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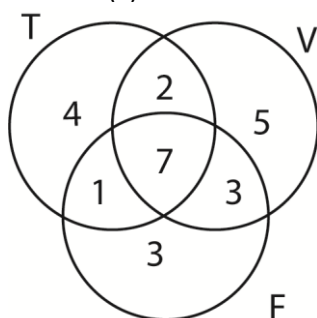


UCE MATHEMATICS PAPER 2 2016 guide

SECTION A (40 marks)

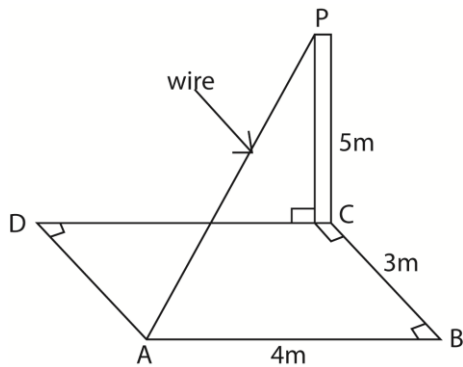
Answer all questions in this section

- Given that $h(x) = 3x - 2$. Find the value of
 - $h(-2)$
 - x when $h(x) = 7$
- Josephine obtained 95% in a test which was marked out of 80marks. How many marks did she score out of 80?
- The Venn diagram below shows the number of students who play tennis (T), volley (V) and football (F).



Find

- The number of students who play one game
 - $n(V \cup F \cap T')$
- A straight line passes through the points $(-2, 5)$ and $(2, -3)$. Determine the equation of the line.
 - The volume of the sphere is 200cm^3 . Calculate the volume of a similar sphere whose radius is half of the given sphere.
 - Given that $\frac{a+b\sqrt{2}}{c} = \frac{4+\sqrt{2}}{4-\sqrt{2}}$, find the values of a , b and c .
 - The coordinates of points A and B are $(-4, -5)$ and (x, y) respectively. The coordinates of the midpoint of \overline{AB} are $(-3, 1)$. Determine the values of x and y .
 - The position vectors of A and B are \mathbf{a} and \mathbf{b} respectively. A point x , is on \overline{AB} such that $4\overrightarrow{AX} = 3\overrightarrow{AB}$. Find the position vector of x , in terms of \mathbf{a} and \mathbf{b} .
 - An examination body pays its setter shs. 100,000 as basic fee and 8,000 for each question set. A withdrawing tax of 6% is deducted from a setter's gross pay. Okot set ten questions. How much was his net pay.
 - The figure below shows a vertical pole, CP of height 5m standing on a rectangular horizontal slab ABCD. $\overline{AB} = 4\text{cm}$ and $\overline{BC} = 3\text{m}$. PA is a wire that supports the pole.



Calculate the angle between the wire PA and the slab ABCD.

SECTION B

Answer any **five** questions from this section. All questions carry equal marks

11. A group of 84 tourist were asked whether they had visited Gulu, Mbarara or soroti. The number of tourist who had visited Gulu was equal to the number of tourist who had visited Mbarara. 54 had visited Soroti. 14 had visited Soroti and Gulu only. 12 had visited Soroti and Mbarara only. 16 had visited Gulu and Mbarara only. 13 had visited all the three towns. 8 had not visited any of the towns.
 - (a) Represent the given information on a Venn diagram
 - (b) How many tourist had
 - (i) Visited Mbarara
 - (ii) Not visited Gulu
 - (c) Given that a tourist is selected at random, what is the probability that the tourist had visited two towns only.
12. Towns P and Q are 100km apart. A pick-up starts from town P at 5.00am at a steady speed of 30km/h for 1 hour. It increases its speed to 100km/h until it reaches town Q. Meanwhile a taxi start at 5.30 am from Q towards P at steady speed of 60km/h until it breaks down $1\frac{1}{2}$ hour later.
 - (a) On the axes, draw distance-time graphs for the pick-up and taxi.
Use scale 2cm: 30minutes on the horizontal axis and 2cm: 10km on vertical axis)
 - (b) Use your graph to find
 - (i) the time the taxi and the pick-up passed each other and how far they were fro P.
 - (ii) how far the taxi was from town Q when it broke down
 - (iii) the time the pick-up reached town Q.
13. (a) Evaluate $\frac{2\frac{1}{2} + (\frac{3}{5} \times 1\frac{1}{4})}{1\frac{1}{8} - \frac{3}{4}}$.
 - (b) A lake occupies an area of 43.75km^2 . What would be its area in cm^2 , on a map whose scale is 1:250,000?
14. (a) Given $T = \{2, 5, 6, 8, 9, 10, 12, 13\}$ Illustrate on a papygram the relations
 - (i) "greater than by 3".
 - (ii) "Factor of"
 - (b) If $f(x) = x + 13$ and $g(x) = \log_{10}(x + 2)$.
Find
 - (i) The value of x when $f(x) = 0$
 - (ii) $gf(85)$.

15. (a) a bank in a certain country buys and sells foreign currency as follows

Currency	Buying (shs.)	Selling (shs.)
1US dollar (\$)	2900	3000
1 pound sterling (£)	4,650	4,700

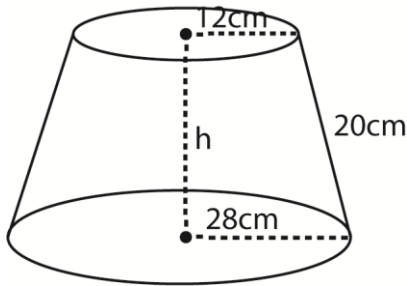
A tourist arrived in that country with \$4500. She converted all the dollars to shillings at the bank. During her stay she spent shs 9,900,000 and then converted the remaining shillings to pound sterling. Calculate the amount she received in pound sterling.

- (b) A generator is being sold in cash or on hire purchase. Its cash value is shs. 894,000. On hire purchase, a deposit of 50% of the cash value is made and followed by equal monthly instalment of shs. 65,000 for 8months. Calculate the money saved when one buys the generator in cash rather than on hire purchase.

16. Given that $OP = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$, $PQ = \begin{pmatrix} 4 \\ -8 \end{pmatrix}$, $OR = \frac{1}{2} OQ$ and S is a point on \overline{PQ} such that $\overline{PS}:\overline{SQ} = 1:3$, find

- (a) OR
(b) (i) PR
(ii) $|PR|$
(c) OS

17. The diagram below shows a lampshade made out of a lower part of a cone. The base radius is 28cm, the top radius is 12 cm and the slant height is 20cm.



Calculate the

- (i) Height, h, of the lampshade
(ii) Surface area of the lampshade (Use $\pi = 3.14$)

Solutions

SECTION A (40 marks)

Answer all questions in this section

1. Given that $h(x) = 3x - 2$. Find the value of

- (iii) $h(-2)$
 $h(-2) = 3(-2) - 2 = -8$
 (iv) x when $h(x) = 7$
 $7 = 3x - 2$
 $9 = 3x$
 $x = \frac{9}{3} = 3$
 Or
 Let $3x - 2 = y$

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

$$h'(x) = \frac{x+2}{3}$$

$$h'(7) = \frac{7+2}{3} = \frac{9}{3} = 3$$

2. Josephine obtained 95% in a test which was marked out of 80 marks. How many marks did she score out of 80?

Let the marks scored be x

$$\Rightarrow \frac{x}{80} \times 100 = 95$$

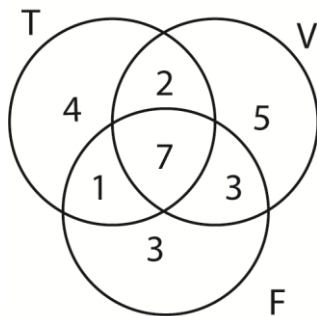
$$x = \frac{95 \times 80}{100} = 76$$

Or using the knowledge of equivalent fraction

$$\frac{x}{80} = \frac{95}{100}$$

$$x = \frac{95 \times 80}{100} = 76$$

3. The Venn diagram below shows the number of students who play tennis (T), volley (V) and football (F).



Find

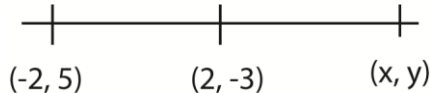
- (a) The number of students who play one game

$$\begin{aligned} \text{Number of students playing one game} &= n(T) \text{ only} + n(V) \text{ only} + n(F) \\ &= 4 + 5 + 3 = 12 \end{aligned}$$

- (b) $n(V \cup F \cap T') = n(V \cup F) \text{ only} = 3 + 3 + 5 = 11$

4. A straight line passes through the points $(-2, 5)$ and $(2, -3)$. Determine the equation of the line.

Method I: using gradient method



$$\text{Gradient} = \frac{-3-5}{2-(-2)} = \frac{y-5}{x-(-2)}$$

$$\frac{-8}{4} = \frac{y-5}{x+2}$$

$$4(y-5) = -8(x+2)$$

$$4y - 20 = -8x - 16$$

$$4y + 8x - 4 = 0$$

$$y + 2x - 1 = 0$$

Method II: using general equation

$$y = mx + c$$

$$m = \frac{-3-5}{2-(-2)} = \frac{-8}{4} = -2$$

Using point (-2, 5)

$$5 = -2(-2) + c$$

$$c = 1$$

By substitution

$$y = -2x + 1 \text{ or } 2x + y - 1 = 0$$

5. The volume of the sphere is 200cm^3 . Calculate the volume of a similar sphere whose radius is half of the given sphere.

$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

$$\Rightarrow \frac{4}{3}\pi r^3 = 2000$$

$$r = \left(\frac{2000 \times 3}{4\pi}\right)^{\frac{1}{3}} = \left(\frac{1500}{\pi}\right)^{\frac{1}{3}}$$

$$\text{Radius of small sphere} = \frac{1}{2} \left(\frac{1500}{\pi}\right)^{\frac{1}{3}}$$

$$\text{Volume} = \frac{4}{3}\pi \left[\frac{1}{2} \left(\frac{1500}{\pi}\right)^{\frac{1}{3}}\right]^3 = \frac{4}{3}\pi \times \frac{1}{8} \times \frac{1500}{\pi} = 250\text{cm}^3$$

6. Given that $\frac{a+b\sqrt{2}}{c} = \frac{4+\sqrt{2}}{4-\sqrt{2}}$, find the values of a, b and c.

$$\frac{a+b\sqrt{2}}{c} = \frac{4+\sqrt{2}}{4-\sqrt{2}} = \frac{(4+\sqrt{2})(4+\sqrt{2})}{(4-\sqrt{2})(4+\sqrt{2})} = \frac{16+8\sqrt{2}+2}{4^2-(\sqrt{2})^2} = \frac{18+8\sqrt{2}}{14} = \frac{9+4\sqrt{2}}{7}$$

Hence $a = 9$, $b = 4$, $c = 7$

7. The coordinates of points A and B are (-4, -5) and (x, y) respectively. The coordinates of the midpoint of \overline{AB} are (-3, 1). Determine the values of x and y.

Let the midpoint be M

$$\begin{array}{ccc} | & | & | \\ \hline & & \\ \hline \end{array}$$

A (-4, -5) M(-3, 1) B (x, y)

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

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

$$x - 4 = -6; x = -2$$

$$\frac{y+(-5)}{2} = 1$$

$$\frac{y-5}{2} = 2$$

$$y - 5 = 2; y = 7$$

Hence $x = -2$ and $y = 7$

Alternatively

$$\overline{AM} = \overline{MB}$$

$$\text{OM} - \text{OA} = \text{OB} - \text{OM}$$

$$\begin{pmatrix} -3 \\ 1 \end{pmatrix} - \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -4 \\ -5 \end{pmatrix} - \begin{pmatrix} -3 \\ 1 \end{pmatrix}$$

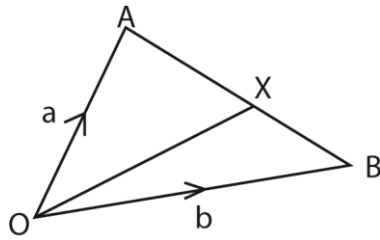
$$\begin{pmatrix} -3-x \\ 1-y \end{pmatrix} = \begin{pmatrix} -1 \\ -6 \end{pmatrix}$$

$$-3-x = -1; x = -2$$

$$1-y = -6; y = 7$$

Hence $x = -2$ and $y = 7$

8. The position vectors of A and B are a and b respectively. A point x, is on \overline{AB} such that $4\overline{AX} = 3\overline{AB}$. Find the position vector of x, in terms of a and b.



$$4\overline{OX} = 3\overline{AB}$$

$$\overline{OX} = \frac{3}{4}\overline{AB}$$

$$\overline{OX} - \overline{OA} = \frac{3}{4}(\overline{OB} - \overline{OA})$$

$$\overline{OX} = \overline{OA} + \frac{3}{4}(\overline{OB} - \overline{OA}) = \overline{a} + \frac{3}{4}(\overline{b} - \overline{a}) = \frac{4\overline{a} + 3\overline{b} - 3\overline{a}}{4} = \frac{\overline{a} + 3\overline{b}}{4}$$

$$\therefore \overline{OX} = \frac{\overline{a} + 3\overline{b}}{4}$$

9. An examination body pays its setter shs. 100,000 as basic fee and 8,000 for each question set. A withholding tax of 6% is deducted from a setter's gross pay. Okot set ten questions. How much was his net pay.

$$\begin{aligned}\text{Gross pay} &= \text{Basic Pay} + \text{setting fee} \\ &= 100,000 + 8,000 \times 10 \\ &= \text{shs. } 180,000\end{aligned}$$

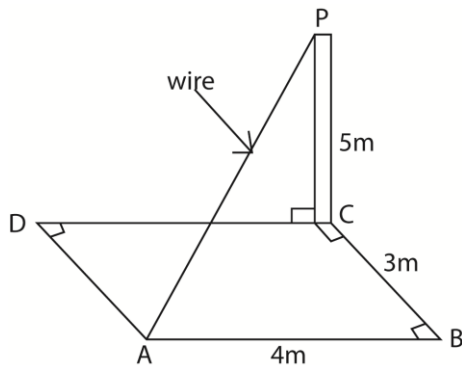
$$\text{Withholding tax} = \frac{6}{100} \times 180,000 = \text{shs. } 10,800$$

$$\begin{aligned}\text{Net pay} &= \text{Gross pay} - \text{withholding tax} \\ &= 180,000 - 10,800 = \text{shs. } 169,200\end{aligned}$$

Or

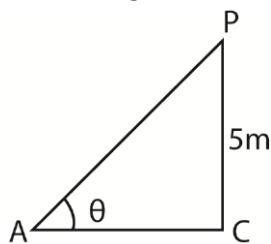
$$\text{Net pay} = \left(\frac{100-6}{100}\right) \times 180,000 = \text{shs. } 169,200$$

10. The figure below shows a vertical pole, CP of height 5m standing on a rectangular horizontal slab ABCD. $\overline{AB} = 4\text{m}$ and $\overline{BC} = 3\text{m}$. PA is a wire that supports the pole.



Calculate the angle between the wire PA and the slab ABCD.

Let the angle be θ



$$\overline{AC}^2 = \overline{AB}^2 + \overline{BC}^2 = 4^2 + 3^2 = 25$$

$$\overline{AC} = \sqrt{25} = 5$$

$$\tan \theta = \frac{5}{5} = 1$$

$$\theta = \tan^{-1} 1 = 45^\circ$$

SECTION B

Answer any **five** questions from this section. All questions carry equal marks

11. A group of 84 tourist were asked whether they had visited Gulu, Mbarara or soroti. The number of tourist who had visited Gulu was equal to the number of tourist who had visited Mbarara. 54 had visited Soroti. 14 had visited Soroti and Gulu only. 12 had visited Soroti and Mbarara only. 16 had visited Gulu and Mbarara only. 13 had visited all the three towns. 8 had not visited any of the towns.

(d) Represent the given information on a Venn diagram

$$n(E) = 84$$

Let G = Gulu, M = Mbarara, S= Soroti

Summary

$$n(S) = 54,$$

$$n(S \cap G) \text{ only} = 14,$$

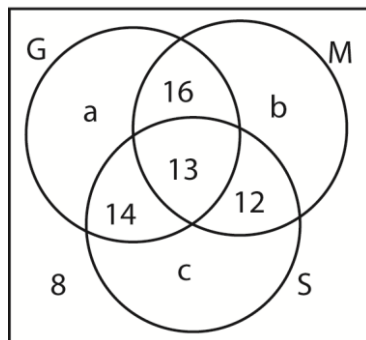
$$n(S \cap M) \text{ only} = 12$$

$$n(G \cap M) \text{ only} = 16$$

$$n(S \cap G \cap M) = 13$$

$$n(S \cup G \cup M)' = 8$$

$$n(E) = 84$$



(e) How many tourist had

(iii) Visited Mbarara

$$n(S) = 54$$

$$14 + 13 + 12 + c = 54$$

$$39 + c = 54$$

$$c = 54 - 39 = 15$$

$$n(G) = n(M)$$

$$a + 16 + 13 + 14 = b + 16 + 13 + 12$$

$$a + 43 = b + 41$$

$$a = b + 41 - 43 = b - 2$$

$$\text{but } n(E) = 84$$

$$\Rightarrow (b-2) + 16 + 13 + 14 + 12 + 15 + b + 8 = 84$$

$$2b = 84 - 76 = 8$$

$$b = \frac{8}{2} = 4$$

$$n(M) = 16 + 13 + 12 + 4 = 45$$

(iv) Not visited Gulu

$$n(G)' = 4 + 12 + 15 + 8 = 39$$

- (f) Given that a tourist is selected at random, what is the probability that the tourist had visited two towns only.

No. of tourist who had visited two towns only = $16 + 14 + 12 = 42$

$$P(\text{tourists who visited only two towns}) = \frac{42}{84} = \frac{1}{2}$$

12. Towns P and Q are 100km apart. A pick-up starts from town P at 5.00am at a steady speed of 30km/h for 1 hour. It increases its speed to 100km/h until it reaches town Q. Meanwhile a taxi start at 5.30 am from Q towards P at steady speed of 60km/h until it breaks down $1\frac{1}{2}$ hour later.

- (a) On the axes, draw distance-time graphs for the pick-up and taxi.

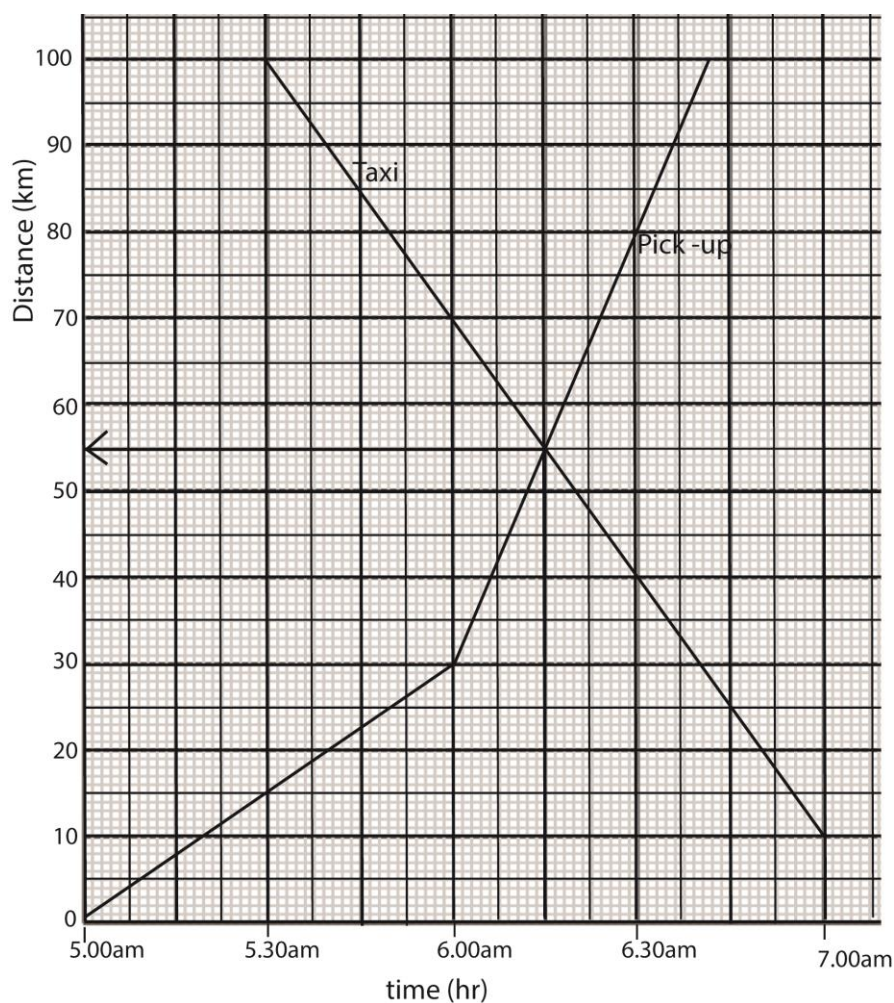
Use scale 2cm: 30minutes on the horizontal axis and 2cm: 10km on vertical axis)

A Pick-up

Time	5.00am	5.30am	6.00am	12.42pm
Distance(km)	0	15	30	100

Taxi

Time	5.00am	5.30am	6.00am	6.30am	7.00am
Distance (km)	0	0	30	60	90km



- (b) Use your graph to find

- (iv) the time the taxi and the pick-up passed each other and how far they were from P.

time 6:15am

Distance from P = 55km

- (v) how far the taxi was from town Q when it broke down
90km

- (vi) the time the pick-up reached town Q.

6.42am

13. (a) Evaluate $\frac{2\frac{1}{2} + (\frac{3}{5} \times 1\frac{1}{4})}{1\frac{1}{8} - \frac{3}{4}}$.

$$\frac{2\frac{1}{2} + (\frac{3}{5} \times 1\frac{1}{4})}{1\frac{1}{8} - \frac{3}{4}} = \frac{\frac{5}{2} + (\frac{3}{5} \times \frac{5}{4})}{\frac{9}{8} - \frac{3}{4}} = \frac{\frac{5}{2} + \frac{3}{4}}{\frac{9}{8} - \frac{3}{4}} = \frac{\frac{10+3}{4}}{\frac{9-6}{8}} = \frac{13}{4} \div \frac{3}{8} = \frac{13}{4} \times \frac{8}{3} = \frac{26}{3} = 8\frac{2}{3}$$

(b) A lake occupies an area of 43.75km^2 . What would be its area in cm^2 , on a map whose scale is 1:250,000?

$$1\text{cm} \equiv 250,000\text{cm}$$

$$1\text{cm} \equiv \frac{250,000}{100,000}\text{km} = 2.5\text{km}$$

$$1\text{cm}^2 \equiv 6.25\text{km}^2$$

$$X\text{cm}^2 \equiv 43.75\text{km}^2$$

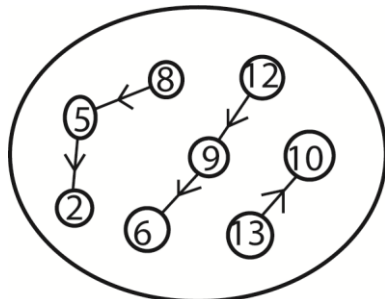
$$6.25x = 43.75$$

$$x = \frac{43.75}{6.25} = 7\text{cm}^2$$

Hence the area on the map = 7cm^2

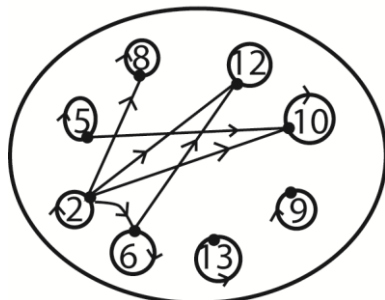
14. (a) Given $T = \{2, 5, 6, 8, 9, 10, 12, 13\}$ Illustrate on a papygram the relations

- (i) "greater than by 3".



- (ii) "Factor of"

A factor of



- (b) If $f(x) = x + 13$ and $g(x) = \log_{10}(x + 2)$.

Find

- (i) The value of x when $f(x) = 0$

$$\Rightarrow x + 13 = 0$$

$$x = -13$$

- (ii) $gf(85)$.

$$gf(85) = g(85 + 13) = g(98)$$

$$g(98) = \log_{10}(98 + 2) = \log_{10} 100 = 2\log_{10} 10 = 2 \times 1 = 2$$

15. (a) a bank in a certain country buys and sells foreign currency as follows

Currency	Buying (shs.)	Selling (shs.)
1US dollar (\$)	2900	3000
1 pound sterling (£)	4,650	4,700

A tourist arrived in that country with \$4500. She converted all the dollars to shillings at the bank. During her stay she spent shs 9,900,000 and then converted the remaining shillings to pound sterling. Calculate the amount she received in pound sterling.

Note: when converting dollars to shillings, the bank will buy each dollar at shs. 2,900

$$\Rightarrow \text{US \$ } 1 = 2,900/=$$

$$\text{US \$ } 4500 = 4500 \times 2,900 = 13,050,000/=$$

$$\text{Balance} = 13,050,000 - 9,900,000 = 3,150,000$$

When buying pound sterling, the bank will sell at 4,700

$$4700/= \equiv 1 \text{ pound sterling}$$

$$\therefore 3,150,000/= \equiv \frac{3,150,000}{4700} = 670.2 \text{ pound sterling}$$

Hence the tourist received 670.2 pound sterling

- (b) A generator is being sold in cash or on hire purchase. Its cash value is shs. 894,000. On hire purchase, a deposit of 50% of the cash value is made and followed by equal monthly instalment of shs. 65,000 for 8 months. Calculate the money saved when one buys the generator in cash rather than on hire purchase.

Buying at hire purchase

$$\text{Initial deposit} = \frac{50}{100} \times 894,000 = 447,000 \neq$$

$$\text{Monthly instalments} = 8 \times 65,000 = 520,000/=$$

$$\text{Total payments} = 520,000 + 447,000 = 967,000/=$$

$$\text{Money saved} = 967,000 - 894,000 = 73,000$$

16. Given that $OP = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$, $PQ = \begin{pmatrix} 4 \\ -8 \end{pmatrix}$, $OR = \frac{1}{2} OQ$ and S is a point on \overline{PQ} such that $\overline{PS}:\overline{SQ} = 1:3$,

find

- (a) OR

$$PQ = OQ - OP$$

$$\begin{pmatrix} 4 \\ -8 \end{pmatrix} = OQ - \begin{pmatrix} 3 \\ 4 \end{pmatrix}$$

$$OQ = \begin{pmatrix} 4 \\ -8 \end{pmatrix} + \begin{pmatrix} 3 \\ 4 \end{pmatrix} = \begin{pmatrix} 7 \\ -4 \end{pmatrix}$$

$$OR = \frac{1}{2} OQ = \frac{1}{2} \begin{pmatrix} 7 \\ -4 \end{pmatrix} = \begin{pmatrix} 3.5 \\ -2 \end{pmatrix}$$

- (b) (i) PR

$$PR = OR - OP$$

$$= \begin{pmatrix} 3.5 \\ -2 \end{pmatrix} - \begin{pmatrix} 3 \\ 4 \end{pmatrix} = \begin{pmatrix} 0.5 \\ -6 \end{pmatrix}$$

- (ii) |PR|

$$|PR| = \sqrt{(0.5)^2 + (-6)^2} = \sqrt{36.25} = 6.021$$

- (c) OS

$$PS:SQ = 1:3 \text{ or } \overline{PS}:\overline{SQ} = 1:3$$

$$\frac{\overline{PS}}{\overline{SQ}} = \frac{1}{3}$$

$$3PS = SQ$$

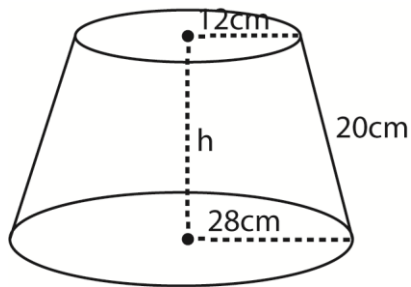
$$3(OS - OP) = OQ - OS$$

$$3OS - 3OP = OQ - OS$$

$$4OS = 3OP + OQ$$

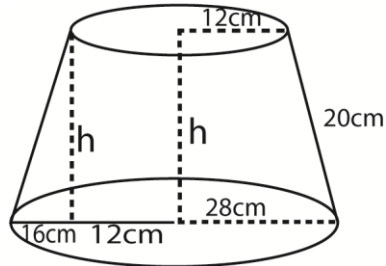
$$OS = \frac{1}{2}(3OP + OQ) = \frac{1}{4}\left[3\begin{pmatrix} 3 \\ 4 \end{pmatrix} + \begin{pmatrix} 7 \\ -4 \end{pmatrix}\right] = \frac{1}{4}\begin{pmatrix} 16 \\ 8 \end{pmatrix} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$$

17. The diagram below shows a lampshade made out of a lower part of a cone. The base radius is 28cm, the top radius is 12 cm and the slant height is 20cm.



Calculate the

- (i) Height, h , of the lampshade



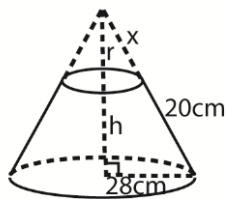
From the figure

$$h^2 = 20^2 - 16^2$$

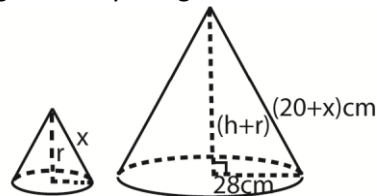
$$h^2 = 400 - 256 = 144$$

$$h = \sqrt{144} = 12\text{cm}$$

Method II



Using similarity of figures



radius = 12cm

Using similar cones

$$\frac{12}{28} = \frac{x}{20+x}$$

$$28x = 12(20+x)$$

$$28x = 240 + 12x$$

$$16x = 240$$

$$x = \frac{240}{16} = 15\text{cm}$$

$$r^2 = 15^2 - 12^2 = 225 - 144 = 81$$

$$r = \sqrt{81} = 9$$

Using big cone

$$(h+9)^2 = (20+15)^2 - 28^2$$

$$= 1,225 - 784 = 441$$

$$h+9 = \sqrt{441} = 21$$

$$h = 21 - 9 = 12\text{cm}$$

(ii) Surface area of the lampshade (Use $\pi = 3.14$)

Assuming both end of the lampshade are open

S.A of lamp shade = curved S.A of big cone - curved S.A of small cone

$$= \pi RL_1 - \pi rL_2$$

$$= (3.14 \times 28 \times 35) - (3.14 \times 12 \times 15)$$

$$= 3077.2 - 565.2$$

$$= 2512\text{cm}^2$$

Alternatively

Surface area of the curved surface lampshade = $\pi(R + r)L$ where L = slanting length

$$= 3.14(28 + 12)(20) = 2512\text{cm}^2$$

If the top of the lampshade is closed

S.A = S.A of curved surface + Area of the top

$$= 2512 + 3.14 \times (12)^2 = 2512 + 452.16 = 2,964.16\text{cm}^2$$

Thank you

Dr. Bbosa Science