

**SINGAPORE POLYTECHNIC    2021 / 2022 Semester 1 MST**

**Module Name:** Foundation Mathematics

**Module Code:** MS960Y

**Course:** Polytechnic Foundation Programme

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| No.  | SOLUTION                                                                                                                                                                                                                                                                                                                    |
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| 1(a) | $\left( \frac{3a^0(-b)^2}{c^2} \right) \left( \frac{c^6}{6ab^4} \right)$ $= \left( \frac{3b^2}{c^2} \right) \left( \frac{c^6}{6ab^4} \right)$ $= \frac{c^4}{2ab^2}$                                                                                                                                                         |
| 1(b) | $(h^5k)^2(2h^{-1}k)^{-3}$ $= (h^5k)^2(2^{-3}h^3k^{-3})$ $= (h^{10}k^2)(2^{-3}h^3k^{-3})$ $= 2^{-3}h^{13}k^{-1}$ $= \frac{h^{13}}{8k}$                                                                                                                                                                                       |
| 1(c) | $\left[ \frac{27}{(2q^2)^3} \right]^{\frac{1}{3}} \div \frac{4}{\sqrt{q^{16}}} = \frac{27^{\frac{1}{3}}}{(2q^2)} \div \frac{4}{\sqrt{q^{16}}}$ $= \frac{27^{\frac{1}{3}}}{(2q^2)} \div \frac{4}{q^8}$ $= \frac{27^{\frac{1}{3}}}{(2q^2)} \times \frac{q^8}{4}$ $= \frac{3}{(2q^2)} \times \frac{q^8}{4}$ $= \frac{3q^6}{8}$ |

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| 2(a) | $\begin{aligned} & (x-16y)^2 - (x+16y)^2 \\ &= [(x-16y) + (x+16y)][(x-16y) - (x+16y)] \\ &= (2x)(-32y) \\ &= -64xy \end{aligned}$                                                                                                                                                                                                                    |
| 2(b) | $\begin{array}{r} x^2 + x - 2 \\ 3x+1 \overline{) 3x^3 + 4x^2 - 5x - 7} \\ \underline{-(3x^3 + \phantom{4}x^2)} \phantom{- 5x - 7} \\ 3x^2 - 5x \phantom{- 7} \\ \underline{-(3x^2 + \phantom{4}x)} \phantom{- 7} \\ -6x - 7 \\ \underline{-(-6x - 2)} \\ -5 \end{array}$ <p>Quotient = <math>x^2 + x - 2</math><br/>Remainder = <math>-5</math></p> |
| 2(c) | $\begin{aligned} & (a^2 - 2)^2 - 3(a^2 - 2) - 28 \\ \text{Let } b &= a^2 - 2, \\ & b^2 - 3b - 28 \\ &= (b-7)(b+4) \\ \\ & \therefore (a^2 - 2)^2 - 3(a^2 - 2) - 28 \\ &= ((a^2 - 2) - 7)((a^2 - 2) + 4) \\ &= (a^2 - 9)(a^2 + 2) \\ &= (a+3)(a-3)(a^2 + 2) \end{aligned}$                                                                            |
| 2(d) | <p>Let <math>f(x) = 2x^3 - 3x^2 + px + q</math>,</p> $\begin{aligned} f(-2) &= 0 \\ 2(-2)^3 - 3(-2)^2 + p(-2) + q &= 0 \\ -16 - 12 - 2p + q &= 0 \\ -2p + q &= 28 \quad \text{-----(1)} \end{aligned}$                                                                                                                                               |

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|          |                                                                                                                                                                                                              |
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|          | $f(1) = 6$ $2(1)^3 - 3(1)^2 + p(1) + q = 6$ $2 - 3 + p + q = 6$ $p + q = 7 \quad \text{-----}(2)$<br>$(1) - (2): \quad -3p = 21$ $p = -7$ $-7 + q = 7$ $q = 14$                                              |
| 3(a)(i)  | $\frac{3p-5q}{p^3q^{10}} \times \frac{8p^5q^7}{6p-10q}$ $= \frac{3p-5q}{p^3q^{10}} \times \frac{8p^5q^7}{2(3p-5q)}$ $= \frac{8p^2q^7}{2q^{10}}$ $= \frac{4p^2}{q^3}$                                         |
| 3(a)(ii) | $\frac{1}{6-2a} - \frac{a}{a^2-9}$ $= \frac{1}{2(3-a)} - \frac{a}{(a+3)(a-3)}$ $= \frac{1}{2(3-a)} + \frac{a}{(a+3)(3-a)}$ $= \frac{a+3}{2(3-a)(a+3)} + \frac{2a}{2(a+3)(3-a)}$ $= \frac{3a+3}{2(3-a)(a+3)}$ |

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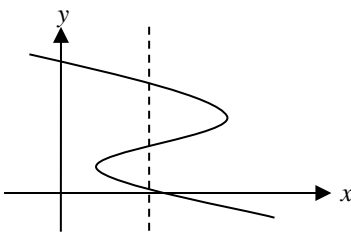
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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| 3(a)<br><br>(iii) | $1 + \frac{1}{R}$ $\frac{1}{R} + \frac{1}{2R}$ $\frac{R+1}{2R}$ $= \frac{R}{\frac{2}{2R} + \frac{1}{2R}}$ $= \frac{R+1}{\frac{R}{3}}$ $= \frac{R+1}{R} \div \frac{3}{2R}$ $= \frac{R+1}{R} \times \frac{2R}{3}$ $= \frac{2(R+1)}{3}$                                                                                                                                                                                                   |
| 4                 | $\frac{5x^2 - 5x + 6}{(x-2)(x^2+4)} = \frac{A}{x-2} + \frac{Bx+C}{x^2+4}$ <p>Multiply every term by <math>(x-2)(x^2+4)</math>,</p> $5x^2 - 5x + 6 = A(x^2+4) + (Bx+C)(x-2)$ <p>Subst <math>x = 2</math>:</p> $5(2)^2 - 5(2) + 6 = A((2)^2 + 4)$ $16 = 8A$ $A = 2$<br>$5x^2 - 5x + 6 = 2(x^2+4) + (Bx+C)(x-2)$ $5x^2 - 5x + 6 = 2x^2 + 8 + Bx^2 - 2Bx + Cx - 2C$ <p>Comparing coefficients of <math>x^2</math>,</p> $5 = 2 + B$ $B = 3$ |

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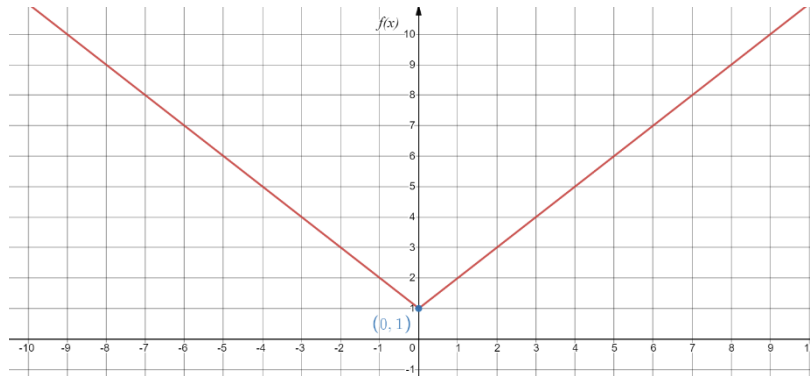
|      |                                                                                                                                                                             |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <p>Comparing constant terms,</p> $6 = 8 - 2C$ $2C = 2$ $C = 1$ $\frac{5x^2 - 5x + 6}{(x-2)(x^2+4)} = \frac{2}{x-2} + \frac{3x+1}{x^2+4}$                                    |
| 5    | <p>Accept any sketch that fails the “vertical line test”. An example is shown below:</p>  |
| 6(a) | Yes, it is a function because each $x$ value has a different $y$ value.                                                                                                     |
| (b)  | $f(-6) = 4$<br>$f(3) = 1$                                                                                                                                                   |
| (c)  | $x = -4$ and $x = 4$                                                                                                                                                        |
| (d)  | The coordinates of the $x$ -intercept are $(-2, 0)$ and $(2, 0)$ .                                                                                                          |
| (e)  | The coordinates of the $y$ -intercept are $(0, -2)$ .                                                                                                                       |
| (f)  | $(-\infty, \infty)$                                                                                                                                                         |
| (g)  | $[-2, \infty)$                                                                                                                                                              |
| (h)  | $g(x) = f(x) + 3$ $=  x  - 2 + 3 =  x  + 1$                                                                                                                                 |

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7(a)

|                                                                                                                                             |                                                                                                                                                                                                                                                                                                                    |
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| <b>1. Understand the problem</b> <ul style="list-style-type: none"> <li>State the given conditions and quantities.</li> </ul>               | Time taken to travel downstream is 5 hours<br>Time taken to travel upstream is 6 hours<br>Speed of the stream is 3 km/hr                                                                                                                                                                                           |
| <b>2. Devise a plan</b> <ul style="list-style-type: none"> <li>Identify which are the relevant concepts that can be applied.</li> </ul>     | Let the speed of the boat in still water = $x$ km/hr.<br>Speed of the boat downstream = $(x + 3)$ km/hr.<br>Hence, distance covered in 5 hrs = $(x + 3) \times 5$<br>(because Distance = Speed $\times$ Time)<br>Speed of the boat upstream = $(x - 3)$ km/hr<br>Therefore, distance covered in 6 hrs = $6(x - 3)$ |
| <b>3. Implement the plan</b> <ul style="list-style-type: none"> <li>Carry out the plan, showing each step clearly.</li> </ul>               | Distance between the two coastal towns is fixed.<br>(Meaning the same)<br><br>$5(x + 3) = 6(x - 3)$ ----- (1)<br>$\Rightarrow 5x + 15 = 6x - 18$<br>$\Rightarrow 6x - 5x = 15 + 18$<br>$\Rightarrow x = 33$<br><br>Hence the speed of motorboat M1 in still water was 33 km/hr.                                    |
| <b>4. Look back</b> <ul style="list-style-type: none"> <li>Substitute your answer back and check if it satisfies the conditions.</li> </ul> | Substitute $x = 33$ into equation (1) to check the distance between coastal towns is correct<br>$5(33 + 3) = 180$ km ----- (2a)<br>$6(33 - 3) = 180$ km ----- (2b)<br>Equation (2a) and (2b) give the same value, so the answer is correct ☺                                                                       |

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| 7(b) | <p>Let <math>t</math> (hours) be the time measured from 12pm i.e. when motorboat M1 had left the coastal town.</p> <p>Since motorboat M2 left the same coastal town 15 minutes later, time travelled by motorboat M2 will be <math>(t - 0.25)</math>, as 15 minutes = 0.25 hours.</p> <p>Both motorboat M1 and motorboat M2 travelling upstream from the same coastal town met when they had travelled the same distance on the river.</p> <p>Equating the distances that both motorboats had travelled along the river:</p> $30t = 40(t - 0.25) \quad \text{for } t \geq 0.25$ $30t = 40t - 10$ $t = 1 \text{ hour}$ <p>Hence the two motorboats would meet each other along the river at 1pm.</p> |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|