Broadrick Secondary School

4E5N Preliminary Examination 2024

Paper 2 Marking Scheme

1a	4.2×10^6	B1
b	$\frac{4.2\times10^6-3.6\times10^6}{3.6\times10^6}\times100\%$ $=16\frac{2}{3}\%$	M1 A1
c	$\frac{3.6\times10^6}{100-4}\times100\%$ $=3750000$ $=3.75\times10^6$	M1 A1
2a	$12x-8x^2=6-8x^2$ $12x=6$ $x=\frac{1}{2}$	M1 A1
b	$1-3p\geq5$ $-3p\geq4$ $p\leq-\frac{4}{3}$	B1
c	$3A=\frac{Ap+h}{1-h}$ $3A(1-h)=Ap+h$ $3A-3Ah=Ap+h$ $3A-3Ah-Ap=h$ $A(3-3h-p)=h$ $A=\frac{h}{3-3h-p}$	M1 (make linear) M1 (Factorise) A1
d		M1 (combine) M1 (expand)

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

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

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

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

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

<table>
<tr><td></td><td>= 90.0302 = 90.0 m^2</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
(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

Bulk price (100+ packs)</td><td>

$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

Regular set

Small set</td><td>$3 x 1000 = $3000
or
$2.80 x 1000 = $2800
or
$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>

Total weight of shirts = 140 g x 1000 = 140 kg

<table>
<tr><th>Local Courier</th><th>Number of parcels</th><th>Cost</th></tr>
<tr><td>Simply Post</td><td>$\frac{140}{80}\approx 2$
1 parcel of 80 kg +
1 parcel of 60 kg</td><td>$(4.80+1.85\times 2\times 79)$
$+(4.80+1.85\times 2\times 59)$
$=520.20$</td></tr>
<tr><td>Singapore Post</td><td>$\frac{140}{50}\approx 3$
2 parcels of 50 kg +
1 parcel of 40 kg</td><td>$2(6+1.80\times 2\times 49)$
$+(6+1.80\times 2\times 39)$
$=511.20$</td></tr>
<tr><td>DPEX</td><td>$\frac{140}{30}\approx 5$
4 parcels of 30 kg +
1 parcel of 20 kg</td><td>$4(5.5+1.60\times 2\times 29)$
$+(5.5+1.60\times 2\times 19)$
$=727.60$</td></tr>
</table>

Choose Singapore Post & Large Set of refreshment.

Total costs after GST =
$(14000+3600+1200+3000+4200+511.20)\times\frac{109}{100}$
</td><td>M1 (T-shirt printing)

M1 (bag)

M1 (medals)

M1 (shipping)

M1 (cost after GST)</td></tr>
</table>

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