NBCS
NORTHERN BEACHES CHRISTIAN SCHOOL

MATHEMATICS

2021 Year 10 5.3 –Yearly Examination

General Instructions

- Reading time – 5 minutes
- Working time – 90 minutes
- Write using black pen
- NESA approved calculators may be used
- For questions in Section II, show relevant mathematical reasoning and/or calculations

Total marks: 60

Section I – 25 marks (pages 1 – 8)

- Attempt Questions 1 – 25
- Allow about 35 minutes for this section

Section II – 35 marks (pages 9 – 15)

- Attempt Questions 26 – 32
- Allow about 55 minutes for this section

Section I

25 marks
Attempt questions 1 – 25
Allow about 35 minutes for this section

Use the multiple-choice answer sheet for questions 1 – 25

1. What is the value of $4^2 \times 4^3$?

   (A) 4^5

   (B) 4^6

   (C) 16^5

   (D) 15^6

2. For $f(x) = -x^2 - 8x + 8$, what is $f(-3)$?

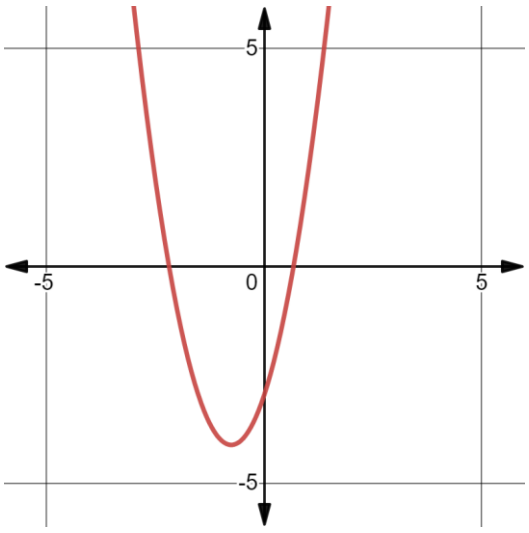
   (A) -21

   (B) -7

   (C) 23

   (D) 41

3. Which statement correctly matches the parabola below?



   (A) $b^2 - 4ac > 0$

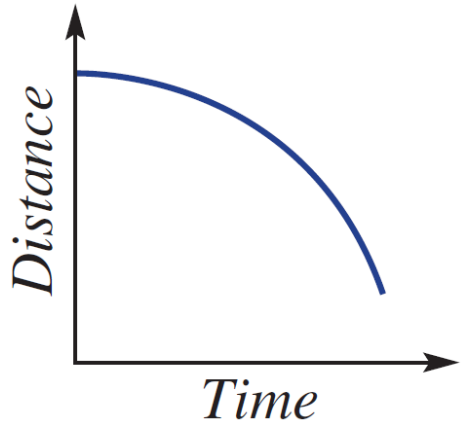
   (B) $b^2 - 4ac < 0$

   (C) $b^2 - 4ac = 0$

   (D) $b^2 + 4ac > 0$

4. What is the most appropriate description for the distance-time graph below?

Distance from home vs time passed



(A) Increasing distance from home. Speed decelerating.

(B) Decreasing distance from home. Speed decelerating.

(C) Increasing distance from home. Speed accelerating.

(D) Decreasing distance from home. Speed accelerating.

5. The ten letters of the word JOHNNYDEPP are written on separate cards.

The cards are placed face down on a table. One card is chosen at random.

What is P(N ∪ P)?

(A) $\frac{1}{5}$

(B) $\frac{2}{5}$

(C) $\frac{1}{2}$

(D) $\frac{3}{5}$

6. What is the range of the function $y = 2x^2 + 4$?

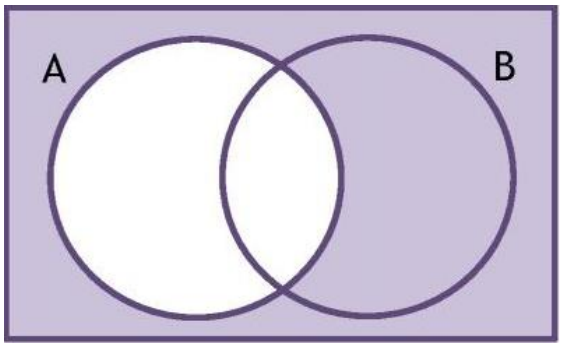
(A) $0 \geq y \geq 4$

(B) $y \geq 4$

(C) $x \geq 4$

(D) $2 \geq x \geq 4$

7. Which statement best describes the shaded area in the Venn diagram below?



(A) B only

(B) $\bar{A}$

(C) $A \cap B$

(D) $\overline{(A \cap B)}$

8. The signal of a local radio station can be picked up within a radius of 26 km.
How large an area is this, to the nearest km^2?

(A) 82 km^2

(B) 153 km^2

(C) 676 km^2

(D) 2124 km^2

9. Olivia is x years old and her brother Logan is 3 years younger.
What is the total of Olivia and Logan's ages?

(A) $3 - x$

(B) $x + 3$

(C) $2x - 3$

(D) 3

10. What is the solution to the equation $\frac{x+2}{4} = 6$?

(A) $x = 8$

(B) $x = 12$

(C) $x = 22$

(D) $x = 26$

11. What is the equation $4y - 3x = 12$ in gradient-intercept form?

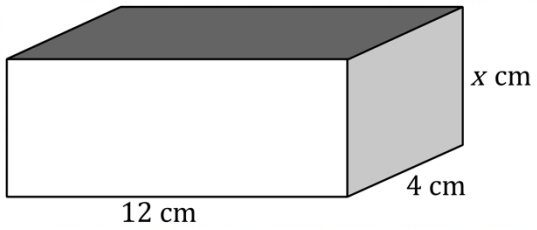
(A) $y = -\frac{3}{4}x - 3$

(B) $y = -\frac{3}{4}x + 3$

(C) $y = \frac{3}{4}x - 3$

(D) $y = \frac{3}{4}x + 3$

12. The rectangular prism below has a surface area of 160 cm^2.



Not to scale

What is the value of x ?

(A) 2

(B) 3

(C) 4

(D) 5

13. For the scores 12, 14, 19, 20, 20, 21, 22, 22, 22, 24, consider the following statements.

A The median is greater than the mean.

B The mode is less than the median.

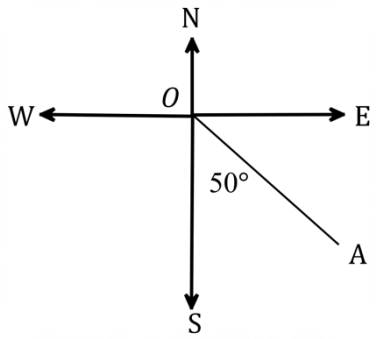
(A) Both statement A and B are true.

(B) Both statement A and B are false.

(C) Statement A is false and statement B is true

(D) Statement A is true and statement B is false

14.



What is the true bearing of A from O in the above diagram?

(A) 040°T

(B) 050°T

(C) 130°T

(D) 320°T

15. Which of these quadratic relationships, when graphed, will have a maximum turning point?

(A) $y = 3x^2$

(B) $y = 3 + x^2$

(C) $y = -3 + x^2$

(D) $y = -x^2 - 3$

16. Simplify $\frac{2x}{3} + \frac{x}{5}$

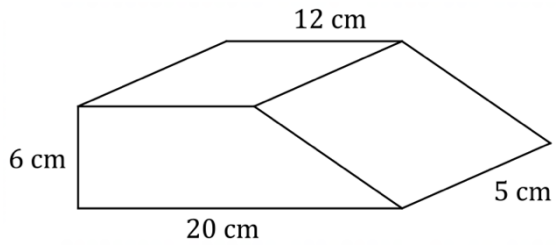
(A) $\frac{2x}{15}$

(B) $\frac{2x}{3}$

(C) $\frac{3x}{8}$

(D) $\frac{13x}{15}$

17.



Not to scale

What is the volume of the above prism?

(A) 96 cm^3

(B) 480 cm^3

(C) 600 cm^3

(D) 960 cm^3

18. What is the exact value of $\sin 330^o$?

(A) $-\sin 30$

(B) $-\frac{1}{2}$

(C) $\frac{\sqrt{3}}{2}$

(D) $-\frac{1}{\sqrt{2}}$

19. Which of the following does $5x^{\frac{3}{2}}$ become when written in surd form?

(A) $5x\sqrt{x}$

(B) $5x\sqrt{x^3}$

(C) $\frac{5\sqrt{5x}}{2}$

(D) $\frac{\sqrt{5x}}{3}$

20. The point $(a, 2)$ lies on the line whose equation is $2x + y + 4 = 0$. What is the value of a?

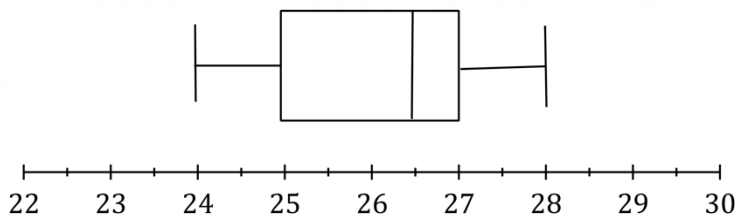
(A) –8

(B) –3

(C) 3

(D) 8

21. A box plot for a set of scores is shown below.



For what values are the middle 50% of scores between?

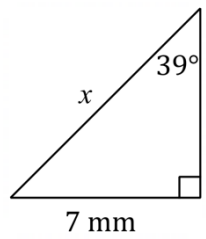
(A) 25 and 26.5

(B) 25 and 27

(C) 26.5 and 27

(D) 26.5 and 28

22.



What is the length of x in millimetres?

(A) $7\sin 39°$

(B) $\dfrac{7}{\sin 39°}$

(C) $7\cos 39^{o}$

(D) $\dfrac{7}{\cos 39^{o}}$

23. What is $\frac{3}{\sqrt{3}-1}$ with a rationalised denominator?

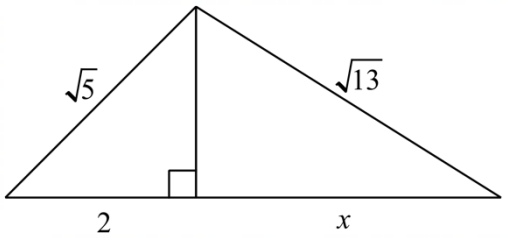
(A) $\dfrac{3\sqrt{3}+3}{2}$

(B) $\dfrac{\sqrt{3}-1}{3}$

(C) $\dfrac{\sqrt{3}}{2}$

(D) $\dfrac{3\sqrt{3}}{2}$

24.



Not to scale

What is the value of x in the above diagram?

(A) $\sqrt{12}$

(B) $\sqrt{18}$

(C) 3

(D) 6

25. Which of the following relations is **NOT** a function?

(A) $x^2 + y^2 = 1$

(B) $y = x^2 - 1$

(C) $y = \dfrac{1}{x-2} + 3$

(D) $y = \sin x$

END OF SECTION I

Section II

35 marks
Attempt questions 26 – 32
Allow about 55 minutes for this section

Answer each question in the spaces provided.
Your responses should include relevant mathematical reasoning and/or calculations.

Question 26 (5 marks) **Marks**

(a) Fully simplify **3**

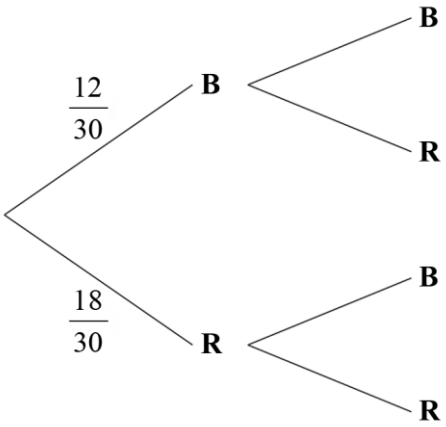
$$\frac{x^2+3x+2}{x^2+4x+3} \times \frac{x^2-9}{3x+6}$$

(b) A closed cylinder has a height of 12 cm and a diameter of 10 cm. **2**
What is the surface area of the cylinder, correct to the nearest whole number?

Question 27 (5 marks) **Marks**

(a) In a drawer there are 30 ribbons. Twelve are blue and eighteen are red.
Two ribbons are selected at random, without replacement.

(i) Complete the probability tree diagram by adding all probabilities of every arm **1**



(ii) What is the probability of selecting a pair of ribbons which are the same colour? **2**

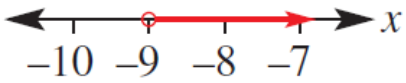
(b) Hunter is on the top of a 70 m high cliff. He observes a man swimming out to sea at an angle of depression of 50°.

(i) Draw a diagram below representing the above information **1**

(ii) Find the distance the man is from the base of the cliff? **1**
Answer to the nearest metre.

Question 28 (5 marks) **Marks**

(a) Write the following as an inequality **1**



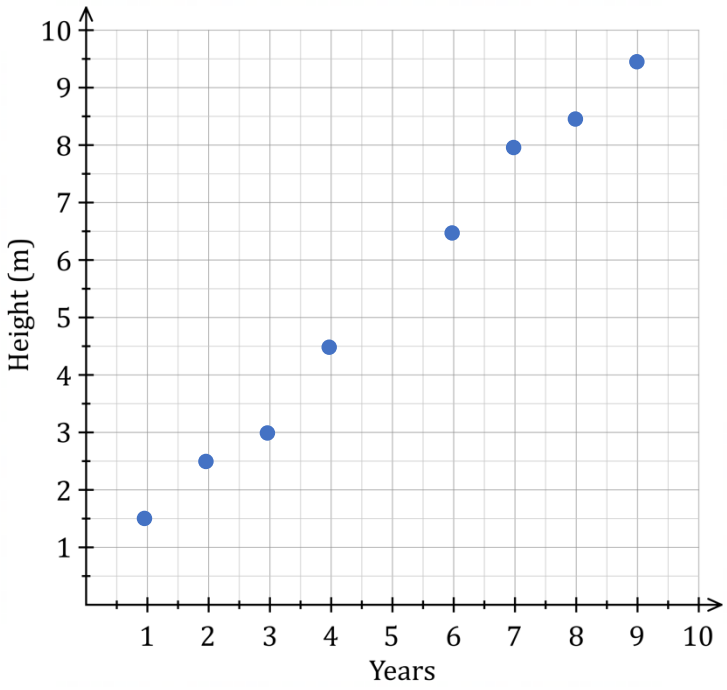
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(b) Daisy is an agricultural scientist studying the growth of a particular tree over several years. The data she recorded is shown in the table below.

Years since planting, t	1	2	3	4	5	6	7	8	9
Height of tree, H metres	1.5	2.5	3.0	4.5		6.5	8.0	8.5	9.5

(i) Draw a line of best fit, using the scatterplot data below. **1**



(ii) Daisy did not record the tree's height after five years. **1**
Using the graph, predict the height after five years.

.....

(c) Expand and fully simplify $\left(3\sqrt{10}+5\sqrt{2}\right)^2$ **2**

.....

.....

.....

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.....

.....

Question 29 (5 marks) **Marks**

(a) For parabola $y = 3x^2 + 6x - 15$, answer the following questions

(i) Find the x-intercepts, leaving your answers in surd form **2**

(ii) What are the coordinates of the vertex of this parabola? **1**

(b) Solve $5m - 4 = m + 16$ **1**

(c) Find the midpoint of the line segment that joins $(-2, -5)$ and $(2, 8)$ **1**

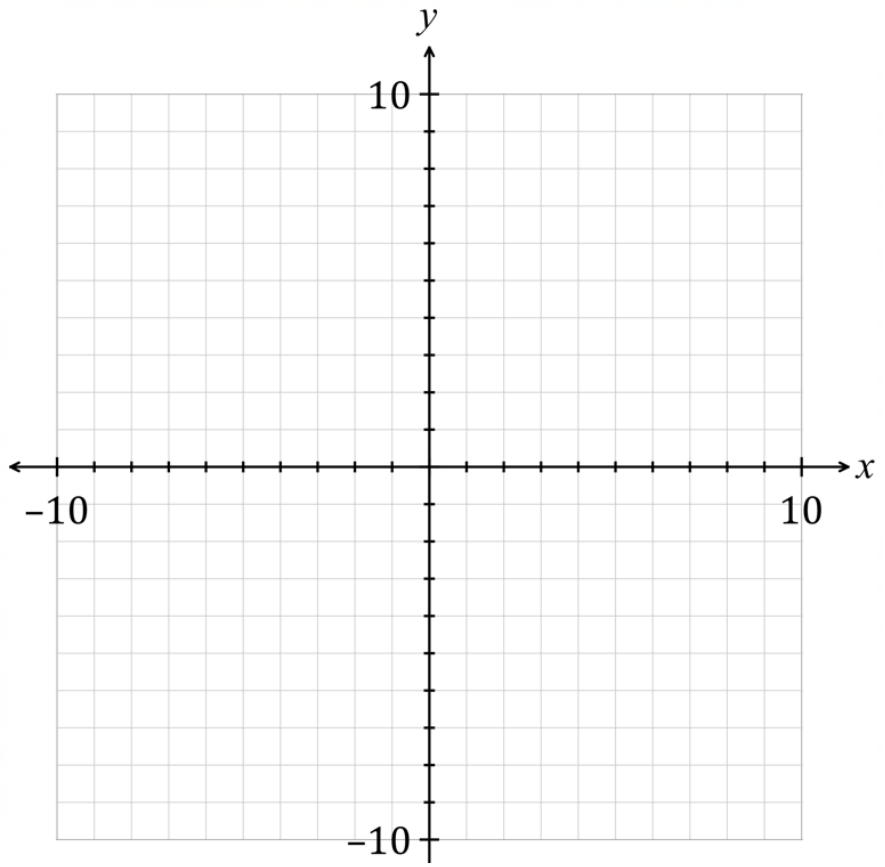
Question 30 (5 marks) **Marks**

(a) Solve simultaneously. **2**

$7x + 2y = 34$

$5x - 2y = 14$

(b) (i) Draw the line $2x - y + 6 = 0$ on the number plane below. **2**



(ii) What is the equation of a line perpendicular to the line drawn that passes through $(0, 15)$? **1**

Question 31 (5 marks) **Marks**

(a) What is the reference angle in the first quadrant for $\sin 150^o$? **1**

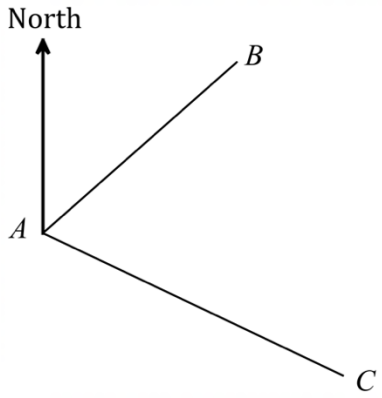
(b) If $V = \frac{G^2 h}{4\pi} \quad (G > 0)$ **1**
express this with G as the subject

(c) Solve $3^{2x-1} = \frac{1}{81}$ **1**

(d) Find the obtuse angle θ for $\cos\theta = -\frac{1}{\sqrt{2}}$ **2**

Question 32 (5 marks) **Marks**

(a) Points A, B and C are all located on level ground. Point A to point B is a distance of 853 m on a true bearing of 048°. Point A to point C is a distance of 1142 m on a true bearing of 113°.

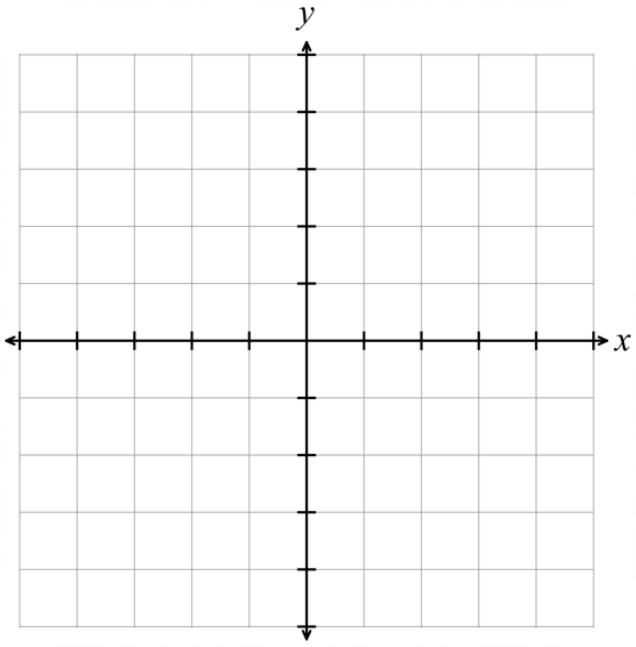


Not to scale

(i) Show that $\angle BAC = 65^o$ **1**

(ii) What is the distance between points B and C to the nearest metre? **2**

(b) Draw a neat sketch of $y = x^3 + 1$, labelling the y-intercept **2**



End of paper

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Love Learning

Year 10 5.3 Mathematics Section 1 - Answer Sheet

Student Number SOLNS

Completely fill the response oval representing the most correct answer.
If you make a mistake clearly pace a cross through your incorrect answer and write your new answer to the right.

1	A	●	B	○	C	○	D	○
2	A	○	B	○	C	●	D	○
3	A	●	B	○	C	○	D	○
4	A	○	B	○	C	○	D	●
5	A	○	B	●	C	○	D	○
6	A	○	B	●	C	○	D	○
7	A	○	B	●	C	○	D	○
8	A	○	B	○	C	○	D	●
9	A	○	B	○	C	●	D	○
10	A	○	B	○	C	●	D	○
11	A	○	B	○	C	○	D	●
12	A	●	B	○	C	○	D	○
13	A	○	B	○	C	○	D	●
14	A	○	B	○	C	●	D	○
15	A	○	B	○	C	○	D	●
16	A	○	B	○	C	○	D	●
17	A	○	B	●	C	○	D	○
18	A	○	B	●	C	○	D	○
19	A	●	B	○	C	○	D	○
20	A	○	B	●	C	○	D	○
21	A	○	B	●	C	○	D	○
22	A	○	B	●	C	○	D	○
23	A	●	B	○	C	○	D	○
24	A	●	B	○	C	○	D	○
25	A	●	B	○	C	○	D	○

Section II

35 marks
Attempt questions 26 – 32
Allow about 55 minutes for this section

Answer each question in the spaces provided.
Your responses should include relevant mathematical reasoning and/or calculations.

Question 26 (5 marks)

Marks

(a) Fully simplify $\dfrac{x^2+3x+2}{x^2+4x+3} \times \dfrac{x^2-9}{3x+6}$ **3**

$= \dfrac{(x+2)(x+1)}{(x+3)(x+1)} \times \dfrac{(x+3)(x-3)}{3(x+3)}$

① for any progress

② for almost there

$= \dfrac{(x-3)}{3}$

③ correct simplification

(b) A closed cylinder has a height of 12 cm and a diameter of 10 cm. **2**
What is the surface area of the cylinder, correct to the nearest whole number?

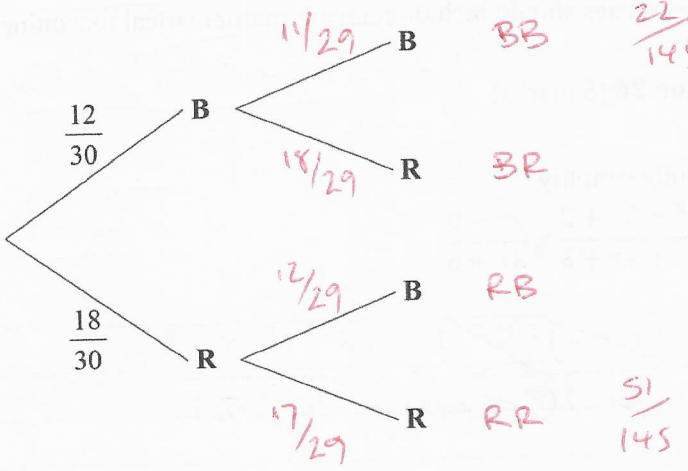
$SA = 2\pi r^2 + 2\pi rh$
$= 2\pi(5)^2 + 2\pi(5)(12)$
$= 170\pi$
$= 534.07\ldots$
$= 534 cm^2$

① for progress

Question 27 (5 marks) **Marks**

(a) In a drawer there are 30 ribbons. Twelve are blue and eighteen are red.
Two ribbons are selected at random, without replacement.

(i) Complete the probability tree diagram by adding all probabilities of every arm **1**



(ii) What is the probability of selecting a pair of ribbons which are the same colour? **2**

$P(\text{same}) = \left(\frac{12}{30} \times \frac{11}{29}\right) + \left(\frac{18}{30} \times \frac{17}{29}\right)$

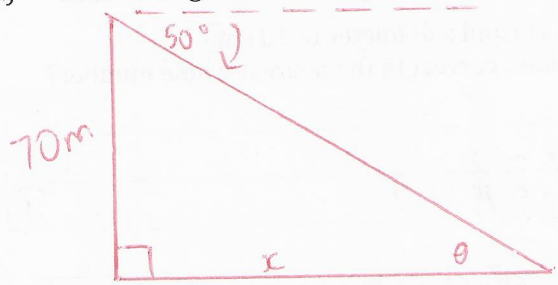
$= \frac{22}{145} + \frac{51}{145}$

$= \frac{73}{145}$

① for progress

(b) Hunter is on the top of a 70 m high cliff. He observes a man swimming out to sea at an angle of depression of 50°.

(i) Draw a diagram below representing the above information **1**



① correctly labelled

(ii) Find the distance the man is from the base of the cliff? **1**
Answer to the nearest metre.

careful ecf if diagram was wrong

$\tan 50 = \frac{70}{x}$

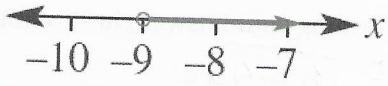
$x = \frac{70}{\tan 50}$

$= 59\text{m}$

Question 28 (5 marks)

Marks

(a) Write the following as an inequality **1**



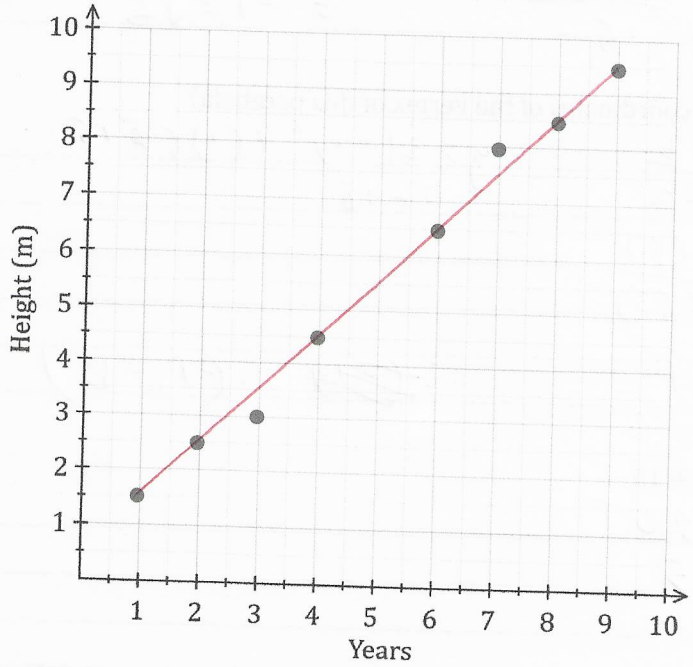
$x > -9$

(b) Daisy is an agricultural scientist studying the growth of a particular tree over several years. The data she recorded is shown in the table below.

Years since planting, t	1	2	3	4	5	6	7	8	9
Height of tree, H metres	1.5	2.5	3.0	4.5		6.5	8.0	8.5	9.5

(i) Draw a line of best fit, using the scatterplot data below. **1**

must have 1 data point above & below the line



(ii) Daisy did not record the tree's height after five years. Using the graph, predict the height after five years. **1**

5.5m

(c) Expand and fully simplify $(3\sqrt{10} + 5\sqrt{2})^2$ **2**

$= 3\sqrt{10}(3\sqrt{10} + 5\sqrt{2}) + 5\sqrt{2}(3\sqrt{10} + 5\sqrt{2})$

$= 9(10) + 15\sqrt{20} + 15\sqrt{20} + 25(2)$

$= 90 + 30\sqrt{20} + 50$

$= 140 + 60\sqrt{5}$

(1) for any meaningful progress

Question 29 (5 marks) **Marks**

(a) For parabola $y = 3x^2 + 6x - 15$, answer the following questions

(i) Find the x-intercepts, leaving your answers in surd form **2**

$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

$= \frac{-(6) \pm \sqrt{(6)^2-4(3)(-15)}}{2(3)}$

$= \frac{-6 \pm \sqrt{216}}{6}$

$= \frac{-6 \pm 6\sqrt{6}}{6}$

$= -1 \pm \sqrt{6}$

(ii) What are the coordinates of the vertex of this parabola? **1**

$x = \frac{-b}{2a}$

$= \frac{-(6)}{2(3)}$

$= -1$

$y = 3(-1)^2 + (1)6 - 15$

$= -18$

$\therefore (-1, -18)$

(b) Solve $5m - 4 = m + 16$ **1**

$4m = 20$

$m = 5$

(c) Find the midpoint of the line segment that joins $(-2, -5)$ and $(2, 8)$ **1**

$(0, \frac{3}{2})$

Question 30 (5 marks)

Marks

(a) Solve simultaneously. **2**

$7x + 2y = 34$ ①

$5x - 2y = 14$ ②

① + ② sub into ①

$12x = 48$

$x = 4$

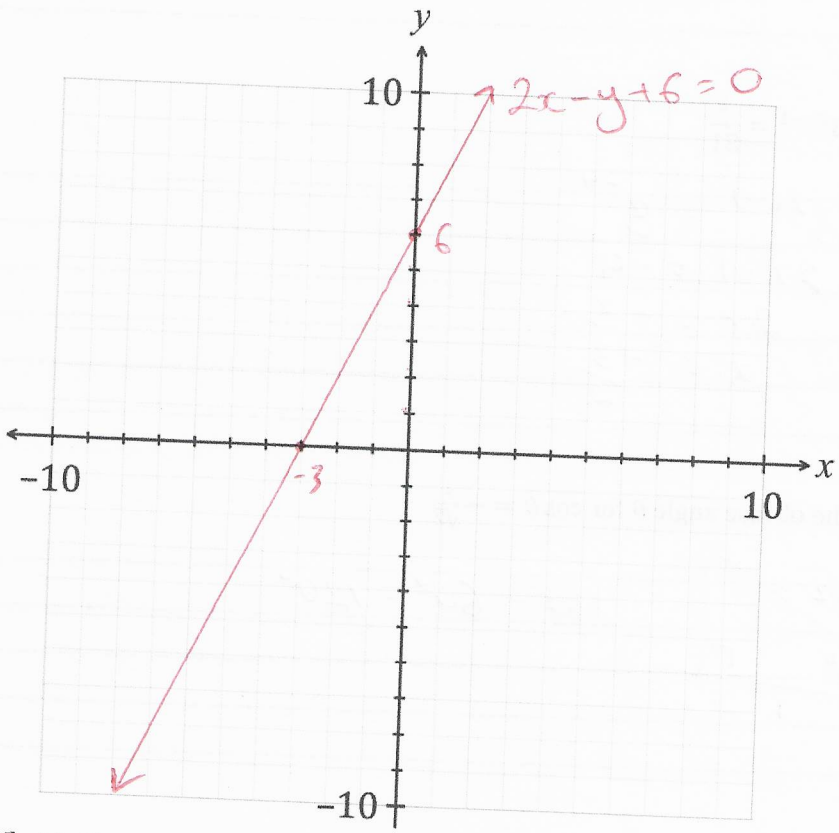
$7(4) + 2y = 34$

$2y = 6$

$y = 3$

ECF was awarded if students made incorrect progress but used that progress correctly to find the other value

(b) (i) Draw the line $2x - y + 6 = 0$ on the number plane below. **2**



(ii) What is the equation of a line perpendicular to the line drawn that passes through $(0, 15)$? **1**

$m_1 = 2$ $m_2 = -\frac{1}{2}$

$\therefore y = -\frac{1}{2}x + 15$

Awarded the mark if students found the negative reciprocal of the gradient, even if they used the wrong y-intercept.

Question 31 (5 marks) **Marks**

(a) What is the reference angle in the first quadrant for $\sin 150^o$? **1**

$30°$

(b) If $V = \frac{G^2 h}{4\pi}$ $(G > 0)$ **1**

express this with G as the subject

$G = 2\sqrt{\frac{V\pi}{h}}$

Also accepted the unsimplified version where the 4 was under the square root

(c) Solve $3^{2x-1} = \frac{1}{81}$ **1**

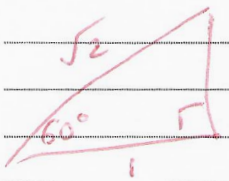
$3^{2x-1} = 3^{-4}$

$2x - 1 = -4$

$2x = -3$

$x = -\frac{3}{2}$

(d) Find the obtuse angle θ for $\cos\theta = -\frac{1}{\sqrt{2}}$ **2**



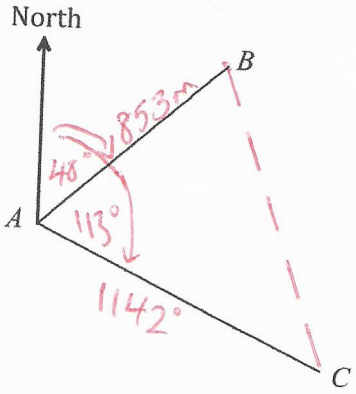
$180° - 60° = 120°$

Answer should be 135. Solution used ~~incorrect exact value~~ triangle, silly error!

Question 32 (5 marks)

Marks

(a) Points A, B and C are all located on level ground. Point A to point B is a distance of 853 m on a true bearing of 048°. Point A to point C is a distance of 1142 m on a true bearing of 113°.



Not to scale

(i) Show that $\angle BAC = 65^o$ **1**

113 − 48 = 65°

(ii) What is the distance between points B and C to the nearest metre? **2**

$c^2 = a^2 + b^2 - 2ab\cos C$

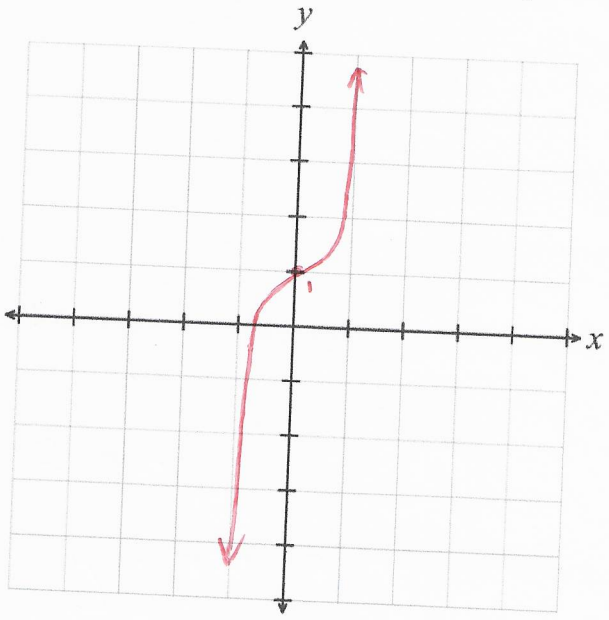
$= 853^2 + 1142^2 - 2(853)(1142)\cos 65°$

$= \sqrt{1208406.128}$

$= 1099\ m^2$

Many students used pythagoras or trig ratios. These only apply to right-angled triangles

(b) Draw a neat sketch of $y = x^3 + 1$, labelling the y-intercept **2**



① correct shape

① correct y-intercept.

To access the y-intercept mark you must have drawn a cubic. No marks awarded if you drew a straight line or a parabola, for example.

End of paper