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NATIONAL SENIOR CERTIFICATE EXAMINATION
SUPPLEMENTARY EXAMINATION MARCH 2016

MATHEMATICS: PAPER I

MARKING GUIDELINES

Time: 3 hours

150 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

SECTION A**QUESTION 1**

$$(a) \quad (1) \quad = \frac{(2x+13)(x-1)}{x-1}$$

$$= 2x+13 \quad (2)$$

$$(2) \quad 2x+13 = x^2$$

$$x^2 - 2x - 13 = 0$$

$$x = \frac{2 \pm \sqrt{56}}{2}$$

$$x = 1 \pm \sqrt{14} \quad (3)$$

$$(b) \quad (1) \quad \frac{2^{9x} \cdot 2^{6x}}{2^{15x-2}}$$

$$= \frac{2^{15x}}{2^{15x-2}}$$

$$= 2^2 \quad (4)$$

$$(2) \quad 2^m = 2^2$$

$$m = 2 \quad (2)$$

$$(c) \quad (1) \quad x = -2$$

$$y = 1 \quad (2)$$

$$(2) \quad 0 = \frac{3}{x+2} + 1$$

$$0 = 3 + x + 2$$

$$x = -5$$

$$A(-5; 0)$$

New Equation

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

[16]

QUESTION 2

$$\begin{aligned} \text{(a)} \quad p - 3 &= 9 \quad \therefore p = 12 \\ 25 - 12 &= q \quad \therefore q = 13 \end{aligned} \quad (4)$$

$$\begin{aligned} \text{(b)} \quad 2a &= 4 \\ a &= 2 \\ 3(2) + b &= 9 \\ b &= 3 \\ 2 + 3 + c &= 3 \\ c &= -2 \\ T_n &= 2n^2 + 3n - 2 \end{aligned} \quad \begin{matrix} (5) \\ [9] \end{matrix}$$

QUESTION 3

$$\begin{aligned} \text{(a)} \quad &10; 11; 12,1; \dots \\ (1) \quad &T_8 = 10(1,1)^7 = 19,487171 \text{ km} \quad (3) \\ (2) \quad &S_8 = \frac{10[(1,1)^8 - 1]}{1,1 - 1} = 114,358881 \text{ km} \quad (3) \\ \text{(b)} \quad (1) \quad &a + 4d = 0 \\ &a + 13d = -36 \\ &d = \frac{-36}{9} = -4 \\ &a + 4(-4) = 0 \\ &T_1 = 16 \quad (5) \\ (2) \quad &d = -4 \\ &16 + 22(-4) + 16 + (23 - p - 1)(-4) = -96 \\ &-56 - 88 + 4p = -96 \\ &4p = 48 \\ &p = 12 \quad (4) \end{aligned}$$

(c) (1) S_{∞} exists because $r = \frac{2}{3}$ and $-1 < \frac{2}{3} < 1$ (2)

(2)
$$S_{\infty} = \frac{-4}{1 - \frac{2}{3}}$$

$$= -12$$
 (2)
[19]

QUESTION 4

(a)
$$301\,964 = \frac{x \left[1 - \left(1 + \frac{0,11}{12} \right)^{-120} \right]}{\frac{0,11}{12}}$$

 $x = R4\,159,55$ (3)

(b)
$$BO = \frac{4\,159,55 \left[1 - \left(1 + \frac{0,11}{12} \right)^{-36} \right]}{\frac{0,11}{12}}$$

 $BO = R127\,053,07$ (3)
[6]

QUESTION 5

(a)
$$f'(x) = \lim_{h \rightarrow 0} \frac{(x+h)^2 + \pi - (x^2 + \pi)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{x^2 + 2xh + h^2 + \pi - x^2 - \pi}{h}$$

$$= \lim_{h \rightarrow 0} \frac{h(2x + h)}{h}$$

$$= \lim_{h \rightarrow 0} 2x + h$$

 $f'(x) = 2x$ (4)

(b) $f(x) = ax + 5 + cx^{-1}$
 $f'(x) = a - cx^{-2} = \frac{ax^2 - c}{x^2}$
 $\therefore a = 1 \text{ and } c = 3$ (7)
[11]

QUESTION 6

(a) $\sqrt{x-2} = 4-x$
 $x-2 = 16-8x+x^2$
 $0 = x^2-9x+18$
 $(x-6)(x-3) = 0$
 $x = 6 \text{ or } x = 3$

Check:

$$\sqrt{6-2} + 6 = 8 \neq 4$$

$$\sqrt{3-2} + 3 = 4$$

$$\therefore x = 3$$

(6)

(b) $x^2 - 4x - 4 + x < 0$
 $x^2 - 3x - 4 < 0$
 $(x-4)(x+1) < 0$

$$\begin{array}{ccccccc} + & & - & & + & & \\ \hline & -1 & & & 4 & & \end{array}$$

$$-1 < x < 4 \quad \text{or} \quad x \in (-1; 4)$$

(4)

(c) (1) C

(1)

(2) D

(1)

(3) D

(1)

(4) B

(1)

[14]

75 marks

SECTION B

QUESTION 7

$$(a) \quad 10\,147 \left(1 + \frac{0,15}{4}\right)^{12} (1 + 0,15)^9 + 23\,786 (1 + 0,15)^4$$

$$= R97\,125,19 \quad (5)$$

$$(b) \quad A = \frac{2\,172((1 + 0,15)^{12} - 1)}{0,15}$$

$$A = R62\,991,62 \quad (3)$$

(c) Young ladies investment n years after 12 years

$$= 62\,991,62 (1 + 0,15)^n + \frac{2\,172 [(1 + 0,15)^n - 1]}{0,15} = 77\,471,12 (1,15)^n - 14\,480$$

Young man's investment n years after 12 years

$$= 97\,125,15 (1,15)^n$$

$$\begin{aligned} \text{Now, } & 77\,471,12 (1,15)^n - 14\,480 \\ & < 77\,471,12 (1,15)^n \\ & < 97\,125,15 (1,15)^n \end{aligned} \quad \left. \vphantom{\begin{aligned} \text{Now, } & 77\,471,12 (1,15)^n - 14\,480 \\ & < 77\,471,12 (1,15)^n \\ & < 97\,125,15 (1,15)^n \end{aligned}} \right\}$$

$$\therefore \text{ true} \quad (5)$$

[13]

QUESTION 8

$$(a) \quad (1) \quad (4 \times 3 \times 2 \times 1) \times 2 = 48 \text{ ways} \quad (2)$$

$$(2) \quad 4 \times 3 \times 1 + 4 \times 3 \times 1 = 24 \quad (3)$$

$$(3) \quad 5 \times 4 \times 3 \times 2 + 5 \times 4 \times 3 \times 2 \times 1$$

$$= 240 \text{ numbers} \quad (3)$$

$$(b) \quad (1) \quad \frac{1}{6} \quad (2)$$

$$(2) \quad \frac{7}{36}$$

	1	2	3	4	5	6
1	x	x	x	x	x	x
2	x	x	x	x	x	x
3	x	x	x	x	x	y
4	x	x	x	x	y	y
5	x	x	x	x	x	x
6	x	x	y	y	y	y

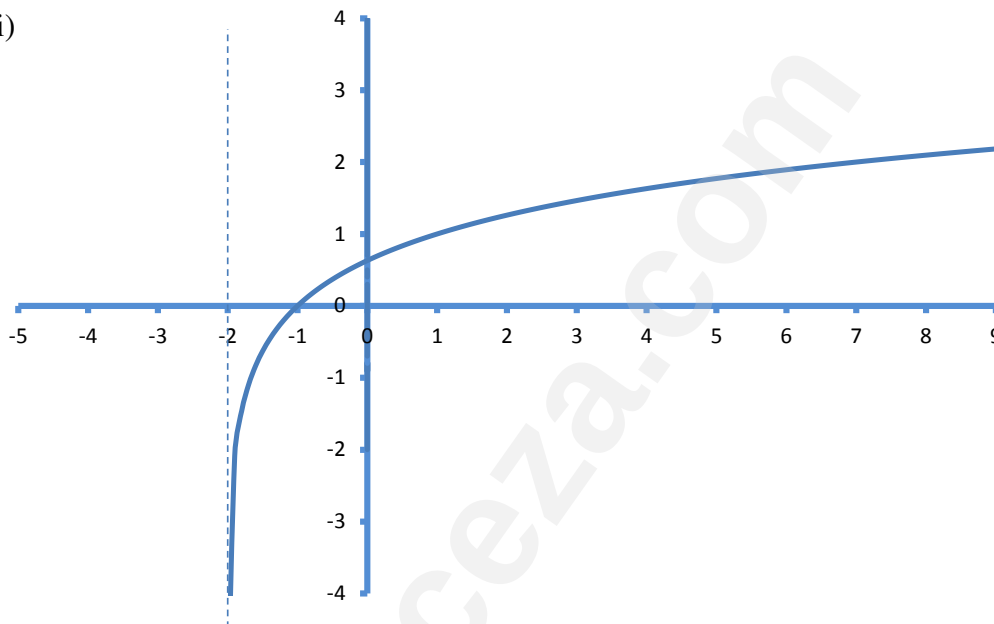
(4)
[14]

QUESTION 9

(a) (1) $x = 3^y - 2$
 $x + 2 = 3^y$
 $y = \log_3(x + 2)$

(3)

(2) (i)



(3)

(ii) $x \in (-1; \infty)$ or $x > -1$

(1)

(3) $g(x) = \frac{x-2-4}{x-2}$

$$g(x) = \frac{x-2}{x-2} - \frac{4}{x-2}$$

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

$\therefore$ point of intersection of asymptotes is (2;1)

$$\therefore h(x) = 3^x - 8$$

(4)

(b) (1) $0 = -x^2 - 4x$
 $x(x+4) = 0$
 $x = 0$ or $x = -4$

$$-2x - 4 = 0$$

$$x = -2$$

$$y = -(-2)^2 - 4(-2)$$

$$y = 4$$

$$\Delta AOD = \frac{1}{2} \times 4 \times 4$$

$$= 8 \text{ square units}$$

(6)

$$(2) \quad k < -1$$

(2)

$$\begin{aligned} (3) \quad & -(x-p)^2 - 4(x-p) \\ &= -(x^2 - 2px + p^2) - 4x + 4p \\ &= -x^2 + 2px - p^2 - 4x + 4p \\ & B(0; -5) \\ & \therefore -p^2 + 4p = -5 \\ & \therefore p^2 - 4p - 5 = 0 \quad \therefore p = -1 \quad \text{or} \quad p = 5 \\ & \therefore p < -1 \end{aligned}$$

(4)

[23]

QUESTION 10

$$\begin{aligned} (a) \quad & g'(x) = 3x^2 - 4x + k \\ & 3(3)^2 - 4(3) + k = 4 \\ & k = -11 \end{aligned}$$

$$\begin{aligned} p &= (3)^3 - 2(3)^2 - 11(3) + 12 \\ p &= 27 - 18 - 33 + 12 \\ p &= -12 \end{aligned}$$

$$\begin{aligned} -12 &= 4(3) + t \\ t &= -24 \end{aligned}$$

$$\begin{aligned} x^3 - 2x^2 - 11x + 12 &= 4x - 24 \\ x^3 - 2x^2 - 15x + 36 &= 0 \\ (x-3)(x^2 + x - 12) &= 0 \\ (x-3)(x-3)(x+4) &= 0 \end{aligned}$$

or

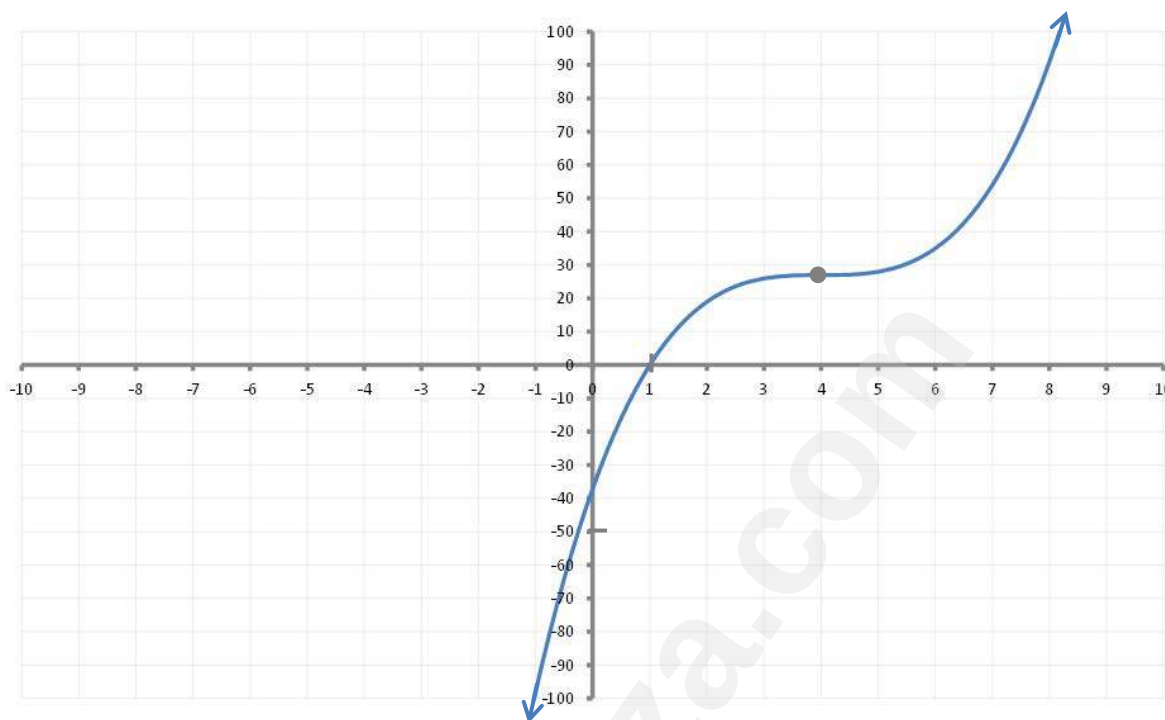
$$\begin{aligned} (x-3)^2(x+4) &= 0 \\ \text{since 3 is a repeated root} \end{aligned}$$

$$\begin{aligned} y &= 4(-4) - 24 \\ y &= -40 \end{aligned}$$

$$A(-4; -40)$$

(9)

(b)



(6)

[15]

QUESTION 11

$$(a) \quad V_{outer} = \frac{2}{3}\pi(r+2)^3$$

$$= \frac{2}{3}\pi(r^3 + 6r^2 + 12r + 8)$$

$$= \frac{2}{3}\pi r^3 + 4\pi r^2 + 8\pi r + \frac{16\pi}{3}$$

$$V_{inner} = \frac{2}{3}\pi r^3$$

$\therefore$ volume of rubber

$$= 4\pi r^2 + 8\pi r + \frac{16\pi}{3}$$

(4)

$$(b) \quad \frac{dv}{dr} = 8\pi r + 8\pi$$

$$\therefore 8\pi p + 8\pi = \frac{88\pi}{3}$$

$$\therefore p + 1 = \frac{11}{3}$$

$$p = \frac{8}{3} \text{ cm}$$

(6)

[10]

75 marks

Total: 150 marks