Blacktown Boys' High School

2022 Year 11

Assessment Task 3

Mathematics Advanced

General Instructions

- Reading time – 10 minutes
- Working time – 2 hours
- Write using black pen
- Calculators approved by NESA may be used
- A reference sheet is provided for this paper
- All diagrams are not drawn to scale
- In Questions 11 – 25, show relevant mathematical reasoning and/or calculations

Total marks: 70

Section I – 10 marks (pages 3 – 7)
- Attempt Questions 1 – 10
- Allow about 15 minutes for this section

Section II – 60 marks (pages 8 – 20)
- Attempt Questions 11 – 25
- Allow about 1 hour 45 minutes for this section

Assessor: Mrs Chirgwin

Student Name: _____

Teacher Name: _____

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Section I

10 marks
Attempt Questions 1–10

Use the multiple choice answer sheet for Questions 1–10.

Q1. Which of the following is equivalent to $\dfrac{1}{2\sqrt{3}+\sqrt{10}}$?

A. $\sqrt{3}-\sqrt{10}$

B. $2\sqrt{3}+\sqrt{10}$

C. $\dfrac{2\sqrt{3}-\sqrt{10}}{2}$

D. $\dfrac{2\sqrt{3}+\sqrt{10}}{2}$

Q2. Which of the following lines is perpendicular to $y=5x-3$ and has the same y-intercept?

A. $x+5y+15=0$

B. $x+5y+3=0$

C. $x-5y-3=0$

D. $x-5y-15=0$

Q3. Let $g(x)=x^2-2x+5$ and $f(x)=e^{7-3x}$. Then $f\big(g(x)\big)$ is given by

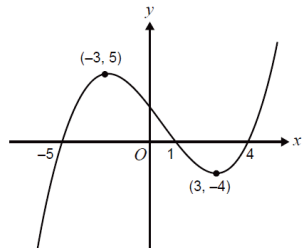
A. $e^{-3x^2+6x+22}$

B. e^{-3x^2+6x-8}

C. e^{-3x^2-6x-2}

D. $e^{14-6x}-2e^{7-3x}+5$

Q4. For the graph of $y=f(x)$ shown below, $f'(x)$ is negative when



A. $-3\le x\le 3$

B. $-3<x<3$

C. $x<-5$ or $1<x<4$

D. $x<-3$ or $x>3$

Q5. Which of the following relations is ‘one-to-many’?

A. $y=5e^{-2x}+1$

B. $y=\sqrt{1-x^2}$

C. $x=y^2+1$

D. $x=(2y-1)^{-1}$

Q6. The range of $y=e^{-x}+1$ is

A. $(-\infty,1)$

B. $(-\infty,\infty)$

C. $(-1,\infty)$

D. $(1,\infty)$

Q7. Given that $x = 3^p$ and $y = 9^q$, then $\log_3(x^5y^3)$ is

A. $5p + 6q$

B. $5p + 3q$

C. $3p + 9q$

D. $15p + 27q$

Q8. A general practitioner doctor is interested in knowing how many years his patients stay with him. Let X be the number of years a patient will stay with the doctor. Over the years, he has established the following probability distribution:

x	1	2	3	4	5	6
$P(X = x)$	$2k$	k	$2k$	$3k$	0.34	$2k$

The value of k is

A. 0.034

B. 0.066

C. 0.34

D. 0.66

Q9. Shirley is a table tennis player. If she wins a game, the probability that she will win the next game is 0.8. If she loses a game, the probability that she will lose the next game is 0.4. Shirley has just won a game. The probability that she will win exactly one of her next two games is:

A. 0.28

B. 0.32

C. 0.64

D. 0.92

Q10. Two non-mutually exclusive events, A and B, such that $P(A) = \frac{2}{5}$ and $P(B) = \frac{1}{4}$. If $\bar{A}$ denotes the complement of A and $P(A \cup B) = \frac{5}{8}$, then $P(\bar{A} \cap B)$ is

A. $\frac{29}{40}$

B. $\frac{21}{40}$

C. $\frac{19}{40}$

D. $\frac{9}{40}$

End of Section I

Mathematics Advanced

Section II Answer Booklet

60 marks
Attempt Questions 11-25
Allow about 1 hour and 45 minutes for this section

Instructions

- Answer the questions in the spaces provided. Sufficient spaces are provided for typical responses.
- Your responses should include relevant mathematical reasoning and/or calculations.
- Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Question 11 (2 marks)

Solve $|5x - 2| = 8$ **2**

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Question 12 (2 marks)

Find the exact value of $\sec\frac{4\pi}{3}\cot\frac{4\pi}{3}$. **2**

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Question 13 (4 marks)

Consider the function $f(x) = \dfrac{3}{x+2}$

(a) Show that $f(x)$ is neither an even nor an odd function. **1**

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(b) State the domain of $y = f(x)$. **1**

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(c) Sketch the graph of $y = f(x)$. **2**

Question 14 (4 marks)

Find the derivative of the following, leaving your answers in the simplest form.

(a) $y = e^{10x} + \dfrac{x}{2}$ **2**

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(b) $y = \dfrac{5-3x}{5x+2}$ **2**

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Question 15 (2 marks)

Given that $\tan\theta = \dfrac{11}{15}$, find the exact values of $\sin\theta$. **2**

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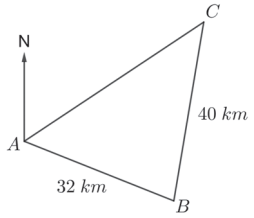
Question 16 (5 marks)

Two geologists on a large flat site drive $32\ km$ from point A on a bearing of $112°T$ to point B. They then drive $40\ km$ on a bearing of $010°T$ to point C.



NOT TO SCALE

(a) Show that $\angle ABC = 78°$. **1**

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(b) Use the cosine rule to find the distance of point C from point A to the nearest kilometre. **2**

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(c) Find the bearing of A from C, round your answer to the nearest degree. **2**

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Question 17 (5 marks)

Solve the following equations to find the exact values of x.

(a) $\log_5(7x+1) - \log_5(x-1) = 2$ **2**

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(b) $3 \times 9^x - 13 \times 3^x + 4 = 0$ **3**

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Question 18 (5 marks)

Joshua has noticed that the probability distribution for $X =$ number of students in line at the front office when he is at the front office is shown below.

x	0	1	2	3	4
$P(X = x)$	0.22	0.16	0.31	k	0.13

(a) Show that the value of k is 0.18. **1**

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(b) Find the value of $E(X)$. **1**

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(c) Find the variance of X and the standard deviation. Round your answers to 3 significant figures. **2**

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(d) What is the probability that there will be no less than 3 students in line when Joshua is at the front office? **1**

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Question 19 (5 marks)

A bag contains five red and six blue discs. One disc is drawn at random from the bag and replaced only if it is blue. Another disc is then drawn.

(a) Find the probability of selecting a red and then a blue disc. **1**

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(b) Find the probability of selecting two discs of the same colour. **2**

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(c) Find the probability of selecting at least one red disc. **2**

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Question 20 (6 marks)

An experimental vaccine was injected into a rat. The amount, M millilitres, of vaccine present in the bloodstream of the rat, t hours later was given by

$$M = e^{-\frac{t}{4}} + 2$$

(a) How much vaccine was initially injected into the rat? **1**

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(b) At what rate was the amount of vaccine decreasing at the end of 3 hours? **2**

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(c) Show that there will always be more than 2 millilitres of vaccine present in the rat's bloodstream. **1**

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(d) Sketch the curve of $M = e^{-\frac{t}{4}} + 2$ to show how the amount of vaccine present in the rat's bloodstream changes over time. **2**

Question 21 (3 marks)

The curve $y = ax^3 + bx$ passes through the point $(1, 7)$. The tangent at this point is parallel to the line $y = 3x - 8$. Find the values of a and b.

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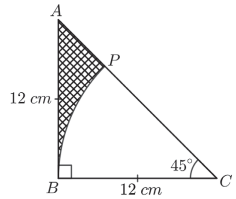
Question 22 (4 marks)

In the diagram below, ABC is a right-angled isosceles triangle with $\angle ABC = 90°$ and $AB = BC = 12\ cm$. Arc BP with centre C and radius CB is drawn to meet AC at P.



(a) Find the exact area of the shaded region ABP. **2**

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(b) Find the exact perimeter of the shaded region ABP. **2**

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Question 23 (6 marks)

(a) Given that $f(x) = (3 - 2x)\sqrt{4x + 1}$, show that $f'(x) = \dfrac{4(1 - 3x)}{\sqrt{4x + 1}}$. **3**

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(b) Find the equation of the normal at $x = 0$. **2**

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(c) Hence find the area enclosed by the normal and the x and y axes. **1**

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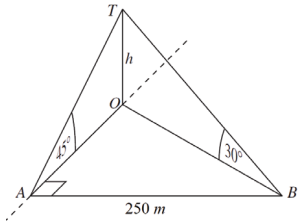
Question 24 (3 marks)

A surveyor stands at point A, which is due south of tower OT of height h metres. The angle of elevation of the top of the tower from A is 45°. The surveyor then walks 250 metres due east to point B, from where he measures the angle of elevation of the top of the tower to be 30°.



(a) Show that $OB = \sqrt{3}h$. **1**

(b) Find the height of the tower OT, round your answer to the nearest metre. **2**

Question 25 (4 marks)

(a) Show that $\dfrac{\tan\theta}{\sec\theta - 1} - \dfrac{\tan\theta}{\sec\theta + 1} = 2\cot\theta$. **2**

(b) Hence solve $\dfrac{\tan\theta}{\sec\theta + 1} - \dfrac{\tan\theta}{\sec\theta - 1} = \dfrac{2}{\sqrt{3}}$, where $0 \le \theta \le 2\pi$. **2**

End of Section II

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

BBHS 2022 Year 11 Mathematics Advanced AT3

Section II extra writing space

If you use this space, clearly indicate which question you are answering.

Student Name:_____

Multiple Choice Answer Sheet

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ⊗ C ○ D ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word 'correct' and drawing an arrow as follows.

A ⊗ B ⊗ ← correct C ○ D ○

Start Here →

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 ○

2022 Year 11 Mathematics Advanced AT3 Solutions

Section 1

Q1. — **C** — 1 Mark

$$\frac{1}{2\sqrt{3}+\sqrt{10}} \times \frac{2\sqrt{3}-\sqrt{10}}{2\sqrt{3}-\sqrt{10}}$$
$$= \frac{2\sqrt{3}-\sqrt{10}}{12-10}$$
$$= \frac{2\sqrt{3}-\sqrt{10}}{2}$$

Q2. — **A** — 1 Mark

$y = 5x - 3$
$m_1 = 5$

Perpendicular line:
$m_2 = -\frac{1}{5}$
$y = -\frac{1}{5}x - 3$
$5y = -x - 15$
$x + 5y + 15 = 0$

Q3. — **B** — 1 Mark

$f(g(x)) = e^{7-3(x^2-2x+5)}$
$f(g(x)) = e^{7-3x^2+6x-15}$
$f(g(x)) = e^{-3x^2+6x-8}$

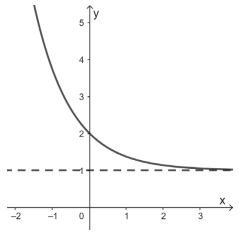
Q4. — **B** — 1 Mark

$f(x)$ has negative gradient where $-3 < x < 3$

Q5. — **C** — 1 Mark

$y = 5e^{-2x} + 1$ is an exponential function that is "one-to-one".
$y = \sqrt{1 - x^2}$ is a semi-circle that is "many-to-one".
$x = y^2 + 1$ is a sideways parabola that is "one-to-many".
$x = (2y - 1)^{-1} = \frac{1}{2y-1}$ is a hyperbolic function that is "one-to-one".

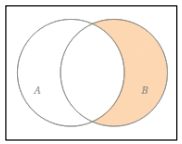
Q6. — **D** — 1 Mark

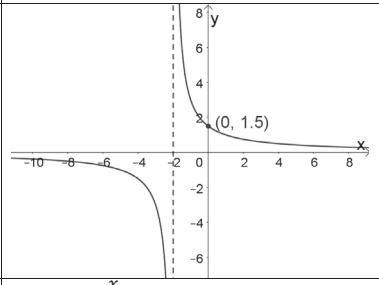


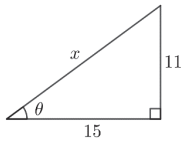
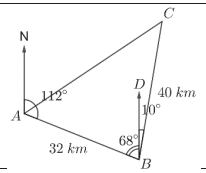
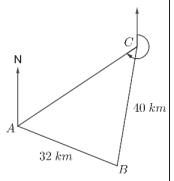
Range is $(1, \infty)$

Q7. — **A** — 1 Mark

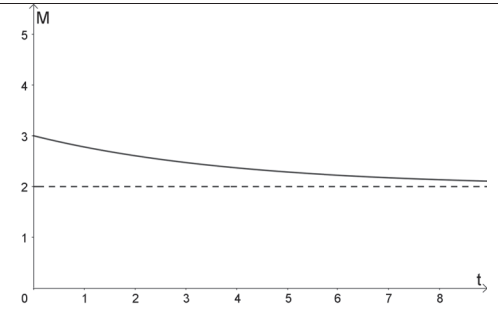
$\log_3(x^5y^3) = \log_3(x^5) + \log_3(y^3)$
$= 5\log_3(x) + 3\log_3(y)$
$= 5\log_3(3^p) + 3\log_3(9^q)$
$= 5p\log_3(3) + 3\log_3(3^{2q})$
$= 5p + 6q$

Q8.	**B** $2k + k + 2k + 3k + 0.34 + 2k = 1$ $10k = 1 - 0.34$ $k = 0.066$	1 Mark
Q9.	**A** $P(WL) + P(LW)$ $= 0.8 \times 0.2 + 0.2 \times 0.6$ $= 0.28$	1 Mark
Q10.	**D**  $P(\bar{A} \cap B) = P(A \cup B) - P(A)$ $= \frac{5}{8} - \frac{2}{5}$ $= \frac{9}{40}$ Or $P(\bar{A} \cap B) = P(B) - P(A \cap B)$ $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ $\frac{5}{8} = \frac{2}{5} + \frac{1}{4} - P(A \cap B)$ $P(A \cap B) = \frac{2}{5} + \frac{1}{4} - \frac{5}{8}$ $P(A \cap B) = \frac{1}{40}$ $P(\bar{A} \cap B) = P(B) - P(A \cap B)$ $P(\bar{A} \cap B) = \frac{1}{4} - \frac{1}{40}$ $P(\bar{A} \cap B) = \frac{9}{40}$	1 Mark

Section 2		
Q11	$\|5x - 2\| = 8$ $5x - 2 = 8$ OR $-(5x - 2) = 8$ $5x = 10$ $-5x + 2 = 8$ $x = 2$ $-5x = 6$ $x = -\frac{6}{5}$	2 Marks Correct solution 1 Mark Solves for one correct answer for x
Q12	$\sec\frac{4\pi}{3}\cot\frac{4\pi}{3}$ $= \frac{1}{\cos\frac{4\pi}{3}} \times \frac{1}{\tan\frac{4\pi}{3}}$ $= -2 \times \frac{1}{\sqrt{3}}$ $= -\frac{2}{\sqrt{3}}$	2 Marks Correct solution 1 Mark Identifies $\sec\frac{4\pi}{3}\cot\frac{4\pi}{3}$ $= \frac{1}{\cos\frac{4\pi}{3}} \times \frac{1}{\tan\frac{4\pi}{3}}$
Q13a	$f(x) = \frac{3}{x+2}$ $f(-x) = \frac{3}{-x+2}$ $f(x) \neq f(-x)$ $\therefore f(x)$ is not an even function. $-f(-x) = -\frac{3}{-x+2}$ $-f(-x) = \frac{3}{x-2}$ $f(x) \neq -f(-x)$ $\therefore f(x)$ is not an odd function.	1 Mark Correct solution
Q13b	Domain: $x \neq -2$ or $(-\infty, -2) \cup (-2, \infty)$	1 Mark Correct solution
Q13c	 	2 Marks Correct graph with all features shown 1 Mark Correct graph with some features shown
Q14a	$y = e^{10x} + \frac{x}{2}$ $\frac{dy}{dx} = 10e^{10x} + \frac{1}{2}$	2 Marks Correct solution 1 Mark Differentiates e^{10x} or $\frac{x}{2}$ correctly
Q14b	$y = \frac{5 - 3x}{5x + 2}$ $\frac{dy}{dx} = \frac{(5x+2) \times (-3) - (5 - 3x) \times 5}{(5x+2)^2}$ $\frac{dy}{dx} = \frac{-15x - 6 - 25 + 15x}{(5x+2)^2}$ $\frac{dy}{dx} = \frac{-31}{(5x+2)^2}$	2 Marks Correct solution 1 Mark Applies the quotient rule correctly

Q15	$\tan\theta = \frac{11}{15}$ $x = \sqrt{11^2 + 15^2}$ $x = \sqrt{346}$ $\sin\theta = \pm\frac{11}{\sqrt{346}}$  	2 Marks Correct solution 1 Mark Finds $\sqrt{346}$
Q16a	Let D be somewhere directly north of B $\angle DBA = 180° - 112° = 68°$ $\angle DBC = 10°$ $\angle ABC = 68° + 10°$ $\angle ABC = 78°$  	1 Mark Correct solution
Q16b	$AC^2 = 32^2 + 40^2 - 2 \times 32 \times 40 \times \cos 78°$ $AC = \sqrt{2624 - 2560\cos 78°}$ $AC = 45.7\ldots$ $AC = 46\ km$ (nearest kilometre)	2 Marks Correct solution 1 Mark Correctly applies the cosine rule
Q16c	$\frac{\sin\angle ACB}{32} = \frac{\sin\angle ABC}{46}$ $\sin\angle ACB = \frac{\sin 78°}{46} \times 32$ $\angle ACB \approx 42.8\ldots$ $\angle ACB = 43°$ (nearest degree) Bearing of A from C is $180° + 10° + 43° = 233°$  Or $\frac{\sin\angle CAB}{40} = \frac{\sin\angle ABC}{46}$ $\angle CAB = 58°$ $\angle NAC = 112° - 58° = 54°$ Bearing of A from C is $360° - (180° - 54°) = 234°$	2 Marks Correct solution 1 Mark Finds $\angle ACB$ or $\angle CAB$
Q17a	$\log_5(7x+1) - \log_5(x-1) = 2$ $\log_5\left(\frac{7x+1}{x-1}\right) = 2$ $\frac{7x+1}{x-1} = 5^2$ $7x + 1 = 25(x-1)$ $7x + 1 = 25x - 25$ $18x = 26$ $x = \frac{13}{9}$	2 Marks Correct solution 1 Mark Finds $\frac{7x+1}{x-1} = 5^2$
Q17b	$3 \times 9^x - 13 \times 3^x + 4 = 0$ $3 \times 3^{2x} - 13 \times 3^x + 4 = 0$ Let $u = 3^x$ $3u^2 - 13u + 4 = 0$ $(3u-1)(u-4) = 0$ $u = \frac{1}{3}\ \ or\ \ u = 4$ $3^x = \frac{1}{3}\ \ or\ \ 3^x = 4$ $x = -1\ \ or\ \ x = \frac{\ln 4}{\ln 3}$	3 Marks Correct solution 2 Marks Makes Significant progress and finds $3^x = 4$ and $3^x = 3^{-1}$ 1 Mark Correct factorisation

Q18a	$0.22 + 0.16 + 0.31 + k + 0.13 = 1$ $k = 0.18$	1 Mark Correct solution
Q18b	$E(X) = 0 \times 0.22 + 1 \times 0.16 + 2 \times 0.31 + 3 \times 0.18 + 4 \times 0.13$ $E(X) = 1.84$	1 Mark Correct solution
Q18c	$Var(X) = E(X^2) - \mu^2$ $Var(X) = (0^2 \times 0.22 + 1^2 \times 0.16 + 2^2 \times 0.31 + 3^2 \times 0.18 + 4^2 \times 0.13) - 1.84^2$ $Var(X) = 1.7144 = 1.71$ (3 sig fig) $\sigma = \sqrt{Var(X)} = \sqrt{1.7144}$ $\sigma = 1.3093\ldots = 1.31$ (3 sig fig)	2 Marks Correct solution 1 Mark Finds the correct variance or standard deviation
Q18d	$P(X \geq 3) = 0.18 + 0.13$ $P(X \geq 3) = 0.31$	1 Mark Correct solution
Q19a	$P(RB) = \frac{5}{11} \times \frac{6}{10}$ $P(RB) = \frac{3}{11}$	1 Mark Correct solution
Q19b	$P(RR) + P(BB) = \frac{5}{11} \times \frac{4}{10} + \frac{6}{11} \times \frac{6}{11}$ $P(RR) + P(BB) = \frac{58}{121}$	2 Marks Correct solution 1 Mark Finds $P(RR)$ or $P(BB)$
Q19c	$P(at\ least\ 1\ red) = 1 - P(no\ red)$ $P(at\ least\ 1\ red) = 1 - P(BB)$ $P(at\ least\ 1\ red) = 1 - \frac{6}{11} \times \frac{6}{11}$ $P(at\ least\ 1\ red) = \frac{85}{121}$	2 Marks Correct solution 1 Mark Recognises $P(at\ least\ 1\ red) = 1 - P(BB)$ and makes significant progress
Q20a	$M = e^0 + 2$ $M = 3$ Initially 3ml of vaccine was injected into the rat.	1 Mark Correct solution
Q20b	$M = e^{-\frac{t}{4}} + 2$ $\frac{dM}{dt} = -\frac{1}{4}e^{-\frac{t}{4}}$ At $t = 3$ $\frac{dM}{dt} = -\frac{1}{4}e^{-\frac{3}{4}}$ $\frac{dM}{dt} = -0.118\ldots$ The amount of vaccine is decreasing at a rate of 0.118mL per hour at the end of 3 hours.	2 Marks Correct solution 1 Mark Finds the correct derivative function
Q20c	As $t \to \infty$ $e^{-\frac{t}{4}} \to 0$ $M \to 0 + 2$ $M \to 2$ There will always be more than 2mL of vaccine present in the rat's bloodstream.	1 Mark Correct solution

Q20d		2 Marks Correct graph with all key features shown 1 Mark Correct graph with some key features shown, must include horizontal asymptote at $y = 2$
Q21	$y = ax^3 + bx$ $\frac{dy}{dx} = 3ax^2 + b$ At $x = 1$, tangent is parallel to $y = 3x - 8$, so the gradient of tangent is $m = 3$ $m_T = 3a \times 1^2 + b$ $m_T = 3a + b$ $3a + b = 3 \quad (1)$ At $(1, 7)$ $7 = a \times 1^3 + b \times 1$ $a + b = 7 \quad (2)$ $(1) - (2)$ $2a = -4$ $a = -2$ Sub $a = -2$ into (2) $-2 + b = 7$ $b = 9$ $\therefore a = -2, b = 9$	3 Marks Correct solution 2 Marks Makes significant progress 1 Mark Finds $3a + b = 3$
Q22a	Area of sector BPC $A_{BPC} = \frac{1}{2} \times 12^2 \times \frac{\pi}{4} = 18\pi \ cm^2$ Area of ΔABC $A_{BPC} = \frac{1}{2} \times 12 \times 12 = 72 \ cm^2$ Area of shaded region ABP $A_{ABP} = (72 - 18\pi) \ cm^2$	2 Marks Correct solution 1 Mark Finds exact area of the sector BPC
Q22b	Perimeter of shaded region ABP $P = AB + AP + BP$ $P = AB + (AC - PC) + BP$ $P = 12 + \left(\sqrt{12^2 + 12^2} - 12\right) + 12 \times \frac{\pi}{4}$ $P = \sqrt{288} + 3\pi$ $P = \left(12\sqrt{2} + 3\pi\right) cm$	2 Marks Correct solution 1 Mark Finds AP or BP

Q23a	$f(x) = (3 - 2x)\sqrt{4x + 1} = (3 - 2x)(4x + 1)^{\frac{1}{2}}$ $f'(x) = -2 \times (4x + 1)^{\frac{1}{2}} + (3 - 2x) \times \frac{1}{2} \times 4(4x + 1)^{-\frac{1}{2}}$ $f'(x) = -2(4x + 1)^{\frac{1}{2}} + 2(3 - 2x)(4x + 1)^{-\frac{1}{2}}$ $f'(x) = (4x + 1)^{-\frac{1}{2}}\left(-2(4x + 1) + 2(3 - 2x)\right)$ $f'(x) = (4x + 1)^{-\frac{1}{2}}(-8x - 2 + 6 - 4x)$ $f'(x) = (4x + 1)^{-\frac{1}{2}}(4 - 12x)$ $f'(x) = \frac{4(1 - 3x)}{\sqrt{4x + 1}}$	3 Marks Correct solution 2 Marks Differentiates correctly using both product and chain rule, combines into one fraction or factorised out $(4x + 1)^{-\frac{1}{2}}$ 1 Mark Correct differentiation of $\sqrt{4x + 1}$
Q23b	At $x = 0$, $f(0) = (3 - 0)\sqrt{0 + 1} = 3$ $f'(0) = m_T = \frac{4(1 - 0)}{\sqrt{0 + 1}} = 4$ $m_N = -\frac{1}{4}$ Equation of normal $y - 3 = -\frac{1}{4}(x - 0)$ $4y - 12 = -x$ $x + 4y - 12 = 0$	2 Marks Correct solution 1 Mark Finds the gradient of the normal
Q23c	x-intercept, $y = 0$, $x = 12$ y-intercept, $x = 0$, $y = 3$ $Area = \frac{1}{2} \times 3 \times 12 = 18 \ units^2$	1 Mark Correct solution
Q24a	$\tan 30° = \frac{h}{OB}$ $OB = \frac{h}{\tan 30°}$ $OB = \sqrt{3}h$	1 Mark Correct solution
Q24b	$\tan 45° = \frac{h}{OA}$ $OA = h$ $OB^2 = OA^2 + AB^2$ $\left(\sqrt{3}h\right)^2 = h^2 + 250^2$ $3h^2 - h^2 = 62500$ $2h^2 = 62500$ $h^2 = 31250$ $h = \sqrt{31250}$ $h = 176.77 \ldots$ $h = 177 \ m$	2 Marks Correct solution 1 Mark Establishes $\left(\sqrt{3}h\right)^2 = h^2 + 250^2$

Q25a	$\frac{\tan\theta}{\sec\theta-1}-\frac{\tan\theta}{\sec\theta+1}=2\cot\theta$ $LHS=\frac{\tan\theta}{\sec\theta-1}-\frac{\tan\theta}{\sec\theta+1}$ $LHS=\frac{\tan\theta\,(\sec\theta+1)-\tan\theta\,(\sec\theta-1)}{(\sec\theta-1)(\sec\theta+1)}$ $LHS=\frac{\tan\theta\sec\theta+\tan\theta-\tan\theta\sec\theta+\tan\theta}{\sec^2\theta-1}$ $LHS=\frac{2\tan\theta}{\sec^2\theta-1}$ $LHS=\frac{2\tan\theta}{\tan^2\theta}$ $LHS=\frac{2}{\tan\theta}$ $LHS=2\cot\theta$ $LHS=RHS$	2 Marks Correct solution 1 Mark Obtains $\frac{2\tan\theta}{\sec^2\theta-1}$
Q25b	$\frac{\tan\theta}{\sec\theta+1}-\frac{\tan\theta}{\sec\theta-1}=\frac{2}{\sqrt{3}}$ $\frac{\tan\theta}{\sec\theta-1}-\frac{\tan\theta}{\sec\theta+1}=-\frac{2}{\sqrt{3}}$ $2\cot\theta=-\frac{2}{\sqrt{3}}$ $\tan\theta=-\sqrt{3}$ $\theta=\frac{2\pi}{3},\frac{5\pi}{3}$	2 Marks Correct solution 1 Mark Finds $2\cot\theta=-\frac{2}{\sqrt{3}}$