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Student Number

**Year 11 Mathematics Advanced
Assessment 2, 2019**

Section I

5 marks
Attempt Questions 1-5

(LMD) Mrs de Gorter *
(ARP) Mr Perkins
(RAS) Mr Smith
(AYG) Ms Gallagher
(WMD) Mr Dunstan
(RJW) Mr Williams
(ESP) Mrs Pratt
(AXD) Mrs Davis
(ARM) Mr Mallam
(VAB) Mrs Barnsley
(JZT) Mrs Thomas

THURSDAY 16th MAY, 2019

Periods 2 or 4
55 minutes

220 copies

**Year 11
MATHEMATICS ADVANCED
Major Assessment Task 2**

Topic	Marks
Multiple Choice	/ 5
Algebra, Surds and Number	/ 17
Functions and Graphs	/ 19
Transformations and Symmetry	/ 9
Trigonometry	/ 18
Total Marks:	/68

Instructions to students:

- Write all answers in the spaces provided
- Write in blue or black pen
- Show **all necessary working** to gain full marks
- Marks may not be awarded for careless or badly arranged working
- Diagrams are **not to scale**
- Approved calculators may be used
- A reference sheet is provided at the back of this paper and may be detached

1. Which phrase best describes the graph of $y = 5x - 3$?

- A. many-to-many
- B. one-to-many
- C. many-to-one
- D. one-to-one

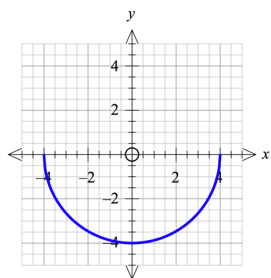
2. Find $f(-4)$, given $f(x) = |5 - x^2| - 15$

- A. 4
- B. -4
- C. 6
- D. -6

3. Which of the following defines the domain of the function $f(x) = \frac{1}{x-2}$?

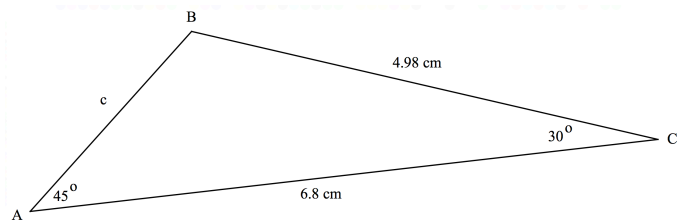
- A. All real x , $x \leq 2$
- B. All real x , $x \geq 2$
- C. $-2 \leq x \leq 2$
- D. All real x , $x \neq 2$

4. Which one of the following equations represent this graph?



- A. $f(x) = -\sqrt{x^2 - 16}$
 B. $f(x) = -\sqrt{x^2 + 16}$
 C. $f(x) = -\sqrt{16 - x^2}$
 D. $f(x) = -\sqrt{16 + x^2}$

5. For triangle ABC shown, which one of the following statements is true?



- A. $c^2 = 5^2 + 6.8^2 + 2 \times 5 \times 6.8 \times \cos 30^\circ$
 B. $\frac{\sin B}{6.8} = \frac{\sin 45}{5}$
 C. $\text{Area} = \frac{1}{2} \times 5 \times 6.8 \times \sin 45$
 D. $\sin 30 = \frac{c}{6.8}$

END OF MULTIPLE CHOICE SECTION

Section II

55 marks

Attempt Questions 6-9.

Answer in the spaces provided.

Question 6 Algebra, Surds and Number

(17 marks)

- (a) Evaluate $-2.8 \times (3.25 - 1.65)$ correct to 2 significant figures. 1
- (b) Rationalise the denominator of $\frac{2}{5\sqrt{3}}$, leaving your answer in simplest surd form. 1
- (c) If $\sqrt{2} + \sqrt{8} = \sqrt{x}$, find the value of x . 2
- (d) Expand and simplify $(7p - 8)^2$ 1
- (e) Factorise and simplify $\frac{m^2 + 3m + 2}{m^2 - 1}$ 2

- (f) Solve
- (α) $2x^2 + x = 6$ 2
- (β) $\frac{k-3}{4} + \frac{k+7}{2} = 6$ 3
- (γ) $|2x + 3| = 4$ 2
- (g) Solve $(3x - 1)^2 - 17(3x - 1) + 16 = 0$ by reducing it to a quadratic equation. 3

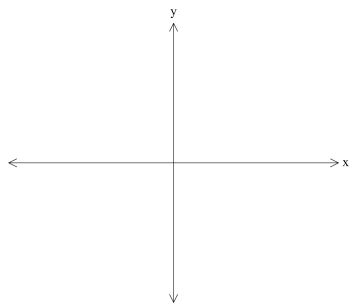
End of Question 6

Question 7 Functions and Graphs (19 marks)

- (a) Given that $f(x) = 2x^2 - 3$ and $g(x) = x + 7$,
- (i) Evaluate $f(3)$ 1
- (ii) Evaluate $f(-4) - g(3)$. 2
- (iii) Solve $g(x) = 5$ 1
- (iv) Find an expression for $g(x) + 4$ 1
- (v) Find an expression for $f(2x)$ 1
- (vi) Evaluate $f(g(-2))$ 2

- (b) Sketch $y = 3^x - 3$, clearly showing the asymptote and the intercepts.

2



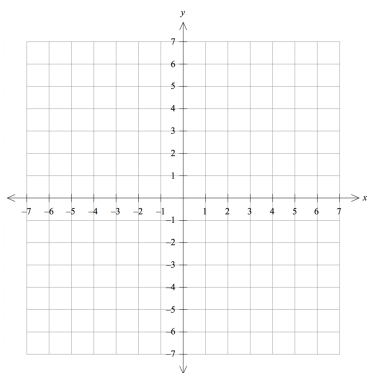
- (c) The equation of a circle is $x^2 - 6x + y^2 + 8y = -21$.

(i) Complete the square to find the centre and radius of the circle.

2

(ii) Sketch the circle.

1



(iii) Explain why a circle is not a function.

1

- (d) Find the zeroes of the cubic equation $y = (x - 4)(x + 2)(2x + 3)$.

1

- (e) A plant grows at a rate inversely proportional to the temperature outside.
At 25°C, it grows 2 cm per day.
How many cm will it grow per day at a temperature of 40°C?

2

- (f) By examining the discriminant, state whether the parabola $y = 2x^2 + 3x + 4$ has two, one or no real roots.

2

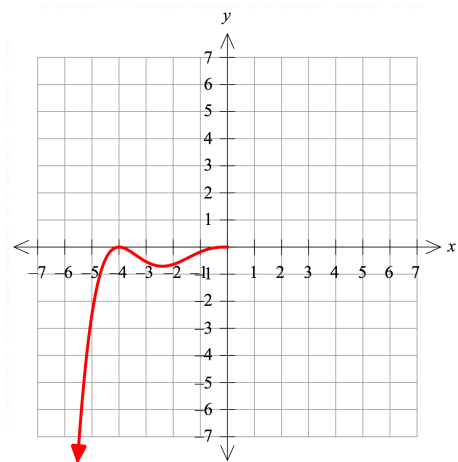
End of Question 7

Question 8 Transformations and Symmetry

(9 marks)

- (a) Complete the sketch of this function given that the function is odd.

1



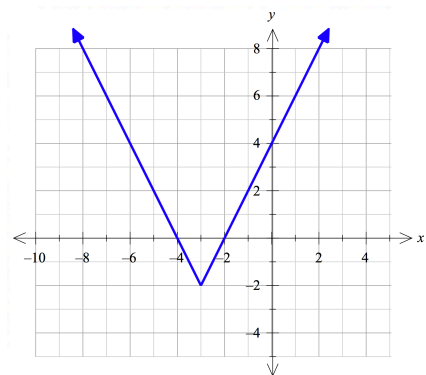
- (b) A sketch of $g(x)$ is shown below.

- (i) State the domain and range of $g(x)$.

2

- (ii) On the same set of axes, draw $g(x - 2) + 3$.

2



- (c) The parabola $f(x) = x^2 + 3$, is shifted left two units and up one unit.

2

Write down the equation of the new curve.

- (d) Determine algebraically whether the function $y = x - x^3 + \frac{1}{x}$ is an odd function, an even function or neither.

2

End of Question 8

Question 9 Trigonometry

(18 marks)

- (a) In $\triangle ABC$, AC is 20 cm, $BC = 22$ cm and $\angle ABC = 15^\circ$.
Find the **obtuse** angle $\angle BAC$ to the nearest minute.

2

- (b) Solve for $0^\circ \leq x \leq 360^\circ$, answering to the nearest minute if applicable.

(α) $\sin x = \frac{1}{\sqrt{2}}$

2

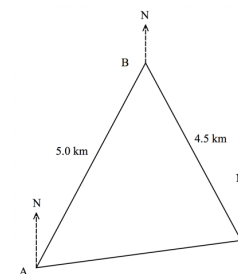
(β) $2\cos x = -0.4$

2

- (c) Given $\tan \theta = -\frac{\sqrt{33}}{4}$ and $\cos \theta > 0$, find the exact value of $\sin \theta$.

2

- (d) A boat race course consists of three legs. Buoys marked A, B and C are placed as shown. The leg from A to B is 5.0 km. The leg from B to C is 4.5 km. The bearing of B from A is 050° . The bearing of C from B is 175° .



- (i) Find $\angle ABC$.

1

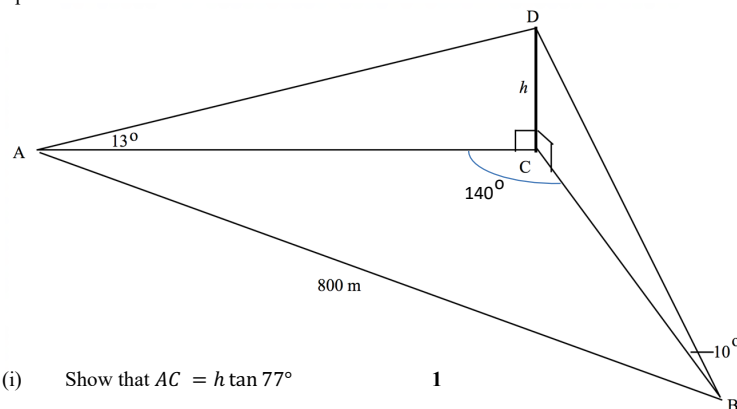
- (ii) What is the total area enclosed by the course? (correct to 1 decimal place)

2

- (e) Prove $1 - 2\sin^2 \theta = 2\cos^2 \theta - 1$.

2

- (f) A building CD of height h metres has an angle of elevation 13° from a point A due west of the building. From another point B, the angle of elevation is 10° . The points A and B are at ground level and on the same level as the base of the building. A and B are 800 m apart.



- (i) Show that $AC = h \tan 77^\circ$

1

- (ii) Find a similar expression for BC (in terms of h).

1

- (iii) Use the cosine rule to calculate h to the nearest metre.

3

End of Question 9

END OF PAPER

Year 11 Advanced Assessment Task 2 Student Solutions - 2019

MULTI-CHOICE

- 1 D : one-to-one
- 2 B : $5(-4) = |5 - (-4)| - 15$
 $= |-11| - 15 = -4$
- 3 D : all real x , $x \neq 2$
- 4 C : full circle is $x^2 + y^2 = 16$
 $\rightarrow y^2 = 16 - x^2$
 $\rightarrow y = \pm \sqrt{16 - x^2}$
bottom half is $y = -\sqrt{16 - x^2}$
- 5 B : SINE RULE
 $\frac{\sin A}{a} = \frac{\sin B}{b} \Rightarrow \frac{\sin 45}{6.8} = \frac{\sin 45}{5}$

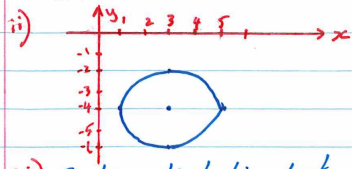
SHORT ANSWER

6. a) $-2.8 \times (3.25 - 1.65) = -4.48$
 $= -4.5$ (2 s.f.)
- b) $\frac{2}{5\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{2\sqrt{3}}{15}$
- c) $\sqrt{2} + 2\sqrt{2} = 3\sqrt{2}$
 $= \sqrt{9 \times 2}$
 $= \sqrt{18} \therefore x = 18$
- d) $(7p - 8)^2 = 49p^2 - 112p + 64$
- e) $\frac{(m+2)(m+1)}{(m-1)(m+1)} = \frac{m+2}{m-1}$
- f) a) $2x^2 + x - 6 = 0$
 $(2x-3)(x+2) = 0 \therefore x = \frac{3}{2}, -2$
- b) $\frac{k-3}{4} + \frac{k+7}{2} = 6$ $\times$ both sides by 4
 $k-3 + 2k+14 = 24$
 $3k+11 = 24 \rightarrow k = \frac{13}{3}$
- i) $2x+3 = 4$ or $2x+3 = -4$
 $x = \frac{1}{2}$ $x = -\frac{7}{2}$

- g) let $u = 3x - 1$
 $u^2 - 17u + 16 = 0$
 $(u-16)(u-1) = 0$
 $u = 1, 16$
 $\therefore 3x - 1 = 1$ or $3x - 1 = 16$
 $x = \frac{2}{3}$ $x = \frac{17}{3}$
7. a) i) $f(3) = 2 \times 3^2 - 3 = 15$
ii) $f(-4) = 2 \times 16 - 3 = 29$
 $g(3) = 3 + 7 = 10$
 $f(-4) - g(3) = 29 - 10 = 19$

- iii) $5 = x + 7$
 $x = -2$
- iv) $g(x) + 4 = x + 7 + 4$
 $= x + 11$
- v) $f(2x) = 2(2x)^2 - 3$
 $= 8x^2 - 3$
- vi) $g(-2) = 5$
 $f(g(-2)) = 2 \times 5^2 - 3$
 $= 47$

- b) $y = 3^x - 3$
when $x = 0$ $y = -2$
when $y = 0$ $x = 1$
- c) i) $x^2 - 6x + 9 + y^2 + 8y + 16 = -21 + 9 + 16$
 $(x-3)^2 + (y+4)^2 = 4$
Centre $(3, -4)$ radius 2



iii) Fails vertical line test

d) $0 = (x-4)(x+2)(2x+3)$

$x = 4, -2, -\frac{3}{2}$

e) $G = \frac{k}{T}$

plug in $T=25$: $2 = \frac{k}{25}$

$k = 50$

plug in $T=40$: $G = \frac{50}{40} = 1.25 \text{ cm/day}$

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

$= 9 - 4 \times 2 \times 4 = -23$

$\Delta < 0 \therefore$ no real roots

8. a)

b) i) domain: all real x
range: $y \geq 2$

c) $g(x) = (x+2)^2 + 4$

d) $f(-x) = (-x) - (-x)^3 + \frac{1}{(-x)}$

$= -x + x^3 - \frac{1}{x}$

$= -(x - x^3 + \frac{1}{x})$

$= -f(x) \therefore$ ODD

9. a) $\frac{\sin A}{22} = \frac{\sin 15}{20}$

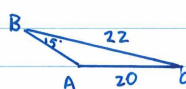
$A = \sin^{-1}\left(\frac{22 \sin 15}{20}\right)$

$= 16^\circ 32' 27.51''$

obtuse $A = 180 - 16^\circ 32' 27.51''$

$= 163^\circ 27' 32.49''$

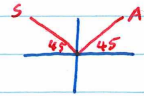
$= 163^\circ 28'$



b) a) $x = \sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$

$= 45^\circ$

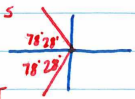
$\therefore x = 45^\circ, 135^\circ$



b) $\cos x = -0.2$

related $x = \cos^{-1}(0.2)$

angle $= 78^\circ 28'$



$x = 101^\circ 32', 258^\circ 28'$

c) $\tan \theta < 0$ $\cos \theta > 0 \rightarrow$ IV quadrant

$x = \sqrt{33+16} = 7$

$\therefore \sin \theta = -\frac{\sqrt{33}}{7}$

$x = \sqrt{33+16} = 7$

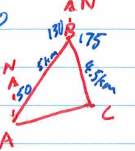
d) i) $\angle ABC = 360 - 175 - 130$

$= 55^\circ$

ii) $A = \frac{1}{2} \times 5 \times 4.5 \times \sin 55^\circ$

$= 9.21546 \dots$

$= 9.2 \text{ km}^2$



e) LHS $= 1 - 2 \sin^2 \theta$

$= 1 - 2(1 - \cos^2 \theta)$

$= 1 - 2 + 2 \cos^2 \theta$

$= 2 \cos^2 \theta - 1 = \text{RHS}$

f) i) $\angle ADC = 90 - 13 \rightarrow \tan 77 = \frac{AC}{h}$

$= 77 \therefore AC = h \tan 77^\circ$

ii) $\angle BDC = 90 - 10 \rightarrow \tan 80 = \frac{BC}{h}$

$= 80 \therefore BC = h \tan 80^\circ$

iii) In $\triangle ABC$:

$800^2 = AC^2 + BC^2 - 2 \times AC \times BC \times \cos 140$

$800^2 = (h \tan 77)^2 + (h \tan 80)^2 - 2 h \tan 77 h \tan 80 \cos 140$

$800^2 = h^2 (\tan^2 77 + \tan^2 80 - 2 \tan 77 \tan 80 \cos 140)$

$h^2 = \frac{800^2}{(\tan^2 77 + \dots)}$

$h^2 = 7226.664233$

$h = 85.00978$

$= 85 \text{ m}$