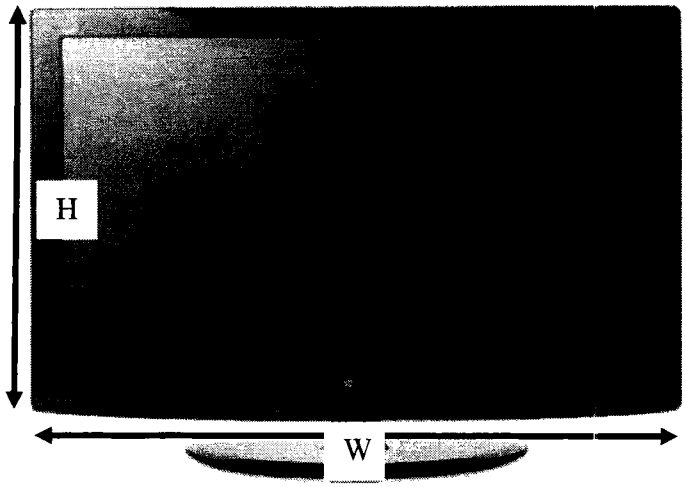
(iii) $y = 2x^2 - 5$,

Answer Graph ..... [1]

(b) Write down a possible equation for graph 3.

Answer ..... [1]

21



4K ULTRA HD
SMART OLED TV

Cash price: $3679.00

Dimensions (W x H):

1661mm x 935mm

(a) Mr Chua wants to buy a television set.

He pays a downpayment of $1000 and the remaining to be paid in monthly instalments over 2 years at a simple interest rate of 8.5%.

Calculate his monthly instalment.

Answer $..... [3]

(b) The size of the television in inches is based on the area of the screen.

The table shows the corresponding values of size of the television set and its area.

Mr Chua claims that the television set he bought is 70 inches.

Is Mr Chua correct?

Explain your answer with calculation.

Size (inch)	**Area (m^2) (corrected to 3 decimal places)**
50	0.689
55	0.835
60	0.992
65	1.166
70	1.349
75	1.553
80	1.763

Answer [2]

End of Paper

Setter: Mrs Silia Goh

AHMAD IBRAHIM SECONDARY SCHOOL
END-OF-YEAR EXAMINATION 2022

SECONDARY 3 NORMAL (ACADEMIC)

Name:	Class:	Register No.:

MATHEMATICS **4045/02**
Paper 2 **29 September 2022**
2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on a l the work you hand in.
Write in dark blue or black pen.
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For Examiner's Use
/70

Mathematical Formulae

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Statistics

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

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

Answer **all** questions.

1 **(a)** Simplify $(3x)^0 \times \left(x^2 y^{-5}\right)^{-1}$.

Answer ..... [2]

(b) Simplify $\left(\frac{9x^6y^4}{x^2y^4}\right)^{\frac{1}{2}}$.

Answer .....[2]

2 The table shows the approximate population of the world in the past centuries.

Year	World population
1600	5.54×10^7
1700	6.03×10^8
1800	9.90×10^8
1900	1.65×10^9
2000	6.14×10^9

(a) Calculate the percentage increase in population from 1700 to 1800.

Answer .....% [2]

(b) Calculate the number of times that the population in 2000 is as large as that in 1600.
Give your answer in standard form.

Answer ..... [2]

---

3 **(a)** Use factorisation to solve $2x^2 + 5x - 3 = 0$.
Show your working.

Answer $x =$ ..... or $x =$ .....[3]

(b) The following shows a wrong solution.

$$10y^2 + 15y = 0$$
$$2y + 3 = 0$$
$$y = -1.5$$

Explain why the solution is wrong.

Answer .....

.....[1]

---

4 $x^2 - 8x - 12 = (x + a)^2 + b$.

(a) Find a and b.

Answer $a =$ ..... or $b =$ ..... [3]

(b) Hence solve $x^2 - 8x - 12 = 0$, giving your answers correct to 2 decimal places.

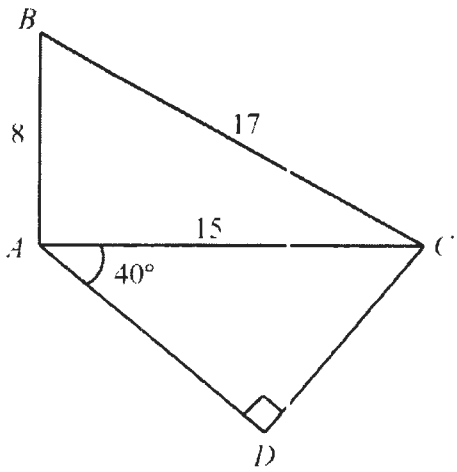
Answer $x =$ ..... or $x =$ ..... [2]

---

5 Solve $\frac{2}{x-3} - \frac{1}{2x+1} = 5$, giving your answers correct to 2 decimal places.
Show your working.

Answer x = ... or x = ... [5]

6



ABCD is a quadrilateral.
AB = 8 cm, *BC* = 17 cm and *AC* = 15 cm.
Angle *CAD* = 40°.

(a) Is triangle *ABC* a right-angled triangle? Show all working. [2]

Answer

(b) Find the length of

(i) *CD,*

Answer ..... cm [2]

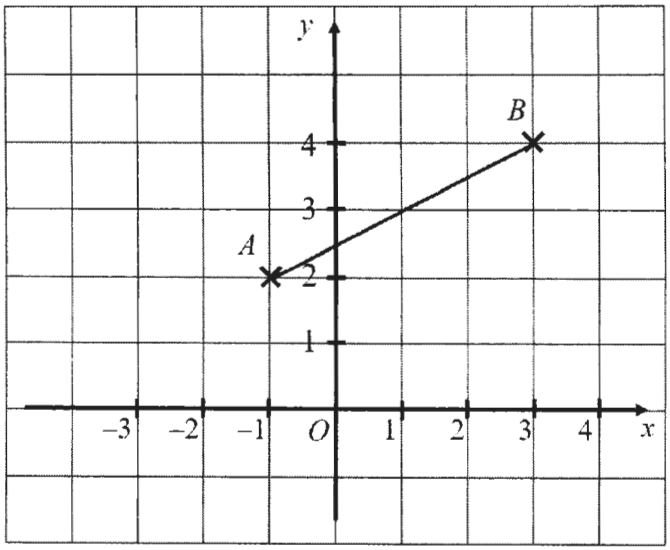
(ii) *AD.*

Answer ..... cm [2]

(c) Calculate the area of quadrilateral *ABCD.*

Answer ..... cm^2 [2]

7



A is the point $(-1, 2)$ and B is the point $(3, 4)$.

(a) Find the equation of AB,

Answer ..... [3]

(b) Calculate the length of AB.

Answer .....units [2]

Point C lies on the y-axis such that $AC = BC$.

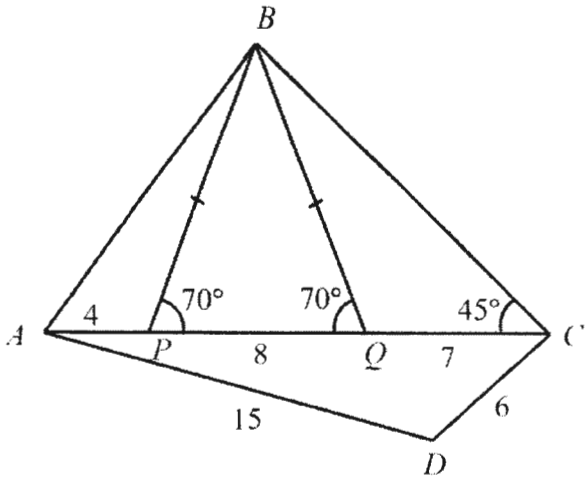
(c) Find the coordinates of point C.

Answer $C = (\ldots\ldots\ldots, \ldots\ldots\ldots)$ [3]

(d) Hence find the area of triangle OBC.

Answer ..... units^2 [2]

8



A, B, C, D, P and Q are points on horizontal ground.
A, P, Q and C lie on the same line.
$AP = 4$ m, $PQ = 8$ m, $QC = 7$ m, $AD = 15$ m and $CD = 6$ m.
Angle BPQ = angle $BQP = 70°$ and angle $BCQ = 45°$.

(a) Calculate angle PBQ.

Answer Angle PBQ = ... [1]

(b) Show that $BQ = 11.695$ m, correct to 5 significant figures. [2]

Answer

(c) Calculate angle ADC.

Answer Angle ADC = ... [3]

(d) Calculate the area of triangle ADC.

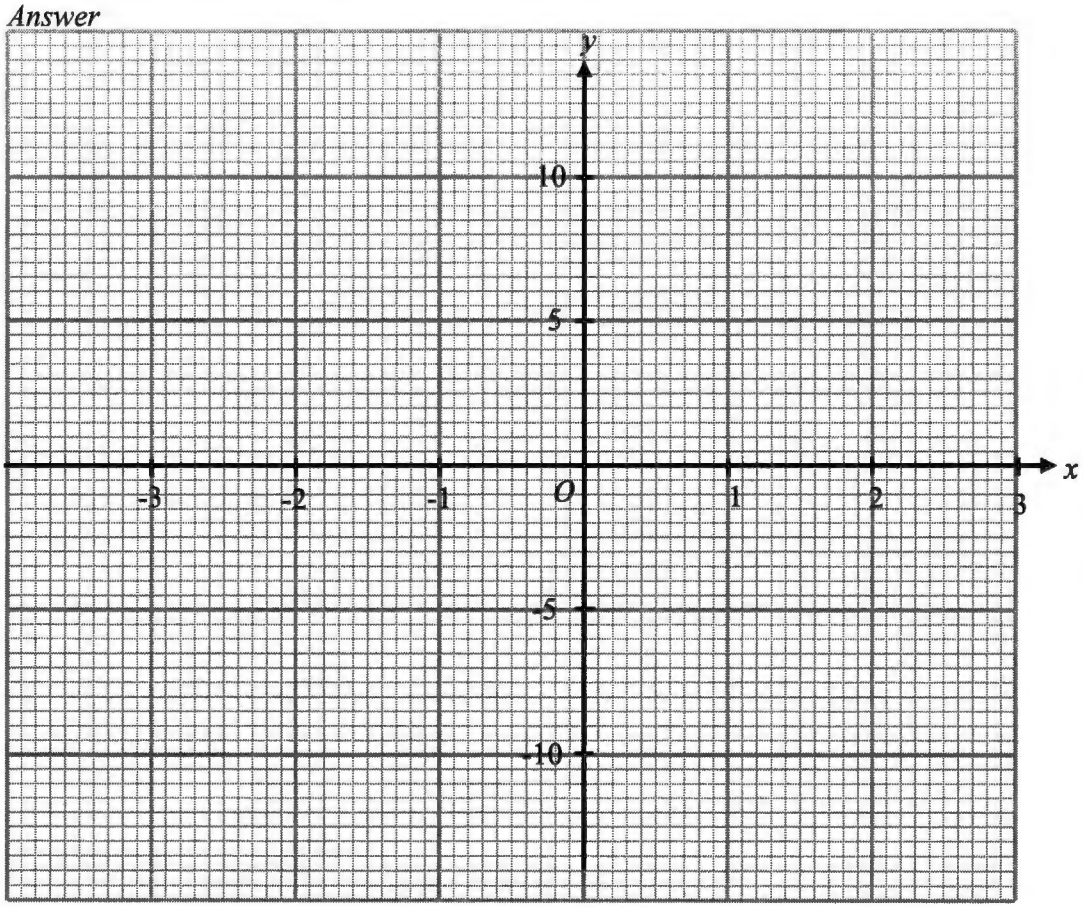
Answer ..... m^2 [2]

9 **(a)** Complete the table of values for $y = x^3 - 6x + 1$. [2]

x	–3	–2	–1	0	1	2	3
y	–8		6	1		–3	10

(b) Draw the graph of $y = x^3 - 6x + 1$ for $-3 \leq x \leq 3$. [3]

Answer



(c) Using your graph, find

(i) the largest value of x when $y = 3$.

Answer $x =$ ..... [1]

(ii) the values of x where the gradient of the graph is 0.

Answer $x =$ ..... or $x =$ ..... [2]

(d) By drawing a tangent, estimate the gradient of the graph of $y = x^3 - 6x + 1$ when $x = -2$.

Answer ..... [2]

(e) The equation $x^3 - 6x + 8 = 0$ has only one solution.
Explain how this can be seen from your graph.

Answer .....

.....[2]

10 Alice earns \$5000 per month.
Beatrice earns \$7500 per month.
They share an apartment and agree to share the rent of the apartment based on the ratio of their earnings.

The rent of the apartment for one month is \$1920.

(a) Calculate how much Alice should pay for the rent of the apartment in a year.

Answer \$ ..... [3]

Janice decides to invest \$20 000 for 4 years.

The table below shows the different investment and promotion plans that the different banks offer.

Bank	Investment plans	Promotion
A	3.8% per annum simple interest	One time additional \$100 interest
B	3.6% per annum compound interest, compounded annually	–
C	3.5% per annum compound interest, compounded half-yearly	One time additional \$80 interest

(b) Calculate the amount of interest earned the end of 4 years if Janice were to choose Bank A.

Answer \$ ..... [2]

(c) Which bank should Janice invest in?
Explain your answer.

Answer Janice should choose Bank ..... because .....

..... [5]

End of Paper

Setter: Miss Melody Ho

AISS 3N Mathematics EOY PAPER 1 2022 Answer Scheme [70 marks]

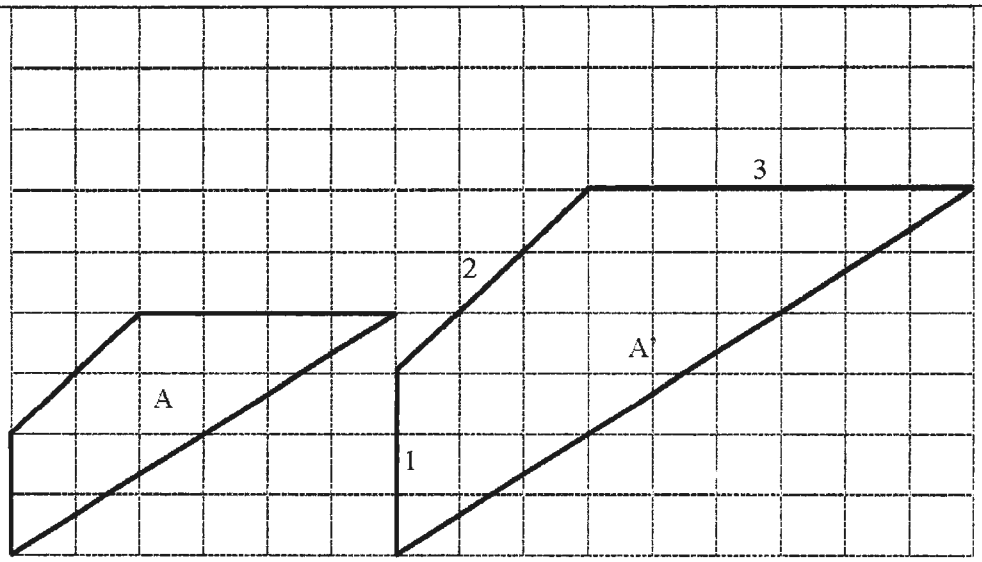
Qns	Answers	Marks	Remarks
1	$\frac{\sqrt{1\times100}}{4}-\frac{10}{4}$ $=2.5$	M1 for obtaining 2 correct terms A1	To be able to round off correctly to 1 significant figure. [Total: 2M]
2	$4x<13$ $x<\frac{13}{4}$ $x<3.25$ Largest integer of $x=3$	M1 A1	To be able to solve linear inequality and using it to find the largest integer. [Total: 2M]
3	map : actual 1.2 cm : 4.5 km 1.2 : 450000 1 : 375000 $n=375000$	M1 A1	To be able to convert km into cm and using map scale concept 1: n to find the value of n [Total: 2M]
4	Let x be the no. of men and y be the no. of days $x=\frac{k}{y}$ (where k is a constant) $16=\frac{k}{36}$ $k=576$ $x=\frac{576}{y}$ When $y=12$, $x=\frac{576}{12}$ $x=48$ No. of additional men needed $=48-16$ $=32$ Alternative solution: using ratio No. of men | $\times3$ | No. of days 16 | $\times3$ | 48 36 | $\div3$ | 12 Thus, no. of additional men needed $=48-16$ $=32$	M1 A1	To be able to understand that the context is inversely proportional and using the correct equation to solve this question. [Total: 2M]

5	Income in 2020 $= \frac{100}{104} \times 15600$ $= 15000$ OR 104% represent \$15600 1% represent \$150 100% represent \$150 × 100 = \$15000	M1 A1	To be able to apply concept on reverse percentage to solve question. [Total: 2M]
6a	$\sin A^\circ = 0.9$ $A^\circ = \sin^{-1}(0.9)$ $A^\circ = 64.1580^\circ$ Obtuse angle of A $= 180^\circ - 64.1580^\circ$ $= 115.8419^\circ$ $= 115.8^\circ$ $A = 115.8$ (to 1 dec place)	B1	To be able to understand what an obtuse angle is and using trigonometric concept to find angle. [Total: 1M]
6b	$\cos B^\circ = -0.5$ $B^\circ = \cos^{-1}(-0.5)$ $B = 120$	B1	To be able to apply trigonometric concept for cosine to find the required obtuse angle. [Total: 1M]
7a	$y = kx^3$ (where k is a constant) $54 = k(6)^3$ $k = \frac{54}{216}$ $k = \frac{1}{4}$ $y = \frac{1}{4}x^3$	M1 A1	To be able to formulate the correct equation to find constant k and then, using it to form an equation connecting y and x. [Total: 2M]
7b	$y = \frac{1}{4}x^3$ $y = \frac{1}{4}(2)^3$ $y = \frac{1}{4}(8)$ $y = 2$	B1	To be able to substitute value of x correctly into an equation to find the value of y. [Total: 1M]

8a	$b=\dfrac{2a}{w+a}$ $b=\dfrac{2(0.45)}{3.15+0.45}$ $b=\dfrac{0.9}{3.6}$ $b=0.25$ or $b=\dfrac{1}{4}$	B1	To be able to substitute values of two variables correctly into an equation to find the value of unknown in a formula. [Total: 1M]
8b	$b=\dfrac{2a}{w+a}$ $b(w+a)=2a$ $bw+ba=2a$ $2a-ba=bw$ $a(2-b)=bw$ $a=\dfrac{bw}{2-b}$ or $-\dfrac{bw}{b-2}$	M1 for obtaining $bw+ba=2a$ A1	To be able to manipulate the equation and make a the subject of the formula. [Total: 2M]
9	$\dfrac{3x-1}{2x^2-7x-15}-\dfrac{1}{x-5}$ $=\dfrac{3x-1}{(2x+3)(x-5)}-\dfrac{1}{x-5}$ $=\dfrac{3x-1}{(2x+3)(x-5)}-\dfrac{1(2x+3)}{(2x+3)(x-5)}$ $=\dfrac{3x-1-2x-3}{(2x+3)(x-5)}$ $=\dfrac{x-4}{(2x+3)(x-5)}$	M1 for being able to factorize to form $(2x+3)(x-5)$ M1 for make common denominator A1	To be able to factorize the denominator using trial-and-error method, make common denominator before simplifying into a single fraction [Total: 3M]
10a	$\dfrac{27x^2y^3z}{81xy^3z^3}=\dfrac{27xy^3z(x)}{27xy^3z(3z^2)}$ $=\dfrac{x}{3z^2}$	B1	To be able to take out common factors and simplify correctly. [Total: 1M]
10b	$\dfrac{3m^2}{m^2-49}\div\dfrac{8m}{m+7}$ $=\dfrac{3m^2}{(m+7)(m-7)}\times\dfrac{m+7}{8m}$ $=\dfrac{3m}{8(m-7)}$	M1 for being able to factorize to form $(m+7)(m-7)$ A1	To be able to factorize and perform division of fractional fractions correctly. [Total: 2M]
11a	$2x(x-2y)-x(7y+x)$ $=2x^2-4xy-7xy-x^2$ $=x^2-11xy$	M1 A1	To be able to expand and simplify correctly. [Total: 2M]

11b	$2x^2+5x=0$ $x(2x+5)=0$ $x=0$ or $2x+5=0$ $x=0$ or $x=-\frac{5}{2}$ $x=0$ or $x=-2\frac{1}{2}$	B2	To be able to solve quadratic equation by taking out common factor and using zero product rule to find solutions. [Total: 2M]
12a	$\left(\frac{64}{27}\right)^{-\frac{2}{3}}-\left(\frac{27}{64}\right)^{\frac{2}{3}}$ $-\left(\frac{3}{4}\right)^2$ $-\frac{9}{16}$	M1 getting either $\left(\frac{27}{64}\right)^{\frac{2}{3}}$ or $\left(\frac{3}{4}\right)^2$ A1	To be able to simplify negative indices and applying laws of indices to solve question. [Total: 2M]
12b	$32^{\frac{4}{5}}=2^n$ $\left(2^5\right)^{\frac{4}{5}}=2^n$ $2^4=2^n$ $n=4$	M1 Able to express 32 as 2^5 A1	To be able to make common base, apply indices law, and thus using it to find the value of n. [Total: 2M]
13	$\frac{t-4}{2t-11}=\frac{1}{5}$ $5(t-4)=2t-11$ $5t-20=2t-11$ $5t-2t=-11+20$ $3t=9$ $t=3$ Coordinate of A is (6,3) Alternatively,	M1 obtaining $\frac{t-4}{2t-11}$ using the formula of gradient M1 obtaining the correct equation $3t=9$ A1	To be able to apply the formula of gradient for two points to formulate an equation to solve for t. [Total: 3M]

	$Y = mX + c$ $4 = \frac{1}{5}(11) + c$ $c = 4 - \frac{11}{5}$ $c = \frac{9}{5}$ $y = \frac{1}{5}x + \frac{9}{5}$ *when* $x = 2t, y = t$ $t = \frac{1}{5}(2t) + \frac{9}{5}$ $5t = 2t + 9$ $3t = 9$ $t = 3$ Coordinate of A is $(6, 3)$		
14a	Total number of students surveyed = 1 + 4 + 8 + 5 + 3 + 5 = 26	B1	To be able to read values correctly from the bar graph. [Total: 1M]
14b	Mean of number of boxes of Pokémon cards $= \frac{\text{total no. of boxes}}{\text{total no. of children}}$ $= \frac{72}{1+4+8+5+3+5}$ $= \frac{72}{26}$ $= 2\frac{10}{13}$ or 2.77 (to 3 sig fig)	M1 A1	To be able to understand what is mean number and using the information from bar graph to solve this question. [Total: 2M]
14c	Pie chart. Easier to compare relative size of each category with the whole.	B1	To be able to suggest another better statistical diagram to represent data. [Total: 1M]

15a			To be able to use scale factor to correctly draw the enlarged diagram. 1 mark for 2 correct sides 2 marks for all 3 correct sides [Total: 2M]
15b	(measure 6.3) $\frac{2.6}{6.3} = 0.413$ Answer: 0.413 or $\frac{26}{63}$	B1	To be able to find the scale factor. [Total: 1M]
16a	$693 = 3^2 \times 7 \times 11$	B2	To be able to perform prime factorization on a number and express it as a product of its prime factors. [Total: 2M]
16b	$693n = 3^2 \times 7 \times 11 \times n$ For n to be a perfect square, $n = 7 \times 11$ $= 77$	B1	To be able to understand what it takes to be a perfect square and using the concept to find the value of n. [Total: 1M]
16c	$588 = 2^2 \times 3 \times 7^2$ $693 = 3^2 \times 7 \times 11$ LCM = $2^2 \times 3^2 \times 7^2 \times 11$	B1	To be able to find the LCM when given two numbers. [Total: 1M]

17ai	The common difference is -7. The first negative no. $= 19-7-7-7$ $= -2$	B1	To be able to recognise the pattern of the sequence and using it to find the first negative number. [Total: 1M]
17aii	$T_n = a+(n-1)d$ $T_n = 47+(n-1)(-7)$ $T_n = 47-7n+7$ $T_n = -7n+54$	B1	To be able to find the general term of this sequence. [Total: 1M]
17b	For -25 to be a term in the sequence, there will be a nth term. $2n^2-13n-7=-25$ $2n^2-13n-7+25=0$ $2n^2-13n+18=0$ $(2n-9)(n-2)=0$ $(2n-9)=0$ or $(n-2)=0$ $n=\frac{9}{2}$ or $n=2$ (rejected) Since $n=2$ which is a whole number or positive integer, -25 is a term in the sequence.	M1 for obtaining $2n^2-13n+18=0$ A1 for able to explain why -25 is a term in the sequence	To be able to formulate an equation, factorize a quadratic equation, and using zero product rule to find the value of n. [Total: 2M]
18ai	x-coordinate of F $= 2-4$ $= -2$ Thus, the coordinate of F is $(-2,6)$.	B1	To be able to understand the requirement of the question to find the correct x-coordinate for F. [Total: 1M]
18aii	The equation of the line EF is $y=6$.	B1	To be able to state the equation of a horizontal line. [Total: 1M]
18b	$y=-2x+5$ Let the coordinate of R be $(2t,t)$ $t=-2(2t)+5$ $t=-4t+5$ $5t=5$ $t=1$ Thus, the coordinate of R is $(2,1)$.	M1 being able to obtain the equation $t=-2(2t)+5$ M1 to obtain the correct the value of t. A1	To be able to express R as $(2t,t)$, formulate an equation, solve the linear equation to find the value of t. [Total: 3M]

18c	$2y+4x=7$ $2y=-4x+7$ $y=-2x+\frac{7}{2}$ Same gradient and different y-intercept. The lines are parallel and do not intersect each other.	A1 A1	To be able to relate and explain that lines of same gradient are parallel and thus, do not intersect. [Total: 2M]
19a	ΔABC is similar to ΔAXY $\frac{AC}{5}=\frac{8}{4}$ Ratio of corresponding sides of similar triangles are the same $AC=\frac{8}{4}\times 10$ $=10$ cm $XC=10-4$ $=6$ cm	M1 A1	To be able to use Pythagoras' apply similarity concept to find the length of AC. [Total: 2M]
19b	$\sin\angle ACB=\frac{8}{10}$ $\angle ACB=\sin^{-1}(\frac{8}{10})$ $=53.1°$	M1 A1	To be able to apply TOA CAH SOH to find the required angle. [Total: 2M]
20ai	Graph 5	B1	To be able to recognise graphs of power functions [Total: 4M]
20aii	Graph 2	B1	
20a iii	Graph 4	B1	
20b	$y=2x^3+5$	B1	
21a	Remaining money left after down payment = 3679 – 1000 = 2679 Interest incurred for 2 years $=2679\times\frac{8.5}{100}\times 2$ = 455.43 Total amount payable = 455.43 + 2679 = 3134.43 Monthly instalment for 2 years $=3134.43\div 24$ = 130.60125 = 130.60	M1 M1 A1	To be able to apply down payment and simple interest concept to find the monthly instalment. [Total: 3 M]
21b	1661 mm = 1.661 m 935 mm = 0.935 m Area $=1.661\times 0.935$ $=1.553035$ m² Not correct, the size of the television in inch will be 75 inches since $1349 < 1.553035 < 1.763$.	M1 A1	To be able to perform unit conversion and using it to solve this question. [Total: 2M]

Setter : Mrs Silia Goh

2022 Sec 3NA Math EOY Paper 2 Marking Scheme

Qn		Working	Mark Awarded	Sub-total	Remarks
1	(a)	$(3x)^0 \times (x^2y^{-5})^{-1}$ $= 1 \times x^{-2}y^5$ $= x^{-2}y^5$ $= \frac{y^5}{x^2}$	M1 A1	 2	M1 awarded for simplifying both terms. A1 is not awarded if answer is not placed in a fraction.
	(b)	$\left(\frac{9x^6y^4}{x^2y^4}\right)^{\frac{1}{2}}$ $= \frac{3x^3y^2}{xy^2}$ $= 3x^2$ <u>Alternative solution</u> $\left(\frac{9x^6y^4}{x^2y^4}\right)^{\frac{1}{2}}$ $= (9x^4)^{\frac{1}{2}}$ $= 3x^2$	M1 A1 [M1] [A1]	 2	
2	(a)	Percentage increase $= \frac{(9.90\times 10^8) - (6.03\times 10^8)}{6.03\times 10^8} \times 100\%$ = 64.2% (to 3 s.f.)	M1 A1	 2	M1 given when both increase and fraction are correct.
	(b)	$(6.14 \times 10^9) \div (5.54 \times 10^7)$ = 110.8303249 = 1.11×10^2 (to 3 s.f.)	M1 A1	 2	Answer should be in standard form to obtain A1.
3	(a)	$(2x-1)(x+3) = 0$ $2x - 1 = 0$ or $x + 3 = 0$ $x = ½$ $\quad x = -3$	M1 A2	 3	A1 for each correct value of x.
	(b)	y can be 0 and we cannot divide by 0.	B1	1	
4	(a)	$x^2 - 8x - 12$ $= (x-4)^2 - (-4)^2 - 12$ $= (x-4)^2 - 28$ $a = -4, b = -28$	M1 A2	 3	Other methods (e.g. formula / factorization) will not be accepted.
	(b)	$(x-4)^2 - 28 = 0$ $(x-4)^2 = 28$			

Qn		Working	Mark Awarded	Sub-total	Remarks
		$x-4=\pm\sqrt{28}$ $x=4\pm\sqrt{28}$ $x=9.29$ or -1.29 (to 3 s.f.)	M1 A1	 2	
5		$\frac{2}{x-3}-\frac{1}{2x+1}=5$ $\frac{2(2x+1)-1(x-3)}{(x-3)(2x+1)}=5$ $2(2x+1)-(x-3)=5(x-3)(2x+1)$ $4x+2-x+3=5(2x^2-5x-3)$ $3x+5=10x^2-25x-15$ $10x^2-28x-20=0$ $5x^2-14x-10=0$ $x=\frac{-(-14)\pm\sqrt{(-14)^2-4(5)(-10)}}{2(5)}$ $=\frac{14\pm\sqrt{396}}{10}$ $=3.39$ or -0.59 (to 2 d.p.)	M1 M1 M1 A2	 5	 ECF to be allowed.
6	**(a)**	$AB^2+AC^2=8^2+15^2=289$ $BC^2=17^2=289$ $AB^2+AC^2=BC^2$ By the converse of Pythagoras' Theorem, triangle ABC is right-angled.	M1 A1	 2	Calculate both values of AB^2+AC^2 and BC^2 to get M1.
	(b) (i)	$\sin 40°=\frac{CD}{15}$ $CD=15\sin 40°$ $=9.6418$ (to 5 s.f.) $=9.64$ cm (to 3 s.f.)	M1 A1	 2	M1 for correct trigonometric ratio.
	(ii)	By Pythagoras' Theorem, $AD=\sqrt{15^2-9.6418^2}$ $=11.491$ (to 5 s.f.) $=11.5$ cm (to 3 s.f.)	M1 A1	 2	ECF from 8 (b) (i).
	(c)	Area of quadrilateral $ABCD$ $=\left(\frac{1}{2}\times 8\times 15\right)+\left(\frac{1}{2}\times 9.6418\times 11.491\right)$ $=115$ cm^2 (to 3 s.f.)	M1 A1	 2	ECF from 8 (b). M1 for correct calculations of area for both triangles.

Qn		Working	Mark Awarded	Sub-total	Remarks
7	(a)	Gradient $= \frac{4-2}{3-(-1)}$ $= \frac{1}{2}$ $y = 0.5(x) + c$ $y = 0.5(3) + 3$ $c = 2.5$ $y = 0.5x + 2.5$	M1 M1 A1	3	M1 for obtaining gradient. M1 for obtaining the value of c. A1 for correct equation.
	(b)	$\sqrt{(-1-3)^2 + (2-4)^2}$ $= 4.47$ units (to 3 s.f.) or -4.47 (reject)	M1 A1	2	
	(c)	Let the coordinates of C be $(0, k)$. Length of AC $= \sqrt{(-1-0)^2 + (2-k)^2}$ $= \sqrt{1 + (2-k)^2}$ Length of BC $= \sqrt{(3-0)^2 + (4-k)^2}$ $= \sqrt{9 + (4-k)^2}$ Length of AC = Length of BC $\sqrt{1 + (2-k)^2} = \sqrt{9 + (4-k)^2}$ $1 + (2-k)^2 = 9 + (4-k)^2$ $1 + 4 - 4k + k^2 = 9 + 16 - 8k + k^2$ $4k = 20$ $k = 5$ The coordinates of C are $(0, 5)$.	M1 M1 A1	3	M1 to be given for equation (which may or may not be simplified). E.g. $\sqrt{(-1-0)^2 + (2-k)^2} = \sqrt{(3-0)^2 + (4-k)^2}$
	(d)	Area $= \frac{1}{2} \times 3 \times 5$ $= 7.5$ units^2	M1 A1	2	ECF (full 2 marks) from 6 (c).
8	(a)	Angle PBQ $= 180° - 2(70°)$ (base angles of isosceles triangle) $= 40°$	B1	1	
	(b)	$\frac{BQ}{\sin 70°} = \frac{8}{\sin 40°}$	M1		

Qn		Working	Mark Awarded	Sub-total	Remarks
		$BQ = \frac{8\sin 70°}{\sin 40°}$ = 11.695 m (to 5 s.f.) (shown)	A1	2	
	(c)	$AC = 4 + 8 + 7$ = 19 m $\cos \angle ADC = \frac{15^2 + 6^2 - 19^2}{2(15)(6)}$ $\angle ADC = \cos^{-1}\left(\frac{15^2 + 6^2 - 19^2}{2(15)(6)}\right)$ = 123.749° (to 3 d.p.) = 123.7° (to 1 d.p.)	M1 M1 A1	3	M1 for length of AC. M1 for using the cosine rule, with the correct values substituted.
	(d)	Area $= \frac{1}{2} \times 15 \times 6 \times \sin 123.749°$ = 37.4 m² (3 s.f.)	M1 A1	2	ECF from 7 (c). M1 for using formula to find area of triangle.
9	(a)	$p = (-2)^3 - 6(-2) + 1$ = 5 $q = (1)^3 - 6(1) + 1$ = –4	B1 B1	2	Working not required for B2.
	(b)	2 marks for all correctly plotted points • At least 3 points correctly plotted → 1 mark • All 7 points correctly plotted → 2 marks 1 mark for smooth curve	B2 B1	3	ECF from 9 (a). Full 3 marks to be awarded if all criteria are met.
	(c) (i)	$x = 2.60$ Accept 2.55 to 2.65 (inclusive)	B1	1	
	(c) (ii)	$x = 1.40$ or -1.40 Accept 1.35 to 1.45 (inclusive) and -1.45 to -1.35 (inclusive)	B2	2	
	(d)	1 mark for tangent drawn 1 mark for calculating tangent correctly. Accepted range: between 5.7 to 6.3 (inclusive).	M1 A1	2	Allow ECF if graph not drawn properly. (Gradient should be 6, ± 5%)

Qn		Working	Mark Awarded	Sub-total	Remarks
	(e)	$x^3 - 6x + 8 = 0$ $x^3 - 6x + 1 = -7$ From the graph, the line $y = -7$ only intersect the curve $y = x^3 - 6x + 1$ at one point. Hence, $x^3 - 6x + 8 = 0$ has only one solution.	M1 A1	2	
10	(a)	Alice : Beatrice = 5000 : 7500 = 2 : 3 Rent paid by Alice in a month $= \frac{2}{5} \times 1920$ = \$768 Rent paid by Alice in a year = 12 × 768 = \$9216	 M1 M1 A1	3	
	(b)	Interest excluding promotion $= \frac{20000 \times 3.8 \times 4}{100}$ = \$3040 Interest including promotion = 3040 + 100 = \$3140	 M1 A1	2	
	(c)	<u>Bank B:</u> Total amount = 20 000 $(1 + 3.6/100)^4$ = \$23 039.2861 Interest earned = 23 039.2861 – 20 000 = \$3039.29 (to 2 d.p.) <u>Bank C:</u> Number of half-years = 4 × 2 = 8 Interest rate per half-year = 3.5 / 2 = 1.75% Total amount = 20 000 $(1 + 1.75/100)^8 + 80$ = \$23 057.6357 (to 4 d.p.) Interest = \$23 057.6347 – 20 000	M1 M1 M1		

Qn		Working	Mark Awarded	Sub-total	Remarks
		= $3057.64 (to 2 d.p.) Janice should choose Bank A because 3140 > 3057.64 > 3030.29, which means that Bank A has the highest interest.	M1 A1	5	ECF for concluding statement, as long as students chose the bank with the largest interest (according to their calculations).

9 This table of values is for $y = x^3 - 6x + 1$.

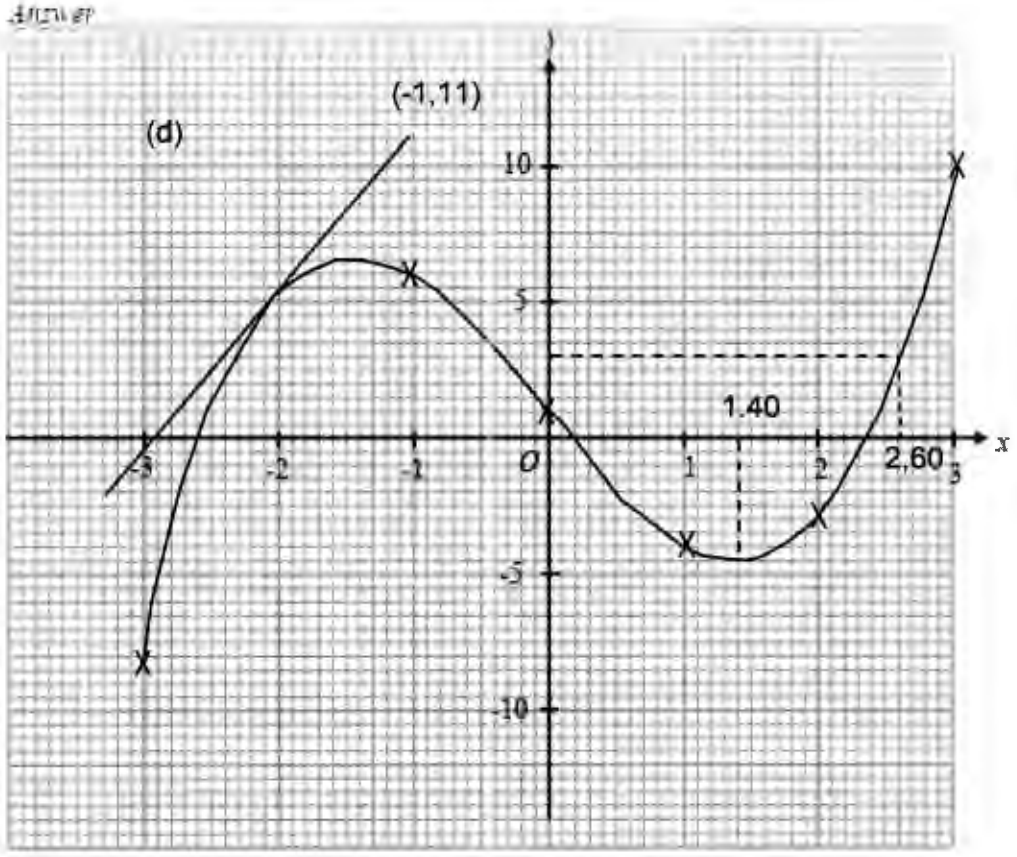
x	–3	–2	–1	0	1	2	3
y	–8	p	6	1	q	–3	10

(a) Calculate the values of p and of q.

Answer $p =$ ..... or $q =$ ..... [2]

(b) Draw the graph of $y = x^3 - 6x + 1$ for $-3 \leq x < 3$ in the grid provided below. [3]

Answer



(c) Using your graph, find.

(i) The largest value of x when $y = 3$.

Answer $x =$ ..... [1]