

Errata for E.G.M.O.

<https://web.evanchen.cc/geombook.html>

EVAN CHEN

Last updated March 18, 2020

This document contains an exhaustive list of all mistakes that I am aware of in my textbook *Euclidean Geometry in Mathematical Olympiads*. Most are annoying but benign, but a few (colored red) are substantial. You can send any more mistakes you find to the author at the email on evanchen.cc.

I currently do not have any plans to create a second edition.

- p. xi append a comma after “lectures at MOP”.
- p. xiii change “explain how it comes from” to “explain where it comes from”.
- p. xiv second bullet, the phrase “intersection the medians” is missing “of”.
- p. 7 beneath Figure 1.3A, change “orthocenter of H ” to “orthocenter of ABC ”.
- p. 10 change (LBC) to (IBC) in the paragraph starting “Because $LB = LI = LC$ ”.
- p. 12 **Theorem 1.22, the four points could also be collinear.**
- p. 12 Proposition 1.24, the isosceles triangle condition holds only when A, B, C are not collinear.
- p. 16 in problem 1.33, change “ $\angle KC = 90^\circ$ ” to “ $\angle KCB = 90^\circ$ ”.
- p. 18 in problem 1.37, delete the word “again” in the definition of Q .
- p. 18 in problem 1.39, I is the incenter of $\triangle ABC$.
- p. 19 in problem 1.45, change “ray BI ” to “the $\angle B$ -bisector”.
- p. 20 in problem 1.47, change “Let ABC be triangle” to “Let ABC be a triangle”.
- p. 24 in Problem 2.2, change $\angle BCA = \angle YZX$ to $\angle ABC = \angle XYZ$.
- p. 28 change “immediately corollary” to “immediate corollary”.
- p. 29 in Theorem 2.9, excise “of Intersecting Circles” from the theorem name.
- p. 29 in proof of Theorem 2.9, change both > 0 's to < 0 's.
- p. 30 bottom of page, “coaxal” should be “coaxial”.
- p. 31 in Lemma 2.13, the circles can also be tangent to one another at X (i.e. the intersection is counted with multiplicity).

- p. 32 near start of S2.6, “alluded the excenter” is missing “to”.
- p. 33 in Lemma 2.20, swap the definitions of X and D . (The problem is technically correct as stated, but it should be consistent with Figure 2.6A.)
- p. 34 in solution to Example 2.21, in “we already know that that lines PQ , RS , and XY concur at a point X ”, the extraneous “that” and “ X ” should both be deleted.
- p. 34 end of third paragraph after Example 2.21, change “ ω_1 an ω_3 ” to “ ω_1 and ω_3 ” and change O_1O_3 to $\overline{O_2O_3}$.
- p. 35 in the second set of aligned equations, change O_2X^2 to OO_2^2 .
- p. 39 Example 2.24, I is the incenter.
- p. 40 Problem 2.29, change “six points” to “the six points”.
- p. 40 Problem 2.30, the lines may also be pairwise parallel.
- p. 46 change $\frac{1}{1}\frac{1}{1}\frac{1}{1} = 1$ to $1 \cdot 1 \cdot 1 = 1$. (not technically wrong but quite misleading as written.)
- p. 48 Theorem 3.8, the lines may also be pairwise parallel.
- p. 49 third to last line, lengths are multiplied by $|k|$.
- p. 51 before Lemma, in “this circles is called the nine-point circle”, change “circles” to “circle”.
- p. 54 third paragraph, change “pick let” to “let”.
- p. 65 Problem 4.25, change $\frac{BM}{MC}$ to $\frac{CM}{MB}$.
- p. 67 in Lemma 4.33, change the second ω to Ω .
- p. 76 Theorem 5.1 is missing a factor of $\frac{1}{2}$.
- p. 68 just before Problem 4.38, change “show” to “shown”.
- p. 71 Problem 4.53 is missing a trailing period.
- p. 92 in Problem 5.23, when defining point G , line HE should intersect Γ_1 , not Γ_2 . Also, “interest” should be “intersect” in the first line.
- p. 97 Figure 6.2A, should be $iz = -4 + 3i$.
- p. 101 in the proof of Example 6.10, Lemma 6.3 should be Lemma 6.5. Also, $\frac{xa}{bc}$ should be $\frac{bc}{xa}$ (two changes).
- p. 105 in Problem 6.20 change “Theorem 6.16” to “Theorem 6.15”.
- p. 107 the proof of part (a) of the theorem has several issues, and is probably best to just ignore. (The result is still true, and the proof of part (b) is correct.)
- p. 111 the last expression should actually be negated.
- p. 112 in the second displayed line, change $y^2 + x^2z/y$ to $-y^2 + x^2z/y$. In the fourth, change the second y^2/z^2 to z^2/y^2 . In the ninth, change the second y^2/z^2 to z^2/y^2 .

- p. 113 in the definition of M_2 , change DH_A to AH_A .
- p. 114 Solution 6.27, the a in the numerator of a' should be \bar{a} . Follow through with the rest of the solution.
- p. 121 “his idea” to “this idea”.
- p. 132 in the proof of Example 7.20, change $C = (0, 0, 1)$ to $D = (0, 0, 1)$.
- p. 133 Proposition 7.21, last display, change S_a to S_A .
- p. 136 very top, $c = AE$ should be $c = AC$.
- p. 138 eighth line from top, change $AD : AC$ to $AD : CD$.
- p. 139 Solution 7.29, change the first display to $0 = c^2(t-1) + (a^2 - b^2) \implies t = \frac{c^2 + b^2 - a^2}{c^2}$.
- p. 140 in the second display, $x + y$ should be $x - y$.
- p. 142 very top, in $a^2 = S_{AB} + S_{AC}$, change LHS to $a^2 S_A$. Also, the rest of the solution is wrong, since a factor of two is dropped in the first display.
- p. 145 Problem 7.44, change the angle condition to $\angle BC_1 A_1 = \angle ACB = \angle B_1 C_1 A$.
- p. 146 Problem 7.52, change $\angle PCB$ to $\angle PBC$.
- p. 144 second line of 7.42, change “tangency points” to “tangency point”.
- p. 149 second paragraph of 8.1, change “three ordinary points” to “three noncollinear ordinary points”.
- p. 149 third paragraph of 8.1, change R to r .
- p. 150 in Lemma 8.1, replace “tangents from A^* ” with “tangency points from A^* ”.
- p. 151 at start of 8.2, in “simplest example is a just a line”, delete the extra “a”.
- p. 151 immediately before figure, add a period after 8.2A.
- p. 155 first bullet, delete the extra comma.
- p. 159 second line of Example 8.15, change “tangent to ω at T ” to “tangent to Ω at K ”. Also, in the second paragraph of the proof, change the last Γ to Ω .
- p. 159 in Lemma 8.16, change “fixes B and C ” to “swaps B and C ”.
- p. 162 item 5 of list, change G_1 to G_1^* . Also in the first paragraph of the solution.
- p. 163 switch C^* and D^* in the diagram.
- p. 163 step 3, change BS^* to BC^* .
- p. 164 switch S^* and R^* in the diagram.
- p. 167 Problem 8.36, “circumcircle” is misspelled.
- p. 171 Theorem 9.2, change “ \overline{AB} and \overline{XY} ” to “segments AB and XY ”.
- p. 173 in Problem 9.4, add $k \neq 0$.

- p. 174 display in proof of Lemma 9.9, change $(A, B; Q, P)$ to $(A, B; P, Q)$.
- p. 174-175 in names of Lemmas 9.11-9.12, change “Induces” to “Induce”.
- p. 175 “directed form *of* Ceva’s theorem”.
- p. 176 in Problem 9.14, delete “and Lemma 9.18” (and “proofs” to “proof”).
- p. 177 in Lemma 9.18, change “imply” to “implies”.
- p. 178 in the proof of Theorem 9.19, change $\angle CAY = \angle YBC$ to $\angle ACY = \angle YCB$.
- p. 179 top of page, first sentence, ℓ is allowed to pass through O .
- p. 181 in Lemma 9.27, change “pole” to “polar” (two instances).
- p. 184 in Theorem 9.33, uniqueness is not true for (b) or (c). The last sentence is also wrong as written. The correct sentence is: if the *circumcircle* of a cyclic quadrilateral is preserved, then so is the cross ratio of the cyclic quadrilateral.
- p. 184 in Example 9.34, swap the definitions of P, Q .
- p. 187 in solution to 9.38, I_A is the A -excenter (of course).
- p. 189 in Solution 1, T should be $\overline{AA} \cap \overline{CR}$.
- p. 190 immediately before problems, P is the point at infinity along \overline{AC} instead.
- p. 193 Problem 9.58, delete the last “again” in definitions of P, Q .
- p. 200 in third sentence of proof, add “of” after “radical center”.
- p. 201 Lemma 10.9, change “though” to “through”.
- p. 202 Proposition 10.14, delete extra “the” before M .
- p. 202 part (a), the latter four circles should be $(PAB), (PCD), (QAD), (QBC)$.
- p. 206 problem 10.23, change “IMO 2005/2” to “IMO 2005/5”, and “lie of the sides” to “lie on the sides”.
- p. 209 problem 11.6, change “circumcenter” to “circumcircle”.
- p. 210 problem 11.8, assume $AB \neq AC$.
- p. 210 problem 11.10, change “ PA, PB, PC ” to “ AP, BP, CP ”.
- p. 216 in phrase “third column from the first column”, change “first” to “second”.
- p. 218 in definition of vector addition, change to $\langle x_1 + x_2, y_1 + y_2 \rangle$.
- p. 223 hint 77, replace “ $\angle CMN = \angle BMN$ ” with “ $\angle CNM = \angle BNM$ ”.
- p. 223 hint 96 is wrong (see page 274 correction below).
- p. 224 hint 112 is wrong (see page 274 correction below).
- p. 225 hint 164 should be: let $X = \overline{EF} \cap \overline{BC}$ and $Y = \overline{AD} \cap \overline{EF}$, show $(X, Y; E, F) = -1$.
- p. 226 hint 183, replace “ $ABCD$ ” with “ $ABXY$ ”.

- p. 226 hint 185, replace “ $\angle WXY = 40^\circ$ ” with “ $\angle XZY = 40^\circ$ ”.
- p. 226 hint 193, replace “major arc BC ” with “arc \widehat{BAC} ”.
- p. 226 hint 197 is wrong (see correction to Solution 6.45 below).
- p. 226 hint 218, change AC and BD to AB and XY .
- p. 227 hint 231, replace P, C, D with P, A, B ; replace $ABCD$ with $AXBY$.
- p. 227 hint 232, L should be the midpoint of BC .
- p. 227 hint 252, replace O with O^* .
- p. 227 hint 255, replace C with C^* .
- p. 228 hint 257, change “as do C and F ” to “as do B and D ”.
- p. 229 hint 303, change first two instances of de to bc .
- p. 229 hint 316, change “the circle is” to “the circle is centered at”.
- p. 229 hint 321, delete “applies”.
- p. 230 hint 355, change AC to AB .
- p. 230 hint 340, replace P with $\overline{A_1A_2} \cap \overline{C_1C_2}$.
- p. 230 hint 362, X should instead be the second intersection of QI with the circumcircle.
- p. 231 hint 373, replace “ $90^\circ - A$ ” with “ $90^\circ - B$ ”.
- p. 231 hint 380, replace “ $\sin 30^\circ$ ” with “ $i \sin 30^\circ$ ”.
- p. 231 hint 383, “trigonometric” is misspelled.
- p. 231 hint 389, change L^* to A^* .
- p. 231 hint 393, delete “ $M = (0 : 1 : 1)$ ” and change the later “ L ” to “ M ”.
- p. 232 hint 425, change “reflection” to “reflections”.
- p. 233 hint 449, change A to C .
- p. 235 hint 544, change “equivalent” to “equivalent to”.
- p. 235 hint 554, change the similarity to $\triangle AOD \sim \triangle CO_1D$.
- p. 238 hint 649 is wrong (see correction to Solution 6.45 below).
- p. 238 hint 653 is missing a period.
- p. 238 hint 666, change $\frac{XB}{XA}$ to $\frac{XA}{XB}$.
- p. 242 in Solution 1.46, should be $\triangle O'AB \cong \triangle ODC$.
- p. 243 in Solution 1.50, one also needs to check A, P, W are collinear. Thus, add the remark $\angle NPA = \angle NMA = \angle NMC = \angle NBC = \angle NBW = \angle NPW$.
- p. 246 in Solution 3.17, change X_1Y_1 to $X'Y'$ at the bottom (twice).

- p. 249** Solution 3.29, add a remark that (AMN) is tangent to (ABC) .
- p. 250** in Solution 4.50, second-to-last sentence, change “circumcircle” to “circumcenter”.
- p. 250** in Solution 4.52, second display, change $\angle BDE = \angle BED + \angle BDE = \dots$ to $\angle BDE = \angle BED + \angle DBE = \dots$.
- p. 252** in Solution 4.52, last display, change $\angle BED + \angle BDE$ to $\angle BED + \angle DBE$.
- p. 252** in Solution 5.21, change $-BI \cdot CI \cdot \sqrt{2}$ to $+BI \cdot CI \cdot \sqrt{2}$. Thus, in last display change $\sqrt{2}$ to $-\sqrt{2}$.
- p. 259** in Solution 6.36, change $ab - 1$ to $ab + 1$ and follow through.
- p. 262** there is a minus sign missing on fifth display. Carrying through, we actually get $x = h - \frac{bc(a+b+c)}{b^2+bc+c^2}$ instead, id est we want $x/h = 1 - \frac{bc}{b^2+bc+c^2}$ to be real.
- p. 265** in Solution 6.45, the solution proves $|(a-b)(c-e)(d-f)| = |(d-e)(f-b)(a-c)|$. It should instead prove $|(b-c)(a-e)(f-d)| = |(c-a)(e-f)(d-b)|$, which is the same up to permutation of point labels.
- p. 268** at the end of Solution 7.42, the end of the display should be $-2S_A + 2bc$.
- p. 268** Solution 7.44, A_0 should be $(0 : a - uc/a : uc/a)$ in the second display.
- p. 271** the solution 7.52, second-to-last display, the expressions actually equal $-\gamma$, not γ .
- p. s 273-274** Solution 8.31, swap A and C everywhere.
- p. 274** Solution 8.36, change “nine-point circle” to “the nine-point circle” in second sentence.
- p. 274** the solution 8.37 is wrong, it assumes AB passes through the center of ω_2 .
- p. 276** in Solution 9.47, change $(A, X; B, C)$ to $(A, X; C, B)$.
- p. 277** in Solution 9.50, change $\overline{CG} \cap \overline{BE}$ to $\overline{CG'} \cap \overline{BE}$.
- p. 281** in Solution 10.26, the last line, change $\angle HMN$ to $\angle HNM$.
- p. 282** in Solution 10.29, change $(P, E; X, Y)$ to $(F, E; X, Y)$ in last paragraph.
- p. 288** in Solution 11.9, last display, change $\frac{KL}{PL}$ to $\frac{PL}{KL}$.
- p. 296** in Solution 11.18, very very end, change $2t$ to $(b^2 + c^2)t$.
- p. 297** in Solution 11.18, the first display should read $-a^2v + b^2w + c^2v = (b^2 + c^2)t + (abc)^2 - (ab)^2S_B - a^2t = S_A((ab)^2 + 2t)$. The next display should be $X' = (a^2vw : S_A(c^2S_C + t)((ab)^2 + 2t) : S_A(b^2S_B + t)((ac)^2 + 2t))$. Similarly for Y' and Z' .
- p. 297** in Solution 11.19, start of last paragraph, change DBC_1 to DB_1C_1 .
- p. 303** in the description of IMO, change “problem” to “problems”.
- p. 305** the link to reference [3] is broken. Thankfully, it’s on this website!
- p. 305** reference [10], change “Geogebra” to “Geogebra”.