SINGAPORE POLYTECHNIC 2018 / 2019 Semester 1 MST

Module Name: Foundation Mathematics **Module Code:** MS960Y

Course: Polytechnic Foundation Programme

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No.	SOLUTION
1(a)	$\left(5p^0r^2h^5\right)\left(\frac{r^3}{15ph^2}\right)$ $=\left(5r^2h^5\right)\left(\frac{r^3}{15ph^2}\right)$ $=\frac{r^{2+3}h^{5-2}}{3p}$ $=\frac{r^5h^3}{3p}$
1(b)	$\left(wd^2\right)^3\left(w^5d^{-1}\right)^{-1}$ $=\left(w^3d^6\right)\left(w^5d^{-1}\right)^{-1}$ $=\left(w^3d^6\right)\left(\frac{w^5}{d}\right)^{-1}$ $=\left(w^3d^6\right)\left(\frac{d}{w^5}\right)$ $=\frac{d^7}{w^2}$
1(c)	$\left(8\sqrt{k^{12}}\right)^{\frac{1}{3}}\div\frac{4}{k}$ $=\left(8\left(k^6\right)\right)^{\frac{1}{3}}\div\frac{4}{k}$ $=2k^2\div\frac{4}{k}$ $=2k^2\times\frac{k}{4}$ $=\frac{k^3}{2}$
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No.	SOLUTION
2(a)(i)	$x^2(5x-2)+7(5x-2)$ $=(5x-2)(x^2+7)$
2(a)(ii)	$(x-3)^{\frac{1}{2}}-(x-3)^{\frac{3}{2}}$ $=(x-3)^{\frac{1}{2}}\left[1-(x-3)\right]$ $=(x-3)^{\frac{1}{2}}(4-x)$
2(b)(i)	$\frac{2}{a^2+a}+\frac{3}{a^2-1}$ $=\frac{2}{a(a+1)}+\frac{3}{a^2-1}$ $=\frac{2}{a(a+1)}+\frac{3}{(a+1)(a-1)}$ $=\frac{2(a-1)+3a}{a(a+1)(a-1)}$ $=\frac{5a-2}{a(a+1)(a-1)}$
2(b)(ii)	$\frac{3x}{25-x^2}\bullet\frac{x-5}{6x^2}$ $=\frac{3x}{(5+x)(5-x)}\bullet\frac{x-5}{6x^2}$ $=\frac{1}{(5+x)(5-x)}\bullet\frac{x-5}{2x}$ $=\frac{-(5-x)}{2x(5+x)(5-x)}$ $=\frac{-1}{2x(5+x)}$
2(b)(iii)	$\frac{1}{\frac{1}{R}+\frac{1}{2R}+\frac{1}{4R}}$

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No.	SOLUTION
	$= \dfrac{1}{\frac{4}{4R}+\frac{2}{4R}+\frac{1}{4R}}$ $= \dfrac{1}{\frac{7}{4R}}$ $= \dfrac{4R}{7}$
3	$\dfrac{3x^2-4x+7}{(x-1)(x^2+2)} = \dfrac{A}{x-1}+\dfrac{Bx+C}{x^2+2}$ Multiply every term by $(x-1)(x^2+2)$, $3x^2-4x+7 = A(x^2+2)+(Bx+C)(x-1)$ Subst $x = 1$: $6 = 3A$ $A = 2$ Comparing coefficients of x^2, $3 = A+B$ $3 = 2+B$ $B = 1$ Comparing constant terms, $7 = 2A-C$ $7 = 4-C$ $C = -3$ $\dfrac{3x^2-4x+7}{(x-1)(x^2+2)} = \dfrac{2}{x-1}+\dfrac{x-3}{x^2+2}$
4(a)	$x^2-4x+3 = 0$ $(x-3)(x-1) = 0$ $x = 3, x = 1$

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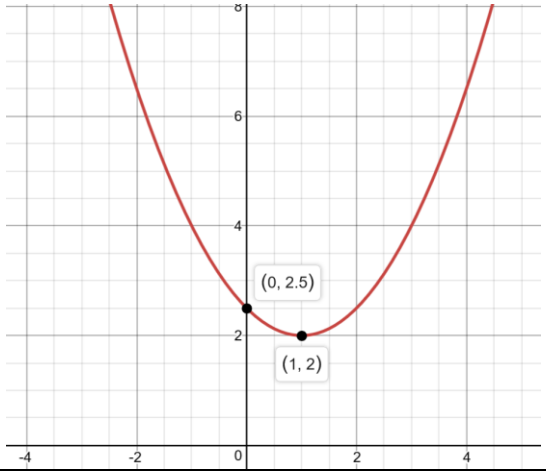
No.	SOLUTION
4(b)	$4x^2+12x=11$ $4\left(x^2+3x\right)=11$ $4\left(\left(x+\frac{3}{2}\right)^2-\left(\frac{3}{2}\right)^2\right)=11$ $\left(x+\frac{3}{2}\right)^2-\left(\frac{3}{2}\right)^2=\frac{11}{4}$ $\left(x+\frac{3}{2}\right)^2=5$ $x+\frac{3}{2}=\sqrt{5}$ or $-\sqrt{5}$ $x=-\frac{3}{2}+\sqrt{5}$ or $-\frac{3}{2}-\sqrt{5}$
5(a)	Let the equation be $f(x)=a(x-h)^2+k$, Since vertex is at $(1,2)$, $f(x)=a(x-1)^2+2$ Since curve passes through $(3,4)$, subst $(3,4)$ in $f(x)=a(x-1)^2+2$: $4=a(3-1)^2+2$ $2=a(4)$ $4a=2$ $a=0.5$ $f(x)=0.5(x-1)^2+2$ or $f(x)=0.5x^2-x+2.5$
5(b)	y-intercept: $f(0)=0.5(0-1)^2+2=2.5$ 
5(c)	Domain: $\{x \mid -\infty < x < \infty\}$ Range: $\{f(x) \mid f(x) \geq 2\}$

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No.	SOLUTION
6(a)(i)	$f(4) = 1 - 4 + 3\sqrt{4}$ $= 3$
6(a)(ii)	$f(x+1) = 1 - (x+1) + 3\sqrt{x+1}$ $= -x + 3\sqrt{x+1}$
6(b)(i)	$g(-1.5) = 0$ $g(0) = 0$
6(b)(ii)	$g'(-1.5)$ is greater than $g'(0)$. The gradient of the tangent line at x = -1.5 is positive while the gradient of the tangent line at x = 0 is zero.
6(b)(iii)	The graph of $h(x)$ can be obtained by shifting the graph of $g(x)$ up by 1 unit. The graph of $m(x)$ can be obtained by shifting the graph of $g(x)$ to the right by 1 unit. $h(x) = g(x) + 1$ $m(x) = g(x-1)$
6(c)	Shifted one unit to the left, $y = \frac{1}{x+1}$ Shrink vertically by a factor of $\frac{1}{2}$, $y = \frac{1}{2(x+1)}$ Shifted two units down, $\therefore y = \frac{1}{2(x+1)} - 2$ is the transformed function.

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<table>
<tr><th>No.</th><th>SOLUTION</th></tr>
<tr><td>7</td><td>
<table>
<tr><td>1. Understand the problem
• State the given conditions and quantities.
• Identify the unknown that you are asked to find.</td><td>Quantity of milk bottles to be sold: 1000

Cost price: $1

Demand quantity and selling price related by:
$D = -400p^2 + 400p + 3400$

Profit = total revenue – total cost</td></tr>
<tr><td>2. Devise a plan
• Break down the problem into smaller parts.
• Identify which are the relevant concepts that can be applied.</td><td>First, find the selling price in order to sell 1000 bottles (solving quadratic equation).

Thereafter, find profit.</td></tr>
<tr><td>3. Implement the plan
• Carry out the plan, showing each step clearly.</td><td>Find the selling price:

$1000 = -400p^2 + 400p + 3400$
$0 = -400p^2 + 400p + 2400$
$p = 3 \text{ or } -2 (\textit{rejected})$

Find profit:

Profit = total revenue – total cost
= (quantity)(selling price) – (quantity)(cost price)
= (1000)(3) – (1000)(1)
= 2000</td></tr>
<tr><td>4. Look back
• Ask yourself -“Does the answer make sense?”</td><td>Yes, one of the answers for selling price of -$2 was rejected as real prices cannot be negative.</td></tr>
</table>
</td></tr>
</table>

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<table>
<tr><th>No.</th><th>SOLUTION</th></tr>
<tr><td>8</td><td>
<table>
<tr><td>1. Understand the problem
• State the given conditions and quantities.
• Identify the unknown that you are asked to find.</td><td>Let x be the gross annual income,
chargeable income = x – total reliefs</td></tr>
<tr><td>2. Devise a plan
• Break down the problem into smaller parts.
• Identify which are the relevant concepts that can be applied.
• It might be helpful to make a table.</td><td>First, find the total reliefs.
<table>
<tr><th>Type of relief</th><th>Amount</th></tr>
<tr><td>Personal</td><td>$5000</td></tr>
<tr><td>Unemployed spouse</td><td>$2000</td></tr>
<tr><td>Child</td><td>$2000 per child</td></tr>
<tr><td>Insurance premiums</td><td>$1000</td></tr>
<tr><td>CPF contributions</td><td>$10000</td></tr>
<tr><td>Total</td><td>$20000</td></tr>
</table>
Next, calculate the income tax for each tier.
<table>
<tr><th>Chargeable Income ($)</th><th>Tax Rate (%)</th><th>Income Tax</th></tr>
<tr><td>On the first 30000</td><td>1.0</td><td>$30000\times0.01=300$</td></tr>
<tr><td>On the next 10000</td><td>3.5</td><td>Given that total income tax payable was $625,
625 – 300 = 325</td></tr>
</table></td></tr>
<tr><td>3. Implement the plan
• Carry out the plan, showing each step clearly.</td><td>Let the amount of chargeable income in the second tier be y,
$y\times\frac{3.5}{100}=325$</td></tr>
</table>
</td></tr>
</table>

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No.	SOLUTION	
		$y = \frac{325}{0.035}$ $= 9285.714$ Total chargeable income = \$30000 + y = \$39285.71 Since chargeable income = x – total relief, 39285.71 = x – 20000 x = 39285.71 + 20000 x = 59285.71
	4. Look back • Substitute your answer back into the problem and check if it satisfies the given conditions.	Chargeable income = 59285.71 – 20000 = 39285.71

Chargeable Income ($)	**Tax Rate (%)**	**Income Tax**
On the first 30000	1.0	$30000 \times 0.01 = 300$
On the next 10000	3.5	$9285.71 \times 0.035 = 325$