Becca Hudson / 12.1 IB Math SL
January 11, 2018
Test: Vectors, calculus, binomial

82 (1)

Solutions

1.(a)(i) $\vec{AB} = \vec{OB} - \vec{OA}$ M1

$= \begin{pmatrix} 6-5 \\ 5-2 \\ 3-1 \end{pmatrix} = \begin{pmatrix} 1 \\ 3 \\ 2 \end{pmatrix}$ A1

(ii) $\vec{AC} = \vec{OC} - \vec{OA}$

$= \begin{pmatrix} 7-5 \\ 6-2 \\ a+1-1 \end{pmatrix} = \begin{pmatrix} 2 \\ 4 \\ a \end{pmatrix}$ A1

b) $\cos\frac{\pi}{2} = \frac{\vec{AB} \cdot \vec{AC}}{|\vec{AB}||\vec{AC}|}$ R1

$0 = 1 \cdot 2 + 3 \cdot 4 + 2a$ A1 A1

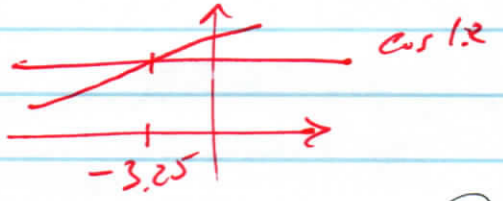
$a = -7$ A1

c)(i) $\cos\theta = \frac{1 \cdot 2 + 3 \cdot 4 + 2a}{\sqrt{1^2+3^2+2^2} \times \sqrt{2^2+4^2+a^2}}$ M1 A1 A1

$= \frac{2a+14}{\sqrt{14}\sqrt{a^2+20}} = \frac{2a+14}{\sqrt{14a^2+280}}$ A1

(ii)

$\cos 1.2 = \frac{2a+14}{\sqrt{14a^2+280}}$ A1 M1



$a = -3.251637\ldots$

≈ -3.25 A2

(15)

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Test: Vectors, Calculus SOLUTIONS

2.(a) $f(2) = a(2^3) + b(2)^2 + c = 9$ M1 A1
$8a + 4b + c = 9$

(b) ~~$f'(2) = 0$~~ $f'(1) = 0$ M1 A1
$f'(x) = 3ax^2 + 2bx$ A1A1
~~$f'(2) = 12a + 4b = 0$~~
$f'(1) = 3a + 2b = 0$ (1) A1

$f(1) = a(1)^3 + b(1)^2 + c = 4$ M1A1
$a + b + c = 4$ (2)

(c) $8a + 4b + c = 9$ (1)
$3a + 2b = 0$ (2)
$a + b + c = 4$ (3)

$7a + 3b = 5$ $(1-3)_{\times 2}$ M1
$14a + 6b = 10$
$9a + 6b = 0$ (2) $\times 3$
$5a = 10$
$a = 2$ $\Rightarrow$ (2) $3(2) + 2b = 0$
$b = -3$
$2 + -3 + c = 4 \Rightarrow c = 5$

$a = 2, b = -3, c = 5$ A1 A1 A1

(13)

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(3)

Solutions

3. $f'(x) = \frac{1}{4}(2)x = \frac{1}{2}x$

$f'(4) = \frac{1}{2}(4) = 2$

L: $y - 6 = 2(x - 4)$ (4)

4. (a) $P(x=2) + P(x=3) = 0.5$ M1

$r + 0.2 = 0.5$

$r = 0.3$ A1

(b) $E(x) = 0p + 1q + 2(0.3) + 3(0.2) = 1.4$ ~~A1~~ A1

$q + 1.2 = 1.4$ A1

$q = 0.2$ A1

$p + 0.2 + 0.3 + 0.2 = 1.0$ M1 A1

$p = 0.3$ A1 (8)

5. (a) $p = 0.05 \quad n = 240$

$E(x) = np = 0.05 \cdot 240 = 12$ A1 A1

(b) $P(X=15) = \binom{240}{15} 0.95^{(240-15)} \cdot 0.05^{15}$ M1 A1

$= 0.0732959...$

≈ 0.0733

(c) $P(x \geq 10) = 1 - P(x \leq 9)$ A1

$= 1 - 0.2356711...$ M1

$= 0.7643288...$

≈ 0.764 A1 (7)

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6.(a) $r = \frac{4}{1.6} = 2.5$ M1 A1

(b) $S_6 = \frac{0.64\left(1-2.5^6\right)}{1-2.5}$ A1
$= 103.74$ A1

(c) $S_n = 0.64\left(\frac{2.5^n - 1}{2.5-1}\right) > 75{,}000$ M1 A1
$2.5^n > 75{,}000\left(\frac{1.5}{0.64}\right) + 1 = 175{,}782.25$
$n > \log_{2.5} 175{,}782.25 = 13.180\ldots$
$n = 14$ A1 (7)

7. $a = 13.3823\ldots \approx 13.4$ M1 A1 A1
$b = 137.4827\ldots \approx 137$

(b) $c(t) = 13.38\ldots t + 137.48\ldots$ A1
$c(7) = 13.38\ldots(7) + 137\ldots = 231.1589\ldots$ A1
≈ 231 A1 (integer)

(c) $f(0) = \frac{2000}{1+99e^{-k(0)}}$ M1 $= \frac{2000}{100}$ A1 $= 20$ A1

(d) Error on test. The value of k should be given (9)

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Test

SOLUTIONS

8. (a) $m = 3$ A1
$n = 4$ A1

(b) $2^{3(2x+1)} = 2^{4(2x-3)}$ M1 M1

$3(2x+1) = 4(2x-3)$
$6x + 3 = 8x - 12$ A1
$x = 7\frac{1}{2}$ A1 (6)

9(a) 5^- A1 $f: (5, -1)$ M1

(b) $f(f(-1)) = f(2)$ M1 A1
$= 1$ A1

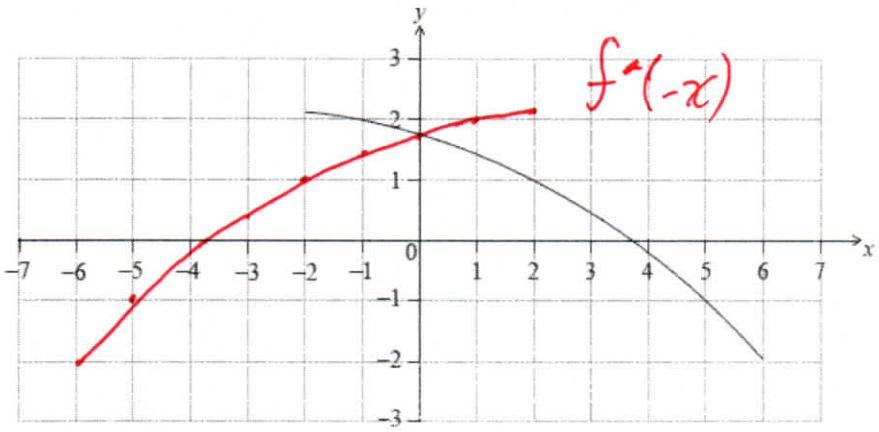
(c) on exam graph A2 (7)

10. (a) on sheet N3

(b) $G(45) = 95e^{(-0.02(45))} + 40$ M1
$= 78.624...$

$G(45) \cdot 45 = 78.624... \cdot 45$ M1
$= 3538.08...$
$\approx \$3540$ A1 (6)

9a. The following diagram shows the graph of a function f.



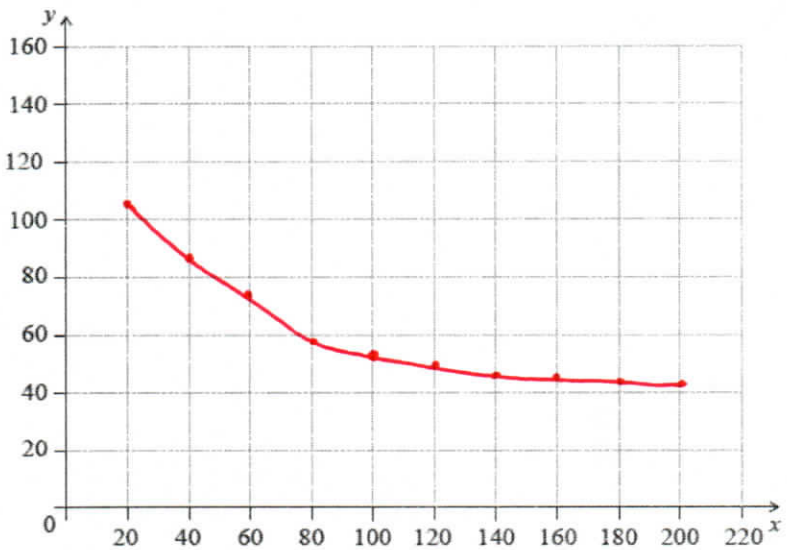
Find $f^{-1}(-1)$. *[2 marks]*

9b. Find $(f \circ f)(-1)$. *[3 marks]*

9c. On the same diagram, sketch the graph of $y = f(-x)$. *[2 marks]*

10a. Let $G(x) = 95e^{(-0.02x)} + 40$, for $20 \leq x \leq 200$.

On the following grid, sketch the graph of G. *[3 marks]*



10b. Robin and Pat are planning a wedding banquet. The cost per guest, *G* dollars, is modelled by the function $G(n) = 95e^{(-0.02n)} + 40$, for $20 \leq n \leq 200$, where n is the number of guests.

Calculate the **total** cost for 45 guests. *[3 marks]*