

Calculator Model:



# KENT RIDGE SECONDARY SCHOOL PRELIMINARY EXAMINATION 2022

**MATHEMATICS  
PAPER 2**

**4048/02**

**SECONDARY 4 EXPRESS/ 5 NORMAL (ACADEMIC)**

**Tuesday 23 Aug 2022**

**2 hours 30 minutes**

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Name: \_\_\_\_\_ ( ) Class: Sec \_\_\_\_\_

## MARK SCHEME

The total number of the marks for this section is **100**.

For Examiner's Use	
Total	100

### Penalty:

- 1. Poor presentation for algebraic notations and solving equations (-1 overall)**
- 2. Accuracy errors (-1 overall)**

This Question Paper consists of **24** printed pages, including this page.

S/n	Solutions	Marks	Comments
1(a)	$5(4x + 1) > 3(3 - 2x)$ $20x + 5 > 9 - 6x$	M1	
	$26x > 4$ $x > \frac{2}{13}$	A1	Do not accept $x > 0.154$
1(b)	$\left(\frac{b^8}{16a^{12}}\right)^{\frac{1}{4}}$	M1	
	$= \frac{b^2}{2a^3}$	A1	
1(c)	$\frac{x}{(5-2x)^2} + \frac{3}{5-2x}$ $= \frac{x+3(5-2x)}{(5-2x)^2}$	M1	$\frac{x}{(2x-5)^2} - \frac{3(2x-5)}{(2x-5)^2}$ M1
	$= \frac{15-5x}{(5-2x)^2}$	A1	Accept $\frac{5(3-x)}{(5-2x)^2}$ or $\frac{5(3-x)}{(2x-5)^2}$
1(d)	$14x + 12y = 66 \dots(1)$ $15x - 12y = 21 \dots(2)$ $(1) + (2): 29x = 87$	M1	Equivalent method or Substitution method
	$x = 3, y = 2$	A1,A1	
1(e)	$\frac{(5x+4)(5x-4)}{(5x+4)(3x-1)}$	M2	
	$= \frac{5x-4}{3x-1}$	A1	
<b>Q2: Penalize 1 mark for the entire question if no brackets are written.</b>			
2(a)	$\begin{pmatrix} 430 & 635 & 335 \\ 430 & 585 & 310 \end{pmatrix}$	B1	
2(b)	$\begin{pmatrix} 98 \\ 78 \\ 48 \end{pmatrix}$	B1	
2(c)	$\begin{pmatrix} 107750 \\ 102650 \end{pmatrix}$ Value of both elements correct <b>and</b> correct matrix order to award B2	B1 B1	
2(d)	The elements represent the total price of the tickets from <b>all categories</b> sold on <b>Saturday and Sunday respectively</b>	B1	
2(e)	$(1 \ 1)$	B1	
3(a)	Volume $= \frac{2}{3}\pi r^3 + \pi r^3 = \frac{5}{3}\pi r^3$	B1	
3(b)	$\frac{2}{3}\pi r^2 h = \frac{5}{3}\pi r^3 + \frac{1}{3}\pi r^2 h$ $\frac{1}{3}\pi r^2 h = \frac{5}{3}\pi r^3$ $h = 5r$ (shown)	M1  A1	

3(c)	$\frac{2}{3}\pi r^3 = 54\pi$ $r^3 = 81$ $r = 4.3267$	M1	
	Volume of Solid A $= \frac{5}{3}\pi(4.3267)^3 + \frac{1}{3}\pi(4.3267)^2(5 \times 4.3267)$	M1 Ecf	
	$= 848 \text{ cm}^3 \text{ (3sf)}$	A1	
3(d)	$\frac{1}{2} \times (10 + 6) \times y \times (20) = 848.2014$	M1	$\frac{1}{2} \times (10 + 6) \times y$ : M1
	$\text{Height} = \frac{848.2014}{8 \times 20}$	M1 Ecf	
	$= 5.30 \text{ cm}$	A1	
4(a)	$\frac{WY}{\sin 28.6} = \frac{3}{\sin 20}$	M1	
	$WY = \frac{3}{\sin 20} \times \sin 28.6 = 4.20 \text{ m (3sf)}$	A1	
4(b)	$4.1988^2 = 7^2 + 10^2 - 2(7)(10) \cos \angle WXY$	M1 Ecf	
	$\angle WXY = \cos^{-1} \left( \frac{7^2 + 10^2 - 4.1988^2}{2(7)(10)} \right)$	M1 Ecf	
	$= 20.2^\circ \text{ (1dp) shown}$	A1	
4(c)	$\text{Bearing} = 180 - (360 - 308) + 28.6$	M1	(360 - 308) seen: M1
	$= 156.6^\circ \text{ (1dp)}$	A1	
4(d)	$\text{Height} = \sqrt{8^2 - 7^2} = 3.87 \text{ m (3sf)}$	B1	
4(e)	$\text{Shortest } WT = 7 \sin 20.2224 = 2.41966 \text{ m}$	M1	
	Greatest angle of elevation $= \tan^{-1} \frac{3.87298}{2.41966}$	M1 Ecf	
	$= 58.0^\circ \text{ (1dp)}$	A1	

S/n	Solutions	Marks	Comments
5(a)(i)	$\frac{37}{21}$	B1	
5(a)(ii)	Solving $\frac{6n-5}{3n} = \frac{64}{33}$ $n = 27.5$ Since $n$ is not a positive integer, $\frac{64}{33}$ is not a term in the sequence.	B1	Accept: Since the numerator must always be an odd number, $\frac{64}{33}$ is not a term in the sequence.
5(a)(iii)	$T_n = 2 - \frac{5}{3n}$ When $n = 1$ , $T_1 = \frac{1}{3}$ Since $0 < \frac{5}{3n} \leq \frac{5}{3}$ for integer values of $n \geq 1$ , therefore $\frac{1}{3} \leq 2 - \frac{5}{3n} < 2$  Accept since $\frac{5}{3n} > 0$ , $2 - \frac{5}{3n} < 2$ or equivalent reasoning.	M1 A1	Finding $T_1 = \frac{1}{3}$ M1  Do not accept substituting values of $n$ to give a few cases of $T_n$ .
5(b)(i)	130	B1	
5(b)(ii)	$T_n = (n + 1)(n + 2) - 2$	M1	
	$= n^2 + 2n + n + 2 - 2$ $= n^2 + 3n$ (shown)	A1	
5(b)(iii)	$T_k = k^2 + 3k = 208$ $k^2 + 3k - 208 = 0$	M1	
	$(k + 16)(k - 13) = 0$	M1	
	$k = -16$ (reject), $k = 13$	A1	No A1 without method
6(a)	19.25 kg	B1	Accept $19 < Q2 < 19.5$
6(b)	IQR = 22.5 - 15.75	M1	Accept $22.25 < Q3 < 23$ Accept $15.5 < Q1 < 16$
	= 6.75 kg	A1	Accept $6.25 < \text{IQR} < 7.5$
6(c)	27.5 kg	B1	
6(d)	On the average, members in Amazing lost more mass as the median mass loss is higher than Supreme (18 kg)	B1	
	The <b>spread</b> of the mass loss of the members <b>in Amazing is smaller</b> as the <b>interquartile range of Amazing is smaller than Supreme</b> (9 kg)	B1	

6(e)(i)	$\frac{168-20}{200} = \frac{37}{50}$	B1	Accept 0.74
6(e)(ii)	Andy calculated the probability <u>with replacement</u>	B1	
	Correct probability = $\frac{32}{200} \times \frac{31}{199} = \frac{124}{4975}$	B1	Accept 0.0249 (3sf)
7(a)	AD = BE (given)	M2 (all 3)	Accept (angles on a st line). Accept if 60° labelled on diagram to show $\angle BAD = \angle CBE$ .
	$\angle CAB = \angle CBA = 60^\circ$ (interior angles of equilateral triangle) $\angle BAD = \angle CBE = 180 - 60 = 120^\circ$ (adj angles on a st line)		
	AB = BC (sides of equilateral triangle)		
	Therefore, $\triangle ABD \equiv \triangle BCE$ (SAS)	A1	Award A1 if M2 awarded
7(b)(i)	Let A be (a, 0): $\frac{6-0}{7-a} = \frac{6-4}{7-3}$ $a = -5$	M1	Finding gradient $\frac{6-4}{7-3}$ M1
	Area = $\frac{1}{2} \times 5 \times 4$	M1 Ecf	
	= 10 units <sup>2</sup>	A1	
7(b)(ii)	Let point D be (d, 0). OB // DC $\frac{6-0}{7-d} = \frac{4}{3}$ , $d = 2.5$ D is (2.5, 0)	B1	Or scale factor = $\frac{3}{2}$ , $AD = \frac{3}{2} \times 5 = 7.5$ units
7(b)(iii)	$\frac{\text{area of } \triangle ABO}{\text{area of } \triangle ACD} = \left(\frac{5}{7.5}\right)^2 = \frac{4}{9}$	M1 Ecf	
	$\frac{\text{area of } OBCD}{\text{area of } \triangle ACD} = \frac{5}{9}$	A1	

S/n	Solutions	Marks	Comments
8(a)	$p = 2.6$	B1	
8(b)		P2 C1	At least 4 points correct: P1  All 8 points correct: P2
8(c)	Line $y = 5$ <b>drawn or mentioned</b> or line indicated on graph to show x-coordinate solution	B1	
	The line $y = 5$ <b>intercepts the curve at only 1 point</b> , therefore $\frac{x^3}{5} - 2x = 3$ has only one solution	B1	
8(d)(i)	Line $y = -2x + 5$ drawn for $-1 \leq x \leq 4$	B1	
8(d)(ii)	$x = 2.45 \pm 0.2$	B1	Refer to their graph
8(d)(iii)	$\frac{x^3}{5} - 2x + 2 = -2x + 5$ $x^3 - 15 = 0$	M1	
	$A = 0, B = -15$	B1,B1	
<b>Q9(a): Penalize 1 mark for each missing reason or wrong reason up to 2 marks</b>			
9(a)(i)	$\angle OEA = 90$ (radius $\perp$ tan) $\angle OBA = 360 - 90 - 72 - 38$ (angle sum of quadrilateral)	M1	
	$= 160^\circ$	A1	
9(a)(ii)	$\angle BCE = 72 \div 2 = 36$ ( $\angle$ at centre = $2\angle$ at circumference) $\angle DEB = 180 - (36 + 40)$ ( $\angle$ s in opp segments)	M1	
	$= 104^\circ$	A1	

9(a)(iii)	$\angle OBE = (180 - 72) \div 2 = 54$ ( $\angle$ sum of isosceles triangle) $\angle EBA = 160 - 54 = 106$	M1	
	$\angle CBE = 180 - 106 = 74$ (adj $\angle$ s on a st. line) $\angle OEC = 180 - 74 - 36 - 54$ ( $\angle$ sum of triangle)	M1	
	$= 16^\circ$	A1	
9(b)(i)	$r\theta = 12.785 - 4.5 - 4.5 = 3.785$	M1	
	$\theta = \frac{3.785}{4.5} = 0.841$ rad (3sf)	A1	
9(b)(ii)	The perpendicular from the centre of the circle to chord BD bisects the chord. Hence BM = MD.	B1	Accept $\triangle OMB \equiv \triangle OMD$ (RHS) or The <b>perpendicular</b> from the vertex of an <b>isosceles triangle</b> bisects the base
9(b)(iii)	Area of minor sector OAB $= \frac{1}{2}(4.5^2)(0.84111) = 8.5162$ cm <sup>2</sup>  Alternatively: Area of minor sector OBCD M1 $= \frac{1}{2}(4.5^2)(\pi - 2 \times 0.84111) = 14.7761$ cm <sup>2</sup>	M1	
	Area of triangle OBM $= \frac{1}{2}(4.5)(3) \sin(0.84111)$ $= 5.0313$ cm <sup>2</sup>  Alternatively: Area of triangle OBD M1 $= \frac{1}{2}(4.5^2) \sin(\pi - 2 \times 0.84111)$ $= 10.0622$ cm <sup>2</sup>	M1	
	Shaded area $= \frac{\pi(4.5)^2}{4} - 8.5162 - 5.0313$ $= 2.36$ cm <sup>2</sup> (3sf)	A1	Alternatively: Shaded area $= \frac{1}{2}(14.7761 - 10.0622)$ $= 2.36$ cm <sup>2</sup> (3sf)

S/n	Solutions	Marks	Comments
10(a)	Electricity tariff rate for Oct-Dec 22 $= 1.08 \times 30.17 = 32.58 \text{ C/kWh}$	B1	
10(b)	Amount paid before GST $= 1195.87 \times \$0.3258 \times 0.94$ $= \$366.2376$	M1	M1 for using 32.58
	Amount paid after GST $= 1.07 \times \$366.2376$	M1	
	$= \$391.87$	A1	Accept \$391.92 for using more accurate 32.5836 C/kWh in their calculation
10(c)	<b>No. of solar panels to be installed = 20</b>  Based on $9 \div 1.65 \approx 5$ (length) and $4 \div 1 = 4$ (width) $5 \times 4 = 20$	P1	No. of solar panels.  20 seen: P1 Accept $9 \times 2 = 18$ panels  Do not accept $\frac{9 \times 4}{1.65 \times 1} \approx 22$
	Average amount of <b>electricity produced per month</b> $= 20 \times 19 = 380 \text{ kWh}$	E1	P1 $\times 19$ (Their number of panels $\times 19$ )
	Average <b>cost per month after solar energy savings</b> $= (1195.87 - 380) \times \$0.3258 \times 0.94 \times 1.07$ $= \$267.35$	C1	$(1195.87 - E1) \times \$0.3258 \times 0.94 \times 1.07$ seen: C1  Accept if $\times 0.94$ omitted
	Average <b>cost of installing</b> solar panels per month $= 2 \times \$6250 \div (20 \times 12) = \$52.08$	I1	$2 \times \$6250$ seen: I1  If their no. of solar panels $> 20$ , accept $3 \times \$6250$
	<b>Total average amount</b> paid per month $= \$267.35 + \$52.08$ $= \$319.43 (< \$391.87)$	T1	<b>Their C1+ I1</b>
	Since the average amount paid by Mr Robert after installing the solar panels is less than what he is currently paying, he should proceed with the installation.	A1	Awarded independent of accuracy of T1

**Alternative solution for 10(c) based on total cost for 20 years:**

<b>No. of solar panels</b> to be installed = 20	P1
Average amount of <b>electricity produced per month</b> $= 20 \times 19 = 380 \text{ kWh}$	E1
<b>Cost for 20 years</b> <u>before</u> solar energy savings $= \$391.87 \times (20 \times 12) = \$94048.80$	C1
<b>Cost of installing</b> solar panels $= 2 \times \$6250 = \$12500$	I1
<b>Total cost for 20 years</b> <u>after</u> solar energy savings including installation costs $(1195.87 - 380) \times \$0.3258 \times 0.94 \times 1.07 \times (20 \times 12) + \$12500 = \$76664.52$	T1
Since $\$76664.52 < \$94048.80$ , he should proceed with the installation.	A1