BAULKHAM HILLS HIGH SCHOOL

2019

YEAR 11 YEARLY EXAMINATION

Mathematics Advanced

General Instructions

- Reading time – 10 minutes.
- Working time – 2 hours.
- Write using black or blue pen.
- NESA-approved calculators may be used.
- Answer all questions in the answer booklet provided.
- Show all necessary working in Questions 11-15.
- Marks may be deducted for careless or badly arranged work.
- A reference sheet is provided.

Total marks – 85
Exam consists of 10 pages.

This paper consists of TWO sections.

<u>Section 1</u> – Page 2-4 (10 marks)
Questions 1 - 10

- Attempt Questions 1 - 10
  Allow about 15 minutes for this section.

<u>Section II</u> – Pages 5 – 10 (75 marks)

- Attempt questions 11-15
  Allow about 1 hour 45 minutes for this section.

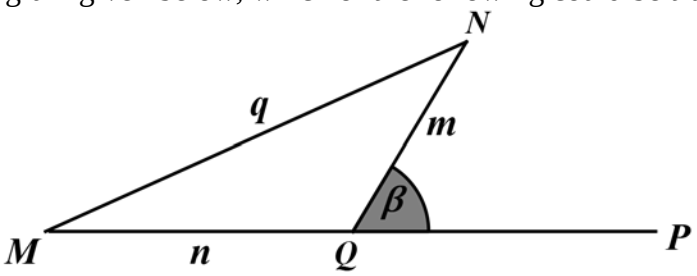
Section I - Multiple Choice (10 marks)
Allow about 15 minutes for this section.

Use the multiple choice page for Question 1 - 10

1 The zeroes of $f(x) = 3x^2 - 5x - 1$ are:

(A) $\frac{-5\pm\sqrt{13}}{6}$ (B) $\frac{5\pm\sqrt{13}}{6}$ (C) $\frac{-5\pm\sqrt{37}}{6}$ (D) $\frac{5\pm\sqrt{37}}{6}$

2 If $\angle NQP = \beta$ in the diagram given below, which of the following could be true?



(A) $q^2 = m^2 + n^2 + 2mn\,cos\beta$ (B) $q^2 = m^2 + n^2 - 2mn\,cos\beta$

(C) $m^2 = q^2 + n^2 - 2qn\,cos\beta$ (D) $\frac{m}{sin\angle NMQ} = \frac{q}{cos\beta}$

3 Which of the following is a one-to-one function?

(A) $y = x^3 - x$ (B) $y = x^2 + 4$ (C) $y = 1 - x^3$ (D) $y = \sqrt{9 - x^2}$

4 If the two straight lines $5x - y + 7 = 0$ and $ax + 2y - 11 = 0$ are perpendicular, then the value of a is:

(A) $-\frac{1}{5}$ (B) $\frac{-2}{5}$ (C) $\frac{1}{5}$ (D) $\frac{2}{5}$

5 The circle with equation $(x + 5)^2 + (y - 2)^2 = 9$ has centre and radius respectively:

(A) (-5,2) and 3

(B) (-5,2) and 9

(C) (5,-2) and 3

(D) (5,-2) and 9

6 How many values of x in the domain $0° \leq x \leq 360°$ satisfy the equation $(3\sin x - 1)(\cos^2 x - 1) = 0$?

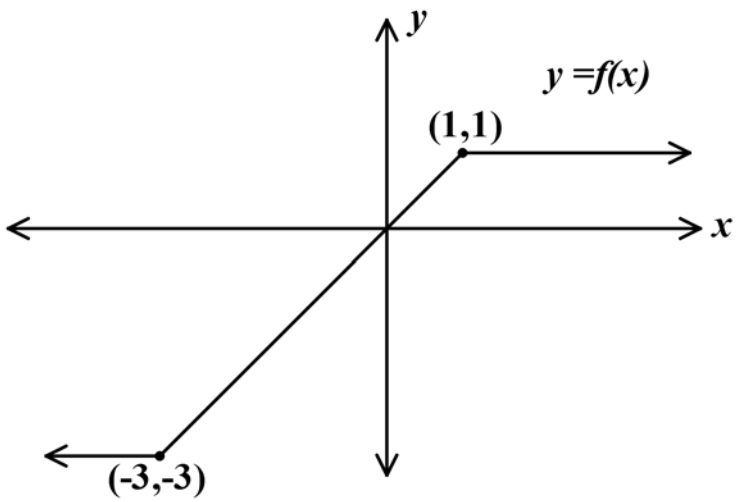
(A) 3 (B) 4 (C) 5 (D) 6

7 Express as a single logarithm:

$$\log_a x - \log_a y + 3\log_a z$$

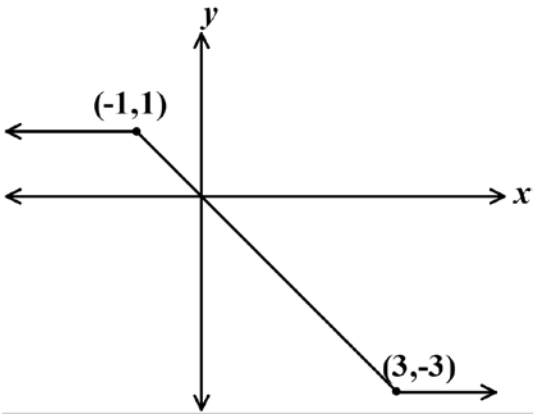
(A) $\log_a(\frac{xz^3}{y})$ (B) $\log_a(xz^3y)$ (C) $\log_a(\frac{3xz}{y})$ (D) $\log_a(\frac{x}{z^3y})$

8 The diagram shows the graph of $y = f(x)$.

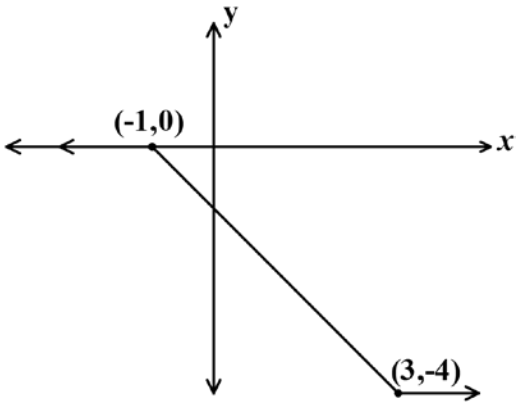


Which of the following shows $= f(-x) - 1$?

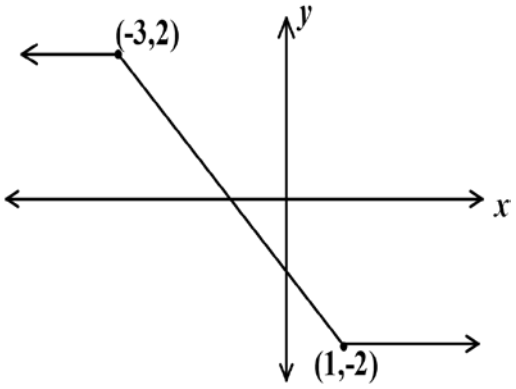
(A)



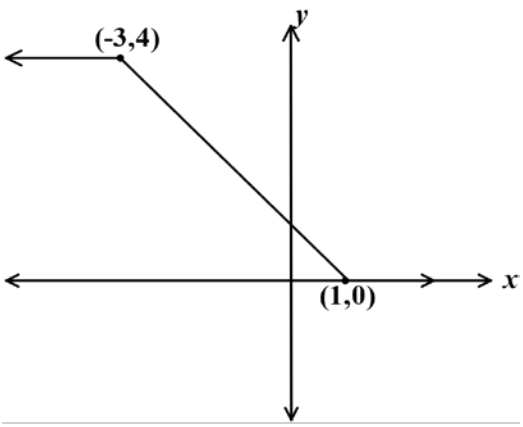
(B)



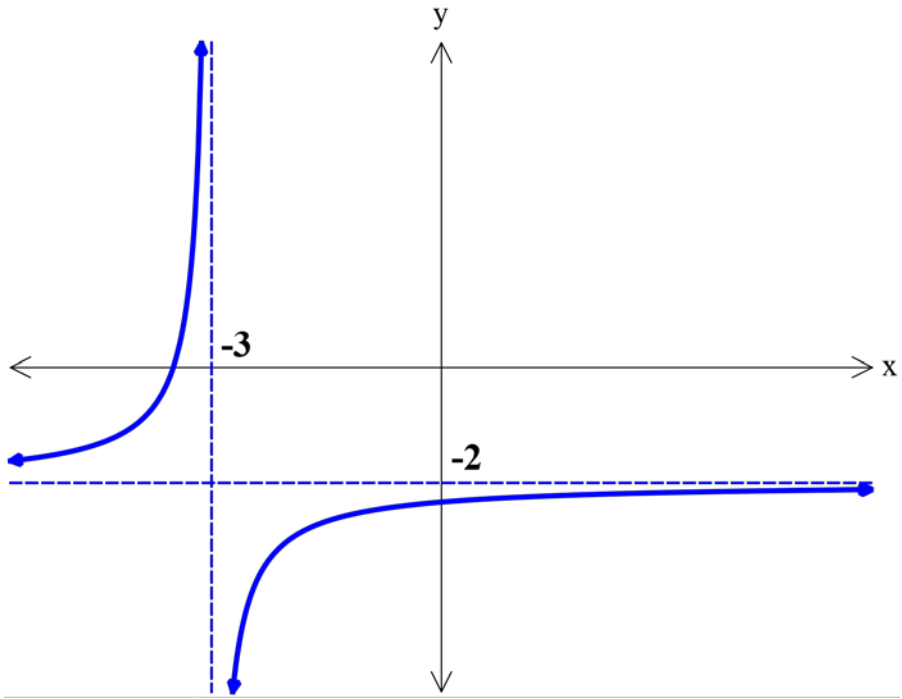
(C)



(D)



9 The graph of $y = \frac{-1}{x+b} + c$ is shown.



The values for b and c are:

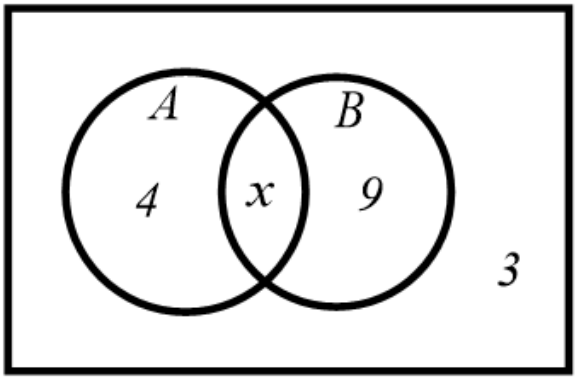
(A) $b = 3 \quad c = 2$

(B) $b = 3 \quad c = -2$

(C) $b = -3 \quad c = 2$

(D) $b = -3 \quad c = -2$

10 In the Venn diagram below, events A and B are independent.



What is the value of x?

(A) 6 (B) 8 (C) 12 (D) 15

End of Section I

Section II (60 marks)

Allow about 1 hour 45 minutes for this section.
Answer each question on the appropriate page in the writing booklet.

Question 11 (15 marks) *Start a new page in your answer booklet* — **Marks**

a) Factorise completely: **2**

$$m^2 + 7m - mn - 7n$$

b) Express as a single fraction in its simplest form: **2**

$$\frac{6}{3x-2} - \frac{8}{4x+1}$$

c) Solve simultaneously: **2**

$$-2x + 7y = 4$$
$$-3x + 5y = -5$$

d) Expand and simplify: $(\sqrt{5} - 2\sqrt{2})(2\sqrt{5} + \sqrt{2})$ **2**

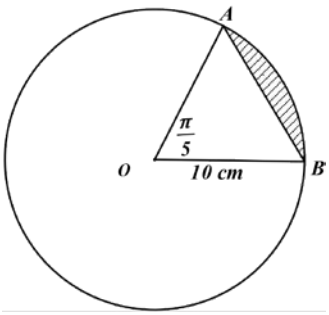
e) Evaluate: **2**

$$\lim_{x \to 5} \frac{x-5}{2x^2 - 9x - 5}$$

f) Simplify the expression: **2**

$$\frac{x^{n+2} + x^n}{x^{n-1} + x^{n+1}}$$

g) The diagram shows a circle with radius 10 cm, centre O.



Given $\angle AOB = \frac{\pi}{5}$:

(i) Find the exact length of the minor arc AB. **1**

(ii) Find the area of the segment shaded, correct to 3 significant figures. **2**

End of Question 11

Question 12 (15 marks) *Start a new page in your answer booklet*

a) Find the derivative of $f(x) = 5x^2 - 2x$ by first principles. **3**

b) Differentiate with respect to x:

(i) $y = 7x^4 + \frac{6}{x} - 9$ **2**

(ii) $y = \sqrt{2x - 5}$ **2**

(iii) $f(x) = \frac{x^2}{4x+1}$ **2**

c) At point P on the curve $y = 2x^2 - 4$, the gradient of the tangent is 6.

(i) Show that the coordinates of P are $(\frac{3}{2}, \frac{1}{2})$. **2**

(ii) Find the equation of the tangent at P. Answer in general form. **2**

d) Given $f(x) = \sqrt{9 - x^2}$:

(i) Show that $f(x)$ is an even function. **1**

(ii) Find the range of $f(x)$. **1**

End of Question 12

Question 13 (15 marks) *Start a new page in your answer booklet*

a) What is the domain of $(x) = \frac{x}{x-3} + \sqrt{x}$? **2**

b) If $\sin\theta = \frac{3}{4}$ and θ is acute, find the exact value of $\tan(\frac{\pi}{2} - \theta)$. **2**

c) Solve $2\sin\theta\cos\theta = \cos\theta$ for $0° \leq \theta \leq 360°$. **3**

d) The discrete random variable X can only take the values 1, 2, 3, 4, 5 and 6. The probability distribution is given below.

x	1	2	3	4	5	6
$p(x)$	$\frac{2}{9}$	$\frac{1}{9}$	$\frac{2}{9}$	$\frac{1}{9}$	$\frac{2}{9}$	$\frac{1}{9}$

(i) Show that the expected value is $(X) = \frac{10}{3}$. **1**

(ii) Find the value of the variance, $Var(X)$. Show your working. **2**

(iii) Find the probability that when two successive independent trials are made, the sum of their values is greater than 10. **2**

e) Solve for x: **3**

$$\log_4(x+4) + \log_4(x-2) = 2$$

End of Question 13

Question 14 *Start a new page in your answer booklet*

a) (i) By rationalising the denominator, show that; **2**

$$\frac{1}{\sqrt{n}+\sqrt{n+1}} = \sqrt{n+1} - \sqrt{n}$$

(ii) Hence or otherwise, evaluate: **1**

$$\frac{1}{\sqrt{0}+\sqrt{1}} + \frac{1}{\sqrt{1}+\sqrt{2}} + \frac{1}{\sqrt{2}+\sqrt{3}} + \frac{1}{\sqrt{3}+\sqrt{4}} + \cdots + \frac{1}{\sqrt{99}+\sqrt{100}}$$

b) A tour group consists of 14 people. 6 speak English only, 5 speak Italian only and 3 speak both English and Italian. None of them speak any other language.

(i) Given that a randomly selected person from this group speaks English, what is the probability that this person also speaks Italian? **1**

(ii) Two of these people are randomly seated next to each other on a bus. What is the probability that they cannot speak the same language? **2**

c) Given the equation of a parabola is $y = 2x^2 - x - 3$:

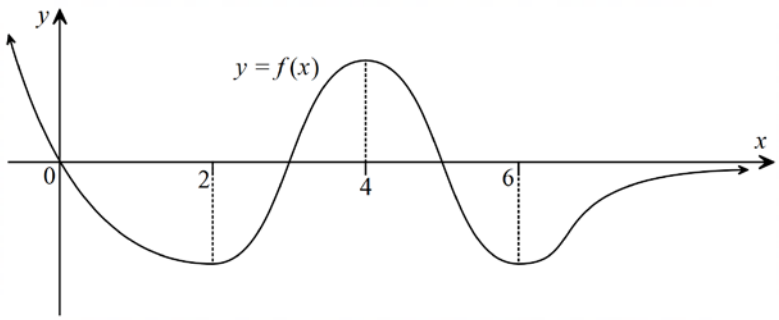
(i) Find its *x*-intercepts. **1**

(ii) Find the equation of its axis of symmetry. **1**

(iii) Find the coordinates of its vertex. **1**

(iv) Neatly sketch the curve showing all important features. **1**

d) Consider the function $y = f(x)$ shown below. **2**



For which values of x is the function increasing?

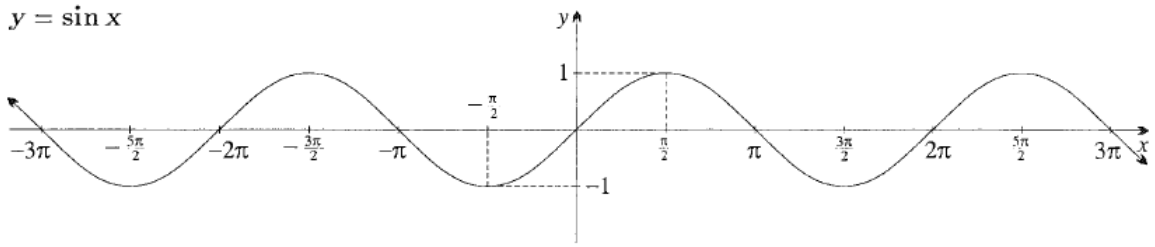
e) Simplify completely : **3**

$$\frac{\sin A}{1+\cos A} + \frac{1+\cos A}{\sin A}$$

End of Question 14

Question 15 (15 marks) *Start a new page in your answer booklet*

a) The graph below shows the curve $y = \sin x$. **2**



By drawing a suitable straight line on the graph provided in the answer booklet (and labelling the line with its equation), determine the number of solutions for the equation:

$$2\sin x = x - 4$$

b) Solve: **2**

$$|1 - 5x| = 16$$

c) Find the value of x if $e^{6x} - 6e^{3x} + 5 = 0$ **3**

d) By completing the square, solve the equation **2**

$$x^2 - 4x - 9 = 0$$

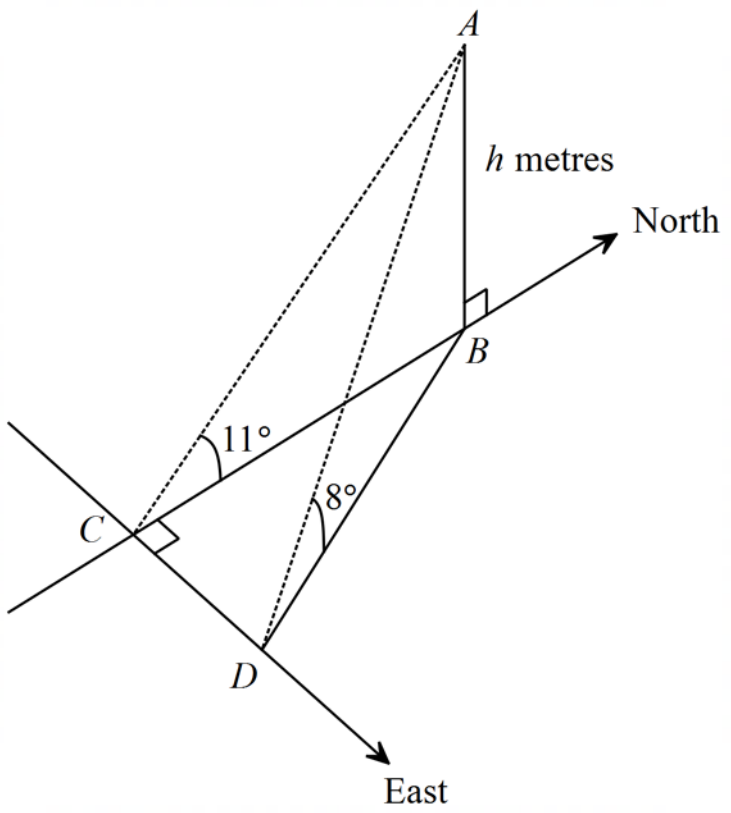
e) For which value(s) of *m* does the parabola $y = 3x^2 - 2mx + 5m$ have one *x*-intercept? **2**

Question 15 continues on the next page

Question 15 continued

f) A vertical tower AB and a straight road CD are on level ground. The tower is due north of C, and D is 2000 metres due east of C.

An observer notices that from C, the angle of elevation of the top of the tower is 11°, while from D, it is 8°.



Let CB= x, BD= y and AB= h.

(i) Show that $x = h \cot 11°$. **1**

(ii) Find the height of the tower, correct to 1 decimal place. **3**

End of Examination

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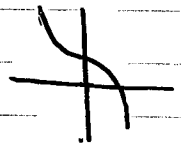
Mult. Choice

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

$= \frac{5 \pm \sqrt{25+12}}{6}$

$= \frac{5 \pm \sqrt{37}}{6}$ (D)

2. (A)

3.  (C)

4. $5x-y+7=0$ has $m=5$

Perp. line has $m=-\frac{1}{5}$

$m = -\frac{A}{B} = -\frac{a}{2} = -\frac{1}{5}$

$5a = 2$

$a = \frac{2}{5}$ (D)

5. (A)

6. $2\sin x = 1$ or $\cos^2 x = 1$

$\sin x = \frac{1}{2}$ $\cos x = \pm 1$

2 solns 3 solns

Total = 5 solns (C)

7. $\log_a \frac{x}{y} + \log_a z^3$

$= \log_a \left(\frac{x}{y} \times z^3\right)$

$= \log_a \left(\frac{xz^3}{y}\right)$ (A)

8. Reflect in y-axis, then translate 1 unit downward. (B)

9. $b=3$, $c=-2$ (B)

10. $P(A|B) = P(A)$ since independent

$\frac{x}{x+9} = \frac{x+4}{x+16}$

$x^2+16x = x^2+13x+36$

$3x = 36$

$x = 12$ (C)

1	D	6	C
2	A	7	A
3	C	8	B
4	D	9	B
5	A	10	C

✓

Question 11

a) $m(n+7) - n(n+7)$

$= (n-n)(n+7)$

11a
(1) Initial grouping/factorizing
(2) Correct soln

b) $\dfrac{6(4x+1) - 8(3x-2)}{(3x-2)(4x+1)}$

$= \dfrac{24x + 6 - 24x + 16}{(3x-2)(4x+1)}$

$= \dfrac{22}{(3x-2)(4x+1)}$

11b
(1) Correctly express with common denominator
(2) Correct soln

c) ① $\times 3$ $\quad -6x + 21y = 12$

② $\times 2$ $\quad -6x + 10y = -10$

$11y = 22$

$y = 2$

$-2x + 14 = 4$

$-2x = -10$

$x = 5$

11c
(1) Correctly express eqns with coefficients equal
(2) Correct soln

d) $(\sqrt{5} - 2\sqrt{2})(2\sqrt{5} + \sqrt{2})$

$= 10 + \sqrt{10} - 4\sqrt{10} - 4$

$= 6 - 3\sqrt{10}$

11d
(1) A correct expansion
(2) Correct soln

e) $\lim_{x \to 5} \dfrac{x-5}{2x^2 - 9x - 5}$

$= \lim_{x \to 5} \dfrac{x-5}{(x-5)(2x+1)}$

$= \dfrac{1}{11}$

11e
(1) Factorise and simplify fraction
(2) Correct answer with correct use of limit notation

f) $$\frac{x^{n+2}+x^{n}}{x^{n-1}+x^{n+1}} = \frac{x^{n}(x^{2}+1)}{x^{n}(x^{-1}+x)}$$

$$= (x^{2}+1) \div \left(\frac{1}{x}+x\right)$$

$$= (x^{2}+1) \div \frac{1+x^{2}}{x}$$

$$= (x^{2}+1) \times \frac{x}{x^{2}+1}$$

$$= x$$

11f
(1) Common factor x^{n} in numerator and denominator cancelled
(2) Correct soln

g) (i) $l = r\theta = 10 \times \frac{\pi}{5}$

$= 2\pi$ cm.

(ii) $A = \frac{1}{2}r^{2}(\theta - \sin\theta)$

$= \frac{1}{2} \times 10^{2} \times \left(\frac{\pi}{5} - \sin\frac{\pi}{5}\right)$

$= 2.03$ cm^{2}

11g (i)
(1) Correct soln
11g (ii)
(1) Correct substitution into formula shown
(2) Correct decimal answer

Question 12.

a) $f(x) = 5x^2 - 2x$

$f(x+h) - f(x) = 5(x+h)^2 - 2(x+h) - (5x^2 - 2x)$

$= 5(x^2 + 2xh + h^2) - 2x - 2h - 5x^2 + 2x$

$= 5x^2 + 10xh + 5h^2 - 2h - 5x^2$

$= 10xh + 5h^2 - 2h$

$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

$= \lim_{h \to 0} \frac{h(10x + 5h - 2)}{h}$

$= 10x + 0 - 2$

$= 10x - 2$.

12a
(1) Correct expression for f(x+h)-f(x)
(2) Correct expression for f'(x) with limit
(3) Correct soln - must use limit notation correctly throughout

b) (i) $y = 7x^4 + \frac{6}{x} - 9 = 7x^4 + 6x^{-1} - 9$

$\frac{dy}{dx} = 28x^3 - 6x^{-2}$ (or $28x^3 - \frac{6}{x^2}$)

12b(i)
(1) One correct term
(2) Correct soln

(ii) $y = \sqrt{2x - 5} = (2x-5)^{1/2}$

$\frac{dy}{dx} = \frac{1}{2}(2x-5)^{-1/2} \cdot 2$

$= (2x-5)^{-1/2}$ or $\frac{1}{\sqrt{2x-5}}$

12b(ii)
(1) 'correct' but missing factor 2
(2) Correct soln

(iii) $f(x) = \frac{x^2}{4x+1}$

$f'(x) = \frac{vu' - uv'}{v^2} = \frac{(4x+1) \cdot 2x - x^2 \cdot 4}{(4x+1)^2}$

$= \frac{8x^2 + 2x - 4x^2}{(4x+1)^2}$

$= \frac{4x^2 + 2x}{(4x+1)^2}$

12b (iii)
(1) Uses quotient rule
(2) Correct soln

c) (i) $m = \frac{dy}{dx} = 4x = 6$ at P.

$\therefore x = \frac{6}{4} = \frac{3}{2}$

12c(i)
(1) Obtains 4x=6
(2) Correctly obtains both x and y

At P: $x = \frac{3}{2}$

$y = 2\left(\frac{3}{2}\right)^2 - 4 = \frac{1}{2}$

$\therefore P\left(\frac{3}{2}, \frac{1}{2}\right)$

(ii) Tangent: $m = 6$, through $P\left(\frac{3}{2}, \frac{1}{2}\right)$

$y - y_1 = m(x - x_1)$

$y - \frac{1}{2} = 6\left(x - \frac{3}{2}\right)$

$y - \frac{1}{2} = 6x - 9$

$2y - 1 = 12x - 18$

$12x - 2y - 17 = 0.$

12c(ii)
(1) Uses pt-gradient or y=mx+b
(2) Correct soln in general form

d) $f(x) = \sqrt{9 - x^2}$

(i) $f(-x) = \sqrt{9 - (-x)^2}$

$= \sqrt{9 - x^2}$

$= f(x)$ $\therefore$ Even function

12d(i)
(1) Correct soln: must show replacement of x with -x

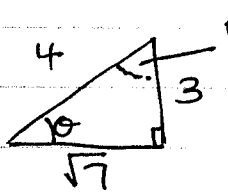
(ii) $0 \leq f(x) \leq 3$ (or $0 \leq y \leq 3$)

12d(ii)
(1) Correct range

Question 13

13a
(1) Partially correct soln
(2) Correct soln

a) $x \geq 0$, $x \neq 3$.

b) 

$\tan\left(\frac{\pi}{2} - \theta\right) = \frac{\sqrt{7}}{3}$.

13b
(1) Correct triangle, incorrect answer OR 'correct answer' for incorrect triangle
(2) Correct soln

c) $2\sin\theta\cos\theta - \cos\theta = 0 \quad (0^\circ \leq \theta \leq 360^\circ)$

$\cos\theta(2\sin\theta - 1) = 0$

$\cos\theta = 0$ or $\sin\theta = \frac{1}{2}$

$\theta = 90^\circ, 270^\circ, 30^\circ, 150^\circ$

13c
(1) Factorises correctly but no correct solns
Doesn't factorise, but 2 correct solns
(2) Factorises and 2 correct solns
(3) All 4 correct solns

d) (i) $E(X) = \sum x \cdot p(x)$

$= (1 \times \frac{2}{9}) + (2 \times \frac{1}{9}) + (3 \times \frac{2}{9}) + (4 \times \frac{1}{9}) + (5 \times \frac{2}{9}) + (6 \times \frac{1}{9})$

$= \frac{10}{3}$.

13d(i)
(1) Correctly shown

(ii) $Var(X) = \sum x^2 \cdot p(x) - \mu^2$

$= \left(\begin{matrix} (1 \times \frac{2}{9}) + (4 \times \frac{1}{9}) + (9 \times \frac{2}{9}) \\ + (16 \times \frac{1}{9}) + (25 \times \frac{2}{9}) + (36 \times \frac{1}{9}) \end{matrix} \right) - \left(\frac{10}{3}\right)^2$

$= 6 - \frac{28}{9}$

$= \frac{26}{9}$.

13d(ii)
(1) Finds $\Sigma x^2 p(x)$
(2) Correct soln

13d(iii)
(1) Recognises (5,6) (6,6) and (6,5) but uses incorrect products
OR Recognises 2 of these and correctly writes their products
(2) Correct soln

(iii) For a sum > 10, we need 5,6 or 6,6 or 6,5

$\therefore P(\text{sum} > 10) = \frac{2}{9} \times \frac{1}{9} + \frac{1}{9} \times \frac{1}{9} + \frac{1}{9} \times \frac{2}{9}$

$= \frac{5}{81}$

e) $\log_4 (x+4)(x-2) = 2$

$x^2 + 2x - 8 = 16$

$x^2 + 2x - 24 = 0$

$(x+6)(x-4) = 0$

$\therefore x = -6, 4$ but $x > 2$ in original equation

$\therefore$ $x = 4$ only

13e
(1) Forms and attempts to solve quadratic eqn
(2) Correctly solves quadratic but doesn't reject x=-6
(3) Correct soln

✓

Question 14.

a) (i) $LHS = \dfrac{1}{\sqrt{n}+\sqrt{n+1}} \times \dfrac{\sqrt{n}-\sqrt{n+1}}{\sqrt{n}-\sqrt{n+1}}$

$= \dfrac{\sqrt{n}-\sqrt{n+1}}{n-(n+1)}$

$= \dfrac{\sqrt{n}-\sqrt{n+1}}{-1}$

$= \sqrt{n+1}-\sqrt{n}$.

14a (i)	
(1)	Attempts to rationalize denominator
(2)	Correct soln
14a (ii)	
(1)	Correct soln

(ii) $Expression = (\sqrt{1}-\sqrt{0}) + (\sqrt{2}-\sqrt{1}) + (\sqrt{3}-\sqrt{2}) + \ldots + (\sqrt{100}-\sqrt{99})$

$= \sqrt{100}$

$= 10$.

b) (i) $P(\text{Italian} \mid \text{English}) = \dfrac{3}{9} = \dfrac{1}{3}$

14b (i)	
(1)	Correct soln

(ii) $P(\text{can't speak same language})$

$= P(IE \text{ or } EI)$

$= \dfrac{5}{14} \times \dfrac{6}{13} + \dfrac{6}{14} \times \dfrac{5}{13}$

$= \dfrac{30}{91}$

I = italian only

E = english only

14b (ii)	
(1)	Correct use of product rule for one for either IE or EI OR Considers both IE and EI but uses incorrect products
(2)	Correct soln

c) $y = 2x^2 - x - 3$

(i) $y = (2x-3)(x+1)$

x-ints : $x = \dfrac{3}{2}, -1$

y-int : -3

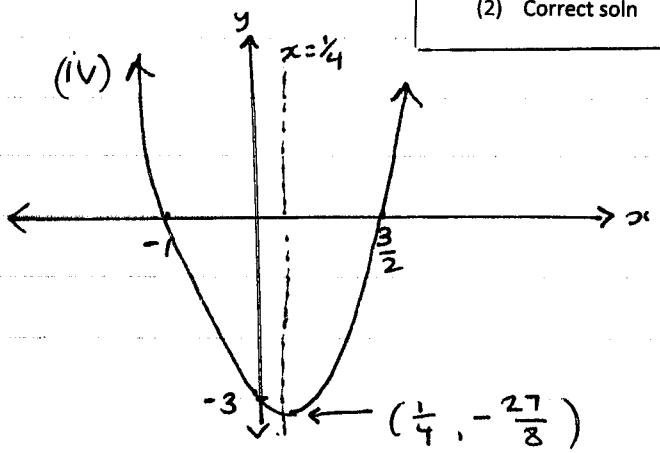
(ii) Axis $x = \dfrac{-b}{2a} = \dfrac{-(-1)}{4}$

$= \dfrac{1}{4}$

(iii) Vertex $\left(\dfrac{1}{4}, -3\dfrac{3}{8}\right)$

$\left(\dfrac{1}{8} - \dfrac{1}{4} - 3\right)$

(iv)



14c (i)		14c (iii)	
(1)	Correct x-intercepts	(1)	Correct coordinates
14c (ii)		**14c (iv)**	
(1)	Correct equation for axis	(1)	Correct sketch including y-intercept

14d
(1) $2<x<4$ or $x>6$
(2) Correct soln

d) $2 < x < 4$ and $x > 6$.

e) $\dfrac{\sin A}{1+\cos A} + \dfrac{1+\cos A}{\sin A} = \dfrac{\sin^2 A + (1+\cos A)^2}{\sin A(1+\cos A)}$

$= \dfrac{\sin^2 A + 1 + 2\cos A + \cos^2 A}{\sin A(1+\cos A)}$

14e
(1) Express with common denominator
(2) Obtain 2(1+cosA) in numerator
(3) Obtain 2cosecA

$= \dfrac{2 + 2\cos A}{\sin A(1+\cos A)}$

$= \dfrac{2(1+\cos A)}{\sin A(1+\cos A)}$

$= \dfrac{2}{\sin A}$

$= 2\,\text{cosec}\, A$.

Question 15

a) On the graph, draw $y = \frac{1}{2}x - 2$ (x-int 4, y-int −2)

Answer: 1 point of intersection ∴ 1 solution

15a
(1) Incorrect line, with 'correct' answer for that line
(2) Correct line ($y = \frac{1}{2}x - 2$) and answer

b) $|1 - 5x| = 16$

$1 - 5x = 16$ or $1 - 5x = -16$

$-5x = 15$ $\quad -5x = -17$

$x = -3$ $\quad x = \frac{17}{5}$

15b
(1) One correct soln
(2) Both correct solns

c) $e^{6x} - 6e^{3x} + 5 = 0$ Let $u = e^{3x}$

$u^2 - 6u + 5 = 0$

$(u-5)(u-1) = 0$

$u = e^{3x} = 5$ or $u = e^{3x} = 1$

$x = \frac{1}{3}\ln 5$, 0.

↖ (NOTE: $\frac{\ln 1}{3}$ must be expressed as 0)

15c
(1) Form and solve a quadratic eq
(2) Solve for x, obtain correct 1 soln
(3) Solve for x, obtaining both solns

d) $x^2 - 4x + 4 = 9 + 4$

$(x-2)^2 = 13$

$x - 2 = \pm\sqrt{13}$

$x = 2 \pm \sqrt{13}$

15d
(1) Forms the perfect square
(2) Correct soln

e) $\Delta = b^2 - 4ac$

$= (-2m)^2 - 4.3.5m$

$= 4m^2 - 60m$

$= 4m(m - 15)$

For one point of intersection, $\Delta = 0$

$\therefore m = 0, 15$.

15e
(1) Obtains correct discriminant but solves incorrectly
OR
Obtains incorrect discriminant but sets to zero and 'solves correctly'
(2) Correct soln

f) (i) In ΔABC $\tan 11° = \frac{h}{x}$

15f (i)
(1) Correctly shown

$\therefore x = \frac{h}{\tan 11°} = h \cot 11°$

(ii) Similarly, in ΔABD $\tan 8° = \frac{h}{y}$

$\therefore y = \frac{h}{\tan 8°} = h \cot 8°$

In ΔCBD,

$(h \cot 8°)^2 = (h \cot 11°)^2 + 2000^2$

$h^2 (\cot^2 8° - \cot^2 11°) = 2000^2$

15f (ii)
(1) Attempt Pythagoras theorem with sides $h\cot 8°$, $h\cot 11°$ and 2000.
(2) Obtain expression for h^2 (in terms of tan or cot)
(3) Correct soln

$h^2 = \frac{2000^2}{\cot^2 8° - \cot^2 11°}$

$= \frac{2000^2}{\tan^2 82° - \tan^2 79°}$

$= 165\,548.86$

$\therefore h = \sqrt{165\,548.86}$

$= 406.9 \text{ m}$.