

## O Level Math Paper 2 Ans Key

$$1 \quad (a) \quad 4m^2 + 2 + 2 + \frac{1}{m^2} = 4m^2 + 4 + \left(\frac{1}{m}\right)^2$$

$$(i) \quad 4m^2 + 4 + \left(\frac{1}{m}\right)^2 = 8^2 = 64$$

$$4m^2 + \left(\frac{1}{m}\right)^2 = 64 - 4 = 60$$

$$(b) \quad x = \sqrt{\frac{3m^2 + 2x}{m^2 - x}}$$

$$x^2 = \frac{3m^2 + 2x}{m^2 - x}$$

$$m^2x^2 - x^3 = 3m^2 + 2x$$

$$m^2x^2 - 3m^2 = x^3 + 2x$$

$$m^2(x^2 - 3) = x^3 + 2x$$

$$m^2 = \frac{x^3 + 2x}{x^2 - 3}$$

$$m = \pm \sqrt{\frac{x^3 + 2x}{x^2 - 3}}$$

$$(c) \quad 4^2(x-1)^2 - 9^2$$

$$= [4(x-1)]^2 - 9^2$$

$$= [4(x-1)+9] [4(x-1)-9]$$

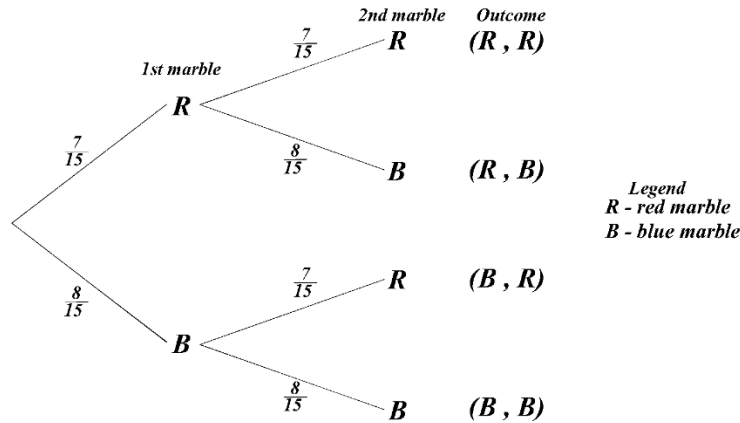
$$= [4x - 4 + 9][4x - 4 - 9]$$

$$= \mathbf{(4x + 5)(4x - 13)}$$

- 2 (a) Since probability he picked a red marble =  $\frac{7}{15}$ ,

He bought =  $15 - 11 = 4$  marbles; **2 red and 2 blue.**

- (b) (i)



(ii) 
$$P(RR \text{ or } BB) = \left(\frac{7}{15}\right)\left(\frac{7}{15}\right) + \left(\frac{8}{15}\right)\left(\frac{8}{15}\right)$$

$$= \frac{49}{225} + \frac{64}{225}$$

$$= \frac{113}{225}$$

(iii) 
$$P(RRR \text{ or } RBR \text{ or } BRB \text{ or } BBB)$$

$$= \left(\frac{7}{15}\right)\left(\frac{7}{15}\right)\left(\frac{7}{15}\right) + \left(\frac{7}{15}\right)\left(\frac{8}{15}\right)\left(\frac{7}{15}\right) + \left(\frac{8}{15}\right)\left(\frac{7}{15}\right)\left(\frac{8}{15}\right) + \left(\frac{8}{15}\right)\left(\frac{8}{15}\right)\left(\frac{8}{15}\right)$$

$$= \frac{113}{225}$$

- 3 (a) 5 units = 160  
1 unit =  $\frac{160}{5} = 32$

13 units =  $13 \times 32 = 416$

(b) (i)  $\frac{80}{x}$

(ii)  $\frac{80}{x} + 1.5$

(iii) Expression:  $10\left(\frac{80}{x} + 1.5\right) + 3(x - 10)$

$$(iv) \quad 10\left(\frac{80}{x} + 1.5\right) + 3(x - 10) = 215$$

$$\frac{800}{x} + 15 + 3x - 30 = 215$$

$$\frac{800}{x} + 3x = 230$$

$$800 + 3x^2 = 230x$$

$$3x^2 - 230x + 800 = 0 \text{ (SHOWN)}$$

$$(v) \quad a = 3; b = -230; c = 800$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-(-230) \pm \sqrt{(-230)^2 - 4(3)(800)}}{2(3)}$$

$$x = 73.0 \text{ or } 3.65 \text{ (rejected)}$$

$$(vi) \quad \begin{aligned} \text{cost price of each card} &= \frac{80}{73} \\ &= \$1.096 \\ &= \mathbf{\$1.10} \text{ (3 sf)} \end{aligned}$$

$$4. \quad (a) \quad \mathbf{P} = \begin{pmatrix} 60 & 40 & 90 \\ 40 & 70 & 50 \\ 80 & 20 & 30 \end{pmatrix}$$

$$(b) \quad \mathbf{M} = 4 \begin{pmatrix} 60 & 40 & 90 \\ 40 & 70 & 50 \\ 80 & 20 & 30 \end{pmatrix} \\ = \begin{pmatrix} 240 & 160 & 360 \\ 160 & 280 & 200 \\ 320 & 80 & 120 \end{pmatrix}$$

$$(c) \quad \mathbf{T} = \begin{pmatrix} 240 & 160 & 360 \\ 160 & 280 & 200 \\ 320 & 80 & 120 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 760 \\ 640 \\ 520 \end{pmatrix}.$$

It represents the total number of customers from all three shops buying Grade A, Grade B and Grade C durians respectively.

(d)  $\mathbf{Q} = \begin{pmatrix} 10 & 7 & 5 \end{pmatrix}$

$$\mathbf{QM} = \begin{pmatrix} 10 & 7 & 5 \end{pmatrix} \begin{pmatrix} 240 & 160 & 360 \\ 160 & 280 & 200 \\ 320 & 80 & 120 \end{pmatrix} = \begin{pmatrix} 5120 & 3960 & 5600 \end{pmatrix}$$

(e)  $\mathbf{QM}$  represents the value of sales received by shops  $X$ ,  $Y$  and  $Z$  respectively over 4 weeks.

5. (a)(i)  $BD = \sqrt{6^2 + 2^2} = \sqrt{40}$

$$\tan \angle HBD = \frac{4}{\sqrt{40}}$$

$$\angle HBD = \tan^{-1} \left( \frac{4}{\sqrt{40}} \right) = 32.3^\circ \text{ (SHOWN)}$$

(a)(ii)  $AF = \sqrt{6^2 + 4^2} = \sqrt{52}$        $(AF)^2 = 52$

$$FC = \sqrt{2^2 + 4^2} = \sqrt{20} \quad (FC)^2 = 20$$

$$\cos \angle AFC = \frac{(AF)^2 + (FC)^2 - (AC)^2}{2(AF)(FC)}$$

$$\cos \angle AFC = \frac{52 + 20 - 40}{2\sqrt{52}\sqrt{20}}$$

$$\cos \angle AFC = \frac{32}{2\sqrt{1040}}$$

$$\angle AFC = \cos^{-1} \left( \frac{32}{2\sqrt{1040}} \right) = 60.3^\circ \text{ ( 1 dp )}$$

(a)(iii) greatest angle of elevation when the point along  $AB$  is closest to  $H$  i.e. at  $A$

$$\tan \theta = \frac{4}{2}$$

$$\theta = \tan^{-1} \left( \frac{4}{2} \right) = 63.3^\circ \text{ ( 1 dp )}$$

(b)(i)  $n + 6$

(b)(ii) since the difference of any 2 consecutive numbers is always equal to 5, the difference of any two numbers in the same column is always a multiple of 5.

(b)(iii) Let the number in the top right be  $n$ .

$$(n-1) + n + (n-1+5) + (n+5) = 96$$

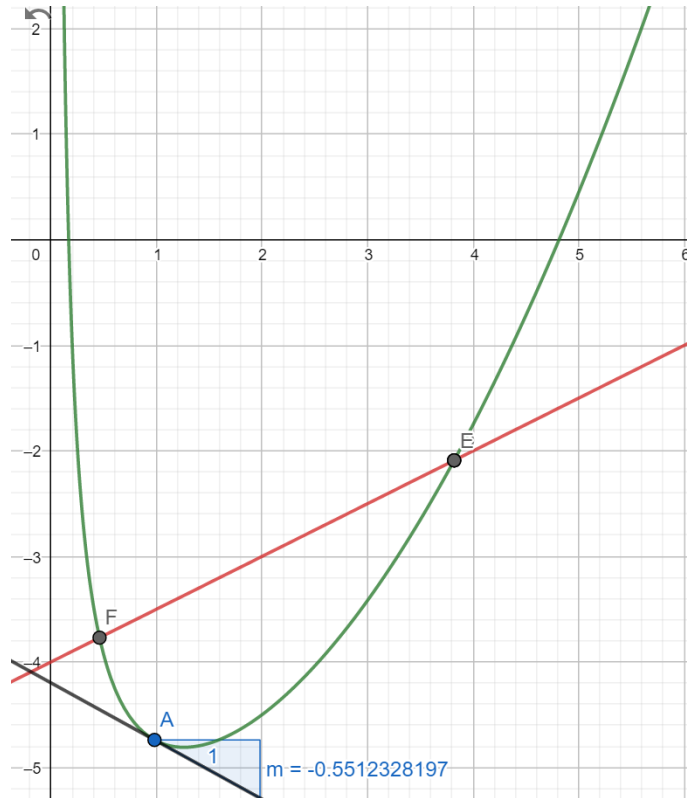
$$4n - 1 - 1 + 5 + 5 = 96$$

$$4n + 8 = 96$$

$$4n = 88$$

$$n = 22$$

6.



(a)  **$w = -1.75$**

(b) 5 points plotted correctly. 2 other points plotted correctly with correct scale. Smooth curve.

(c) attempt to draw a tangent at (1, -4.8).  
**Gradient = -0.5 ( $\pm$  0.1)**

(d)(i) attempted to draw and label  $y = 0.5x - 4$  or tables of values seen.  
Graph drawn correctly

(d)(ii)  **$x = 3.8$  ( $\pm$  0.1)**

$$(iii) \frac{x^2}{4} + \frac{1}{x} - 6 = \frac{x}{2} - 4$$

$$\frac{x^3}{4} + 1 - 6x = \frac{x^2}{2} - 4x$$

$$x^3 + 4 - 24x = 2x^2 - 16x$$

$$x^3 - 2x^2 - 24x + 16x + 4 = 0$$

$$x^3 - 2x^2 - 8x + 4 = 0$$

$$A = -2$$

$$B = -8$$

7. (a)(i)  $\angle BOA = 2 \times 48 = 96^\circ$  (angle at centre =  $2 \times$  angle at circumference)  
 $\angle ABO = \frac{180 - 96}{2} = 42^\circ$  (base angles of isosceles triangle)

(a)(ii)  $\angle BDA = 48^\circ$  (angles in the same segment)

(a)(iii)  $\angle DCA = 42^\circ$  (angles in the same segment)  
 $\angle CDA = 180^\circ - 42^\circ - 32^\circ = 106^\circ$  (angles sum of triangle)

(b) **No.**  $\angle GAB = 48^\circ$   
 $\angle DBA = 42^\circ$

**Since they are not equal, they cannot be alternate angles of a set of parallel lines.**

8. (a) **S(5, 6)**

(b)  $PR = \sqrt{(5-3)^2 + (9-1)^2} = 8.2462 = 8.25$  units.

(c)  $3y = 4x + 5$   
 $y = \frac{4}{3}x + \frac{5}{3}$   
 $m = \frac{4}{3}$ ,  $P(3, 1)$

Equation of line:

$$y = mx + c$$

$$1 = \left(\frac{4}{3}\right)(3) + c$$

$$c = 1 - 4 = -3$$

$$y = \frac{4}{3}x - 3$$

(d) Area triangle  $PRQ = \frac{1}{2} \times 3 \times 2 = \mathbf{3 \text{ units}^2}$

(e) Let the perpendicular distance from  $B$  to  $AC$  be  $h$ .

$$\text{Area triangle } PRQ = \frac{1}{2} \times 8.2462 \times h = 3$$

$$h = 0.728 \text{ units}$$

9. (a) using cosine rule,

$$\begin{aligned} AD^2 &= DC^2 + AC^2 - 2(AC)(DC) \cos \angle DCA \\ &= (9.6)^2 + (4.7)^2 - 2(9.6)(4.7) \cos (180^\circ - 68^\circ) \\ AD &= 12.168 \\ &= \mathbf{12.2 \text{ km}} \text{ (3 sf)} \end{aligned}$$

(b) using sine rule,

$$\begin{aligned} \frac{9.6}{\sin \angle CAD} &= \frac{12.168}{\sin 112^\circ} \\ \sin \angle CAD &= \frac{9.6 \sin 112^\circ}{12.168} \\ \angle CAD &= \sin^{-1} \left( \frac{9.6 \sin 112^\circ}{12.168} \right) = 47.0^\circ \end{aligned}$$

(c) bearing of  $C$  from  $D = 360^\circ - 22^\circ = \mathbf{338^\circ}$

(d) using sine rule:

$$\begin{aligned} \text{Area of } ACD &= 0.5(4.7)(9.6) \sin 112^\circ \\ &= \mathbf{20.9 \text{ cm}^2} \text{ (3 sf)} \end{aligned}$$

(e) smallest angle of elevation happened when it is observed from point  $D$ .  
let the smallest angle of elevation be  $\theta$ .

$$\begin{aligned} \tan \theta &= \frac{450}{9600} \\ \theta &= \tan^{-1} \left( \frac{450}{9600} \right) = 2.6838^\circ = \mathbf{2.7^\circ} \end{aligned}$$

(f) Total length of fence =  $9.6 + 4.7 + 12.168 = 26.468$   
Cost of fencing =  $26.468 \times \$2.70 = \mathbf{\$71.46}$

10. (a) Annual cost of living =  $3165 + 2500 + 2100 + 700 + 400 = \mathbf{\$8865}$

(b) total annual allowance from parents =  $12 \times 700 = \$8400$

Balance allowance needed =  $8865 - 8400 = \$465$

Total number of hours =  $\frac{465}{30} = 15.5$  hours (over 12 months)

Number of hours monthly =  $\frac{15.5}{12} = 1.291 = \mathbf{\underline{1.29 \text{ hours}}}$

(c) It is more practical for her to take the 8-year loan as the repayment amount will be less than that of the 4-year loan. This will allow her to save more of her allowance every month.

Total tuition fees =  $(7040)(4) = \$28\,160$

Processing fees =  $2.5\% \times 28\,160 = \$704$

Total amount owed =  $28160 + 704 = \$28\,864$

Interest for 4 years.

$4.25\% \times 28\,864 \times 4 \text{ years} = \$4906.88$

Total repayment =  $28864 + 4906.88 = \$33\,770.88$

If yearly repayment, \$8442.72 per year

If monthly repayment, \$703.56 per month

Interest for 8 years.

$4.25\% \times 28\,864 \times 8 \text{ years} = \$9813.76$

Total repayment =  $28864 + 9813.76 = \$38677.76$

If yearly repayment, \$4834.72 per year

If monthly repayment, \$402.89 per month

**The end**

**Legend for question paper:**

(Level of difficulty)

[s] – Simple

[m] – Moderate

[c] – Challenging