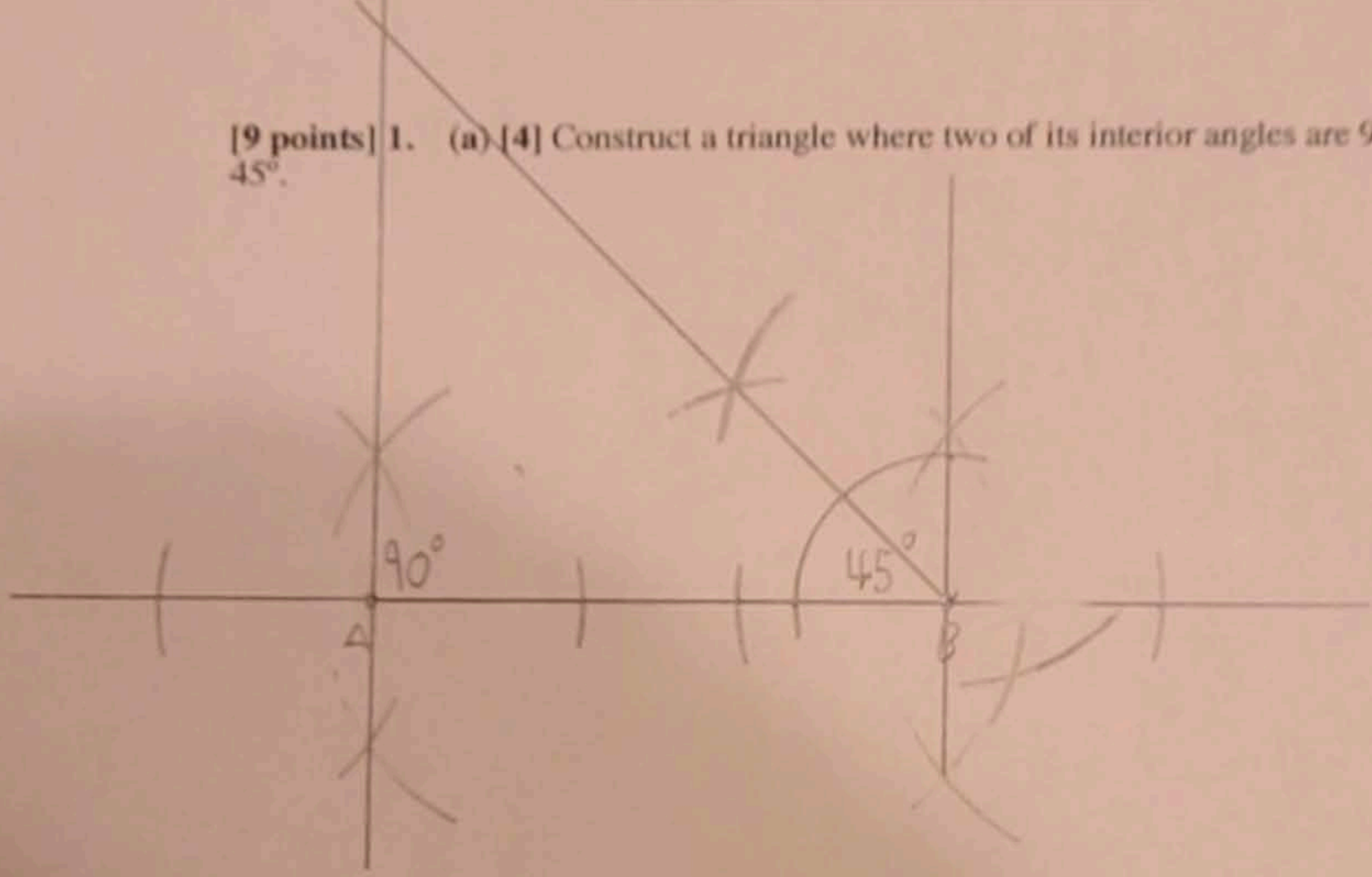
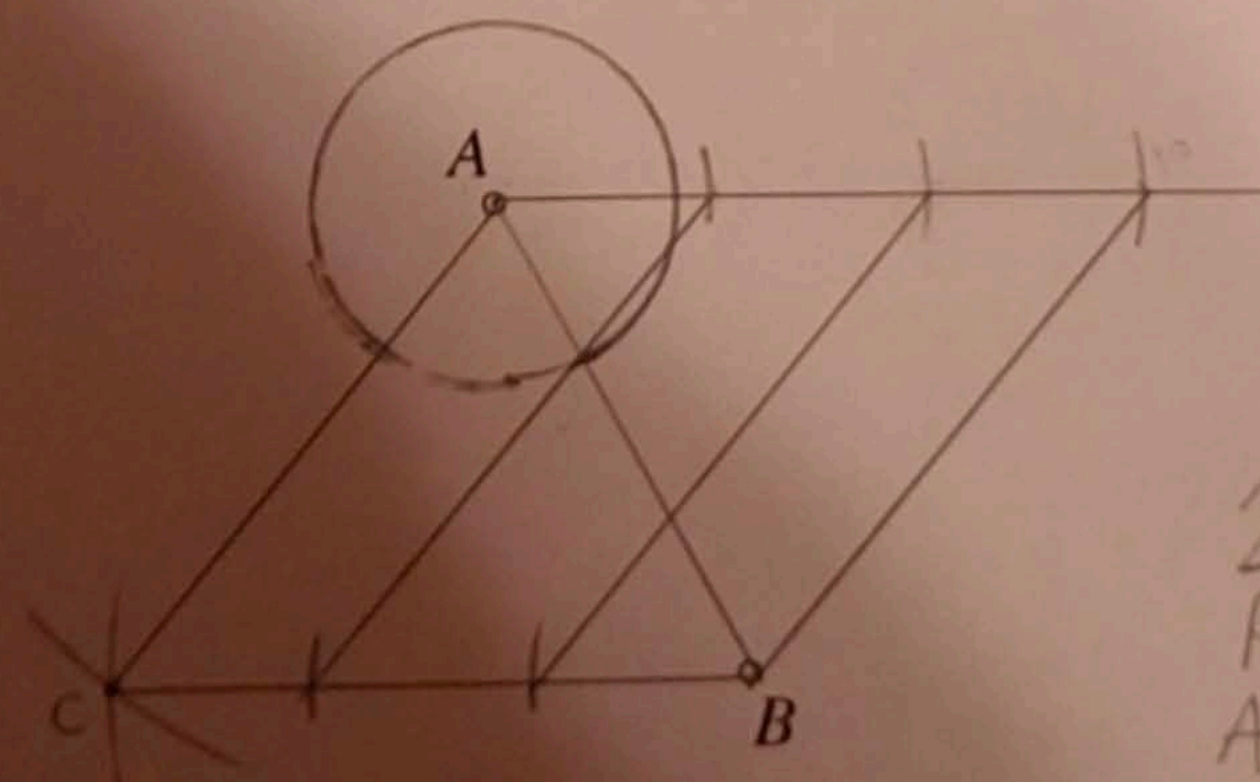
[9 points] 1. (a) [4] Construct a triangle where two of its interior angles are $90°$ and $45°$.



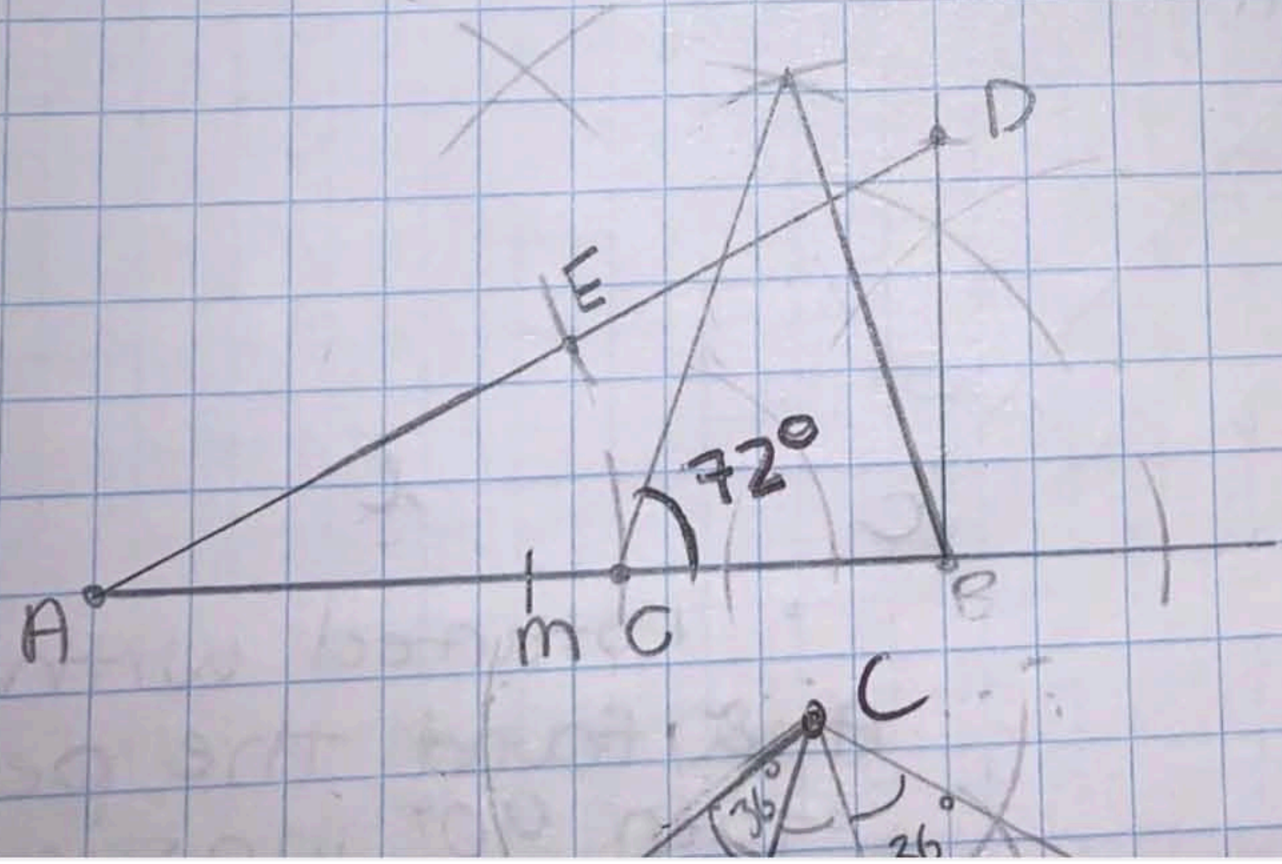
1. Begin with a line segment and mark point A and B
2. create a perpendicular through both points
3. This gives us 2 90° angles. Divide one angle in half and connect the lines

(b) [5] The points A, B (to be shown) are given. Construct a circle centered at A and of radius $\frac{AB}{3}$. (Hint: subdivide AB into equal sub-segments.)



1. Create a new ray emanating from A and mark equal points. Connect the last point with B.
2. Construct a parallelogram centered on A, B. Mark the same distance on the parallel line. Connect the points
3. Draw a circle, Sharp point on A, graphite on the 1/3 marking.

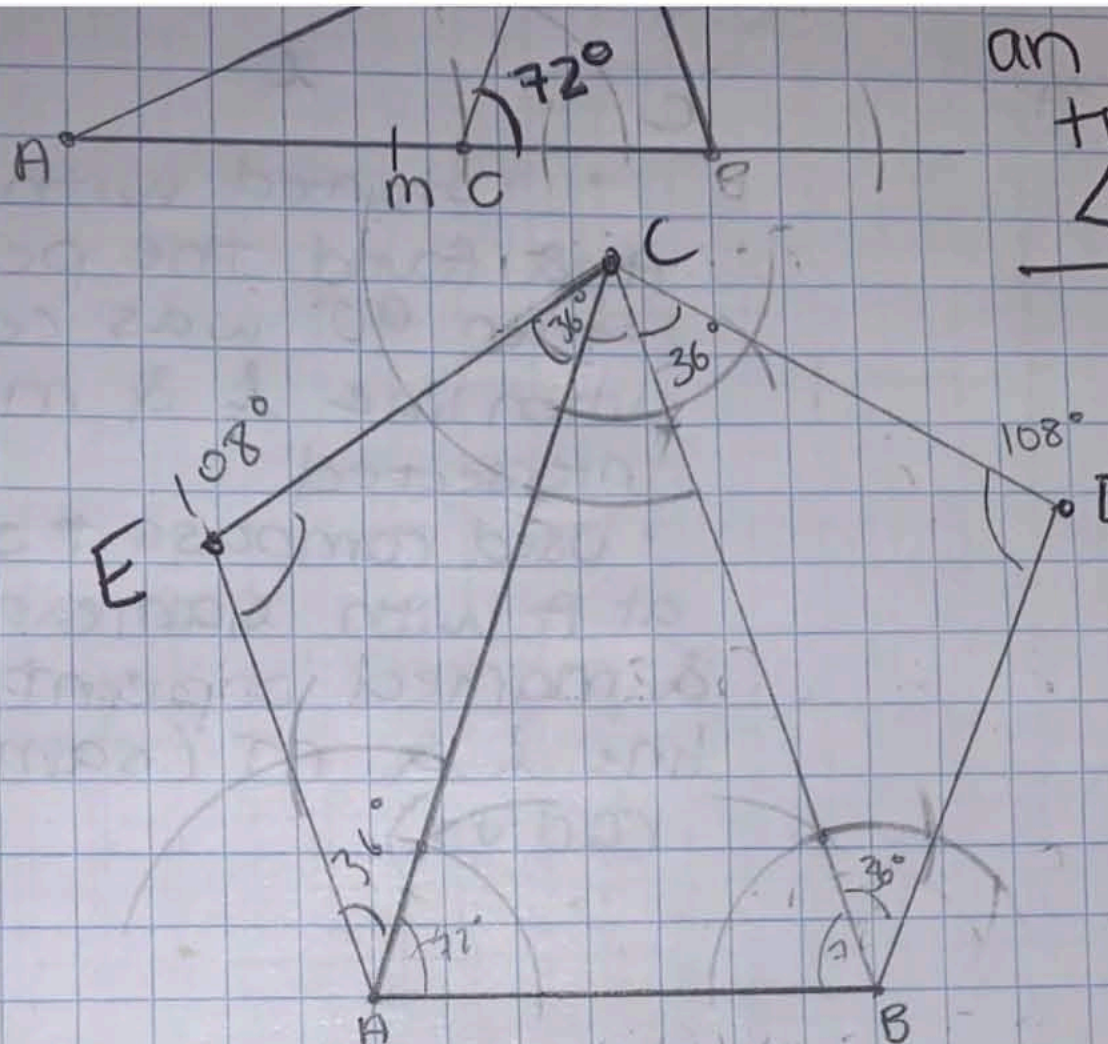
a)



- I constructed a golden cut
- then constructed an acute golden triangle with $\angle 72°$

an acute golden triangle with $\angle 72°$

b)



- I duplicated acute golden triangle $\angle 72°$ from 2a's construction onto line AB & made acute golden triangle
- then I duplicate $\angle 36°$ onto either side of point C, creating ~~obtuse~~ obtuse golden triangles with base AC & BC

Question 3

a) the sequence of numbers $f_1, f_2, f_3,$ ... f_n is the fibonacci number sequence

if $f_1 = 1$, $f_2 = 1$ & $f_n = f_{n-1} + f_{n-2}$ for $n = 3, 4, 5 \ldots$

b) $2f_{20} = 13530$ & $2f_{22} = 35422$. $f_{21} = ?$

$2(f_{20}) + f_{21} = 2f_{22}$ · I divided

a) the sequence of numbers $f_1, f_2, f_3,$ ... f_n is the fibonacci number sequence

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b) $2f_{20} = 13530$ & $2f_{22} = 35422$. $f_{21} = ?$

$$\frac{2(f_{20}) + f_{21}}{2} = \frac{2f_{22}}{2}$$

· I divided f_{20} & f_{22} by 2 & finished the problem.

$$\frac{13530}{2} + f_{21} = \frac{35422}{2}$$

$$6765 + f_{21} = 17{,}711$$

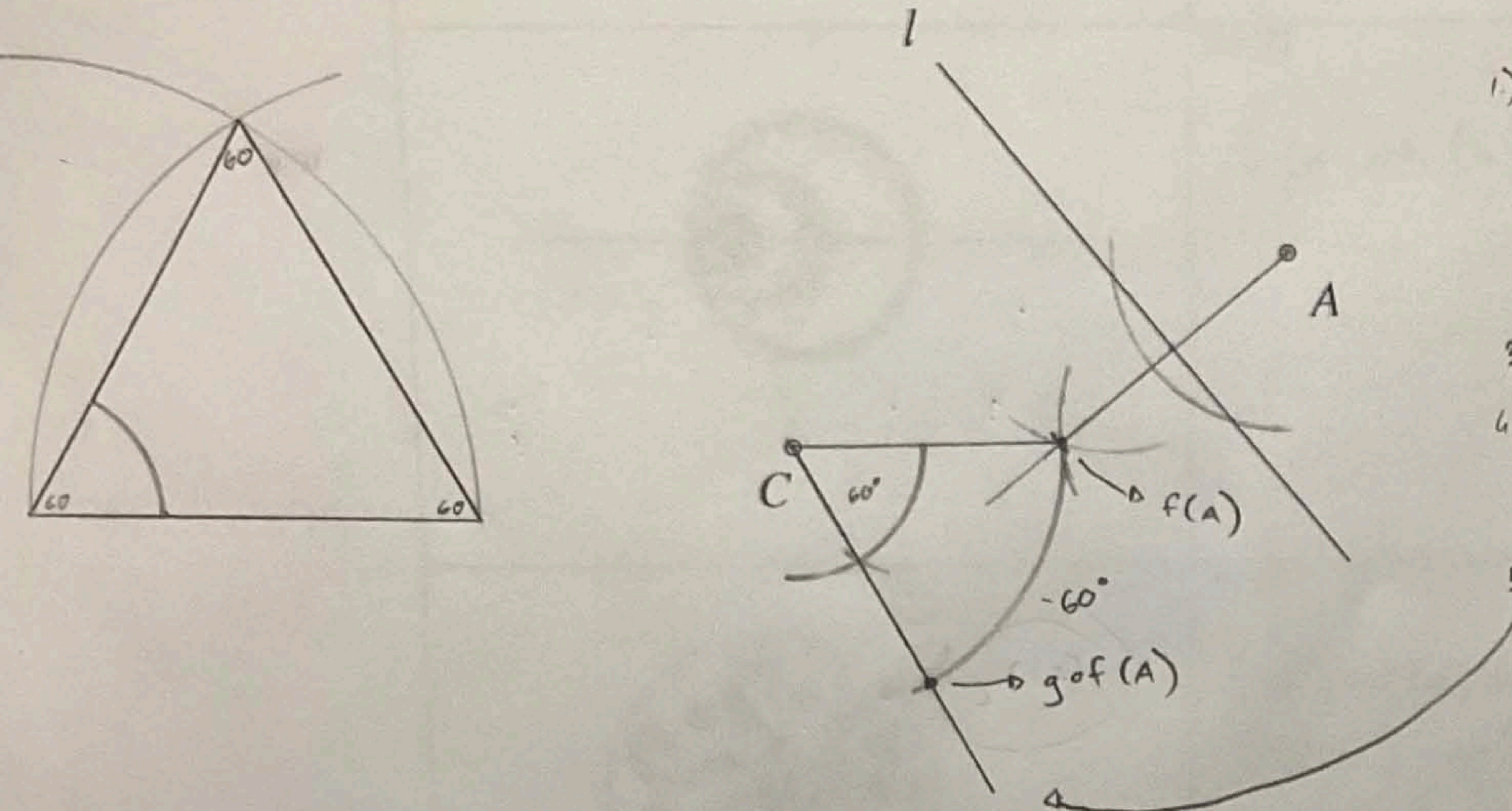
$$f_{21} = 17{,}711 - 6765$$

$$\boxed{f_{21} = 10{,}946}$$

[10 points] 4. [6] (a) Find the image of the point A (shown below) under the composition $g \circ f$ of f followed by g, where f is the reflection with respect to the line l (shown below), and g is the rotation around the center C (shown below) through an angle of -60°.

$g \circ f(A)$ f = refl

$g \cdot \text{rot}(c, -60°)$



1.) make perpendicular (A) towards line l (f(A))

2.) Connect C & f(A)

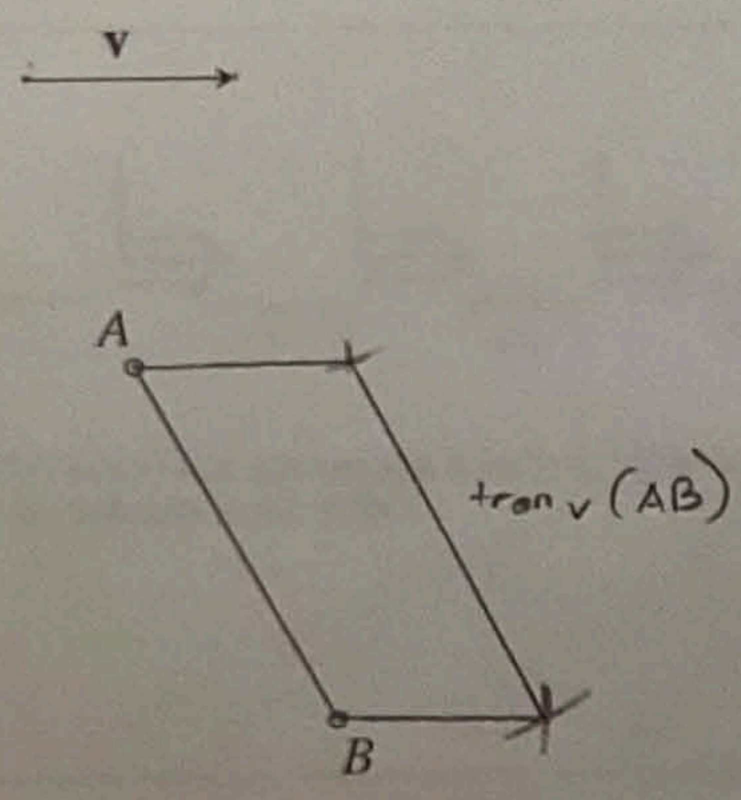
3.) construct equilateral triangle

4.) copy one angle → ; place towards point C

5.) make new line

6.) Join f(A) to new line to get g∘f(A) ✓

(b) [4] Construct the image of the line segment AB (shown below) under the translation with respect to the vector $\boldsymbol{v}$ (shown below).



1.) copy vector v length

2.) mark an arch, stamp point A

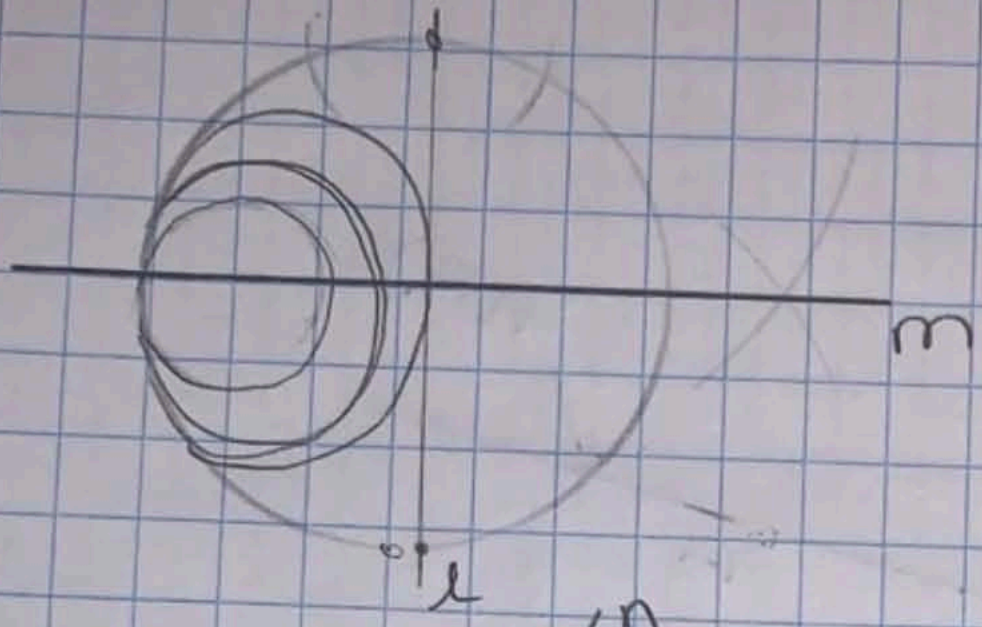
3.) copy distance between left end of v & point A

4.) mark an arch, stamp point right end of v & arch towards 1st arch ✓

5.) make parallelogram to obtain (tran v (AB))

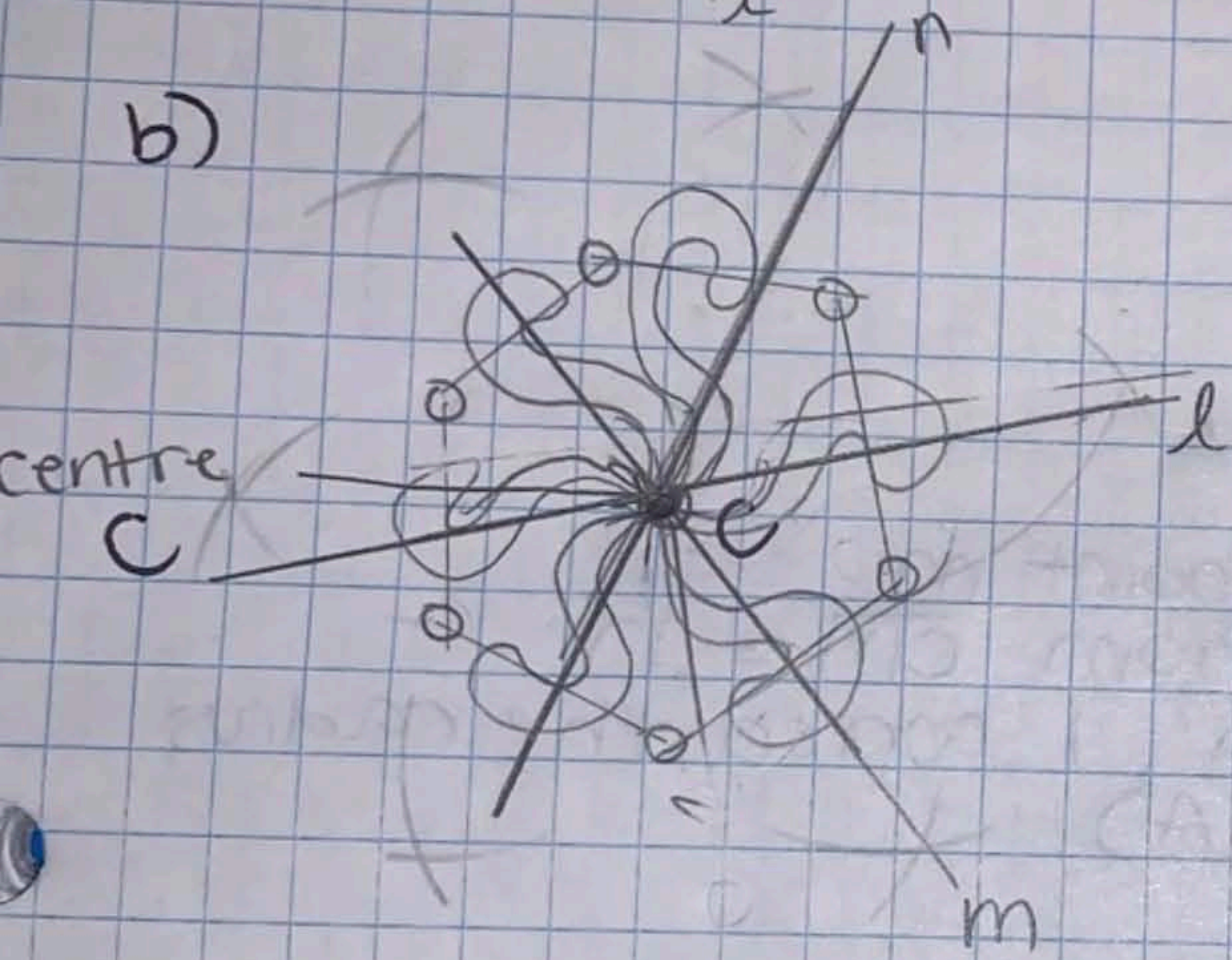
Question #5)

a)



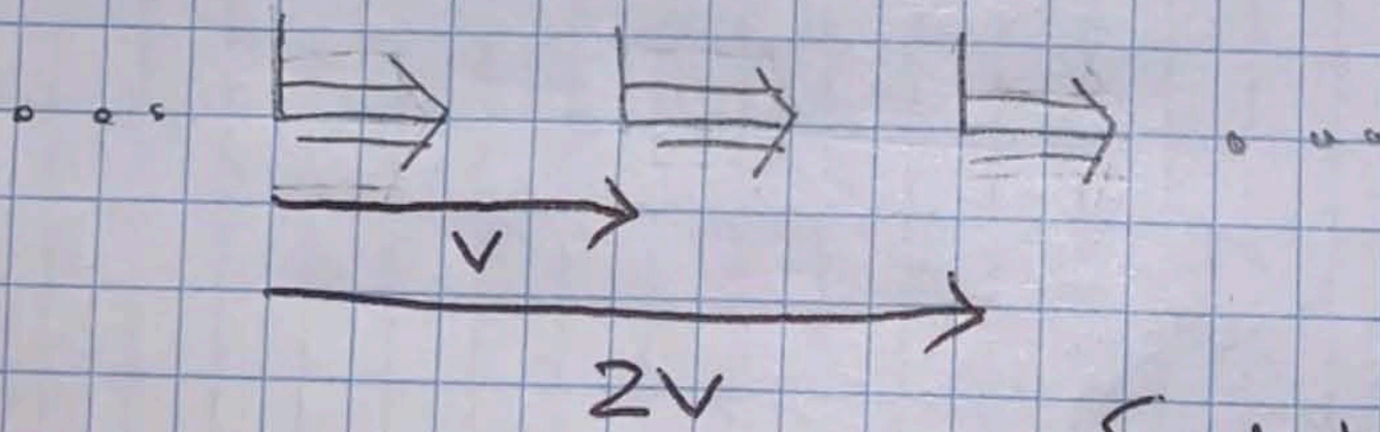
$\{id, ref_m\}$

b)



$\{id, rot(c, 60°), rot(c, 120°), rot(c, 180°), rot(c, 240°), rot(c, 300°)\}$

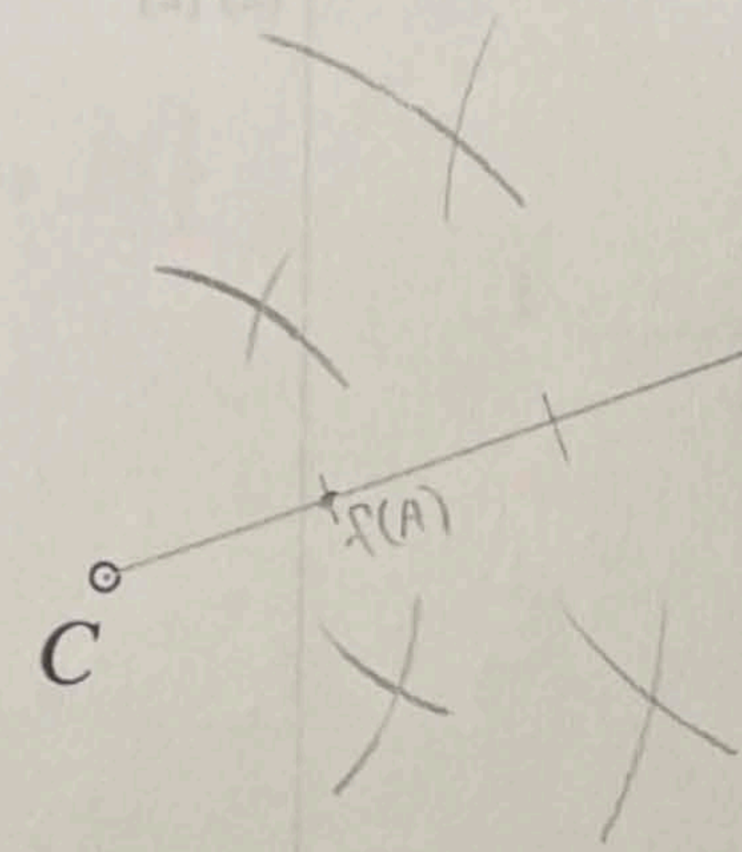
c)



$\{id, tran_v, tran_{2v}, tran_{3v} \ldots tran_{-v}, tran_{-2v}, tran_{-3v} \ldots\}$

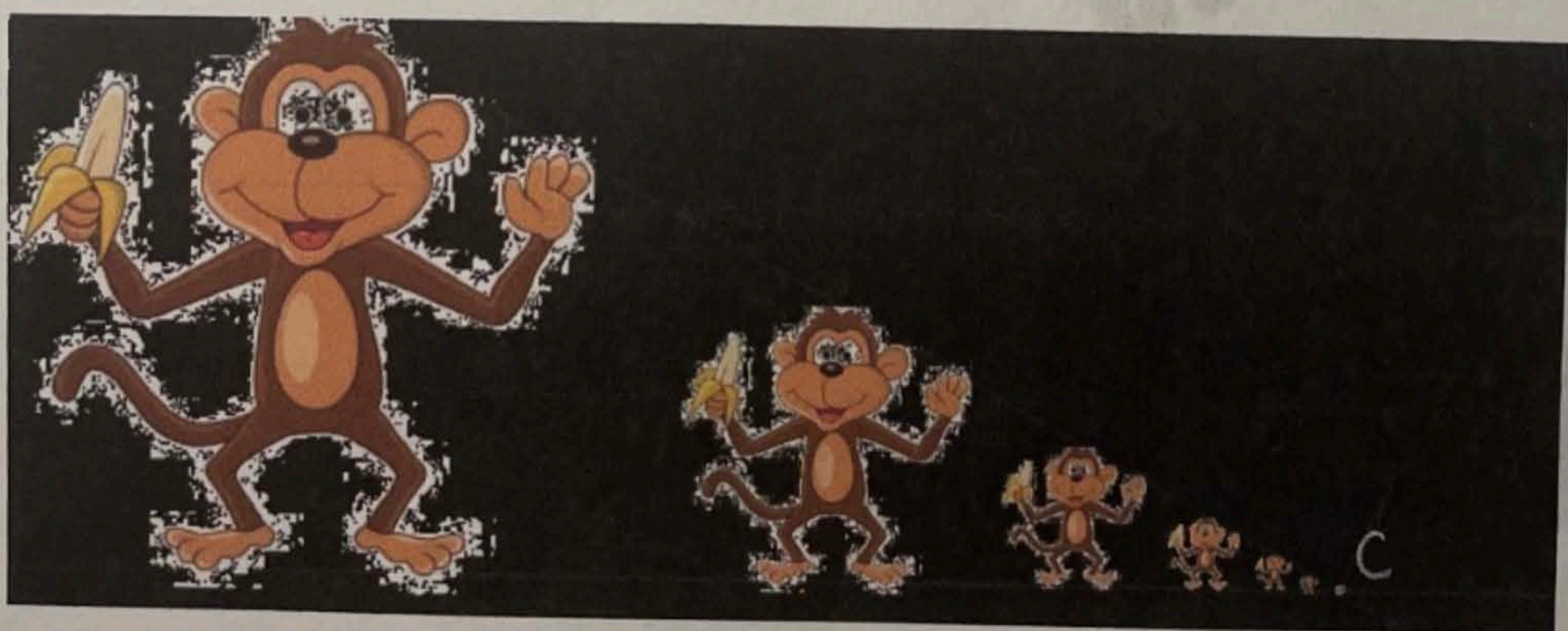
stretching factor $\alpha = \frac{1}{4}$. Construct the point $f(A)$ obtained by applying f to A. [You would need to **construct** the point $f(A)$ using a ruler and a compass!]

Subdivide CA into 4 using midpoint



Good 5

(b) [4] In the figure below every funny monkey every funny monkey except for the first one has a monkey twice its size immediately to the left of it. This pattern of monkeys continues without end, and the final outcome is a fractal called F. Confirm that the result is indeed a fractal: find a proper central similarity f that sends F within itself. You get the full mark if you indicate in the figure the center of your central similarity f, and write down the value of the stretching factor α of your central similarity.



centered at C

stretching factor $\alpha = \frac{1}{2}$

Good 4