Mathematics / 2020 T4 / Sec4Exp5NA /
Preliminary Examinations 2020
Paper 2 Marking Scheme

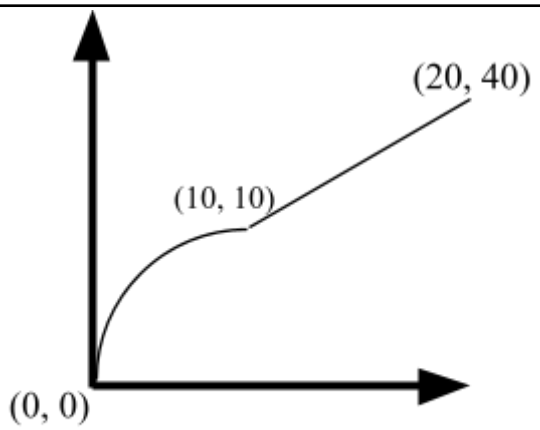
Name: ( )
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Qn	Solution	Marks
1a	$s = 67.5$	B1
1b	$s = ut + \frac{1}{2}at^2$ $\frac{1}{2}at^2 = s - ut$ $a = \frac{s-ut}{\frac{1}{2}t^2}$ $= \frac{2(s-ut)}{t^2}$	M1 A1
2a	$\left(x - \frac{9}{2}\right)^2 - \frac{13}{4}$	B1
2b	$\left(x - \frac{9}{2}\right)^2 - \frac{13}{4} = 0$ $\left(x - \frac{9}{2}\right)^2 = \frac{13}{4}$ $x - \frac{9}{2} = \pm\sqrt{\frac{13}{4}}$ $x = \frac{9}{2} \pm \sqrt{\frac{13}{4}}$ $= 6.3027$ or 2.6972 $= 6.30$ or 2.70	M1 A1
3	$F = \frac{k}{d^2}$ *Since d is decreased by* 75%, *d is now* $0.25d$ *So* $F_{new} = \frac{k}{(0.25d)^2}$	M1 M1 M1 A1
4i	\$2298.96	B1

4ii	$2298.96 - P = P \times \frac{3}{100} \times \frac{18}{12}$ $2298.96 = 0.045P + P$ $2298.96 = 1.045P$ $P = \frac{2298.96}{1.045}$ $= \$2199.96$	M1 A1
4iii	$\frac{2199.96}{80} \times 100 = \$2749.95$	B1
5i	$mean = 181$	B1
5ii	$s.d. = 40.3$	B1
5iii	I disagree with the Principal's comparison as he compared two different values. For 2019 he used the mean but for 2020, he used the median.	B1
6a	$32k^2 - 18 = 2(16k^2 - 9)$ $= 2(4k+3)(4k-3)$	M1 A1
6b	$\frac{32k^2 - 18}{4k^2 + 7k + 3} = \frac{2(4k+3)(4k-2)}{(4k+3)(k+1)}$ $= \frac{2(4k-2)}{(k+1)}$	M1 A1
7	$\frac{x-7}{2x-5} + \frac{2}{5-2x} = -\frac{1}{4}$ $\frac{x-7}{2x-5} - \frac{2}{2x-5} = -\frac{1}{4}$ $\frac{x-7-2}{2x-5} = -\frac{1}{4}$ $\frac{x-9}{2x-5} = -\frac{1}{4}$ $4x - 36 = -2x + 5$ $6x = 41$ $x = \frac{41}{6}$	M1 M1 M1 A1
8	$\frac{V_A}{V_B} = \frac{8}{1} \Rightarrow \frac{h_A}{h_B} = \sqrt[3]{\frac{8}{1}} = \frac{2}{1}$ $\therefore h_A = 2 \times 10 = 20$ cm $\frac{SA_B}{SA_C} = \frac{9}{4} \Rightarrow \frac{h_B}{h_C} = \sqrt{\frac{9}{4}} = \frac{3}{2}$ $\therefore h_B = \frac{3}{2} \times 10 = 15$ cm Difference $= 20 - 15$ $= 5$ cm	M1 M1 M1 A1

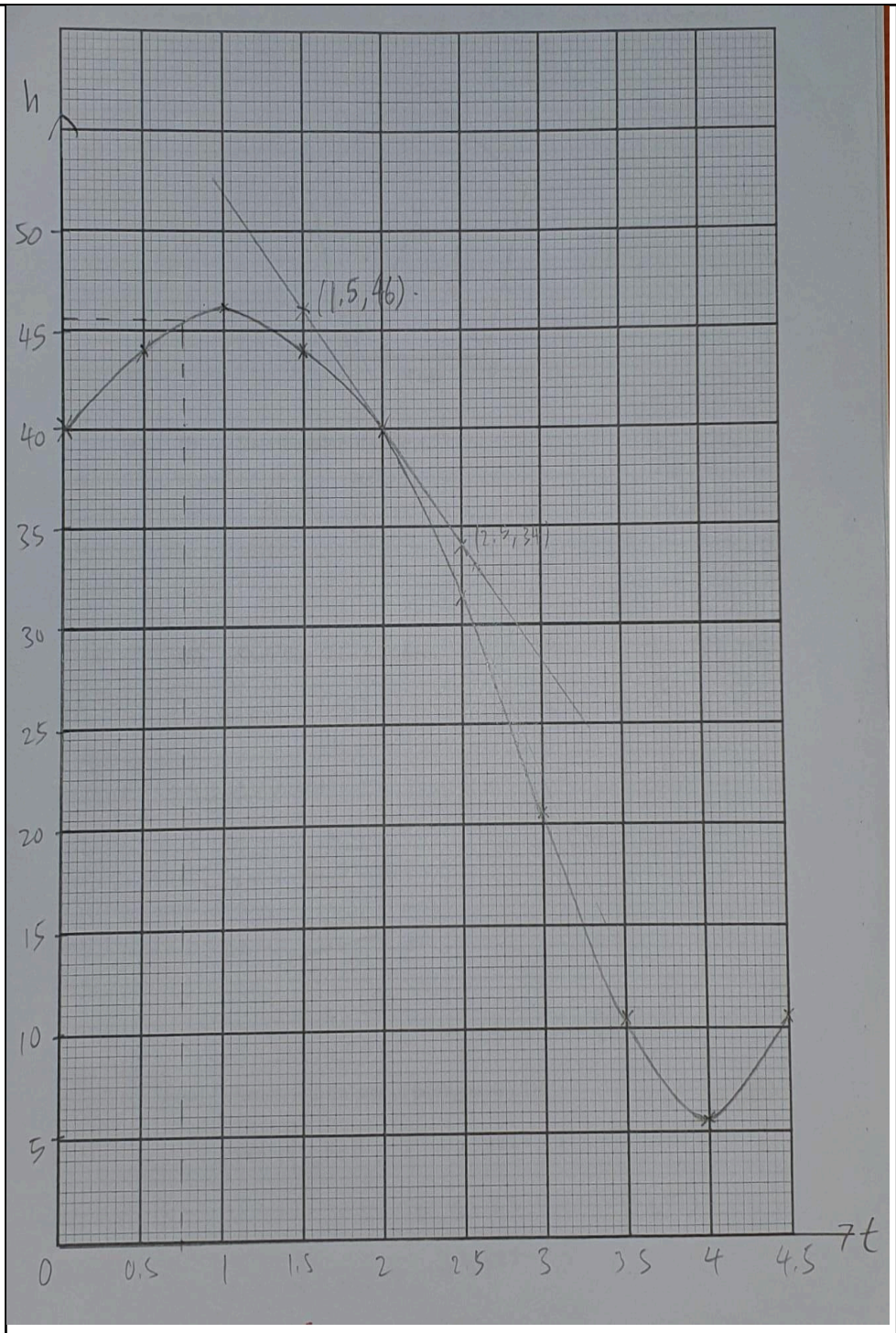
9a	$T_5 = 5^2 \times 63 = 1575$	B1
9b	$T_n = n^2 \times [91 + (n-1)(-7)]$ $= n^2 \times (-7n + 98)$ $= -7n^3 + 98n^2$	M1 A1
9c	$-7n^3 + 98n^2 = 0$ $7n^3 = 98n^2$ $7n = 98$ $n = 14$ Yes. The sequence is a 0 when the term is 14.	M1 A1
10a	$53^2 = 2809$ $45^2 + 28^2 = 2809$ By Converse of PT, since $53^2 = 45^2 + 28^2$, $\angle ADC = 90°$	M1 A1
10b	$72^2 = 53^2 + 116^2 - 2(53)(116)\cos\angle BAC$ $\cos\angle BAC = \left(\frac{116^2 + 53^2 - 72^2}{2(116)(53)}\right)$ $\angle BAC = \cos^{-1}\left(\frac{116^2 + 53^2 - 72^2}{2(116)(53)}\right)$ $= 25.685$ $= 25.7°$	M1 M1 A1
10ci	$\tan 11.77 = \frac{CT}{72}$ $CT = 72\tan 11.77$ $= 15.002$ $= 15.0$ m	M1 A1
10cii	$\frac{1}{2}(53)(116)\sin 25.685$ $= 1332.36$ $= 1330$ m^2	M1 A1
10d	shortest distance $= \frac{1332.36}{\frac{1}{2}\times 116}$ $= 22.9717$ $\angle$ of elevation $= \tan^{-1}\left(\frac{15.002}{22.9717}\right)$ $= 33.14$ $= 33.1°$	 M1 M1 A1

<table>
<tr><td>11i</td><td>
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr>
<tr><td>1</td><td>X</td><td>(2,1)</td><td>(3,1)</td><td>(4,1)</td><td>(5,1)</td></tr>
<tr><td>2</td><td>(1,2)</td><td>X</td><td>(3,2)</td><td>(4,2)</td><td>(5,2)</td></tr>
<tr><td>3</td><td>(1,3)</td><td>(2,3)</td><td>X</td><td>(4,3)</td><td>(5,3)</td></tr>
<tr><td>4</td><td>(1,4)</td><td>(2,4)</td><td>(3,4)</td><td>X</td><td>(5,4)</td></tr>
<tr><td>5</td><td>(1,5)</td><td>(2,5)</td><td>(3,5)</td><td>(4,5)</td><td>X</td></tr>
</table>
</td><td>B1</td></tr>
<tr><td>11iia</td><td>$\frac{1}{10}$</td><td>B1</td></tr>
<tr><td>11iib</td><td>$\frac{3}{10}$</td><td>B1</td></tr>
<tr><td>11iic</td><td>0</td><td>B1</td></tr>
<tr><td>11iid</td><td>$\frac{2}{5}$</td><td>B1</td></tr>
<tr><td>12a</td><td>$\frac{20\text{m}}{1\text{s}} = \frac{2 \div 1000 \text{ km}}{1 \div 60 \div 60 \text{ h}}$
$= 72\text{km/h}$</td><td>M1

A1</td></tr>
<tr><td>12b</td><td>
</td><td>B1 for (10,10)
B1 for curve
B1 for straight line ending at (20,40)</td></tr>
<tr><td>13a</td><td>$\angle DAB + \angle ABC = 180^\circ (\text{int} \angle)$</td><td>B1</td></tr>
<tr><td>13b</td><td>$\cos\theta = \frac{1}{5}$
$\theta = 1.369 rad$</td><td>M1

A1</td></tr>
</table>

13c	arc $AE = 3(1.369) = 4.107$ arc $BE = 2(\pi - 1.369) = 3.5451$ length $AB = \sqrt{5^2 - 1^2} = 4.89897$ perimeter $= 12.551 = 12.6\,\text{cm}$	M1 M1 M1 A1
14ai	23 (angles in same segment)	B1
14aii	$90 - 23 = 67$ (angle in semicircle)	B1
14aiii	$180 - 67 = 113$(angle in opposite segment, cyclic quad)	B1
14b	If D is the center, then $\angle DCE = 90° = \angle DBE$ (tangent $\perp$ radius) $\angle CBE = 65 \times 2$ ($\angle$ centre = 2 $\angle$ at circumference) $= 130°$ $\angle$ sum of quadrilateral $DCEB = 90 + 90 + 130 + 48$ $= 358 \neq 360$ Since the angle sum is not 360°, there is an error in our assumption. D is not the center of the circle.	 M1 M1 A1 A1

15a		
15b	Yes, the minimum point is more than 5m.	B1
15c	45.5m (± 0.25)	B1
15di	Balanced gradient drawn $-12(\pm 1.0)$	B1 B1
15dii	The rate of descend at $t = 2$. The speed of rollercoaster descending at $t = 2$.	B1
15e	$t = 3.5(\pm 0.5)$	B1

16ai	$360 \div 5 = 72^\circ$	B1
16aii	$\angle OBA = 54^\circ$(base of isos triangle) By Sine Rule, $\frac{OA}{\sin 54^\circ} = \frac{4}{\sin 72^\circ}$ $OA = 3.4026\,\text{cm}$ (shown)	M1 M1 A1
16aiii	Area of triangle OAB $= \frac{1}{2}(3.4026)^2 \sin 72^\circ$ $= 5.5055$ Area of ABCDE $= 5.5055 \times 5$ $= 27.5\ \text{cm}^2$	M1 A1
16b	Volume $= 27.52 \times 10 = 275\,\text{cm}^3$ $(3s.f.)$	B1
16c	Total surface area $= 2 \times 27.527 + 5 \times 4 \times 10$ $= 255.054$ Total surface area of 100 prism $= 25505.4$ Assuming paint is 1cm^3 thick, Cans needed $= 25505.4 \div 5000$ $= 6$ cans (rounded up) Total cost $= 6 \times 24.99$ $= 149.94 > 130$ Mr Chin's budget is insufficient.	M1 M1 M1 A1
17a	Option A, as taking Option B will cause him to reach after 6pm.	B1
17b	min. average speed $= \frac{8.8}{14 \div 60} = 37.7$ km/h	M1 A1
17ci	$k = 0.1008 = 0.10$	B1
17cii	<u>Bali Rani Hotel</u> Accommodation = \$262 Waterbom admissions = 3(455 000) + 327 000 = 1692 000 IDR In SGD, Waterbom = \$170.55 Total = \$432.55 > \$430 <u>Bintang Bali</u> Accommodation = \$296 Waterbom admissions = 0.75×170.55 = \$127.91 Total = \$423.91 < \$430	 M1 M1 M1 M1 M1

	<u>Conclusion</u> No, only Bintang Bali will allow Mr Tan to keep the total cost under SGD $430.	A1