**2024 SEED MSCE MOCK**
**PROVISIONAL MARKING KEY**
**MATHEMATICS II**

# SOUTH EAST EDUCATION DIVISION

**2024 MALAWI SCHOOL CERTIFICATE OF EDUCATION MOCK EXAMINATION**

# MATHEMATICS

## PAPER II

**SECTION A** (60 marks)

Answer **all** the **six** questions in this section

1. a. Express as a single fraction in its simplest form. **(5 marks)**

$$1-\frac{1}{x}-\frac{x-2}{x-1}$$

$$=\frac{x(x-1)-(x-1)-x(x-2)}{x(x-1)} \quad (2)$$

$$=\frac{x^2-x-x+1-x^2+2x}{x(x-1)} \quad (1)$$

$$=\frac{x^2-x^2-2x+2x+1}{x(x-1)} \quad (1)$$

$$=\frac{1}{x(x-1)} \quad (1)$$

b. Simplify $\frac{18}{6-\sqrt{6}}$ leaving your answer with a rational denominator. **(5 marks)**

$$=\frac{18}{(6-\sqrt{6})}x\frac{(6+\sqrt{6})}{(6+\sqrt{6})} \quad (1)$$

$$=\frac{18(6+\sqrt{6})}{(6-\sqrt{6})(6+\sqrt{6})} \quad (1)$$

$$=\frac{18(6+\sqrt{6})}{36-6}$$

$$=\frac{18(6+\sqrt{6})}{30} \quad (1)$$

$$=\frac{3(6+\sqrt{6})}{5} \quad (1)$$

$$=\frac{18+3\sqrt{6}}{5} \quad (1)$$

2. a. Given that $g(t) = at^2 + bt - 3$.
If $g(2) = 4$ *and* $g(-2) = 6$ find *a* and *b*.

**(6 marks)**

$g(2) = a(2)^2 + b(2) - 3 = 4$
$4a + 2b = 4 + 3$
$4a + 2b = 7 \quad \ldots \quad (i)$ *(1)*
$g(-2) = a(-2)^2 + b(-2) - 3 = 6$ *(1)*
$4a - 2b = 6 + 3$
$4a - 2b = 9 \quad \ldots \quad (ii)$ *(1)*
$4a + 2b = 7$ *eliminate b (1)*
$+\underline{4a - 2b = 9}$
$8a = 16$
$a = 2$ *(1)*
$4(2) + 2b = 7$ *(1)*
$8 + 2b = 7$
$2b = 7 - 8$
$b = -\frac{1}{2}$ *(1)*

b. Two lines AB and RQ intersect at point P. AB passes through the points *(– 4, 0)* and *(0, 6)*. Given that RQ has the equation of $y = 4x - 4$, find by calculation the coordinates of point P. **(4 marks)**

*Let the equation be* $y = mx + C$

$$m = \frac{change\ in\ y}{change\ in\ x}$$

$$m = \frac{6-0}{0-(-4)} = \frac{6}{4} = \frac{3}{2}$$ *(1)*

$\therefore$ *The equation is*

$$y = \frac{3}{2}x + 6$$

$$y = 4x - 4$$

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

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

$$3x - 8x = 2(-10)$$ *(1)*

$$3x - 8x = -20$$

$$-5x = -20$$

$$x = 4$$ *(1)*

*Substituting in* $y = 4x - 4$

$y = 4(4) - 4$
$= 16 - 4$
$= 12$

$\therefore$ $\boldsymbol{P}\ (4,12)$ *(1)*

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3. a. **Figure 1** is a circle centre BQE with centre O. BQ is a diameter and BH is a tangent to the circle at B.

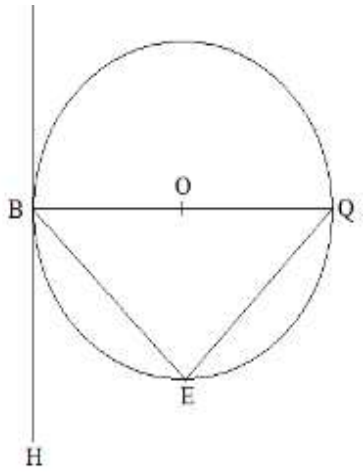



**Figure 1**

Given that angle HBE is acute, show that angle HBE = angle BQE.

**(5 marks)**

$<HBE + <EBO = 90°$, *(radius perpendicular to tangent)* *(1)*
$<HBE = 90° - <EBO$ *(1)*
$<BEQ = 90°$, *(< in semicircle)* *(1)*
$<BQE + <EBO + <BEQ = 90°$, *(sum of <s in a* $\Delta$*)* *(1)*
$\therefore < HBE = < BQE$ *(1)*

b. MN is a straight line with coordinates M (2, *t*) and N(– 6, 2) respectively. The mid-point of MN is P (*r*, 5). Find *t* and *r*.

**(5 marks)**

$$\left(\frac{2+-6}{2}, \quad \frac{t+2}{2}\right) = (r, 5) \quad (1)$$

$$\left(\frac{-4}{2}, \quad \frac{t+2}{2}\right) = (r, 5) \quad (1)$$

$$\left(-2, \quad \frac{t+2}{2}\right) = (r, 5)$$

$r = -2$ *(1)*

$$\frac{t+2}{2} = 5$$

$t + 2 = 10$ *(1)*

$t = 10 - 2$

$t = 8$ *(1)*

4. a. Make *t* the subject of the formula. $L = w\dfrac{(k-t)}{m} - t$ **(4 marks)**

$$L = \frac{w(k-t)}{m} - t$$

$$L + t = \frac{w(k-t)}{m} \quad (1)$$

$$m(L+t) = w(k-t) \quad (1)$$

$$mL + mt = wk - wt$$

$$mt + wt = wk - mL$$

$$t(m+w) = wk - mL \quad (1)$$

$$t = \frac{wk - mL}{m+w} \quad (1)$$

b. In **Figure** 2, $\overrightarrow{AC} = \underline{c}$, $\overrightarrow{CD} = 2\underline{a}$, $\overrightarrow{DB} = \underline{a}$ and $3\overrightarrow{AE} = \overrightarrow{ED}$.

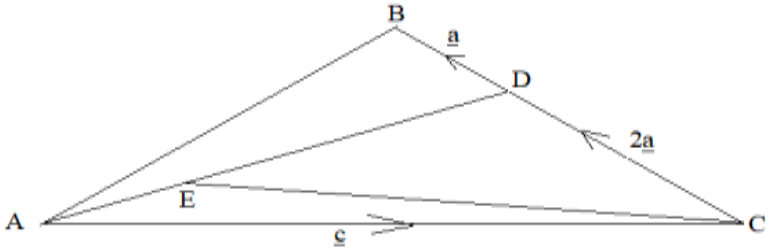



**Figure 2**

Find $\overrightarrow{AE}$, in terms of $\underline{a}$ and $\underline{c}$. **(6 marks)**

$$\overrightarrow{AC} + \overrightarrow{CB} = \overrightarrow{AB} \quad (1)$$

$$\underline{c} + 3\underline{a} = \overrightarrow{AB}$$

$$\overrightarrow{AB} = \underline{c} + 3\underline{a} \quad (1)$$

$$\overrightarrow{AD} + \overrightarrow{DB} = \overrightarrow{AB} \quad (1)$$

$$\overrightarrow{AD} = \overrightarrow{AB} - \overrightarrow{DB}$$

$$= \underline{c} + 3\underline{a} - \underline{a}$$

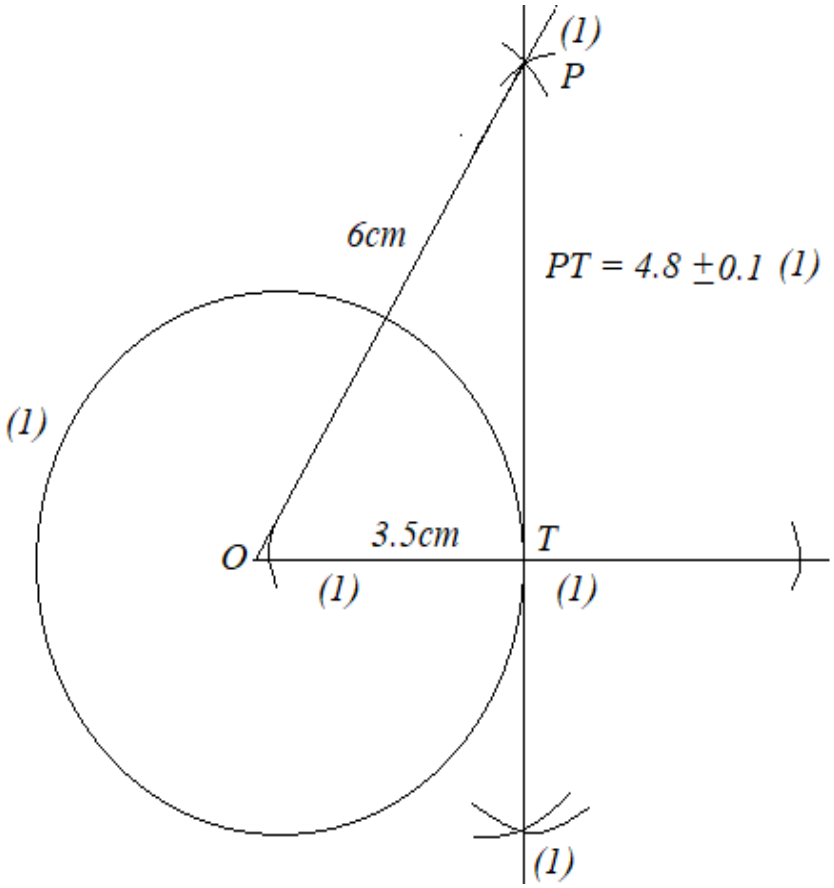
$$= \underline{c} + 2\underline{a} \quad (1)$$

$$\overrightarrow{AD} = 4\overrightarrow{AE}$$

$$\overrightarrow{AE} = \tfrac{1}{4}\overrightarrow{AD} \quad (1)$$

$$= \tfrac{1}{4}(\underline{c} + 2\underline{a}) \quad (1)$$

5. a. Using a ruler and a pair of compasses only, construct in the same diagram;
   - a circle centre O of radius 3.5cm
   - a tangent PT to the circle at T such that OP is 6cm
   - measure and state the length of PT. **(6 marks)**




b. Solve the equation $\log_{10}(2m+6) = 1 + \log_{10}(m-1)$ **(4 marks)**

$log_{10}(2m+6) = 1 + log_{10}(m-1)$

$log_{10}(2m+6) - log_{10}(m-1) = 1$

$log_{10}\frac{(2m+6)}{(m-1)} = log_{10}10$ *(1)*

$\frac{(2m+6)}{(m-1)} = 10$

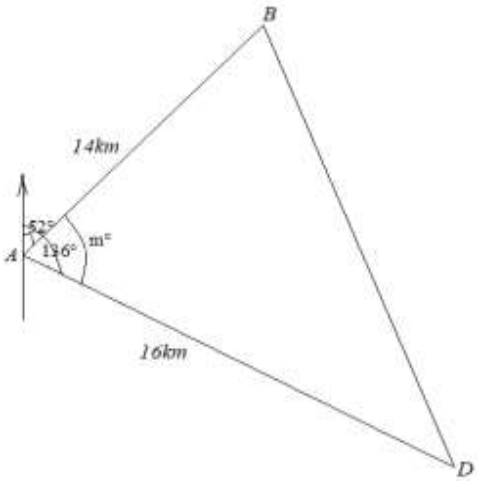
$2m + 6 = 10m - 10$ *(1)*

$2m - 10m = -10 - 6$

$-8m = -16$ *(1)*

$m = 2$ *(1)*

6. a. Two ships leave port A at the same time. One travels for 14km on a bearing of 052° to port B. The other travels at 8 km/hr on a bearing of 136° to port D. How far apart are the two ships after 2 hours? Give your answer correct to 1 decimal place. **(6 marks)**




*(1)*

$m° = 136° – 52°$

$= 84°$ *(1)*

$AD = 8 \times 2 = 16km$

$BD^2 = 14^2+16^2 –2\times14\times16\cos84°$ *(1)*

$= 196 + 256 –46.8288$

$= 405.1712$ *(1)*

$BD = \sqrt{405.1712}$ *(1)*

$= 20.1289$

$= 20.1km$ *(1)*

b. Given that $A = \begin{pmatrix} 2 & 6 \\ 1 & -4 \end{pmatrix}, B = \begin{pmatrix} -3 & 2 \\ 0 & -5 \end{pmatrix}$ *and* $C = \begin{pmatrix} -1 & 8 \\ -5 & 7 \end{pmatrix}$, simplify ¼[A – B + C].

**(4 marks)**

$= \frac{1}{4}\left[\begin{bmatrix} 2 & 6 \\ 1 & -4 \end{bmatrix} - \begin{bmatrix} -3 & 2 \\ 0 & -5 \end{bmatrix} + \begin{bmatrix} -1 & 8 \\ -5 & 7 \end{bmatrix}\right]$ *(2)*

$= \frac{1}{4}\begin{bmatrix} 4 & 12 \\ -4 & 8 \end{bmatrix}$ *(1)*

$= \begin{bmatrix} 1 & 3 \\ -1 & 8 \end{bmatrix}$ ***Check! Put 2 instead of 8*** *(1)*

**SECTION B** (40 marks)

Answer any **four** questions.

7. Solve the equation $2^{2a+3} – 9(2^a) + 1 = 0$ **(10 marks)**

$2^{2a} \times 2^3 –9(2^a) + 1 = 0$ *(1)*

$(2^a)^2 \times 8 –9(2^a) + 1 = 0$

*Let* $2^a = t$

$8t^2 –9t + 1 = 0$ *(1)*

$(8t^2 – 8t) + ( –t + 1) = 0$ *(1)*

$8t(t-1)-1(t-1)=0$ *(1)*

$(8t-1)(t-1)=0$

$8t-1=0$ *or* $t-1=0$

$t=\frac{1}{8}$ *(1)* $t=1$ *(1)* *(2)*

*Substituting* $2^a$ *for* $t$

$2^a=8^{-1}$ $2^a=2^0$

$2^a=2^{-3}$ *(1)* $2^a=2^0$ *(1)* *(2)*

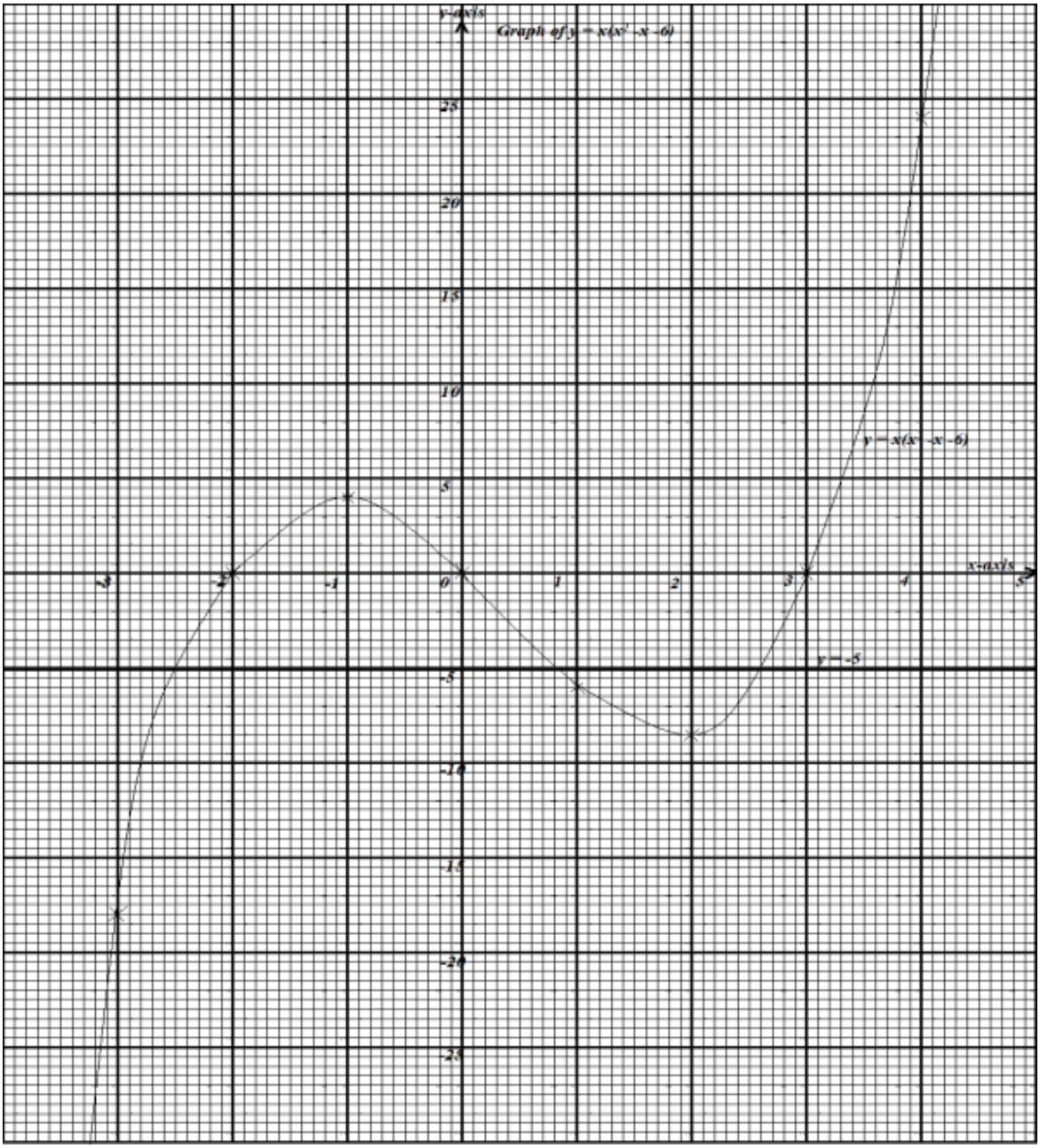
$a=-3$ *(1)* $a=0$ *(1)* *(2)*

8. a. Complete the table of values for the equation $y=x(x^2-x-6)$ **(2 marks)**

**Table 1**

| x | –3 | –2 | –1 | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| y | –18 | 0 | ***4*** | 0 | –6 | ***–8*** | 0 | 24 |
| | | | *(1)* | | | *(1)* | | |

b. Using a scale of 2cm to represent 1 unit on the x – axis and 2cm to represent 5 units on the y – axis, draw the graph of $y=x(x^2-x-6)$. **(5 marks)**




*Correct scale* *(1)*
*Graph of cubic function (2)*
*y – axis* *(1)*
*y – axis* *(1)*

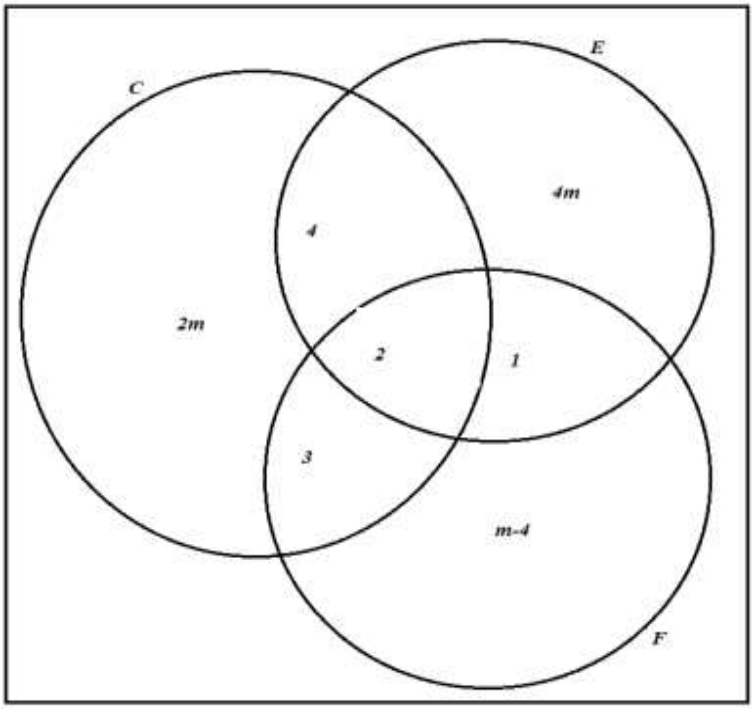
c. Use your graph to solve the equation $x(x^2 - x - 6) + 5 = 0$. **(3 marks)**

$x^3 - x^2 - 6x + 5 = 0$
$-(x^3 - x^2 - 6x = y)$ *(1)*
$5 = -y$ *(1)*
$y = -5$
$x = -2.4 \pm 0.1$ *or* $0.8 \pm 0.1$ *or* $2.6 \pm 0.1$ *(1)*

9. At Mchenga Secondary School, the students can speak at least one of the languages; Chichewa, English or French. In a class of 41 students;
   - 2 students can speak all the three languages
   - 4 students can speak English and Chichewa only
   - 1 student can speak English and French only
   - 3 students can speak Chichewa and French only
   - 2m students can speak Chichewa only
   - 4m students can speak English only and (m – 4) students speak French only.

a. Illustrate this information on a Venn diagram.

$n(\xi) = 41$




*(4 marks)*

b. Find the value of m and hence the number of students who speak English only.

**(10 marks)**

$2m + 4 + 2 + 3 + m - 4 + 1 + 4m = 41$ *(1)*

$7m + 6 = 41$ *(1)*

$7m = 41 - 6$

$7m = 35$ *(1)*

$m = 5$ *(1)*

$English\ only = 4m$

$= 4x5$ *(1)*

$= 20$ *(1)*

10. The first, third and seventh terms of an Arithmetic Progression (AP) with common difference of 2 are the first three terms of a Geometric Progression (GP). Find the sum of the first four terms of the G.P. **(10 marks)**

$a = a$
$a + 2d = ar$
$a + 6d = ar^2$ *(1)*
$a + 2d = ar$
$a + 2(2) = ar$
$a + 4 = ar$ *(1)*
$ar - a = 4$
$a(r - 1) = 4$
$a = \frac{4}{r-1}$
$a + 6d = ar^2$
$6(2) = ar^2 - a$
$12 = a(r^2 - 1)$ *(1)*
*But* $a = \frac{4}{r-1}$
$12 = \frac{4}{r-1}(r^2 - 1)$ *(1)*
$12 = \frac{4}{r-1}(r+1)(r-1)$ *(1)*

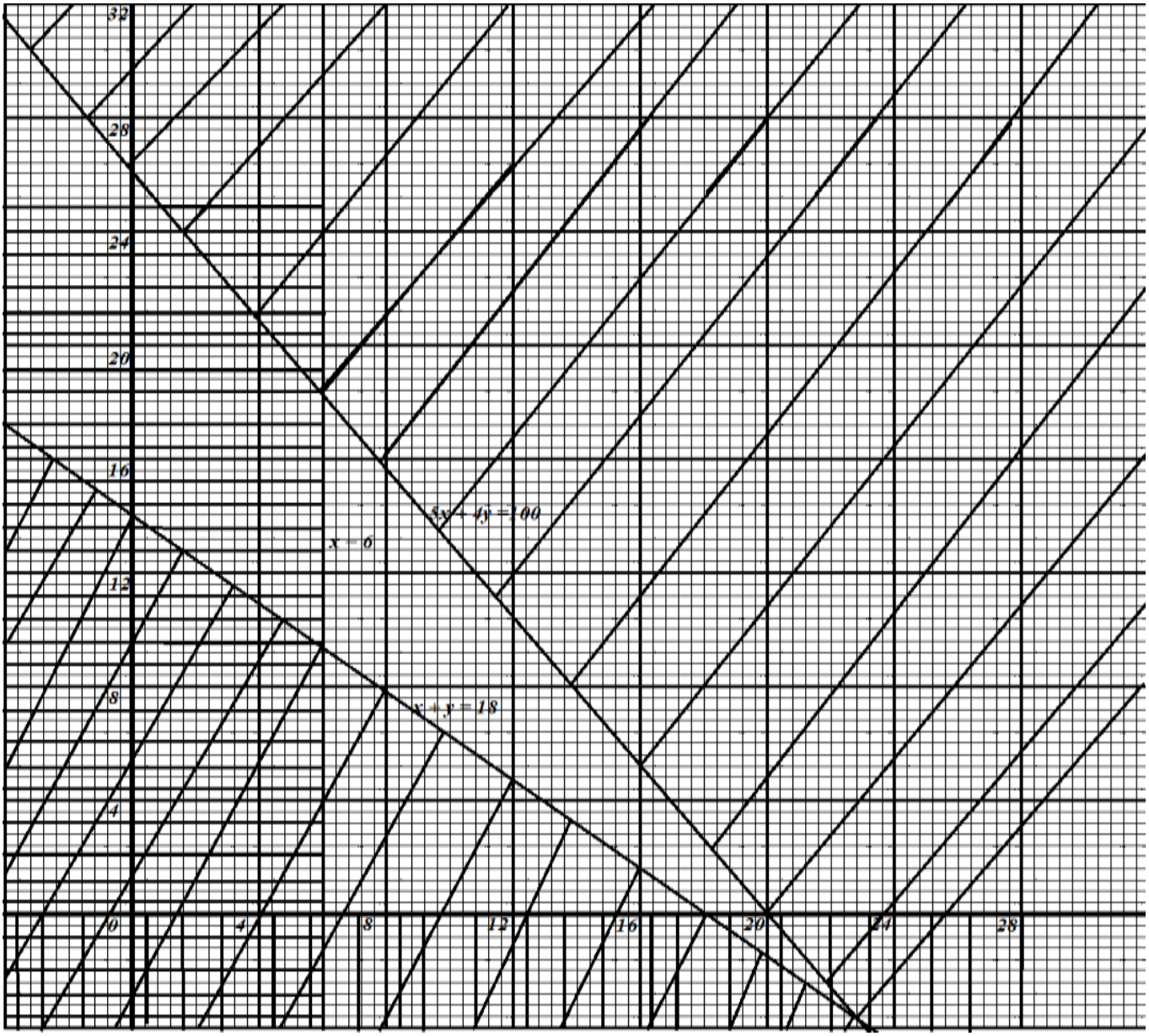
*(Difference of 2 squares)*
$12 = 4r + 4$ *(1)*
$4r + 4 = 12$
$4r = 12 - 4$
$4r = 8$
$r = 2$ *(1)*
*Solving for a*
$a = \frac{4}{2-1}$
$= \frac{4}{1}$
$= 4$ *(1)*
$S_4 = \frac{4(2^4 - 1)}{2 - 1}$
$= \frac{4(16 - 1)}{1}$ *(1)*
$= 4 \times 15$
$= 60$ *(1)*

11. A shopkeeper bought two types of animal feed. Type A costs K750 per bag and type B costs K600 per bag. She had K15,000 available and decided to buy at least 18 bags altogether. She also decided to buy at least 6 bags of type A feed. She made a profit of K20 per bag of type A and K25 per bag of type B.

a. Write down four inequalities to represent this information. Take x to represent the number of type A bags and y to represent the number of type B bags. **(4 marks)**

i. $x \geq 6$
ii. $y \geq 0$
iii. $x + y \geq 18$
iv. $750x + 600y \leq 15000$
$5x + 4y \leq 100$

b. Using scale of 2 cm to represent 4 units on both axes, draw graphs to show the region represented by the four inequalities. Shade the unwanted region. **(4 marks)**




c. Use the graphs to find the maximum profit the farmer could make if he sells all the feeds. **(2 marks)**

*20x + 25y*

| | | | |
|---|---|---|---|
| *At (6, 17)* | *= 20(6) + 25(17)* | *= 545* | |
| *At (8, 14)* | *= 20(8) + 25(14)* | *= 510* | *(1)* |
| *At (10, 12)* | *= 20(10) + 25(12)* | *= 500* | |
| *At (18, 2)* | *= 20(18) + 25(2)* | *= 410* | |

*The farmer can make a profit of K545.* *(1)*

12. **Figure 3** shows a prism AQCGDP 7cm long, with a triangular cross section, DA = DQ = 5cm and AQ = 6cm.

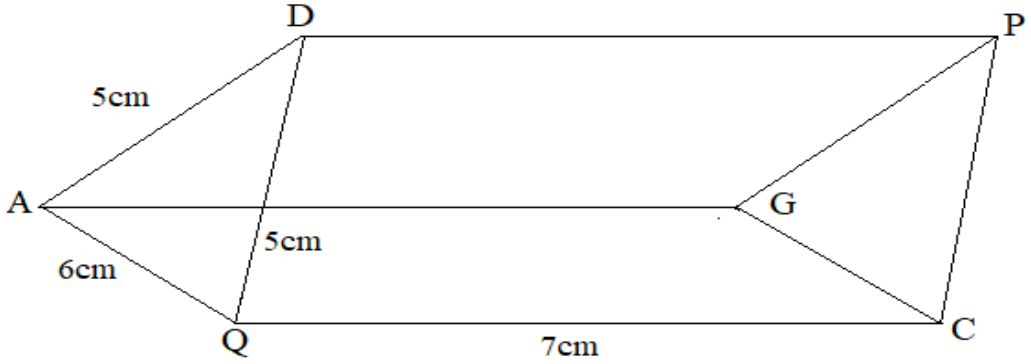
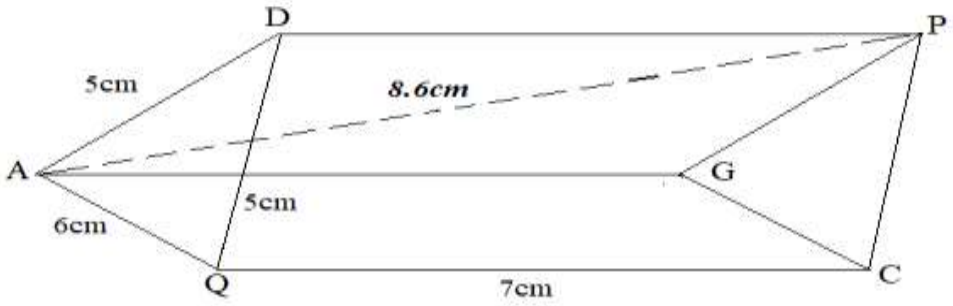



**Figure 3**

Calculate

a. the length of AP.

b. angle between line PC and plane AQCG, giving your answer correct to the nearest degree.




*(1)*

$AD^2 + DP^2 = AP^2$ *(1)*

$5^2 + 7^2 = AP^2$

$25 + 49 = AP^2$ *(1)*

$AP^2 = 74$

$AP = \sqrt{74}$ *(1)*

$= 8.6$ *(1)*

$GP^2 = 5^2 + 6^2 - 2x5x6CosC$ *(1)*

$5^2 = 25 + 36 - 60CosC$

$25 = 25 + 36 - 60CosC$

$60CosC = 36$ *(1)*

$CosC = \frac{36}{60}$

$= 0.6$ *(1)*

$C = Cos^{-1}0.6$ *(1)*

$= 53.1301$

$=53°$ *(1)*

**END OF PROVISIONAL MARKING KEY**
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