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REPUBLIC OF SOUTH AFRICA

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APRIL EXAMINATION

NATIONAL CERTIFICATE

MATHEMATICS N2

(16030192)

6 April 2016 (X-Paper)
9:00–12:00

REQUIREMENTS: **Two sheets of graph paper**
Scientific calculators may be used.

This question paper consists of 7 pages and 1 formula sheet of 2 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
MATHEMATICS N2
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Show ALL formulae and intermediate steps and simplify where possible.
5. Questions may be answered in any order, but subsections of questions must be kept together.
6. Use only BLUE or BLACK ink.
7. ALL final answers must be rounded off to THREE decimal places.
8. Write neatly and legibly.

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QUESTION 1

1.1 Fully factorise the following expressions:

1.1.1 $2x^2a - 8a - 8x^2 + 32$ (4)

1.1.2 $3x^3y - 12x^2y + 9xy$ (3)

1.2 Simplify the following fractions:

1.2.1 $\frac{2}{x} + \frac{2x}{3} - \frac{3x}{2}$ (3)

1.2.2 $1 - \frac{3-a}{3a}$ (3)

1.2.3 $\frac{2ax-4a}{x^2-2x-3} \div \frac{1}{4x-12} \times \frac{x+1}{4ax-8a}$ (5)

[18]

QUESTION 2

2.1 Solve the following equation by using the quadratic formula:

$-3x^2 - 4x = -5$ (4)

2.2 Change the subject of the formulas to the symbol in brackets:

2.2.1 $B = \sqrt{\frac{pq}{Kx}} \quad \ldots\ldots\ldots\ldots\ldots (x)$ (3)

2.2.2. $I = \frac{nE}{R+nr} \quad \ldots\ldots\ldots\ldots\ldots (n)$ (3)

2.3 9 ℓ petrol and a can of oil cost R137.81 together. Peter buys 14 ℓ petrol and a can of oil for R198.26. What is the price of one litre of petrol and one can of oil? (4)

[14]

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QUESTION 3

3.1 Simplify:

$$\frac{a^5b^3}{a^{-2}b^4}\times\sqrt{\sqrt[3]{a^{18}b^{36}}}$$

(4)

3.2 Solve for x:

$3.2^x = 24$ (3)

3.3 Simplify with the aid of logarithmic laws:

$$x=\frac{13{,}4^5\times\sqrt{265}}{(12{,}8)(54{,}6)}$$

Show ALL the steps. (Answers only are not acceptable). (5)

3.4 Prove that $\dfrac{\log_x 9+\log_x 81-\log_x 3}{\log_x 2187}=\dfrac{5}{7}$ (4)

[16]

QUESTION 4

4.1 A pulley turns at 3 500 revolutions per minute.
Calculate:

4.1.1 The angular velocity of the pulley in radians per second.

4.1.2 The diameter of the pulley if the circumferential velocity is 2 015 cm/s.

(2 x 3) (6)

4.2 A sector of a circle has an arc of 22,5 cm, which subtends an angle θ.
If the diameter of the circle is 48 cm, calculate:

4.2.1 The magnitude of the angle θ in degrees. (3)

4.2.2 The area of the circle sector. (2)

4.3 Consider FIGURE 1 below. A paperweight, in the shape of a cone, which containing a liquid has a slant height, AC = 13,2 cm and diameter, BC =16 cm. Determine the following:

4.3.1 AD, the perpendicular height of the paperweight. (2)

4.3.2 How many millilitres of liquid will the paperweight hold when full? (3)

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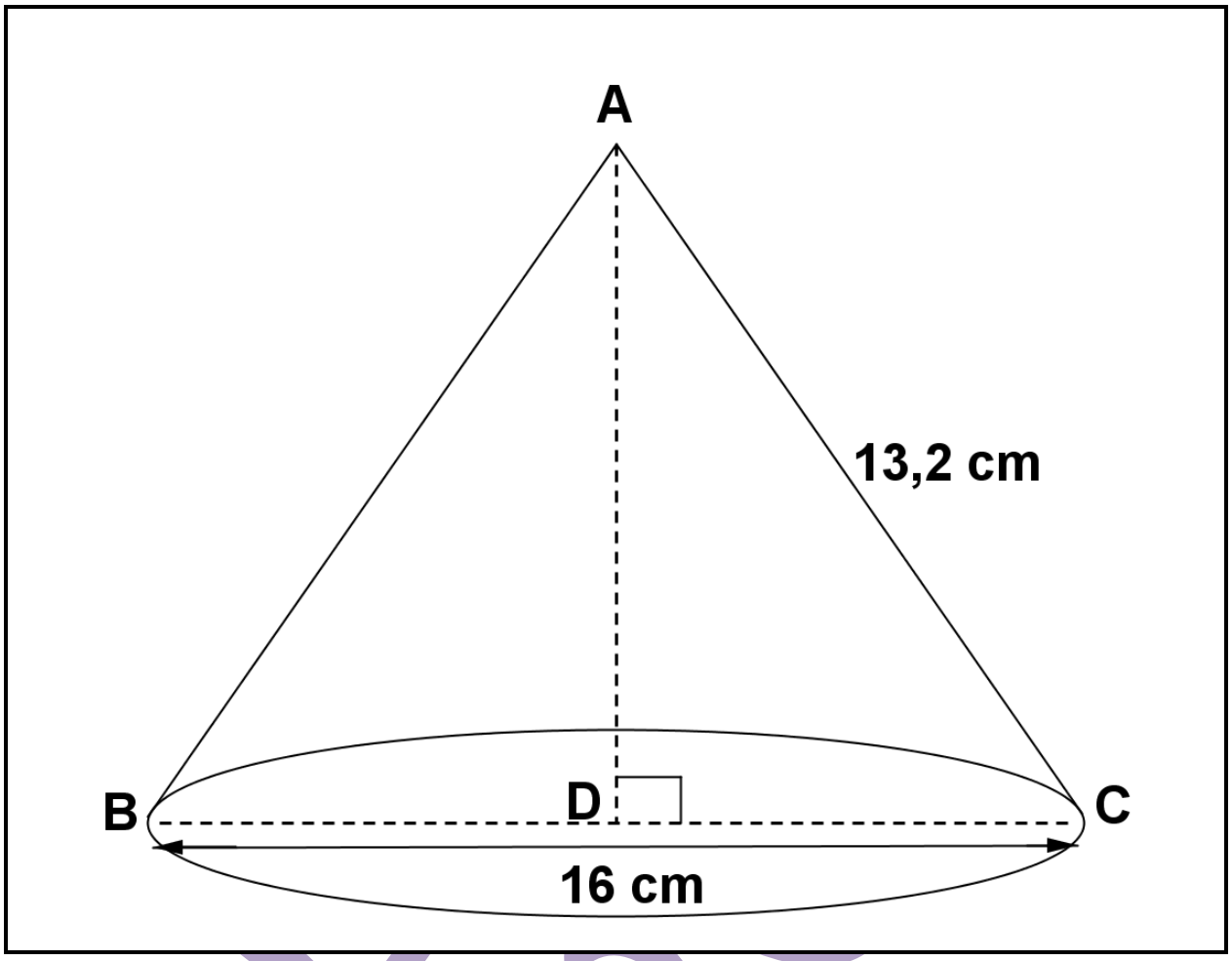

FIGURE 1

4.4 An irregular figure with one horizontal straight side is divided into 7 vertical strips of 8 mm wide each. The ordinates dividing these strips have the following lengths measured in cm: 0; 12; 13; 21; 24; 23; 18; and 0.

Calculate the area of the figure. (4)

[20]

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QUESTION 5

5.1 Consider FIGURE 2 below. ΔABC and ΔACD are two right-angled triangles with AB = 134,5 cm, AD = 56,9 cm and BC = 128 cm. Determine the following:

5.1.1 The magnitude of the angle θ.

5.1.2 The length of side AC.

5.1.3 The magnitude of the angle β. Give your answer for β in radians.

(3 x 3) (9)

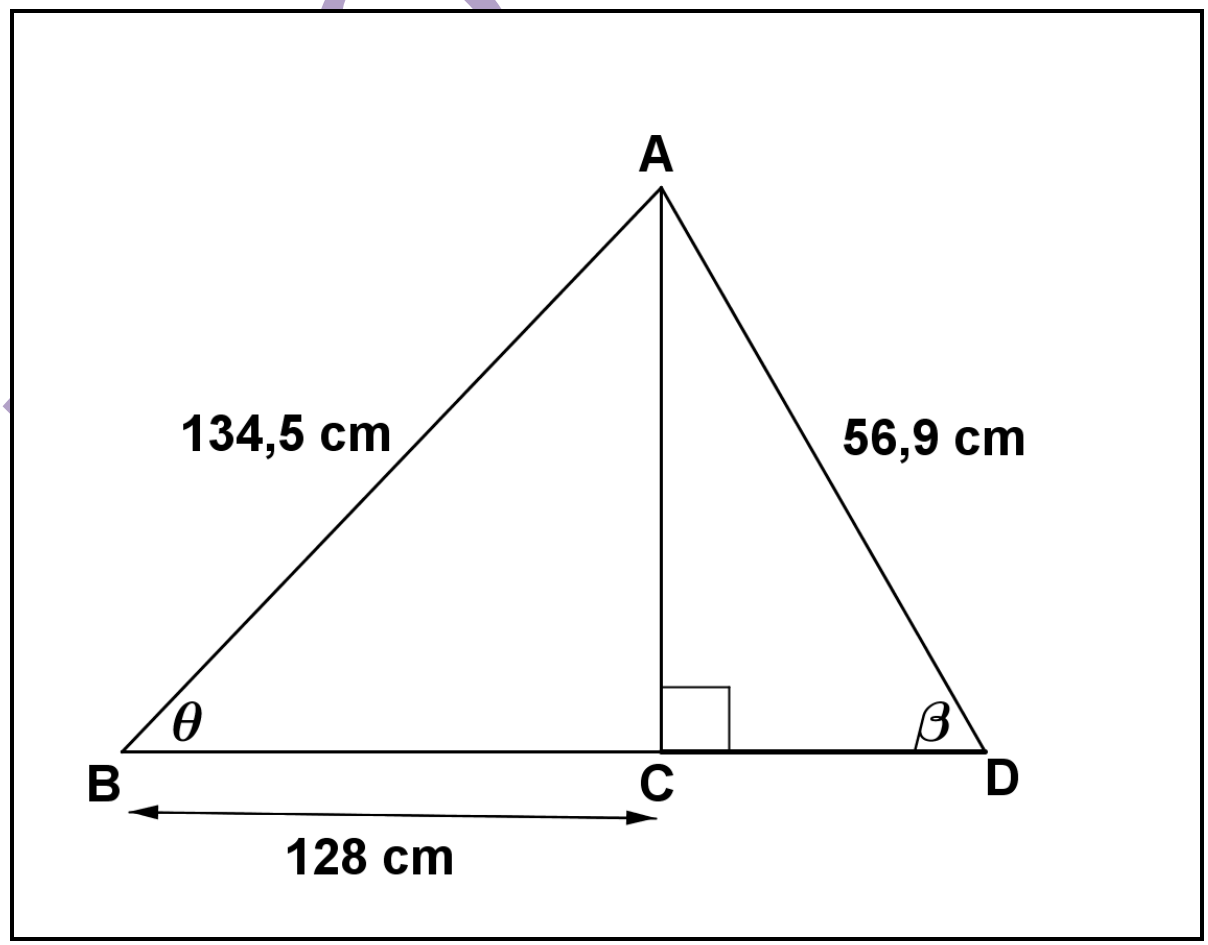

FIGURE 2

5.2 Calculate the value of A for the following:

$3{,}5\tan A + 7 = 0\ ;\ A \in [0^o; 360^o]$ (3)

5.3 An observer is standing 25 m from the foot of the tree. The angle of elevation to the top of a tree is 57^o. Calculate the height of the tree. (4)

[16]

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QUESTION 6

6.1 Draw the following graph on its own system of axes using graph paper:

$y = \cos x - \frac{1}{2}$; $0^o \leq x \leq 360^o$ (3)

6.2 Given: function $y = x^2 - 4x - 5$

Determine the following:

6.2.1 Zero points of the function (2)

6.2.2 y-intercept of the function (1)

6.2.3 The axis of symmetry (1)

6.2.4 The coordinates of the turning point (2)

Hence, draw the graph of $y = x^2 - 4x - 5$ on a system of axes, using graph paper. (3)

6.3 Draw the graph of $x - y = 5$ on the same system of axes used for QUESTION 6.2. (2)

6.4 Read from the graph the coordinates of the point where the two graphs in QUESTION 6.3 intersect. (2)

[16]

TOTAL: 100

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MATHEMATICS N2 - FORMULA SHEET

The right cone

Volume = $\frac{1}{3}\pi r^2 h$

Surface area $= \pi r\sqrt{h^2 + r^2} + \pi r^2$

$= \pi r\ell + \pi r^2$

The right pyramid

Volume = $\frac{1}{3}$ (area of base) × (perpendicular height)

The prism

Volume = (area of base) × (perpendicular height)

The cylinder

Volume = $\pi r^2 h$

Surface area = $2\pi r^2 + 2\pi rh$

The sphere

$V = \frac{4}{3}\pi r^3$; $A = 4\pi r^2$

Degrees and radians

180° = π rad

Sector: $\theta = \frac{\text{arc}}{\text{radius}}$ - ; $A = \frac{1}{2}r^2\theta$

Angular velocity and circumferential velocity

Angular velocity: $w = 2\pi n$

Circumferential velocity: $v = \pi Dn$

n = rotation frequency (r/s = revolution per second)

Mid-ordinate rule

$$\text{Area} = \left[\frac{\text{First ordinate+last ordinate}}{2} + \text{sum of the ordinates}\right] \times \text{distance between the ordinates}$$

= (distance between ordinates) × (sum of mid-ordinates)

Graphs

Straight line: $y = mx + c$ Parabola: $y = ax^2 + bx + c$

Axis of symmetry: $x = \frac{-b}{2a}$

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

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Trigonometry

$90° < \theta < 180°$ $\sin \theta = \sin (180° - \theta)$ $\cos \theta = -\cos (180° - \theta)$

$\tan \theta = -\tan (180° - \theta)$

Reciprocal Identities

$$\sec x = \frac{1}{\cos x} \qquad \operatorname{cosec} x = \frac{1}{\sin x} \qquad \cot x = \frac{1}{\tan x}$$

Segments of circles

Chord length = x Height of segment = h Diameter of circle = D

$$D = h + \frac{x^2}{4h}$$

Regular polygons

Angle subtended at centre of circumscribed circle by one side:

$$\theta = \frac{360°}{\text{number of sides}}$$

R = radius of circumscribed circle

x = length of side

$$x = 2R \sin \frac{\theta}{2}$$

Annulus: $A = \pi\left(R^2 - r^2\right)$

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MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

MATHEMATICS N2

APRIL 2016

This marking guideline consists of 11 pages.

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INSTRUCTIONS AND INFORMATION

1. **✓ equals 1 mark an $\surd$ equals ½ mark.**

2. Half marks are not allocated, unless indicated otherwise.

3. Where a formula is required, using the wrong formula is a principle error and NO marks are allocated.

4. Students should show ALL formulae and intermediate steps and simplify where possible.

5. ALL final answers must be rounded off to THREE decimal places (unless indicated otherwise).

6. Questions may be answered in any order, but subsections of questions must be kept together. If subsections are separated, the student can be penalised by ONE mark.

7. Where a student copied wrongly from the question paper, and the standard of the question is still the same, the student will be penalised by ONE mark.
If the copying error simplifies the question and makes it easier, the student forfeits the marks.

8. Questions must be answered in blue or black ink. Answers in PENCIL are not marked as it is regarded as rough work.

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QUESTION 1

1.1 1.1.1

$$2x^2a-8a-8x^2+32$$
$$2a(x^2-4)-8(x^2-4)$$
$$=2(a-4)(x-2)(x+2) \quad \checkmark \quad \checkmark \quad \checkmark \quad \checkmark$$

(4)

1.1.2

$$3x^3y-12x^2y+9xy$$
$$=3xy(x^2-4x+3)$$
$$=3xy(x-3)(x-1) \quad \checkmark$$
$$\checkmark \quad \checkmark$$

(3)

1.2 1.2.1

$$\frac{2}{x}+\frac{2x}{3}-\frac{3x}{2}$$
$$=\frac{12+4x^2-9}{6x} \quad \checkmark$$
$$=\frac{12-5x^2}{6x} \quad \checkmark \quad \checkmark$$

(3)

1.2.2

$$1-\frac{3-a}{3a} \quad \checkmark$$
$$=\frac{3a-3+a}{3a} \quad \checkmark$$
$$=\frac{4a-3}{3a} \quad \checkmark$$

(3)

1.2.3

$$\frac{2ax-4a}{x^2-2x-3}\div\frac{1}{4x-12}\times\frac{x+1}{4ax-8a} \quad \checkmark$$
$$=\frac{2a(x-2)}{(x-3)(x+1)}\times\frac{4(x-3)}{1}\times\frac{x+1}{4a(x-2)}$$
$$\checkmark \quad \checkmark \quad \checkmark$$
$$=2 \quad \checkmark$$

(5)
[18]

QUESTION 2

2.1 $-3x^2 - 4x + 5 = 0$

$3x^2 + 4x - 5 = 0$

$x = \dfrac{-4 \pm \sqrt{(-4)^2 - 4(3)(-5)}}{6}$ ✓

$x = \dfrac{-4 \pm \sqrt{76}}{6}$ ✓

$x = 0,786 \quad or \quad x = -2,120$ ✓ ✓ (4)

2.2 2.2.1 $B = \sqrt{\dfrac{pq}{Kx}} .....(x)$

$\therefore B^2 = \dfrac{pq}{Kx}$ ✓

$\therefore x = \dfrac{pq}{KB^2}$ ✓

✓ (3)

2.2.2 $I = \dfrac{nE}{R + nr} .....(n)$

$IR + Inr = nE$

$\therefore IR = nE - Inr$

$\therefore IR = n(E - Ir)$ ✓

$\therefore n = \dfrac{IR}{E - IR}$ ✓

$or\ n = \dfrac{-IR}{IR - E}$ ✓ (3)

2.3 $9\ell + c = 137,81.....(1)$ ✓

$14\ell + c = 198,26.....(2)$

(1) – (2) $-5\ell = -60,45$ ✓

$\therefore \ell = 12,09$ ✓

From (1) $9(12,09) + c = 137,81$

$\therefore c = 137,81 - 108,81$

$\therefore c = 29$ ✓ (4)

[14]

QUESTION 3

3.1
$$\frac{a^5b^3}{a^{-2}b^4}\times\sqrt{\sqrt[3]{a^{18}b^{36}}}$$
$$=\frac{a^7}{b}\times\sqrt{a^6b^{12}} \quad ✓ \quad ✓$$
$$=\frac{a^7}{b}\times a^3b^6 \quad ✓$$
$$=a^{10}b^5 \quad ✓$$ (4)

3.2
$$3.2^x=24$$
$$2^x=8 \quad ✓$$
$$2^x=2^3$$
$$x=3 \quad ✓$$ (3)

3.3 .

Show ALL the steps. Answers only are not acceptable.

$$x=\frac{13,4^5\times\sqrt{265}}{12,8\times 54,6}$$
$$\therefore \log x=\log\frac{13,4^5\times\sqrt{265}}{12,8\times 54,6} \quad ✓$$
$$\therefore \log x=\log 13,4^5-\log 265^{\frac{1}{2}} \quad ✓ \quad ✓ \quad -\log 54,6$$
$$\therefore \log x=5\log 13,4-\frac{1}{2}\log 265-\log 12,8-\log 54,6 \quad ✓$$
$$\therefore \log x=4,003$$
$$\therefore x=10^{4,003}$$
$$\therefore x=10\,069,317 \quad ✓$$ (5)

Without rounding off:

$$\log x=4,002744313 \quad ✓$$
$$\therefore x=10^{4,002744313}$$
$$\therefore x=10\,063,390 \quad ✓$$

3.4 $\frac{\log_x 9+\log_x 81-\log_x 3}{\log_x 2187}=\frac{5}{7}$ ✓

$LHS=\frac{\log_x 9+\log_x 81-\log_x 3}{\log_x 2187}$

$=\frac{\log_x 3^2+\log_x 3^4-\log_x 3}{\log_x 3^7}$ ✓ ✓

$=\frac{2\log_x 3+4\log_x 3-\log_x 3}{7\log_x 3}$

$=\frac{5\log_x 3}{7\log_x 3}$

$=\frac{5}{7}=RHS$ ✓

(4)

[16]

QUESTION 4

4.1 4.1.1 The angular velocity of the pulley in radians per second.

$w=2\pi n$ ✓

$w=2\pi(\frac{3500}{60})$ ✓

$w=366{,}519 rad/s$ ✓

(3)

4.1.2 $V=\pi Dn$

$2015=\pi D(\frac{3500}{60})$ ✓ ✓

$10{,}995=D$

$D=10{,}955\ cm$ ✓

(3)

4.2 4.2.1 $\theta=\frac{s}{r}$ ✓

$\theta=\frac{22{,}5}{24}$ ✓ where $s=22{,}5$cm and $r=24$ cm ✓

$\theta=0{,}938$ rad or $53{,}743^o$ ✓

Final round off:

$\theta=0{,}9375$ rad or $53{,}715^o$ ✓

(3)

4.2.2 $A = \frac{1}{2}r^2\theta$

$= \frac{1}{2}(24)^2(0,938)$ ✓

$= 270,144\ \text{cm}^2$ ✓

or

$= \frac{1}{2}(24)^2(0,9375)$ ✓

$= 270\ \text{cm}^2$ ✓

(2)

4.3 4.3.1 $AD^2 = AB^2 - BD^2$

$= (13,2)^2 - (8)^2$ ✓

$= 110,24$

$AD = 10,5\ \text{cm}$ ✓

(2)

4.3.2 $V = \frac{1}{3}\pi r^2 h$

$= \frac{1}{3}\pi(8)^2(10,5)$ ✓

$= 703,717\ \text{cm}^3$ ✓

$= 703,717\ \text{m}\ell$ ✓

or $703,7167544\ \text{cm}^3$ ✓

$= 703,7167544\ \text{m}\ell$ ✓

Follow up with height of 4.3

(3)

4.4 ✓ ✓ ✓

$A = [\frac{0+0}{2} + 12 + 13 + 21 + 24 + 23 + 18] \times 0,8$

$= 88,8\text{cm}^2$ ✓

or $A = 8880\text{mm}^2$ ✓

(4)

[20]

QUESTION 5

5.1 5.1.1 $\cos\theta = \frac{128}{134,5}$ ✓

$\cos\theta = 0,952$ ✓

$\theta = 17,824^o$ ✓

*without rounding off : $\theta = 17,885^o$ ✓

(3)

5.1.2

$AC^2 = 134,5^2 - 128^2$ ✓ or $\sin 17.824 = \frac{opp}{134,5}$ ✓

$AC^2 = 1706,25$ ✓

$AC = 41,307$

✓ ✓

or

In ΔABC

$\tan\theta = \frac{AC}{128}$ ✓

$\therefore AC = 128\tan\theta$ ✓

$\therefore AC = 128\tan 17,885^o$ ✓

$\therefore AC = 41,306$ cm

or

In ΔABC

$\sin\theta = \frac{AC}{134,5}$ ✓

$\therefore AC = 134,5\sin\theta$ ✓

$\therefore AC = 134,5\sin 17,885^o$

$\therefore AC = 41,306$ cm ✓

Or

In ΔABC

$\tan\theta = \frac{AC}{128}$ ✓

$\therefore AC = 128\tan\theta$

$\therefore AC = 128\tan 17,824^o$ ✓

$\therefore AC = 41,155$ cm

✓ (3)

5.1.3

$\sin\beta = \frac{41,307}{56,9}$

$\beta = \sin^{-1} 0,726$ ✓

$\beta = 46,552^o$ ✓

$\beta = 0,812 radians$ ✓

Or

$(or \beta = 46,549^o$

$\beta = 0,812 radians)$ ✓

✓

$\beta = 46,326^o$ ✓

$\therefore \beta = 0,808$ rad ✓

or

$\beta = 46,348^o$ ✓

$\therefore \beta = 0,809$ rad ✓

(3)

5.2 $3,5\tan A + 7 = 0; \quad A \in [0^o; 360^o]$

$\tan A = -2$ ✓

$A = 180 - 63,435 = 116,565$ ✓

$A = 360 - 63,435 = 296,565$ ✓ ✓

(3)

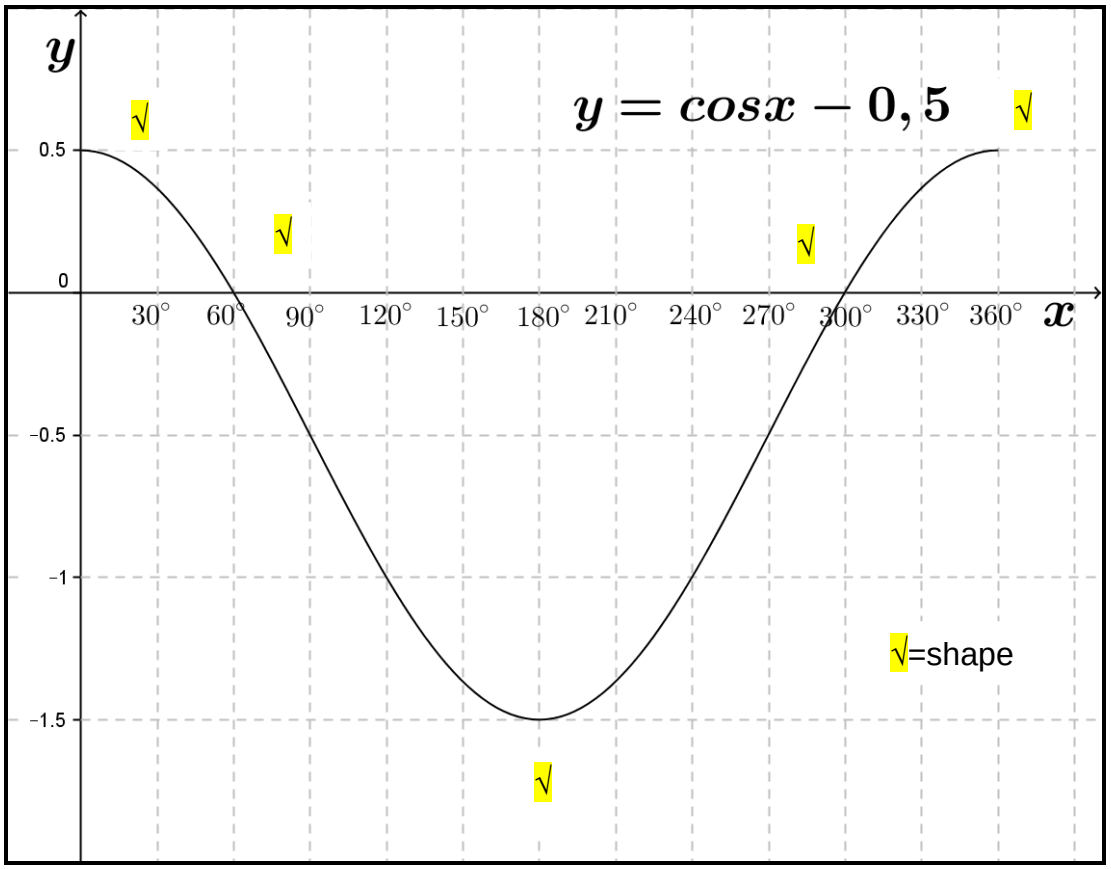
5.3

$$\tan 57^o = \frac{AC}{25} \quad \checkmark \quad \checkmark$$
$$\therefore AC = 25\tan 57^o \quad \checkmark$$
$$\therefore AC = 38,497\text{m} \quad \checkmark$$

(4)
[16]

QUESTION 6

6.1 $y = \cos x - \frac{1}{2}$ for $0^o \le x \le 360^o$



shape	x-intercepts	y-intercept	turning points
½ mark(√)	60°,300° ½ mark& ½ mark √ √	0,5 ½ mark √	(180°,-1,5) ½ mark√ (360°, 0,5) ½ mark√

6 x ½ marks=3 marks (3)

6.2 6.2.1 $x^2 - 4x - 5 = 0$

$(x+1)(x-5) = 0$

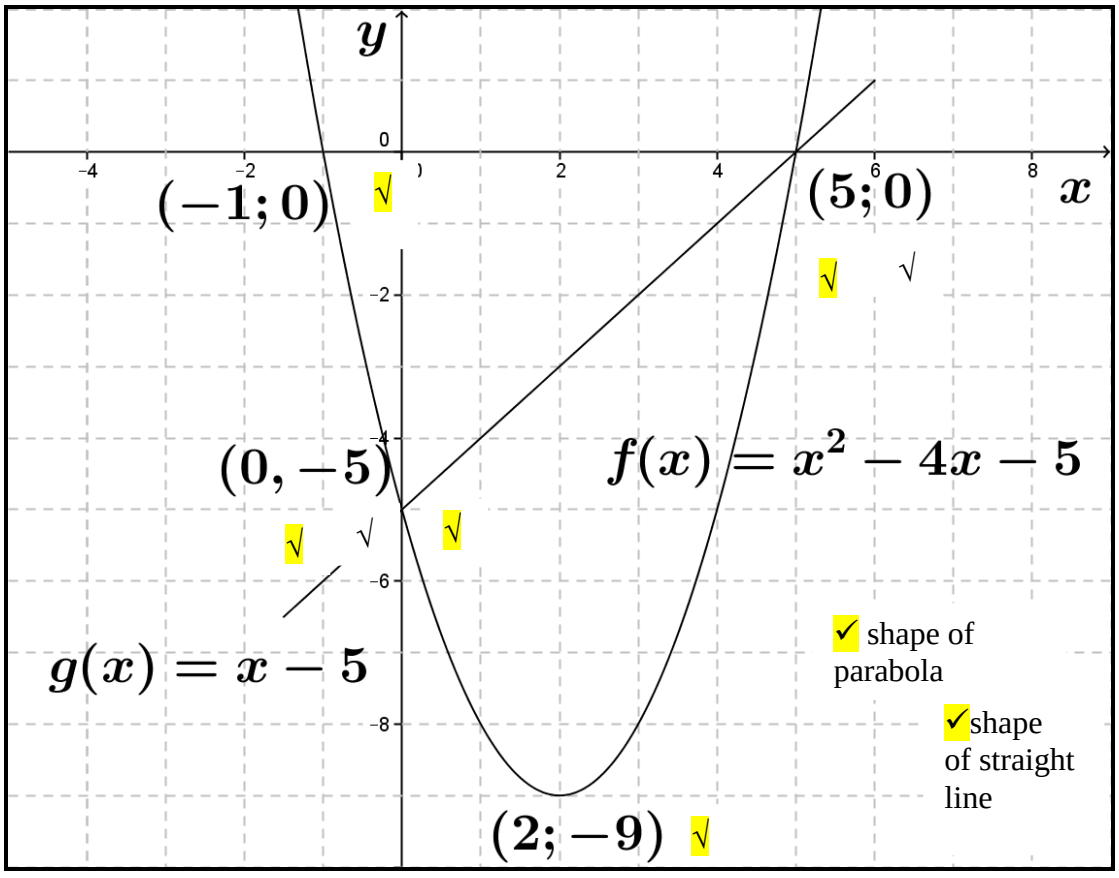
$x = -1$ or $x = 5$

✓ ✓ (2)

6.2.2 let $x = 0$ ✓
$y = -5$ (1)

6.2.3 $x = \frac{-b}{2a}$
$= \frac{-(-4)}{2}$
$= 2$ ✓ (1)

6.2.4 If $x = 2$ then
$y = (2)^2 - 4(2) - 5$
$= -9$
therefore, TP is $(2; -9)$ ✓ ✓ (2)



TP- ½ mark √
x-intercepts(½mark & ½ mark) ✓
Y-intercept(½ mark)
Shape (1 mark) √ ✓ (3)

√ √

6.3 x-intercept ½ mark
y-intercept ½ mark √
shape 1 mark ✓ (2)

6.4 (0;–5) ✓ and (5;0) ✓ (2)
[16]

TOTAL: 100

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