

7. Show that if (A) $aX + bY + cZ = 0$, and (B) $a_1X + b_1Y + c_1Z = 0$, where (C) $X = ax + a_1x_1 + a_2$, (D) $Y = bx + b_1x_1 + b_2$, and (E) $Z = cx + c_1x_1 + c_2$; then $X^2 + Y^2 + Z^2 =$

$$= \frac{\{a_2(bc_1 - b_1c) + anal + \}^2}{(bc_1 - b_1c)^2 + anal +}$$

7. Let $Y = mX$, $Z = nX$. From (A) and (B) we have $bm + cn + a = 0$, and $b_1m + c_1n + a_1 = 0$, $\therefore m = \frac{ca_1 - c_1a}{bc_1 - b_1c}$, $n = \frac{ab_1 - a_1b}{bc_1 - b_1c}$.

$\therefore X^2 + Y^2 + Z^2 = X^2(1 + m^2 + n^2) = \text{say } k^2$

$$\therefore X = \frac{k(bc_1 - b_1c)}{\sqrt{(bc_1 - b_1c)^2 + anal}}$$

similarly for Y and Z .

Now $a_1X + b_1Y + c_1Z = x(aa_1 + bb_1 + cc_1) + x_1(a_1a_2 + \dots) + a_2^2 + b_2^2 + c_2^2$; but by squaring (C), (D), (E), and substituting (A) and (B) in terms of x, x_1 we have $X^2 + Y^2 + Z^2 = x(aa_1 + \dots) + x_1(a_1a_2 + \dots) + (a_2^2 + \dots)$
 $\therefore k^2 = a_2X + b_2Y + c_2Z$

$$k^2 = k \left\{ \frac{a_2(bc_1 - b_1c) \dots anal \dots}{\sqrt{(bc_1 - b_1c)^2 + \dots}} \right\} \quad \text{Q.E.D.}$$

8. If a, b, c, d be the roots of the equation $x^4 + 4px^3 + 6qx^2 + 4rx + t = 0$,

Find the value of $\frac{x^n}{x-a} + \frac{x^n}{x-b} + \frac{x^n}{x-c} + \frac{x^n}{x-d}$ in terms of x, p, q, r, t .

8. The expression becomes

$$x^n [4x^3 - 3x^2(a+b+c+d) + 2x(ab+ac+bc) - \{bcd + \dots\}]$$

$$(x-a)(x-b)(x-c)(x-d)$$

now $a+b+c+d = -4p$; $ab+ac+\dots = 6q$; $bcd + \dots = -4r$; $abcd = t$ and $(x-a)(\dots =$
 $x^4 + 4px^3 + \dots$ Substitute and we get,

$$\frac{4x^n(x^3 + 3x^2p + 3qx + r)}{x^4 + 4px^3 + 6qx^2 + 4rx + t}$$

67. It is required to find the outside diameter of a hollow shaft of the same strength as a solid shaft ten inches in diameter, the inside diameter of the hollow shaft being six inches.

NOTE.—Will our readers send solutions to this problem.

CLASSICS.

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BRADLEY'S ARNOLD.

BY M. A.

Exercise 29 A.

1. Quem cavere debeas, quem timere, jampridem te monco. 2. Scio patrem tuum virum optimum, liberis suis provisorum esse. 3. Fieri non potest ut tantum hoc scelus cuiquam probes. 4. Quærenti quid facerem, num eum et quemadmodum et quando offendissem, nihil mihi respondit. 5. Patriæ an vobismet ipsis consultum vultis? 6. Multa ci ego peccata condonavi; non debuit adeo in te sævire. 7. Adolescenti ei adversabar; senem et imbecillum adjuvare volo. 8. Multas in republica tempestates prospicio; sed neque reipublicæ salutis, nec meæ timeo.

Exercise 29 B.

1. Ferunt cruentum pugionem sicario entorsisse, et alte sublatum humi abjecisse. 2. Nolite ei qui tam bene de republica meritus est, ignobilitatem objicere. 3. Utrum mihi succenseas necne, nihil refert; salutis meæ nihil metuo; jam tibi licebit quotidie mihi mortem, si libebit denunciare. 4. Tibi et creditum et credendum fuit, constabat enim inter omnes nunquam te fidem fefellisse. 5. Magistratum quem sibi nuperrime permisisset, populus, non modo cum aliis communicatum sed totum sibi hac lege ademptum iri, conquestus est. 6. Libertatem nostram ac jura absentibus nobis ademisti, cras nescio an vitas nostras ac fortunas extorsurus sis. 7. Milites ad unum omnes occisi sunt; ab inermibus temperatum est. 8. Rex nostra mitissimi homo ingenii, cur civibus tantam vim frumenti ac pecuniæ imperaverit ignoramus omnes. 9. Nemini unquam qui sibi obstitit parcebat nec, cuiquam qui sibi nocuerat ignoscebat. 10. Tibi cautum volui, nec tamen de hac re te, hominem incautissimum ac temerarium, consuli volebam.

Exercise 52.

1. Num igitur repugnantibus et tela in nos conjicientibus parcendum erit? 2. Num his etiam repugnantibus parcendum est? 3.