Broadrick Secondary School

4E5N Preliminary Examination 2024

Paper 2 Marking Scheme

| | | |
|---|---|---|
| 1a | $4.2\times10^6$ | B1 |
| b | $\frac{4.2\times10^6-3.6\times10^6}{3.6\times10^6}\times100\%$<br>$=16\frac{2}{3}\%$ | M1<br>A1 |
| c | $\frac{3.6\times10^6}{100-4}\times100\%$<br>$=3750000$<br>$=3.75\times10^6$ | M1<br>A1 |
| 2a | $12x-8x^2=6-8x^2$<br>$12x=6$<br>$x=\frac{1}{2}$ | M1<br>A1 |
| b | $1-3p\geq5$<br>$-3p\geq4$<br>$p\leq-\frac{4}{3}$ | B1 |
| c | $3A=\frac{Ap+h}{1-h}$<br>$3A(1-h)=Ap+h$<br>$3A-3Ah=Ap+h$<br>$3A-3Ah-Ap=h$<br>$A(3-3h-p)=h$<br>$A=\frac{h}{3-3h-p}$ | M1 (make linear)<br>M1 (Factorise)<br>A1 |
| d | | M1 (combine)<br>M1 (expand) |

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|---|---|---|
| | $\frac{x}{(x-4)^2}-\frac{3}{4-x}=2$<br>$\frac{x}{(x-4)^2}+\frac{3}{x-4}=2$<br>$\frac{x+3(x-4)}{(x-4)^2}=2$<br>$x+3x-12=2(x^2-8x+16)$<br>$4x-12=2x^2-16x+32$<br>$0=2x^2-20x+44$<br>$0=x^2-10x+22$<br>$x=\frac{-(-10)\pm\sqrt{(-10)^2-4(1)(22)}}{2(1)}$<br>$=\frac{10\pm\sqrt{12}}{2}$<br>= 6.73 or 3.27 (2dp) | M1 (quadratic formula using their found eqn)<br>A1 |
| 3a | $3y+5x-6=0$<br>$y=-\frac{5}{3}x+2$<br>$-1=-\frac{5}{3}(-3)+c$<br>$c=-6$<br>$y=-\frac{5}{3}x-6$ | M1 (find m)<br>M1<br>A1 |
| b | $y=-\frac{5}{3}(0)-6=-6$<br>$B(0,-6)$<br>Mid point of BD = (0, $\frac{9+-6}{2}$) = (0, 1.5)<br>C is ($x$, 1.5) and sub into $y=7.5-x$<br>$1.5=7.5-x$<br>$x=6$<br>So C is (6, 1.5) | M1 (find y value of C)<br>A1 |
| c | Area = $\frac{1}{2}(15)(3)+\frac{1}{2}(15)(6)$ | M1<br>A1 (ECF from |

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|---|---|---|
| | =67.5 | (b)) |
| d | Let $P$ be $(0,-1)$.<br>$\tan \angle ABP = \frac{3}{5}$<br>$\angle ABP = \tan^{-1}\left(\frac{3}{5}\right)$<br><br>Let $Q$ be $(0,1.5)$.<br>$\tan \angle CBQ = \frac{6}{7.5}$<br>$\angle CBQ = \tan^{-1}\left(\frac{6}{7.5}\right)$<br>$\angle ABC = \tan^{-1}\left(\frac{3}{5}\right) + \tan^{-1}\left(\frac{6}{7.5}\right)$<br>= 69.6°<br><br>Or find length of AB, BC and AC and use cosine rule. | M1<br><br>M1<br><br>A1 |
| 4a | 20 | B1 |
| bi | $X = pn^2 + qn$<br>When $n$ = 4 and $X$=2,<br>$2 = p(4)^2 + q(4)$<br>$2 = 16p + 4q$<br><br>When $n$ = 5 and $X$=5,<br>$5 = p(5)^2 + q(5)$<br>$5 = 25p + 5q$ | A1<br><br>A1 |
| bii | $16p + 4q = 2$<br>$80p + 20q = 10 ----(1)$<br>$25p + 5q = 5$<br>$100p + 20q = 20 ----(2)$<br><br>(2)-(1)<br>$20p = 10$<br>$p = 0.5$<br>$q = -1.5$ | M1<br><br>A1<br>A1 |
| biii | | M1 |

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| | $495 = 0.5n^2 - 1.5n$<br>$0 = -495 - 1.5n + 0.5n^2$<br>$0 = n^2 - 3n - 990$<br>$(n-33)(n+30) = 0$<br>$n = 33 \quad \text{or} \quad n = -30$ (rej)<br><br>Since number of vertices is an integer, it is possible to have a *n*-sided polygon with 495 diagonals. | M1<br><br><br><br>A1 |
| 5ai | $\angle ABC = \frac{100}{2} = 50°$ *(angle at centre = 2x angle at circumference)* | B1 |
| aii | $\angle ADC = 180° - 50° = 130°$ *(angles in opp seg)* | B1 |
| aiii | $\angle ACO = \frac{180° - 100°}{2} = 40°$ *(base angles of isos triangle)*<br>$\angle COT = 40°$ *(alt angles, AC//OT)*<br>$\angle OCT = 90°$ *(tan perpendicular to rad)*<br>$\angle OTC = 180° - 90° - 40° = 50°$ *(angle sum of triangle)* | M1<br><br>M1<br>A1 |
| b | $\angle ADC + \angle AOC = 130° + 100°$<br>$= 230°$<br>$\neq 180°$<br>They are not angles in opposite segment.<br>A circle cannot be drawn passing through the points *A*, *O*, *C* and *D*. | B1 |
| c | $\tan 50° = \frac{OC}{4.8}$<br>$OC = 5.72042$<br><br>Minor segment = minor sector – triangle<br>= $\frac{100}{360} \times \pi (5.72042)^2 - \frac{1}{2}(5.72042)^2 \sin(100°)$<br>=12.4 cm² | M1<br><br><br><br>M1<br>A1 |
| 6a | -3.33 (2dp) | B1 |
| 6b | All points plotted correctly<br>Smooth curve | P2<br>C1 |
| 6ci | Tangent drawn such that it passes through (-1,2) and touches curve at 1 point and gradient is negative. | C1 |
| 6cii | $m = \frac{2-(-1)}{-1-0} = -3$<br>$c = -1$<br>$y = -3x - 1$ | M1<br><br><br>A1 |
| 6d | | |

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| | $\frac{1}{x-1}-\frac{1}{4}x=0$<br>$\frac{1}{x-1}-\frac{1}{4}x+\frac{5}{4}x-1=\frac{5}{4}x-1$<br>$y=\frac{5}{4}x-1$<br><br>Draw line on graph<br><br>$x$ = 2.6 and -1.5<br>(accept 2.5, 2.55) (accept -1.4, -1.45, -1.55, -1.6) | M1<br><br>M1<br><br>A1 |
| 7ai | Median = 353 g | B1 |
| aii | UQ: 366 or 367<br>LQ: 342 or 343<br>IQR = $366-342$<br>= 24g (also accept 23 or 25 g depending on their UQ & LQ) | <br><br>M1<br>A1 |
| b | 20%-->32 apples<br><br>Read at 128th apple<br>Min mass = 370 g | M1<br><br><br>A1 |
| c | $\frac{14}{160}\times\frac{160-104}{159}\times 2$<br>= 0.0616 | M1<br><br>A1 |
| d | False.<br>The first quartile which represents 25% of the apples are less than 320g.<br>The upper quartile which represents 75% of the apples are less than 360g which implies that 25% of the apples are more than 360g<br><br>Hence there are equal number of apples weighing less than 320g and more than 360g. | <br><br><br>B1 (states that the whiskers rep 25% of the data) |
| e | I disagree.<br><br>The median mass of apples from tree A is the same as that from tree B. On average, apples from tree A and B weigh the same.<br><br>IQR (Tree B) = 360 – 320 = 40g<br>However, the interquartile range of the masses of the apples from tree B is bigger than that from tree A. The masses of the apples from tree B have a bigger spread, thus are less consistent. | <br><br>B1<br><br><br>B1 |

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| 8a | $BE = \sqrt{15^2 + 8^2}$<br>= 17 cm | M1<br>A1 |
| b | $AG = \sqrt{17^2 + 10^2} = \sqrt{389}$<br>= 19.7 cm (3sf) | M1<br>A1 |
| c | Let *M* be the midpoint of *CG* and *N* be the midpoint of *BF*.<br>$JM = \sqrt{8^2 - 4^2} = \sqrt{48}$<br>Then $JN = 10 + \sqrt{48}$<br>$AN = \sqrt{15^2 + 4^2} = \sqrt{241}$<br>$AJ^2 = (\sqrt{241})^2 + (10 + \sqrt{48})^2$<br>$AJ = 22.96876$<br>= 22.97 (4sf) (shown) | M1<br>M1<br>M1<br>A1 |
| d | $\cos \angle JAG = \dfrac{22.97^2 + \left(\sqrt{389}\right)^2 - 8^2}{2 \times 22.97 \times \sqrt{389}}$<br>$\angle JAG = 19.7796$ =19.8° (1dp)<br>If use exact value, angle =19.78165 = 19.8° (1dp) | M1<br>A1 |
| 9a | Capacity = $\dfrac{1}{3}\pi(2)^2(3) + \dfrac{2}{3}\pi(3)^3$<br>=69.1150 = 69.1 m³ | M1<br>A1 |
| b | Curved hemisphere = $2\pi(3)^2 = 18\pi$<br>Ring = $\pi(3)^2 - \pi(2)^2 = 5\pi$<br>Slant height of cone, L = $\sqrt{2^2 + 3^2} = \sqrt{13}$<br>Curved area of big cone = $\pi(2)\sqrt{13} = 2\pi\sqrt{13}$<br>Using similar solids,<br>$\dfrac{h_{\text{small cone}}}{h_{\text{big cone}}} = \sqrt[3]{\dfrac{1}{10}}$<br>$\dfrac{A_{\text{small cone}}}{A_{\text{big cone}}} = \left(\sqrt[3]{\dfrac{1}{10}}\right)^2 = \dfrac{1}{\sqrt[3]{100}}$<br>$\dfrac{A_{\text{contact with water}}}{A_{\text{big cone}}} = \dfrac{\sqrt[3]{100} - 1}{\sqrt[3]{100}}$<br>$A_{\text{contact with water}} = \dfrac{\sqrt[3]{100} - 1}{\sqrt[3]{100}} \times 2\pi\sqrt{13} = 17.7736$<br>Total area in contact = $18\pi + 5\pi + 17.7736$ | M1 (Hemisphere or ring)<br>M1 (CSA of big cone using their L)<br>M1 (find ratio of h and then area)<br>M1 (find area of cone in contact) |

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<table>
<tr><td></td><td>= 90.0302 = 90.0 m²</td><td>A1</td></tr>
<tr><td>10a</td><td>$\frac{300}{1200}\times 100\% = 25\%$</td><td>B1</td></tr>
<tr><td>b</td><td>$6+1.8\times 2\times 49 = \$182.40$</td><td>M1, A1</td></tr>
<tr><td>c</td><td>
<table>
<tr><th>Item</th><th>Description</th><th>Total cost</th></tr>
<tr><td>Printing of T-shirts</td><td>Double side<br>(Bundle of 500 pcs)</td><td>$7000 x 2= $14000</td></tr>
<tr><td>Goodie Bags</td><td>No of packs req = 1000/5 = 200<br><br>Bulk price (100+ packs)</td><td><br><br>$18 x 200 = $3600</td></tr>
<tr><td>Booking of venue</td><td>6 months in advance</td><td>$1200</td></tr>
<tr><td>Refreshments</td><td>Large set<br><br>Regular set<br><br>Small set</td><td>$3 x 1000 = $3000<br>or<br>$2.80 x 1000 = $2800<br>or<br>$2.50 x 1000 = $2500</td></tr>
<tr><td>Participants medals</td><td>Number of pack of 50 = 1000/50 = 20</td><td>$210 x 20 = $4200</td></tr>
</table>
<br>
Total weight of shirts = 140 g x 1000 = 140 kg
<br><br>
<table>
<tr><th>Local Courier</th><th>Number of parcels</th><th>Cost</th></tr>
<tr><td>Simply Post</td><td>$\frac{140}{80}\approx 2$<br>1 parcel of 80 kg +<br>1 parcel of 60 kg</td><td>$(4.80+1.85\times 2\times 79)$<br>$+(4.80+1.85\times 2\times 59)$<br>$=520.20$</td></tr>
<tr><td>Singapore Post</td><td>$\frac{140}{50}\approx 3$<br>2 parcels of 50 kg +<br>1 parcel of 40 kg</td><td>$2(6+1.80\times 2\times 49)$<br>$+(6+1.80\times 2\times 39)$<br>$=511.20$</td></tr>
<tr><td>DPEX</td><td>$\frac{140}{30}\approx 5$<br>4 parcels of 30 kg +<br>1 parcel of 20 kg</td><td>$4(5.5+1.60\times 2\times 29)$<br>$+(5.5+1.60\times 2\times 19)$<br>$=727.60$</td></tr>
</table>
<br>
Choose Singapore Post & Large Set of refreshment.
<br><br>
Total costs after GST =<br>
$(14000+3600+1200+3000+4200+511.20)\times\frac{109}{100}$
</td><td>M1 (T-shirt printing)<br><br>M1 (bag)<br><br>M1 (medals)<br><br>M1 (shipping)<br><br>M1 (cost after GST)</td></tr>
</table>

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| | =28897.208<br><br>At least 40% to charity, so 60% will be to cover costs:<br>Including charity = $28897.208 \times \frac{100}{60} = 48162.01$<br><br>Fee for each participant= $\frac{48162.01}{1000} = \$48.16$<br><br>To donate at least 60% of the proceeds and cover all costs, sensible amount to charge each participant = $50. | M1 (total including charity)<br><br>A1 |

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