MATHEMATICAL QUESTIONS WITH THEIR SOLUTIONS, FROM THE "EDUCATIONAL TIMES"

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649487691

Mathematical Questions with Their Solutions, from The "Educational Times" by W. J. C. Miller

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W. J. C. MILLER

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MATHEMATICAL QUESTIONS,

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SOLUTIONS,

FROM THE "EDUCATIONAL TIMES,"

Papers and Solutions and published in the "Concational Cines."

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W. J. C. MILLEB, B.A., RECISTERS OF THE GENERAL MEDICAL COUNCIL

FROM JULY TO DECEMBER, 1878.



LOFDON:

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LIST OF CONTRIBUTORS.

LAVERTT, W. H., M.A.; Public Examiner in the University of Oxford.
 LAWRENCE, E. J.; E.Y-ell. Trin. Coll., Cam.
 LINDER, M.A.; Finsbury Park.
 LUVETT, K.M.A.; King Edw. Sch., Birmingham.
 LUVETT, W. S., M.A.; Fellow of Pembroko College, Oxford.
 LOWE, W. H., M.A.; Fellow and Tutor of Trinity College, Dublin.
 MCOAL, M.G., K.M., Academy, Woolwich.
 MCOM, W. S., M.A.; Peunbroke Coll., Camb.
 MCOMMERT, J., M.A.; Peunbroke Coll., Camb.
 MCOMMERT, J. M.A.; Peunbroke Coll., Camb.
 MCOMMERT, J. M.A.; Peunbroke Coll., Camb.
 MARKER, J. C., B.A.; Gymmasium, Meerdeen, MaDORY, M.A.; M.A.; Commassium, Meerdeen, Mannes, M.A.; M.A.; College, Dublin.
 MARKER, J. C., M.A.; Ponthorke Coll., Camb.
 MARTIN, M.; Professour J. Elcolo Polynomia and the mathematics in the University of Edinburgh.
 MATTIN, Bey, H., D.D., M.A.; Examiner in Mathematics in the University of Edinburgh.
 MATTIN, Bey, H., D.D., M.A.; London.
 MATTIN, W.Y. C., B.A.; Jondon.
 MERLICK, THOG. K., Konsington Square, London.
 MERLICK, THOG.; Konsington Square, London.
 MERLICK, THOG. K., Konsington Square, London.
 MERLICK, THOG. K., C.P.; RYOUTH.
 MERLICK, THOG. K., C.P.; Bromiey, Kent.
 MOOK, B., SKREET, M.A. & Pol. of Moral Philoson Solver, Professor ; Paris.
 MOOK, B., KARLEY, M.A.; Pol. Ollin.
 MORGUEL, Professor ; Paris.
 MONS, RUBRER, M.A. & Schole, London.
 MURTHN, H.G. H., Leed Master of the Innorportal Solciaty's School, Joublin.
 MORGUEL, Professor ; Paris.
 MONGEL, Professor ; Paris.
 MONGEL, Professor ; Paris.
 MONGE

SCOTT, E. F., M.A.; Fell. 84. John's Coll., Cam. STITZ, E. B.; Greenville, Chao, United States.
 SERERF, Professor, Paris.
 SMARFR, J. W., M.A.; The Chartenbuise.
 SMARFR, J. W., M.A.; The Chartenbuise.
 SMARFR, Bev. H. T., M.A.; Cherry Mariam.
 SMARFR, Bev. H. T., M.A.; Cherry Mariam.
 SMARFR, J. J. P.; Queen's College, Oxford.
 SIDES, J. J.; Rue des Vieillards. Boulogne.
 SITTRIC, M.A.; Sidney SUBSEC Coll., Camb.
 SPOTTISWORD, W.ITLES, M.A.; President of Royal Society, Growency Place, London.
 SPOTTISWORD, W.I.LAM, M.A.; President of Royal Society, Growency Place, London.
 STADEROW, H.; M.A.; New York.
 STEPTIAN, S., J., LL, D., P. R.S.; Professor of Mathematics in Johns Hopkins University, Member of the Institute of France, &c.
 TATY, C., M.A.; P. Fordessor of Natural Philo-sophy in the University of Edinburgh.
 TANKER, H. W. L., M., Pell, Trin. Coll., Dub.
 TATIOR, Rev.C., M.A.; Pell, SL, John's Coll.Cam.
 TATIOR, Rev.C., M.A.; Pellow and Assistant Tutor of Trainity College, Cambridge.
 THART, A., M.A.; Angedalen Coll., Oxford.
 THOMMON, P. D., M.A.; Pellow and Assistant Tutor of Trainity College, Cambridge.
 THERAY, STATURE, B.A.; Cambridge.
 THERAY, S.A.; M.A.; N. St. John's Coll.Cam.
 TOMMON, P. D., M.A.; Hate Pellow of St. John's Coll., Cambridge. Cambridge.
 TOMMON, P. D., M.A.; M.S., Chubrid Coll.Cam.
 TOMMON, P. D., M.A.; N.S., Chubridge.
 TOMMON, P. D., M.A.; St. John's Coll.Cam.
 TOMMON, P. M. M., Tation, M. K. Garnington Levetory, Oxtant, J., La, Levets, M. Collo, Cam.
 TOMMON, P. M. A.; St. John's Coll.Cam.
 TOMMON, P. M. A.; M.S., Professor of Nat. Philin the University of Naoles.
 TOMMON, P. A.; M. A.; N. J. Fellow and Tutor of Trainity College, Dubli

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4865. (The Editor.)-Given the three axial foci of a Cartesian, prove that the locus of the points of contact of its double tangent is the conic

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 $y^2 = 3x^2 - 2(a + \beta + \gamma)x + \beta\gamma + \gamma a + a\beta$

where a, β, γ are the distances of the foci from the origin. 29

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- 6212. (Prof. Wolstenholme, M.A.)—A circle is drawn touching both branches of a fixed hyperbola in P, P', and meeting the asymptotes in L, L', M, M': prove that (1) LL'= MM'= major axis; (2) the tangents at L, M meet in one focus, and those at L', M' in the other, and the angle between either pair is constant supplementary to the angle between the asymptotes; (3) the directrices bisect LM, L'M': (4) PP' bisects LL', MM', LM, L'M'; (5) the tangents at L, L' intersect on a rectangular hyperbola passing through the foci and having one of its asymptotes coincident with MM' (because ∠ CSL + ∠CS'L' = angle between the asymptotes); (6) LM, L'M touch parabolas having their foci at the foci of the hyperbola, and the tangents at their vertices the directrices of the hyperbola.

- 5334. (Christine Ladd.)—In a spherical triangle, given a, b, B; express the sine and the cosine of e and C in terms of the data. 80
- 5364. (The Editor.)—If ρ₁, ρ₂ be the focal vectors FM, FN of two points M, N on a parabola whose parameter is 4π, δ the chord of the arc MN, and Z the area of the parabolic sector FMN; prove that

- 5371. (S. Roberts, M.A.)—Find the equation of the curve along which the faisceaux of curves U + αV = 0, S + βT = 0 touch, a, β being parameters.
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- 5389. (Professor Townsend, F.R.S.)—In a trinodal quartic curve, in a plane, show, by any method, that the four conics through the three nodes which contain the four bitangent chords touch in pairs at the three nodal points, and, by their lines of passage through them, divide harmonically at once the three nodal angles of the curve and the three angles of the nodal triangle.

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- 5392. (Professor Evans, M.A.)--If $\frac{p_n}{q_n}$ be the last convergent in the

first period of A^{\dagger} expanded as a continued faction, and r the greatest integer contained in A^{\dagger} , show that $p_n = rq_n + q_{n-1}$. 49

- 5398. (The Editor.)—If, in a plane triangle, O be the centre and r the radius of the inscribed circle, P the orthocentre, and p the radius of the circle inscribed in the orthocentric triangle, and Q the centre and B the radius of the circumscribed circle—so that OPQ may be conveniently called the triangle of centres—find expressions for the sides and area of the triangle of centres, and prove that

$$\frac{\cos O_2 O_1 O_3}{\sin \frac{1}{4} A} = \frac{\cos O_3 O_2 O_3}{\sin \frac{1}{4} B} = \frac{\cos O_1 O_3 O_3}{\sin \frac{1}{4} C} = \frac{1 - \cos A - \cos B - \cos C}{4 \sin \frac{1}{4} A \sin \frac{1}{4} B \sin \frac{1}{4} C}.$$

- 5407. (S. Roberts, M.A.)—A system of conics has a common focus and directrix, another system also has a common focus and directrix; required the locus of the intersection of corresponding conics having equal eccentricities.
- 5419. (R. Tucker, M.A.)-Prove that

$$\frac{\pi^2}{16} = \mathbb{R}(1) - \frac{1}{2}\mathbb{R}(3) + \frac{1}{2}\mathbb{R}(5) - \&c. - \frac{1}{2}n\mathbb{R}(4n-1) + \frac{1}{2n+1}\mathbb{R}(4n+1) - \&c.,$$

- where R(2p+1) stands for sum of reciprocals of odd numbers up to 2p+1. 19
- 5432. (Professor Ball, F.R.S.)—From any point perpendiculars are drawn to the generators of the surface $x(x^2+y^2)-2mxy=0$; show that the feet of the perpendiculars lie upon a plane ellipse. 96
- 5446. (S. Roberts, M.A.)-Shew that the triangular numbers which are also squares are given by

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

- 5449. (J. L. McKenzie, B.A.) A line drawn from the common centre of two concentric and coarial ellipses cuts one conic in A and the other in B; prove that the locus of the harmonic conjugate of O with respect to A and B is the quartic
- $[x(a^{-2}-a'^{-3})+y^2(b^{-3}-b'^{-3})]^3-8[x^3(a^{-3}+a'^{-3})+y^2(b^{-3}+b'^{-3})]+16=0.$