

The Arabic Origins of "Mathematical and Computational Terms" in English and European Languages: A Lexical Root Theory Approach

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Abstract: *This paper investigates the Arabic origins of mathematical and computational terms in English, German, French, Latin, Greek, and Sanskrit from a lexical root theory perspective. The data consists of 190 terms like abacus, add, arithmetic, angle, circle, computer, calculate, create, divide, design, digital, equal, informatic, mathematics, minus, plus, multiply, number, one-trillion, quarter, pair, quantity, likelihood, probability, statistics, subtract, zero. The results show that all such words have true Arabic cognates, with the same or similar forms and meanings. Their different forms, however, are all found to be due to natural and plausible causes and different courses of linguistic change. For example, calculate (calculus, calculator), which comes from Latin calx 'limestone', derives from Arabic kils 'limestone, calcium' via lexical shift; Latin abacus 'sand table for calculating' is derived from Arabic ba2S 'pebbles; tiny stones' via /2 & S/-merger into /k/; Latin plus (plural, poly) 'more' is from Arabic abal, ababeel (pl.) 'group; many, much'; Latin minus obtains from Arabic min/mann 'from; reduction, cutting'; digital comes via Latin digitus 'finger' and Greek deka 'hand, ten' from Arabic dijat 'fingers, hand'. Consequently, the results indicate, contrary to Comparative Method claims, that Arabic, English, and all Indo-European languages belong to the same language, let alone the same family. They, therefore, prove the adequacy of the lexical root theory according to which Arabic, English, German, French, Latin, Greek, and Sanskrit are dialects of the same language with Arabic being their origin all because of its phonetic capacity or complexity and huge lexical variety and multiplicity.*

Keywords: *Mathematical and computational terms, Arabic, English, German, French, Latin, Greek, Sanskrit, historical linguistics, lexical root theory, language change (phonetic, morphological, semantic)*

1. INTRODUCTION

The lexical root theory (Jassem 2012a-f, 2013a-q, 2014a-f) derives its name from the use of lexical (consonantal) roots in retracing genetic relationships between words in world languages. It first emerged as a rejection of the Comparative (Historical Linguistics) Method in classifying Arabic as a member of a different language family from English, German, French, and all (Indo-)European languages in general (Bergs and Brinton 2012; Algeo 2010; Crystal 2010: 302; Campbell 2006: 190-191; Yule 2006; Crowley 1997: 22-25, 110-111; Pyles and Algeo 1993: 61-94). In all his twenty-eight studies, Jassem (2012a-f, 2013a-q, 2014a-f) firmly established, on the contrary, the inextricably close, genetic relationship between Arabic and such languages phonetically, morphologically, grammatically, and semantically or lexically so much so that they can be really considered dialects of the same language.

Thus far twenty eight studies have been undertaken on all language levels. Lexically, eighteen studies successfully traced the Arabic origins of English, German, French, Latin, Greek and Sanskrit words in key semantic fields- namely, numeral words (Jassem 2012a), common religious terms (Jassem 2012b), water and sea terms (Jassem 2013d), air and fire terms (Jassem 2013e), celestial and terrestrial terms (Jassem 2013f), animal terms (Jassem (2013g), body part terms (Jassem 2013h), speech and writing terms (Jassem 2013i), time words (Jassem 2013j), family words (Jassem 2013k), cutting and breaking words (Jassem 2013m), movement and action words (Jassem 2013n), perceptual and sensual words (Jassem 2013o), cognitive and mental words (Jassem 2013p), love and sexual words (Jassem 2013q), wining and dining words (Jassem 2014a),

divine and theological terms (Jassem 2014d), and proper names (Jassem 2014f). Morphologically, three studies established the Arabic origins of English, German, French, Latin, and Greek inflectional 'plural and gender' markers (Jassem 2012f), derivational morphemes (Jassem 2013a), and negative particles (Jassem 2013b). Grammatically, six papers described the Arabic origins of English, German, French, Latin, Greek, and Sanskrit personal pronouns (Jassem 2012c, 2013l), determiners (Jassem 2012d), verb 'to be' forms (Jassem 2012e), question and modal words (Jassem 2014b), and prepositions and conjunctions (Jassem 2014c). Phonetically, Jassem (2013c) outlined the English, German, French, Latin, and Greek cognates of Arabic back consonants: viz., the glottals, pharyngeals, uvulars, and velars; needless to say, the phonetic analysis recurred in each study above. Finally, on the applied linguistics level, Jassem (2014e) extended this approach to the field of translation studies, showing how cultural universals can be translated this way between Arabic and such languages. In a nutshell, in all such studies, Arabic, English, German, and French words, for example, were true cognates with similar or identical forms and meanings, whose differences are due to natural and plausible causes and diverse courses of linguistic change.

This paper sets out to examine the Arabic origins and/or cognates of mathematical and computational terms in English and Indo-European languages. It supplements and complements Jassem (2012a) which traced the Arabic origins of numeral words in such languages, by revising and including a huge amount of new data. The remainder of the paper is organized into four sections: (ii) research methods, (iii) results, (iv) discussion, and (v) conclusion.

2. RESEARCH METHODS

2.1 The Data

The data consists of 190 mathematical and computational terms such as *abacus, add, arithmetic, angle, circle, computer, calculate, create, divide, design, digital, equal, informatic, mathematics, minus, plus, multiply, number, one-trillion, quarter, pair, quantity, likelihood, probability, statistics, subtract, zero*, and so on. Their selection has been based on the author's knowledge of their frequency and use and English dictionaries and thesauri. To facilitate reference, they will be arranged alphabetically together with brief linguistic comments in (3.) below.

As for etymological data for English and Indo-European languages, all references are for Harper (2014); for Arabic, the meanings are for Ibn Manzoor (2013) in the main, Altha3alibi (1996: 89-94, 249-54), and Ibn Seedah (1996: 3/118-32, 12/263-66, 13/65-70).

In transcribing the data, normal spelling is used for practical purposes; nevertheless, certain symbols were used for unique Arabic sounds, including /2 & 3/ for the voiceless and voiced pharyngeal fricatives respectively, /kh & gh/ for the voiceless and voiced velar fricatives each, capital letters for the emphatic counterparts of plain consonants /t, d, dh, & s/, and /'/ for the glottal stop (Jassem 2013c).

The above *mathematical and computational* terms can produce fully natural texts on their own in today's English, e.g.,

Albert: Compute $1 + 1 = 2$.

Robert: Calculate $5 \times 2 = 10$.

Matthew: Subtract $100 - 50 = 50$.

Augustine: Divide $1/1 = 0$.

Every word in the above fully natural English text has a true Arabic cognate as will be shown in the analysis below.

2.2 Data Analysis

2.2.1 Theoretical Framework: The Lexical Root Theory

The lexical root theory (Jassem 2012a-f, 2013a-q, 2014a-f) will be used as the theoretical framework for data analysis here. It is so called because of employing the lexical (consonantal) root in examining genetic relationships between words such as the derivation of *observation* from *serve* (or simply *srv*) and *description* (*subscription, prescription, inscription*) from *scribe* (*scr*).

The main reason for that is because the consonantal root carries and determines the basic meaning of the word irrespective of its affixation and vowels such as *observation* (*srv*). Historically speaking, classical and modern Arabic dictionaries (e.g., Ibn Manzoor 1974, 2013) used consonantal roots in listing lexical entries, a practice first founded by Alkhaleel, an 8th century linguist, lexicographer, musician, and mathematician (Jassem 2012e).

The lexical root theory has a simple, straightforward structure, which consists of a theoretical principle or hypothesis and five practical procedures of analysis. The principle states that:

Arabic and English as well as the so-called Indo-European languages are not only genetically related but also are directly descended from one language, which may be Arabic in the end. In fact, it claims in its strongest version that they are all dialects of the same language, whose differences are due to natural and plausible causes and different courses of linguistic change.

To empirically prove that, five applied procedures are used in data collection and analysis: namely, (i) methodological, (ii) lexicological, (iii) linguistic, (iv) relational, and (v) comparative/historical. As all have been reasonably described in the above studies (Jassem 2012a-f, 2013a-q, 2014a-f), a brief summary will suffice here.

Firstly, the methodological procedure concerns data collection, selection, and statistical analysis. Apart from loan words, *all* language words, affixes, and phonemes are amenable to investigation, and *not only* the core vocabulary as is the common practice in the field (Crystal 2010; Pyles and Algeo 1993: 76-77; Crowley 1997: 88-90, 175-178). However, data selection is practically inevitable since no single study can accomplish that at one time, no matter how ambitious it might be. The most appropriate method for approaching that goal would be to use semantic fields such as the present and the above topics. Cumulative evidence from such findings will aid in formulating rules and laws of language change at a later stage (cf. Jassem 2012f, 2013a-f). The statistical analysis employs the percentage formula (see 2.2 below).

Secondly, the lexicological procedure is the initial step in the analysis. Words are analyzed by (i) deleting affixes (e.g., *explained* → *plain*), (ii) using primarily consonantal roots (e.g., *plain* → *pln*), and (iii) search for correspondence in meaning on the basis of word etymologies and origins as a guide (e.g., Harper 2014), which should be used with discretion, though. The final outcome yields Arabic *baien*, *baan* (v) 'clear, plain' via /l/-insertion or split from /n/ (Jassem 2013i).

Thirdly, the linguistic procedure handles the analysis of the phonetic, morphological, grammatical and semantic structures and differences between words. The phonetic analysis examines sound changes within and across categories. More precisely, consonants may change their place and manner of articulation as well as voicing. At the level of place, bilabial consonants ↔ labio-dental ↔ dental ↔ alveolar ↔ palatal ↔ velar ↔ uvular ↔ pharyngeal ↔ glottal (where ↔ signals change in both directions); at the level of manner, stops ↔ fricatives ↔ affricates ↔ nasals ↔ laterals ↔ approximants; and at the level of voice, voiced consonants ↔ voiceless. For example, /t/ may turn into /d/ by voice or /th & s/ by manner.

In similar fashion, vowels change as well. Although the number of vowels differ greatly within and between English (Roach 2008; Celce-Mercia et al 2010) and Arabic (Jassem 2012g, 1987, 1993), all can be reduced to three basic long vowels /a: (aa), i: (ee), & u: (oo)/ (and their short versions besides the two diphthongs /ai (ay)/ and /au (aw)/ which are a kind of /i:/ and /u:/ respectively). They may change according to modifications in (i) tongue part (e.g., front ↔ centre ↔ back), (ii) tongue height (e.g., high ↔ mid ↔ low), (iii) length (e.g., long ↔ short), and (iv) lip shape (e.g., round ↔ unround). In fact, the vowels can be, more or less, treated like consonants where /i:/ is a kind of /j (y)/, /u:/ a kind of /w/, and /a:/ a kind of /h/ or vice versa. Their functions are mainly (i) phonetic such as linking consonants to each other in speech and (ii) grammatical like indicating tense, word class, and number (e.g., *sing*, *sang*, *sung*, *song*; *man/men*). Thus their semantic weight is marginal and little in significance, if not at all. For these reasons, vowels may be totally ignored in the analysis because the limited nature of the changes do not affect the final semantic result at all.

Sound changes result in natural and plausible processes like assimilation, dissimilation, deletion, merger, insertion, split, syllable loss, re-syllabification, consonant cluster reduction or creation

and so on. In addition, sound change may operate in a multi-directional, cyclic, and lexically-diffuse or irregular manner (for detail, see Jassem 2012a-f, 2013c).

Regarding the morphological and grammatical analyses, some overlap obtains. The former examines the inflectional and derivational aspects of words in general (Jassem 2012f, 2013a-b); the latter handles grammatical classes, categories, and functions like determiners, pronouns, nouns, verbs, and case (Jassem 2012c-e, 2013l). Since their influence on the basic meaning of the lexical root is marginal, inflectional and derivational morphemes may also be ignored altogether.

As regards the semantic analysis, meaning relationships between words are examined, including lexical stability, multiplicity, convergence, divergence, shift, split, change, and variability. Stability means that word meanings have remained constant over time. Multiplicity denotes that words might have two or more meanings. Convergence means two or more formally and semantically similar Arabic words might have yielded the same cognate in English. Divergence signals that words became opposites or antonyms of one another. Shift indicates that words switched their sense within the same field. Lexical split means a word led to two different cognates. Change means a new meaning developed. Variability signals the presence of two or more variants for the same word (for detail, see Jassem 2012a-f).

Fourthly, the relational procedure accounts for the relationship between form and meaning from three angles: formal and semantic similarity (e.g., three, *third*, *tertiary* and Arabic *thalath* 'three' (Damascus Arabic *talaat* (Jassem 2012a)), formal similarity and semantic difference (e.g., ship and *sheep* (Jassem 2012b), and formal difference and semantic similarity (e.g., *quarter*, *quadrant*, *carat*, *cadre* and Arabic *qeeraaT* 'a fourth; carat' (Jassem 2012a)).

Finally, the comparative historical analysis compares every word in English in particular and German, French, Greek, Latin, and Sanskrit in general with its Arabic counterpart phonetically, morphologically, and semantically on the basis of its history and development in English (e.g., Harper 2014; Pyles and Algeo 1993) and Arabic (e.g., Ibn Manzour 2013; Altha3aalibi 2011; Ibn Seedah 1996) besides the author's knowledge of both Arabic as a first language and English as an equal second language. Discretion should be exercised here due to uncertainties and inaccuracies, especially in Harper's work, though.

To sum up, the most appropriate operational procedure in relating words to each other genetically would be to:

Select a word, any word,

- Identify the source language meaning on the basis of especially word history or etymology. It is essential to begin with meanings, not sounds or sound laws; the former will lead you to the cognate naturally; the latter will get you lost definitely,
- search for the equivalent meaning in the target language, looking for cognates: i.e., words with similar forms and meanings, and
- Explain the differences in form and meaning between the cognates by following the above steps lexicologically, phonetically, morphologically, and semantically.
- That is the whole story simply and truly. For example, *Augustine* (*Augusta*, *Augustan*, *Augustus*) all come from Latin *August* which means 'holy, sacred' which eventually derives from Arabic *qudus* (*alqudus*) '(the) holy, sacred' via reordering and turning /l, q, & d/ into /u, g, & t/. The same applies to English *Ghost* and German *Geist* (Jassem 2014e).

2.2.2 Statistical Analysis

The percentage formula will be used for calculating the ratio of cognate words or shared vocabulary, which is obtained by dividing the number of cognates over the total number of investigated words multiplied by a 100. For example, suppose the total number of investigated words is 100, of which 90 are true cognates. The percentage of cognates is calculated thus: $90/100 = 9 \times 100 = 90\%$. Finally, the results are checked against Cowley's (1997: 173, 182) formula to determine whether such words belong to the same language or family (for a survey, see Jassem 2012a-b).

3. RESULTS

The Arabic Origins of "Mathematical and Computational Terms" in English and European Languages: A Lexical Root Theory Approach

The main focus of the results will be on the Arabic lexical (consonantal) roots of English, German, French, Latin, Greek, and Sanskrit words; therefore, affixation (prefixes, suffixes, and infixes) will be overlooked generally to save time, space, and effort here although all have true Arabic cognates (see Jassem 2012f, 2013a-b).

Abacus via Latin *abacus* from Greek *abax* (gen. *abakos*) 'sand table for calculating' from Arabic ba2S(at) 'pebbles'; /2 & S/ merged into /k/.

Accrue (*accrual, accretion*) via French from Latin *accrescere* 'increase' from Arabic *kathura/akthara* 'to increase'; /k & th/ merged into /k/.

Accumulate (*accumulation*) via Latin *accumulatus*, past participle of *accumulare* 'heap up' from Arabic kawm(at) 'heap' via /l/-insertion.

Acute (acuity) via Latin *acutus* 'sharp, pointed', *acuere* (v) 'sharpen' from Arabic 2aad 'sharp, end', a2adda (v), 2adeed 'iron, sharp'; /2 & d/ became /k & t/.

Add (*addition, additive*) via Latin *addere* 'add to, join, place upon' from (i) ad- 'to' from Arabic 2atta 'to' via /2/-loss and turning /t/ into /d/ and (ii) *dere* 'put, place' from *dare* 'give' from Arabic 2aTT 'put, place' and/or a3Ta 'give' via /2 (3)/-loss and turning /T (D)/ into /d/; alternatively, from Arabic *ada* 'to get more', *zaad* 'increase, add' via /z & d/-merger, aDaaf 'add' via /D & f/-merger into /d/, or 3add 'count, add' via /3/-loss.

Altitude (*alt, elite, elate, elevate, aloof*) via Latin *altitudinem, altitudo* from *altus* 'high' from Arabic 3aal(iat) 'high', 3iliat (n), 3uloo (n) 'height'; /3/ was dropped.

Amount via French from Latin *admontem (mos)* 'mountain' from Arabic 'amt 'height' or *matn* 'mount' via reordering (Jassem 2013f); or *mudd* 'amount, quantity', *madda* (v) 'stretch, extend' where /n/ split from /m/ and /d/ became /t/.

Angle via French from Latin *angulus* 'angle, corner', *ang(u)ere* (v) 'to compress in a bend, fold, strangle', Sanskrit *ankah* 'hook, bent' from Arabic 2ana (*in2ana*), *in2inaa* (n) 'to bend', turning /2/ into /g/.

Arithmetic via Latin *arithmetica* from Greek *arithmetike (tekhne)* '(the) counting (art)' from *arithmos* 'number, counting, amount' from Arabic *ardham, radham* (n) 'to increase'; *rathm* 'cutting, breaking' via lexical shift; *razma(t)* 'bundle, heap, amount' where /z/ became /th/; *ramz* 'symbol, mark; large battalion' via reordering and turning /z/ into /th/; *raqam* 'number' in which /th/ replaced /q/; or *zumra(t)* 'group' via reordering and replacing /z/ replaced /th/.

Assess (*assessment*) via Latin *assessare* 'fix a tax upon', *assidere* 'to sit beside' from (i) ad 'to' from Arabic 2atta 'to' via /2/-loss and changing /t/ into /d/ and (ii) *sidere* 'sit' from Arabic *jatha* 'sit' via /j & th/-mutation into /s & d/; or, indivisibly, from Arabic a2Sa, 2aS2aS 'count, divide' where /2 & S/ became /s/.

Atom (*atomic, anatomy, epitomic*) via Latin *atomus* 'indivisible particle' from Greek *atomos* 'uncut, indivisible' from (i) a- 'not' from Arabic a 'not in spoken Arabic; question particle' via lexical shift and (ii) *tomos* 'a cutting', *temnein* 'cut' from Arabic *qaTam (inqaTam)* 'to cut (the top)', *quTma(t)* (n) 'very small thing', *aqTam* (adj.) 'cut'; /q & T/ merged into /t/.

Axiom from Arabic *2ikma(t)* 'wisdom' via /2/-loss or mutation into /s/ (cf. **maximum**).

Balance via French from Latin *bilancia, bilanx* 'two pans', (possibly from (i) *bis* 'twice' below) or from bi- (by) 'in, with' from Arabic bi 'in, with' (Jassem 2014c) and (ii) *lanx* 'dish, plate, scale of a balance' from Arabic *laqn* 'large deep dish' via reordering and splitting /q/ into /ks/: i.e. from Arabic *bilaqn* 'lit., by dish'. See **binary**.

Billion (*billionaire*) is a compound of (i) *bi-* (*binary*) and (ii) *million*. See below.

Binary (*binate, bi-*) via Latin *binarius* 'consisting of two' from *bini* 'two-fold, two-by-two' from *bis* 'double' from Arabic sab3 'seven; much' via lexical shift, reversal, and /3/-loss; rub3 'a quarter' via reordering, turning /r/ into /n (s)/, and /3/-loss; *baina* 'between (two)' via lexical shift; *thani* 'two, second' where /th/ became /b/; or biD3 'a few; a number from 3-9' via lexical shift, /D/-evolution into /s (Ø)/, and /3/-loss.

Binary Digit (*bit*) See above and below.

Bit (*a bit*) via Old English *bite/bita* 'biting, piece bitten off', German *Bissen* 'a bite, morsel' from Arabic baDa3, biD3 (n) 'cut; piece; a cut; a few; 3-9 count'; /D/ became /t/ and /3/ was dropped (Jassem 2013p).

Boot 'start up a computer' from Arabic *bada'* 'start'; /t/ replaced /d/.

By via Old English *be* 'near, in, by, during, about' and German *bei* from Arabic *bi* 'by, in, with' (Jassem 2014c).

Calculate (*calculation, calculator, calculus*) via Latin *calculatus*, past participle of *calcularre* 'reckon, compute' from *calculus* below.

Calculus (*calculate*) via Latin *calculus* 'reckoning, account; originally a counting pebble', diminutive of *calx* (genitive *calcis*) 'limestone' from Arabic *kils* 'limestone, calcium' where /s/ became /k/; or *SalSaal*, *Sal* 'limestone, white dust' where /S/ became /k/.

Cardinal (*cardinal number*) via Latin *cardinalis* 'chief, essential' from *cardo* (gen, *cardinis*) 'that on which something turns or depends; pole; originally door hinge' from Arabic *sard* (also *zard*) 'hinge; hole; subsequent; following', turning /s (z)/ into /k/; *Sadr* 'breast; chief' via reordering and turning /S/ into /k/; or *jidaar* 'wall' via lexical shift, reordering, and turning /j/ into /k/. See **ordinal**.

Cent (*century, centenary, centennial, percentage, percentile*) via Latin *centum* 'hundred; hundredth part' from Arabic *hind* (also *hunaidat, hindeed*) 'of camels, a hundred'; /h & d/ became /s & t/. See **hundred**.

Cipher (*decipher, decipherment, zero*) via Old French *cifre*, Modern French *chiffre*, Latin *cifra/zephirum*, Italian *cifra* 'nought, zero' from Arabic *Sifr* 'zero, empty', *Saffar* (v); /S/ became /s (ch)/. See **zero**.

Circle (*circular, circus, circa, circum, circuit*) via Latin *circulus* 'circular figure, small ring, hoop, orbit' from Arabic *qurS(at)* 'a circular shape'; /q & S/ passed into /s & k/.

Combine (*combination*) via Latin *combinare* 'unite' from (i) *com-* 'together' from Arabic *jamee3/jam3* 'together, all' via /3/-loss and replacing /j/ by /k/ (Jassem 2013a) and (ii) *bini* 'two by two', *bi* (adv.) 'twice' from Arabic *bain* 'between' or *bana, banna(t)* (*binayat*) (n) 'build'. See **binary**.

Community (*common*) via French from Latin *communitas* 'community, society', *communis* 'common, shared by all' from Arabic *qaum* 'people, community'; *jamaa3at* (*jam3aanat*) 'group' where /j/ became /k/ while /3/ changed into /n/; or *3umoom, 3aammatt* 'general; group; common people' where /3 & m/ became /k & n/.

Computer (*computerization, computation, compute; dispute; repute; depute; amputate; count*) via French *computer* from Latin *computare* 'count, sum up, reckon together' as a compound of (i) *com-* 'together, all, with' from Arabic *jamee3/jam3* 'together, all' via /3/-loss and replacing /j/ by /k/ and (ii) *putare* 'count, cut' from Arabic baDa3, biD3 (n) 'add, a count between 3-10, cut, clarify' via /3/-loss or *batar/batta* 'cut' (Jassem 2013i, 2013m).

Count (*account, recount, discount*) via French *conter* 'add up; tell a story' from Latin *computare* above; alternatively, from Arabic *nak(k)at* 'to empty or throw out; to indicate or strike with pebbles; to joke', *nukta(t)* (n) 'joke, story; dot; blackmail' via reordering; *nuqT(at)* 'drop; point; mark, dot', *naqaT* (v) 'follow/take the news bit by bit; give (money as a present to newlyweds); dot', *naaqiT* (*naqeeT*) (n) 'a slave's master; slave; count/countess' via lexical shift, reordering, and turning /q & T/ into /k & t/.

Couple (*copula, copulate*) via Latin *copula* 'tie, connection' from Arabic *kabal* or *bakal* 'tie, strangle, knot' via reordering; or *qabeel* 'partner, rival, equal; a group of three' where /q/ became /k/ (Jassem 2014a).

Create (*creature, creation, creativity, creator; recreate, procreate*) via Latin *creatus*, past participle of *creare* 'make, create, produce, beget' from Arabic *Sawar, Soorat* (n) 'create, make, fashion, illustrate'; /S/ became /k/.

Cube (*cubic, cubicle*) via Latin *cubus* and Greek *kybos* 'cube, vertebra' from Arabic *ka3b* 'cube, ankle'; /3/ was lost.

Cycle (*cyclic*) via Latin *cyclus* from Greek *kyklos* 'circle, wheel' from Arabic *lakka(t), lakak* 'a circular object; something tied or folded circularly' via reordering.

Cybernetics (*cyber*) via Greek *kybernetes* 'helmsman, steersman, guide, governor', *kyberne/kybernan* 'to steer' from Arabic *kabeer (kabraan(at))* 'big, large; chief, elder' or *khabeer (khabraan(at))* 'expert, knowledgeable'; /kh/ became /k (s)/.

Deca-/Deci- (*decameter, decimeter, decade*) See **digit & ten**.

Degree from Arabic *qadr* 'quantity, size, grade' or *daraja(t)* 'degree, grade' via reordering and turning /q (j)/ into /g/. See **grade**.

Design from Arabic *Sana3, taSnee3* (n) 'make' via reordering and turning /t, S, & 3/ into /d, s, & g/ (Jassem 2013c). See **sign**.

Devise (*device*) via French from Latin *divisare*, frequentative of *dividere* 'divide' from Arabic *tafaSSaSSa, faSS* (n) 'divide, separate' via reordering and turning /t, f, & S/ into /d, v, & s/; or from Arabic *awjada, wajada* 'find, devise, create' via reordering and turning /w & j/ into /v & s/. See **divide**.

Diagonal via Latin *diagonalis, diagonus* 'slanting line', from Greek *diagonios* 'from angle to angle' from (i) *dia-* 'across' from Arabic *2atta* 'to, until' via /2/-loss and turning /t/ into /d/ and (ii) *gonia* 'angle' from Arabic *2unoo, 2ana* (v) 'bending' where /2/ turned into /g/ or *qunoo, aqna* (adj.) 'height and curvature', changing /q/ into /g/.

Diagramme (*grammar*) is a compound of (i) *dia-* above and (ii) *gram* from Arabic *raqeem, tarqeem* (n) 'writing, numbering' where /t & q/ became /d & g/ (Jassem 2013i). See **gram**.

Dial (*sundial*) from Arabic *daa'ir(at), daar* (v) 'circle'; /r/ became /l/.

Differential (*differential calculus, differ, difference*) from Arabic *far(eed)d, mufrad* (adj) 'single, unique, individual', *tafarrad/infarad* (v) 'to differ, single out' via reordering; or *tafarraq, farraq* 'disperse, divide, differ', mutating /t/ into /d/ and merging /r & q/.

Digital (*digital camera (chamber), digit, digitalization, index, indexical, ten, decimeter, decameter*) via Latin *digitus* 'finger' and Greek *deka* 'hand, finger, ten' from Arabic *dija(t)* '(food-filled) fingers, hand' (cf. Jassem (2012a)).

Dimension via Latin *dimensio(nem)* 'a measuring', *dimetri* 'to measure', from (i) *dis-* 'apart' from Arabic *Taash, Tashsha* (v) 'spread, separate' where /T & sh/ became /d & s/ or *shatta* 'apart' via reversal and turning /sh & t/ into /s & d/ and (ii) *metri* 'to measure' from Arabic *matar* 'cut, measure'. See **measure**.

Distance (*distant, stand, stay, station*) via French *distance* from Latin *distantia, distans* 'standing apart' from (i) *dis* 'apart' from Arabic *Tashsha* 'spread, apart' where /T & sh/ became /d & s/ or *shatta* 'apart' via reversal and turning /sh/ into /s/ and (ii) *stare* 'stand' from Arabic *jatha* 'sit' via lexical shift and turning /j & th/ into /s & t/; *sada2/saTa2* 'lie down flat' via /2/-loss and lexical shift; *sanada, istanda* 'support, stand, sit upright'; or, indivisibly, from Arabic *shatta (shattaan)* 'far, apart, distant', *shataat (tashattut)* (n), turning /t & sh/ into /d & s/.

Divide (*division, dividend, divisive, indivisible*) via Latin *dividere* 'force apart, cleave, distribute' from (i) *dis-* 'apart' above and (ii) *videre* 'to separate' from Arabic *fatta, tafattat* 'divide, break' or *faDDa, tafaDDaD* 'separate, disperse' via reordering and changing /t & D/ into /d/.

Double (*duplicate, duplication, duplicity, duplex*) via Old French *doble* 'double' from Latin *duplus* 'twofold, twice as much', *duplare* (v) from (i) *duo* 'two' below and (ii) *plus* 'more' below; or, as a whole, from Arabic *dabal* 'to double'. See **two & plus**.

Dozen via Old French *dozaine*, from *doze* 'twelve' from Latin *duodecim* 'twelve' from (i) *duo* 'two' below and (ii) *decem* 'ten' below; or, indivisibly, from Arabic *zauj(aan)* 'a couple, pair' via lexical shift, reversal, and turning /j/ into /d/. See **two, digit, & ten**.

Draw via Old English *dragan* 'drag, draw, protract; make a line or figure', German *tragen* 'carry, bear' from Arabic *jarra* 'draw, make a lie, pull, drag' where /j/ became /d/; or qara3a, qur3a (t) (n) 'draw lots' in which /d/ replaced /d/ and /3/ was elided.

Eight via German *acht*, Latin *octo*, Greek *okto*, Sanskrit *astau* from Arabic *tis3 (at)* 'nine' via lexical shift, reversal, and /3 & s/-merger into /gh (k)/. That is, 9 in Arabic is 8 in English and vice versa. Schematically represented, *tis3(at)* → *3ast* → *ast* (Sanskrit) → *act* (Latin/Greek) → *akht/asht* (German) → *eight* (English).

Eleven (twelve) are compounds of (i) one and two below plus (ii) Old English *lif(an)* 'left: i.e., one/two left', from Arabic *fal* 'leave' in reverse or *lafa* 'came' via lexical shift; as a whole, it might come from Arabic *'awalan* 'one, first' via reordering and turning /w/ into /v/. See **one & two**.

Equal (*equality, equity, equitable, equate, equation, equivalent, equivalence, equilibrium*) via Latin *aequus* 'level, even, just' from Arabic *saawa (yusaawi)*, *sawi* (adj.), *sawaasi(at)* (n) 'equal, just, even', turning /s/ into /q/ and inserting /l/; *kufu* 'equal', merging /f & w/; or *qabeel* 'equivalent, counterpart' in which /b/ changed to /v (w)/. See **libra**.

Estimate (estimation, esteem, aim) via Latin *aestimare* 'appraise, calculate' from Arabic *qeema(t)* 'value, price, estimation'; /q/ split into /st/.

Even (odd & even numbers) from Arabic *ithnan* 'two', *thani* 'second', *mathna* 'two' via lexical shift and turning /th/ into /v/ (see Jassem 2013j, 2014c). See **odd**.

Few via Old English *feawe/fea* 'few, seldom' (possibly from Latin *paucus* 'few, little', *paullus* 'little', *parvus* 'little, small', pauper 'poor', Greek *pauros* 'few, little') from Arabic *baqi(at)*, *baqaya* (pl.) 'remnant, leftover, small, trace' in which /b & q/ became /f & k (w)/; *fi'a(t)* 'a small group'; or ba3D/biD3 'a few, some' via /b & D/-merger into /f/ and /3/-loss.

Fibre Optic Cable from Arabic (i) *wabar* 'wool' where /w/ became /f/, (ii) *baSS(at)* 'sight; eye' (Jassem 2013o) where /S/ became /t/, and (iii) *2abl* 'cable' where /2/ became /k/.

Figure via French *figure* from Latin *figura* 'shape, body, form, symbol' from Arabic *faqaar* 'back, vertebrae' via lexical shift; *fakar* 'think, remember' where /k/ became /g/; *Soora(t)* 'picture, shape' via reordering and turning /S & w/ into /f & g/; or *raqam* 'number' via reversal and turning /m/ into /f/.

First (for, fore-; afore, fore, pre, prior) via Old English *fyrst* 'superlative of fore 'before' from Old English *fer* 'for, before, on account of', German *für*, Latin *per/pro* 'before, for, on behalf of', *porro* 'for', Russian *pere* 'through' from Arabic *furr(at)* 'head, chief; first, beginning, choicest'; *far(ee)d* 'one, unique, single, person' in which /d/ split into /s & t/; or *baar* 'first; pure, just' (see Jassem 2014c).

Five via German *fünf*, French *cinque*, Latin *quinque*, and Greek *pente* from Arabic *khams(at)* 'five' via different phonetic processes. That is, /kh/ became /f/ while /m & s/ merged into /v/ in English. In all the others, /m/ became /n/; however, /kh & s/ changed both into /f/ in German but into /k/ in Latin and French in the latter of which reordering and retaining /s/ applied also; /kh/ underwent a further change in Greek, turning into /p/ while /s & t/ merged into /t/. However, it seems that, by analogy with deca- above, Greek *pente* comes from Arabic *banan(at)* 'finger(s)' via lexical shift. See **pentagon**.

Fold (*folder; five-fold*) via Old English/German *faldan* 'bend cloth back over itself' and German *falten* from Arabic *laffa, laffa(t)* (n) 'fold, tie, bend, roll, wrap; group' via reordering and the passage of /t/ into /d/; *faiD* 'much; flooding' via /l/-insertion; or *'alf* 'combination, thousand' via lexical shift, reversal, and /d/-insertion.

Foot (pedal, pedestrian) via Old English *fot*, German *Fuss*, Latin *pes* (gen. *pedis*), Greek *pos*, Sanskrit *pad* from Arabic *ibT, abaaT* (pl.) 'armpit' via lexical shift, reordering, and turning /b & T/ into /f & t/; *iSba3* 'finger' via lexical shift, reversal, and /3/-loss.

Four via German *vier* from Arabic *arba3(at)* 'four', *rub3* 'a fourth', *rabi3* 'fourth' via reordering, turning /b/ into /f/, and /3/-loss. See **pair & quarter**.

Fraction (*fracture*) from Arabic *farkath*, *farkootha(t)* (n) 'to break (bread)' where /th/ became /t/; *farq(at)* 'division, break', *farazdaq* 'of bread, a broken piece' via /z & q/-merger into /k/ and turning /d/ into /t/; or *kasr(at)* 'fracture' via reordering and turning /s/ into /f/ (Jassem 2013m).

Fragment from Arabic *faraq* (*farraq*), *mutafarriq* (adj) 'to divide'; /q/ evolved into /g/.

Frequency (*frequent*) via French frequent from Latin *frequentem*, *frequens* (nom.) 'crowded, repeated' from Arabic *katheer* (*kathraanat*, *mukthir*) 'many, much' via reordering and turning /th/ into /f/; or *firaq*, *furqaan* 'groups, separated' via lexical shift.

Grade (*gradient*, *graduate*, *gradual*, *degrade*, *upgrade*, *downgrade*, *ingredient*) via French from Latin *gradus* 'step, pace, gait, walk' from Arabic *daraj* 'step, walk' via reversal and turning /j/ into /g/; or *qadr* 'quantity, size, grade' via reordering and turning /q/ into /g/.

Gram (kilogram, diagram, telegram, program, grammar, *-graphy*) via French *gramme* from Latin and Greek *gramma* 'small weight; originally letter of the alphabet' from Greek *graphein* 'to draw, write' from Arabic *2arf* 'letter' where /2/ became /g/; *raqam* (*raqeem*) 'number, writing' via reordering (Jassem 2013i); *qaram/jaram* 'cut', turning /q (j)/ into /g/; *gharam* 'weight; a fine', replacing /gh/ by /g/; or *jamra(t)* 'a small stone (for counting or weighing); pebble' via lexical shift and turning /j/ into /g/. See **diagramme** & **graph**.

Grand (*grandeur*) via French from Latin *grandis* 'big, great, full' from Arabic *miqdaar*, *qadr* (n) 'amount, measurement; respect', *qadeer* (adj.) 'powerful, great' via reordering, turning /q/ into /g/, and inserting /n/; or *qinTaar* 'a huge amount of gold/silver money of 1000+' via reordering and turning /q & T/ into /g & d/.

Graph (*graphic*, *graphology*, *digraph*, *telegraph*, *paragraph*, *photography*, *graffiti*) via Greek *graphe* 'writing', *graphein* 'to draw, write' from Arabic *2arf* 'letter; curve'; /2/ became /g/ (Jassem 2013i). See **gram**.

Gross via Old French *gros* 'big, thick, fat, tall, rude' from Latin *grossus* 'thick, coarse' from Arabic *karsh* 'belly; big; group', *kars/riks* 'many' in which /k & sh/ became /g & s/; *jarS* 'big, great' where /j & S/ became /g & s/; or *katheer* 'much' via lexical shift, reordering, and turning /k & th/ into /g & s/.

Group via French *groupe* 'group, cluster' from Italian *gruppo* 'knot, group' from Arabic *karb(at)*, *karab* (v) 'knot; tightening' where /k/ became /g/; *sirb* 'group (of birds)' where /s/ changed into /g/; or *qurba* 'relatives' via lexical shift and turning /q/ into /g/.

Half (halve, behalf) via Old English *hal(f)b* and German *halb* 'side, part' from Arabic half 'a cut' via lexical shift.

Hardware via Old English (i) *harthu* 'hard' from Arabic *3atir* 'hard' via reordering and turning /3 & t/ into /h & d/ and (ii) *waru* 'article of merchandise; guard, protection; object of care' via German Ware 'goods' from Arabic *inaa*, *awaani* (pl.) 'container' where /n/ became /t/; *wi3aa* 'container, anything worn' where /3/ became /t/; or *maa3oon* '(cooking) utensils; clothes; any useful thing' via /m & n/-mutation into /w & r/ and /3/-loss. See **software**.

High (height) via Old English *he(a)h* 'tall, lofty', German *hoh*, *hoch* from Arabic *shaahiq* 'high'; /sh & h/ merged into /h/ and /q/ became /h (gh)/.

Hundred (*cent*, *century*, *centenary*, *centennial*, *percentage*, *percentile*) via Old English *hund/hundred*, Old High German *hunt*, German *hundert*, Gothic *hund*, Breton *kant*, Latin *centum*, Greek *hekaton*, Sanskrit *satam* from Arabic *hindeed* (also *hunaidat*, *hind*) 'of camels, a hundred' via /t/-insertion or split from /n/. Furthermore, Greek *hekaton* may derive from Arabic *3aqd*, *3uqda(t)* 'a decade (of ten years); a knot' in which /3, q, & d/ became /h, k, & t/.

The well-known *kentum-centum* or *centum-satem* divide in European languages which are subdivided into Western (e.g., Italic, Germanic, Hellenic) and Eastern (e.g., Slavic, Indic, Iranian) branches (Campbell 2006: 157, 162; Crowley 1997: 228-229) can be explained in the same way in which /h/ in Arabic *hind* turned into /k/ or /s/ while /d/ into /t/. See **cent**.

Husbandry from Arabic *2usbaan* (*at*), *2asab* (v) 'counting' in which /2/ became /h/ (see Jassem

2013k).

Icon (iconic) via Latin icon from Greek *eikon* 'likeness, image, portrait', *eikenai* 'be like, look like' from Arabic *ka'anna* (also *waika'anna*) 'like, as' via lexical shift.

Imperial (imperialism, imperative, emperor, empire, umpire; emirate, emir) via French *empereur* from Latin *imperator* 'commander, emperor', *imperare* (v) 'command' from Arabic *ameer* 'ruler, prince, emir', *amar* (v) 'to command, order'; /p/ was inserted or split from /m/.

Inch from Arabic *nashsh* 'a 20th measurement'. See **one**.

Increase (decrease) via Latin *increscere* 'increase, swell, grow' from (i) in 'in' from Arabic min 'from' via lexical shift and /m & n/-merger (Jassem 2014c) and (ii) *crescere* 'grow' from Arabic *katheer* 'many, much', *kathura* (v) 'to increase' via reordering and turning //th/ into /s/.

Increment via Latin *incrementare* 'increment' from (i) in 'in' from Arabic min 'from' via lexical shift and /m & n/-merger and (ii) *crementare* 'grow' from Arabic *rakam/inrakam*, *markoom(at)* (adj.) 'heap up, enlarge' via reordering.

Information (*inform*, *informatic*, *informative*, *informant*, *informer*) via French information, informer (v) from Latin *informatio(nem)*, *informare* (v) 'shape, form; instruct, educate, train' from Arabic ma3rifat(un), ma3roof (adj.), 3arifa (v) 'knowledge, information' via reversal and /3/-loss (Jassem 2013i).

Integer (*integrate*, *integrity*, *entire*, *tangible*) via Latin integer 'a whole number; complete' from (i) in 'not' from Arabic in 'not' and (ii) *tangere* 'to touch' from Arabic *Taraq* (*inTaraq*) 'touch, strike', *Tarqa(t)* (n), *maTraq* (n) 'a rod' where /T & q/ became /t & g/; *daqqa* (*indaqq*) 'touch, strike' or *daqar/indaqar* 'hit-stop' via reordering and turning /q/ into /g/; or *daraja(t)* 'degree, step', *adraj/indaraj* (v) 'include' via reordering and turning /d & j/ into /t & g/.

Internet (Internet) via Latin (i) inter (intra, interior, internal, in, inner) 'comparative of in, among, between' from Arabic 3an 'about, on' via /3/-loss or min via /m & n/-merger and lexical shift (Jassem 2014c) and (ii) Old English net 'netting, network, mesh', Old High German *nezzi*, German *Netz* from Arabic *najad* 'to net' or *naseej* 'netting' in which /j & d/ or /s & j/ merged into /t/; or *naqi* 'pure, net' where /q/ became /t/. See **net**.

Kilogram from Greek *khiliol* 'thousand' from Arabic *kail* 'weight' via lexical shift; or hail 'immeasurable; giving without weighing', *haa'il* (adj.) 'very large' via lexical shift and turning /h/ into /kh/.

Latitude via French from Latin *latitudo* 'breadth' from *latus* 'wide' from Arabic 3arD, 3areeD(at) (adj.) 'wide' via /3/-loss and /r & D/-mutation into /l & d/; or Tool 'length' via lexical shift and reversal.

Leg from Arabic *rijl* 'leg, foot' where /r & l/ merged and /j/ became /g/; or 2ijl 'lower leg' via reversal, turning /j/ into /g/, and /2/-loss (Jassem 2013k).

Less via Old English *lesse* 'less' from Arabic *laisa* 'not' or *qaleel*, *aqal* 'little' via reordering and turning /q/ into /s/ (Jassem 2014c).

Libra via Latin *libra* 'pound, balance' from Mediterranean *lithra-* 'a scale' from Arabic *raTl* 'a weight' via reversal and changing /T/ into /th (b)/.

Likely (like, likelihood, likewise, alike, unlike, dislike) via Old English *gelic* of (i) *ge* 'with, together' from Arabic *sawa*, *sawia* 'together' where /s/ became /g/ and (ii) *lik* 'body, form' from Arabic *shakl* 'form, shape' via reversal and /sh & k/-merger or *kull* 'all, total; like, as' via reversal; indivisibly, it comes from Arabic la3alla, 3alla 'perhaps' where /3/ became /k/ (see Jassem 2014a, 2014c).

Litre via French from Latin/Greek *litra* 'pound' from Mediterranean *lithra-* 'a scale' from Arabic *raTl* 'a weight' via reversal. See **libra**.

Load (download, upload) **from** Arabic 3idl, 3udool (pl.) 'equal weight; balance; load' via reversal and /3/-loss. **Down** comes from Arabic *doon* 'down, low' while **up** from Arabic 3ubaab 'height' via /3/-loss (Jassem 2014c).

Long (length) via Old English *lang* 'long', German *lang* from Arabic *nooq* 'lit., female camels; tall' where /l/ split from /n/; *qanoo/qanwaa* 'tall' via reversal and /l/-split from /n/; *saamiq* 'high' via lexical shift and turning /s, m, & q/ into /l, n, & g/; or *salgham* (*samlagh*) 'long' via reordering, merging /s & gh/ into /g/, and replacing /m/ by /n/ (Jassem 2014a).

Macro (macron) via Greek *markos* 'long, large', *mekos* 'length', Latin *macer* 'thin', Old English *mæger* 'thin' from Arabic *markoo* 'large; small' via reordering; *maz(oo/ee)* 'complete, perfect' where /z/ became /k/; or *qaweem*, *qaa'im* 'straight, standing' via lexical shift and reordering. See **micro**.

Major (majority) via Latin *major*, comparative of *magnus* 'large, great' from Arabic *majeed* 'great' where /j & d/ became /g & n/; *jamm* 'much' via reordering; *majmoo3* 'gathered, big, total' via /3/-loss and turning /m/ into /n (Ø)/; or *jamhoor(iat)* 'majority; most people' via reordering and /h/-loss.

Make (maker) via Old English *macian* 'make, do' and German *machen* from Arabic *aqama* 'make, do' via reversal and turning /q/ into /k/.

Many (much, more, most) via Old English *monig/manig* (adj.), *menigu* (n) 'many, much' and German *manch* 'many', *Menge* (n) 'multitude' from Arabic *qaqim/qamqam* 'many' via reordering and turning /q/ into /g/; *majmoo3* 'lit., gathered; many, total', *jama3* (v) 'gather' via reordering, /3/-loss and replacing /m & j/ by /n & g (y)/.

Mark via Old English *mearcian* 'to trace out boundaries' and German *merken* from Arabic *marqoom* 'marked, numbered', *raqam* (n) via reordering; *rasm* 'drawing' via reordering and replacing /s/ by /k/; *makar* (also *maghar/maragh*) 'to paint-mark' via reordering and replacing /gh/ by /k/.

Mass from Arabic *jism* 'body, mass' via reversal and /j & s/-merger; *jam3*, *jamaa3a(t)*, *majmmo3(at)* 'group' via reversal, /3/-loss, and turning /j/ into /s/; or *nass* 'people', turning /n/ into /m/ (see Jassem 2014d).

Mathematics (*maths*) via Latin *mathematica* from Greek *mathematike* 'relating to mathematics' from *mathema* (gen. *mathematos*) 'science, knowledge, lesson; lit., that which is learnt', related to *manthanein* 'learn', *menthere* 'to care' from Arabic *musamma*, *musammayat* (pl.) 'lit., something named; designate; certain', *samma* (v) 'to name' via lexical shift and turning /s/ into /th/; or *mafhoom(at)* 'understood; concept', *faham* (v) via /f & h/-merger into /th/.

Maximum (*maximal*, *maximize*, *Maximus*) via French and Latin *maxima* 'greatest' from Arabic *majmoo3* 'gathered; total' via /3/-loss and /j/-split into /x (ks)/; or *mu3Dham* (*3aDheem*, *a3Dham*) 'greatest, glorified, heightened' via /3 & Dh/-merger into /x/.

Mean (*means*, *median*, *middle*) via French *meien* from Latin *medianus* 'of/in the middle' from Arabic *mata* 'middle; when' where /t/ became /d (n)/; *ma3na* 'meaning' via /2/-loss; or *maheen* 'meager; low' via /h/-loss (see Jassem 2013i, 2014c).

Measure (*meter*, *metrical*, *symmetry*, *geometry*) via Latin *mensurare* 'to measure', *mensura* 'measure', *mensus*, past participle of *metiri* 'to measure' from Arabic *matar* 'cut, measure'; or *miqdaar*, *qadar* (v) 'measure, amount' via /q & d/-merger into /s/. See **meter**.

Meso- (*Mesopotamia*) via Greek *mesos* 'middle, between' from Arabic *masa* 'middle; evening'; or *niSf* (spoken Arabic *niS*) 'middle, half', turning /n/ into /m/ and *mergeing* /S & f/ into /s/.

Meter (*symmetry*, *geometry*, *metrical*) via Latin *metrum* and Greek *metron* 'measure' from Arabic *matar* 'cut, measure'; or *miqdaar* 'amount, measurement' via /q & d/-merger into /t/. See **measure**.

Micro (*micron*) 'small; magnifying; one millionth' via Greek *mikros* 'small, little, trivial' from Arabic *makoor* 'short, small, lowly'; or *markoo* 'small; large' via reordering. See **macro**.

Mid (*middle*, *medial*, *mediate*, *mediater*, *intermediate*, *intermediary*) via Old English *mid* 'with, together with, among', Old English *middel*, German *mittel*, Gothic *midjis* 'middle', Latin *medius* 'in the middle', from PIE **medhyo* 'middle' from Arabic *mata* 'mid'; /t/ passed into /d/. See **mean**.

Mile (*milli-*) via Latin *mille* 'thousand' from Arabic *mi'a(t)* 'hundred', *mi'een* (pl.) in which /t (n)/

passed into /l/; or *meel* 'a distance measurement unit'.

Million (*mile, mille*) via French million 'lit., a great thousand' from Latin *mille* 'thousand' from Arabic *mia(t), mi'een* (pl.) 'hundred'; /l/ split from /n/ besides lexical shift.

Minus (minimum, minimize, minute, diminish, diminutive; minor, minority; minister, administer, administration) via Latin *minus*, minor 'less' from Arabic *maneen (mamnoon)*, *manna* (v) 'reduced, lessened; given', *min* (prep.) 'from, minus'; *numnum* 'very small' via reordering; or *manqooS (naaqiS)* 'reduced', *naqS (nuqSaan)* (n), *naqaS* (v) 'decrease', in which /q & S/ merged into /s/.

Molecule (molecular) via French from Latin *molecula* from (i) *mole* 'mass, barrier' from Arabic *lamam* 'very small things', plural of *lamma(t)* 'a heap' via reversal or *mil2* 'lit., salt; fine dust' via lexical shift and /2/-loss and (ii) Latin *-cle* 'small' from Arabic *qaleel, qall* (v) 'small' where /q/ became /k/.

Mono via Greek *monos* 'single, alone; small, isolated' and/or *manos* 'rare' and English minnow from Arabic *ma3n* 'small, little' via /3/-loss; *amam* 'small' where /m/ became /n/; *maneen* 'weak' via lexical shift; *nama'* (*numnum*) 'small' via reordering and reduction; or *man'a, naa'i* (adj.) 'far, isolated'.

More via Old English *mara* 'greater, stronger, mightier, more' (*comparative of micel* 'great') and German *mehr* 'more' from Arabic *kaamil* 'complete, whole' or *jamal, jumla(t), jameel* 'camel, amount, big, great, beautiful' via reordering and turning /k (j)/ into /c/; or *murr* 'powerful, strong, bitter', *marra(t)* 'much, strong, a time'. See **much**.

Mother Board from Arabic (i) *mar'at* 'woman' via reordering and turning /t/ into /th/, 'um(mat) 'mother', or *amat* 'woman' via /t/-mutation into /th/ and /r/-insertion (Jassem 2013k) and (ii) *dubur (daabir)* 'dorsum, back' via reordering; *batra* 'soft stone' via reordering and turning /t/ into /d/; or *balaaT* 'lit., flat, thin stone; thin flat surface' where /l & T/ became /r & d/.

Much (more, most) via Middle English *muchel* 'large, much' from Old English *micel* 'great in amount or extent' from Arabic *kaamil* 'full, complete' via reordering and turning /k/ into /ch/ besides /l & m/-merger; *jamal, jumla(t), jameel, mujmal* 'camel; amount; total; big, great; beautiful' via reordering and turning /j/ into /s/; or *jamm* 'much' via reversal and turning /j/ into /ch/. See **more**.

Multi (*multitude, multiple, multiply, multiplication; model, mold, mutilate*) via Latin *multus* 'much, many', Greek *mala* 'very, very much' from Arabic *mithl, matheel, amthaal* (pl.) 'times, double; like' via reordering and turning /th/ into /t/; or *lamma(t)* 'a gathering; much' via reordering. See **multiply**.

Multiply (*multiple, multiplication*) is a compound from (i) *multi-* above and (ii) *ply* below. See **plus**.

Myriad via Middle French *myriade* 'countless, ten thousand' from Latin *myrias* (gen. *myriadis*) 'ten thousand' from Greek *myrias* (gen. *myriados*) 'ten thousand, countless', *myrios, myrioi* (pl.) 'countless; ten thousand' from Arabic *miat, mi'aat* (pl.) 'hundred' via lexical shift and passing /t/ into /d/ besides /r/-insertion.

Net (*Internet*) See **internet**.

Nine via German *neun*, French *neuf*, Latin *novem*, Greek *ennea* from Arabic *thamaan(iat)* 'eight', *thaamin* 'eighth', *thumn* 'an eighth', *muthamman* 'eight-sided' via the merger of /th & m/ into /n/ and lexical shift: i.e., Arabic 8 is English 9 and vice versa (cf. Arabic *naief* 'extra; an amount between 1-3'; *nafar* 'below ten'.) Schematically, *thamania* → *famani* → *mani* → *nani* (nine).

As to the Latin and Greek forms, the former shows reordering and replacing /th/ by /v/ as opposed to merging /th, m, & n/ into /n/ in the latter.

Number via Old French *nombre* and Latin *numerus* 'a number, quantity' from Arabic *nimra(t)* 'mark, number' via /b/-insertion; or *na3aama(t)* 'group' via /3/-loss and /b/-insertion.

Numeral via Middle French numeral from Latin *numeralis* 'of or belonging to a number', *numerus* from Arabic *nimra(t), nimar* (pl.) 'mark, number'. See **number**.

Oblong (*oblongata, elongate, prolong, long, length*) from Latin *oblongus* 'more long than broad' from (i) *ob* 'to, toward' from Arabic *bi* 'in, with' via lexical shift (Jassem 2014c) and (ii) *longus* 'long' (*lang* in Old English and German) from Arabic *qanoo/qanwaa* 'tall' via reversal and /l/-split from /n/; or *nooq* 'long, tall; female camels' via /l/-split from /n/. See **long**.

Odd (*odd and even numbers; oddness; odds, oddity*) from Arabic (i) *wa2id* or *a2ad* 'one' via /w & 2/-merger into /o/ or (ii) Arabic *3adoo* 'enemy', *3adaawat* (n) 'animosity, oddity' via /3/-loss. Notice how close the sequence odd, even to Arabic *wa2id* (*a2ad*) 'one', *ithnan* 'two' are. See **even**.

One (once, ounce, a, an, inch, *uni-*, unique, unit, unity, unite, Unitarian, unify, unification, union, unison, only, lonely, alone) via German *eins/eine*, French *un*, and Latin *unus* from Arabic 'ul, 'awwal 'one, first', substituting /l/ for /n/ (Jassem 2012a). Diagrammatically, 'ul → un or 'awwal → wal → wan (one).

Sanskrit *eka* and Russian *adin* derive from Arabic *waa2id* or *a2ad* (in) 'one' in the first of which /2/ became /k/ and /d/ was deleted whereas /2/ was deleted in the latter. See **odd**.

Ordinal (order) via Old French *ordinal* from Latin *ordinalis* 'showing order' from *ordo* (gen. *ordinis*) 'row, series' from Arabic *ratl, artaal* (pl.) 'row, line, order' in which /t & l/ became /d & r (n)/; *radd*(at) 'a fold, a tie; a return, repetition' via reordering; or *3arD* 'row; width' via /3/-loss and turning /D/ into /d/. See **cardinal**.

Over (*overseas, overeat*) via Old English *ofer* 'beyond, above, in, upon, across, past, on high', German *über* from Arabic *waraa* 'beyond' where /w/ became /v/; *3ala* 'on' via reordering and replacing /3 & l/ by /v & r/; or *3abr(a)* 'across' via /3 & b/-merger into /v/ (Jassem 2014c).

Pair (*parity, impair, imparity*) from Arabic *arba3* 'four', *rub3* 'a fourth', *rab3* 'a group' via lexical shift, reversal, and /3/-deletion; or *ribba*(t) 'a group' via reordering and lexical shift. See **four**.

Parameter from Latin *parameter* from Greek *para* 'beside, subsidiary' from Arabic *barra* 'outside' or *wara* 'behind' via lexical shift and turning /w/ into /p/ (Jassem 2014c). See **meter**.

Particle (part, particular) via French *part* 'share' from Latin (i) *partem*, *pars* (nom.) 'a share, piece, fraction, division' from Arabic *batr* 'cut' via reordering and (ii) Latin *-cle* 'small' from Arabic *qaleel* 'small' where /q/ became /k/.

Partition (*part, particle, particular*) via French *part* 'share' from Latin *partem*, *pars* (nom.) 'a share, piece, fraction, division' from Arabic *batr, batar* (v) 'to cut' via reordering.

Pentagon is a compound of Greek (i) *penta* 'five' from Arabic *banaan*(at) 'finger(s)' via lexical shift and (ii) *agon* above. See **five & diagonal**.

Percent (*percentage, percentile*) is a compound of (i) Latin *per* from Arabic *bi-* 'in, with, by' via /r/-insertion (Jassem 2014c) and (ii) *cent* above. See **cent & hundred**.

Pint (*pound*) via Old English *pund* from Latin *pondo* 'pound, weight' from Arabic *bint* 'pebble, stone; girl' via lexical shift and turning /t/ into /d/ (Jassem 2013f); or *tabin* 'a large cup' via lexical shift, reordering, and replacing /t/ by /d/ (cf. **pant** from Arabic *tubbana*(t) 'pant; short trousers' via reordering).

Plus (*plural, plurality, poly*) via Latin *plus* 'more, in greater number, oftener' from *pleos* 'to fill' from Arabic *malee* 'full', *mala* (n) 'most people' where /m/ became /p/; Arabic *'ubal* (*awaabil, 'ubbal, abbaal, abaabeel*) (pl.) 'many, much', *'ubool* (n), *'abila* (v) 'to become many'; *abarra* 'to become more' where /r/ became /l/; or *rabal* 'to become more' via reordering. See **poly**.

Poly via Latin *plus* from Greek *poly*(s), *polloi* (pl.) 'much'. See **plus**.

Pound (pint) via Old English *pund* from Latin *pondo* 'pound, weight' from Arabic *bint* 'pebble, stone; girl' via lexical shift and turning /t/ into /d/ (Jassem 2013f); or *tabin* 'a large cup' via lexical shift and reordering. See **pint**.

Prism via Latin and Greek *prisma* 'something sawed', *prizein* 'to saw' from Arabic *ba*(sh/z)*ar, mab*(sh/z)*oor* (adj.) 'scrape, abrade, cut' or *zabar, mazboor* (adj.) 'cut' via reordering and turning /sh (z)/ into /s/.

Probability (*probably, probable, improbable*) via French from Latin *probabilitas* 'probability, credibility', *probare* (v) 'try, test' from Arabic *rubba (rababa)* 'perhaps, probably, likely' via reordering and /l/-insertion.

Quantity (*quantum, quantify, quantification*) via French from Latin *quantitatem, quantitas* (nom.) 'relative greatness or extent', *quantus* 'how much, of what size, what amount?', related to *qui* 'who', from Arabic *kamm(iat)* 'amount; how much' via /n/-split from /m/; *qad, qand* 'quantity, size' where /d/ became /t/ (see Jassem 2014b).

Quarter (*quart, quartet, quadrant, quadri-, quarantine, square, carat, headquarters*) via French *quatre*, Latin *quattuor*, and Greek *tessares or tettares* 'originally, fourth of something or something cut' from Arabic *qeeraT, qarareeT* (pl.) 'a quarter, a measurement unit', *qaraT* (v) 'cut', *qarTat* (n) 'a cutting' via reordering (and turning /q/ into /t/ in Greek). See **four & square**.

Quota (*quotient, quote, quotation*) via Latin *quota/quotus* 'which, what number (in sequence, order)' from *quot* 'how many' from Arabic *kai (kaifa)* 'how; cutting' (Jassem 2014b); or *qiTT* 'share, allotment, portion'.

Radical (*radicalism, root, radish*) via Latin *radix* (gen. *radicis*) 'root' from Arabic *jadhr, judhoor* (pl.) 'root' via reversal and /j & dh/-merger into /d/. See **radius**.

Radius (*radial, radium*) via Latin *radius* 'rod, staff; beam or ray of light; radius of a circle' from Arabic *quTr* 'radius of a circle; country' or *qarTa(t)* 'rod, staff' via reversal and merging /q & T/ into /d/. See **radical**.

Ratio (*ration, rational*) via Latin *ratio* 'reckoning, numbering, reason, reasoning, understanding' from *rat*, past participle of *rere* 'reckon, calculate, think' from Arabic *ra'a, ru'iat* (n) 'see, think'; or *qadr* 'amount' via reordering and merging /q & d/ into /t/.

Reckon via German *rechnen* 'count, number' from Arabic *raqam* 'number'; /q & m/ turned into /k & n/.

Regular (*regulate, regulation, regal*) via Old French *reguler* from Latin *regularis* 'containing rules', *regula* 'rule' from Arabic *rijl* 'lit., foot, leg; measurement by the leg'; /q/ turned into /g/ besides lexical shift.

ROM (*Read Only Memory*) is an acronym or abbreviation of (i) read from Arabic *ratta* 'speak quickly' where /t/ became /d/, (ii) only as in **one** above, and (iii) memory (memorize, memorial, memoranda, commemorate, remember) via Latin *memoria* 'mind, intelligence, skill', *memorare* (v) 'remember' from Arabic *mirra(t), miraar* (pl.) 'strong mind/opinion, strength', *mareer* (also *marmarees, mamroor*) (adj.) 'very wise, mad' via /m/-duplication; or *mahaara(t), maahir* (adj) 'cleverness, skill' via /h/-mutation into /m/ (Jassem 2013i).

Round from Arabic *dawaraan* 'round' via reordering (Jassem 2014c).

Scale (*scalar, escalate, escalation, escalator*) 'bowl, cup, pan of a balance' via Old English *scealu* and German *Schale* 'cup, dish' from Arabic *kail(at)* 'a weighing cup' via /k/-split into /sk/; *Sa2n* 'a bowl, plate' in which /S, 2, & n/ turned into /s, k, & l/; *thiqal* 'weight; heaviness' where /th & q/ became /s & k/; or *shaqal* 'lift, climb, carry; weigh', *shaqool* 'a measurement unit' via /sh & q/-mutation into /s & k/ (Jassem 2013k).

Score (*scores*) via Old English *scoru* 'twenty' from Old Norse *skor* 'mark, rift, cut' from Arabic *sharkh* 'rift, cut' via reordering and turning /sh & kh/ into /s & k/; or Arabic *3ashr(at)* 'ten', *3ishreen* (pl.) 'twenty' where /3 & sh/ changed to /s & k/.

Second via Latin *secundus* 'following, favourable, assist, give support, 60th part of a minute' from *sequens, sequi* (v) 'follow' from Arabic *saaq* 'follow, drive; leg'. See **sequence**.

Section (*dissection, sect, sectarian*) via Latin *secare* 'to cut' from Arabic *shaqq(at), tashaqqaq* (v) 'dissect, split'; /sh & q/ became /s & k/.

Segment (*segmentation*) from Arabic *qasam(at), (inqasam(at))* 'segment'; reordering and turning /q/ into /g/ were effected.

The Arabic Origins of "Mathematical and Computational Terms" in English and European Languages: A Lexical Root Theory Approach

Semi via Old English *sam-* 'half', Latin *semi* 'half part', Greek *hemi* 'middle', Sanskrit *sami* 'half' from Arabic *masa* 'middle' via reordering; or *niSf* 'half' via reordering, passing /n/ into /m/, and merging /S & f/ into /s/. See **meso**.

Sequence (sequel, consequence, subsequence) via Latin *sequens, sequi* (v) 'follow' from Arabic *saaqa* 'follow, drive, leg'.

Set from Arabic *safaT* 'a set, an arrangement' where /f & T/ merged into /t/; or *Sateet* 'group' where /S/ became /s/ besides syllable loss.

Seven via German *sieben*, Latin *septem*, Greek *hepta*, Sanskrit *sapta*, from Arabic *sab3(at)* 'seven', *sab3een* 'seventy' via /3/-loss and turning /b/ into /v (p)/. In Greek, /s/ became /h/.

Short via Old English *sceort, scort* 'short', German *scurz (kurz)* 'short', Latin *curtus* 'short' from Arabic *qaSeer(at)* 'short'; /q & S/ merged into /sh/.

Sign (signal, insignia; signature; design; designate, designation; consign; resign) via Latin *signum* 'signal, mark, token, symbol', *signare* (v) 'mark out, mark with a stamp, adorn' from Arabic *naqsh* 'sign, decoration'; reversal and turning /q & sh/ into /g & s/ applied (see Jassem 2013c). See **design**.

Six (*sextuplet*) via German *sechs*, French *sies*, Italian *sestet*, Latin *six*, and Greek *hex* from Arabic *sitt(at)* 'six', *suds* 'six; a sixth', *saadis* 'sixth'; /d (t)/ passed into /k/ while /s/ turned into /h/ in Greek.

Size from Arabic *qias, qaas* (v) 'size, measure'; /q/ changed into /s/.

Software (*soft fabrics*) via Old English (i) *softe* 'gentle, mild-natured; easeful, calm, luxurious, level, smooth', German *sanft* from Arabic *Saafi(at)* 'pure, good-natured'; *Soof(at), Soofi* (adj.) 'wool; gentle' via lexical shift; or *baseeT* 'simple, good-natured, level, open' via reordering and turning /b/ into /f/; and (ii) Old English *waru*. See **hardware**.

Square via Old French *esquire* from Latin *exquadrare* of (i) *ex-* 'out' from Arabic *aqSa* 'far' where /q & S/ became /k & s/ (Jassem 2012f, 2014c) and (ii) *quadrare* 'to make square', *quadrus* 'a square' from Arabic *qeeraaT* 'quarter', *qaraT* (v) 'cut'. See **quarter**.

Statistics from German *Statistik* from Latin *statisticum* 'state affairs', *status* 'state, position, order, condition, posture', *stare* (v) 'to stand' from Arabic *jatha* 'sit' via lexical shift; *saTa2/sada2* 'lie down flat' via lexical shift, turning /T (d)/ into /t/, and /2/-loss; *sadaad* 'straightness; paying back' where /d/ became /t/; *izdiaad(at), izdaad (zaada)* (v) 'increase' where /z & d/ changed into /s & t/; or *3adad* 'number, count', *a3daad (pl.)*, *ti3daad(at)* (n) 'number; count' in which /3 & d/ became /s & t/.

Subtract (*subtraction*) via Latin *subtrahere* 'take away, draw off, draw from below' from (i) *sub* 'from under' from Arabic *Sawb* 'under; towards' (Jassem 2014c) and (ii) *trahere* (v) 'pull, draw' from Arabic *Tara2(at)* 'throw, subtract' where /T & 2/ became /t & h (k)/.

Sum (*summary, summarize*) via Latin *summa* 'top, summit; essence, gist; amount' from Arabic *qimma(t)* 'top' or *jam3* 'sum, addition'; /q (j) & 3/ passed into /s & Ø/.

Tall from Arabic *Taal, Taweel* (adj.) 'long, tall'; /T/ became /t/.

Team from Arabic *fi'aam* 'group' where /th/ became /t/; or *dahmaa'* 'a lot of people' in which /d & h/ changed into /t & Ø/.

Technical (*technology, tech, techno, technician*) via Greek *tekhne* 'art, skill, craft in work; a method or system of doing or making' from Arabic *itqaan, atqan* (v) 'doing something skillfully; mastery' in which /q/ became /k/; or Arabic *Takh(Takh)* 'lit., to hit or strike hard objects like metal, wood, and stone; to fire (bullets)' where /T & kh/ became /t & k/.

Ten (*-teen, deci, deca-, digit, digital, dexterity, index*) via German *zehn*, Latin *decem* 'hand; ten' from Greek *deka* 'hand; ten' from Arabic *daja(t)* 'fingers, hand' in which /j/ became /k/ in Greek and /s/ in Latin but merged with /d/ into /t/ in English (cf. Jassem 2012a).

Thirteen-Nineteen are combinations three to nine and ten (-teen) below and above.

Thousand via Old English *thusend* 'ten hundred; several hundreds; great multitude', German *tausend* as a compound of (i) *thou* 'literally, hand; ten' from Arabic *daja(t)* 'fingers, hand' via /d & j/-merger into /th/ or *yad* 'hand' via reversal and turning /d/ into /th/ and (ii) *sand* from cent where /t/ became /d/ from Arabic *hind* (*hindeed, hunaidat*) 'a hundred' in which /h/ became /s/. Indivisibly, it comes from Arabic *sawaad, soodaan* (pl.) 'lit., blackness; multitude, majority' via reordering and /s/-split into /s & th/. In short, Arabic *hind* (*eed*) split into two words, yielding hundred (and cent) and thousand. See **hundred & cent**.

Three (*three, third, tertiary, trio, tri-*) via German *trei*, French *trios*, Latin *tres*, Greek *treis* from Arabic *thalath(at)* 'three', *thulth* 'a third', *thaalith* 'third'; /l/ was replaced with /r/ in all while /th/ was either lost or became /d, t, or s/.

Times from Arabic *kamm* 'quantity, amount' where /k/ became /t/; *qeema(t)* 'value', replacing /q/ by /t/; or *thaani* (*ithanin*) 'two' via lexical shift and changing /th & n/ into /t & m/ (Jassem 2013k).

Ton (*tun*) via Old English *tunne* 'tun, cask, barrel', German *tonne*, Latin *tunna* from Arabic *dan, dinaan* (pl.) 'large cask, barrel' where /d/ became /t/; *qin, qinaan* (pl.) 'a cask, bottle' where /q/ changed into /t/; or *Tun* 'bundle, heap'.

Trillion is made up of the second syllable of million plus the prefix tri- 'three' above.

Twelve consists of (i) two below plus (ii) *-elve* as in eleven above. See **two & eleven**.

Twenty-Ninety (*twentieth*) are made up by the addition of the suffix *-ty* to the relevant cardinal, which developed from a further shortening of *-tig* from German *-zig* 'ten' from Greek *deka* 'hand, ten' from Arabic *dija(t)* 'fingers, hand' in which /d/ passed into /t/ while /j/ into /g (y)/. (See **ten**). Twenty, however, seems to diverge a little by inserting /n/, which is actually retrieved from twin (*zwēne* in Old High German). See **twin & two**.

As to the suffix *-th* (-d) as in fourth, third, it evolved from the Arabic feminine singular suffix *-at* in which /t/ became /th (d)/. Morphologically, the Arabic numerals 1-10 have masculine and feminine forms as in *thalath* 'three (m)' versus *thalathat* 'three (f)'. Thus, /th/ in *seventh* is *-at/* in *sab3at* 'seven (f), for instance; in Greek, Latin, and Sanskrit, *-at/* is retained intact in **seven** above.

Twin (twenty) via Old English *twinn* 'twofold, twin, double' from Arabic *taw'am* 'twin' where /m/ became /n/; *thintain* 'two', *thaani, thawaani* (pl.) 'second', replacing /th/ by /t/ and backing or shifting /i/ to /w/. See **two**.

Two (*two, dual, duality, duet, duo, double, duplicate, twin*) via Old High German *zwēne*, Modern German *zwei*, Latin *duo*, Greek *dyo* from Arabic *ithna* (*ithna(t)an*), *thaani* (adj.) 'two, second' in which /th & n/ merged into /t/. In addition, two, like Old High German *zwēne*, may be a further phonetic reduction of twin via /n/-deletion, which reappears in *twenty* 'two/twin tens'.

WWW (*worldwide web*) is an acronym for (i) world via German *Welt* 'world' from Arabic *balad, bilaad* (pl.) 'country, world' via /b/-mutation into /w/ and /r/-insertion (Jassem 2013f), (ii) wide below, and (iii) web from Old English *webb* 'woven fabric, tapestry' and German *Gewebe* (*earlier weppi*) 'web' from Arabic *3ub3ub* 'a soft woven wool texture' via syllable merger and turning /3/ into /w/.

Weight (*weigh*) via Old English *gewiht* 'weight, weight, heaviness' and German *Gewicht* from Arabic 'ooq, 'ooqiat (variably pronounced *waqiat, wagia(t), waghia(t), wakia(t), w'ia(t), wijia(t), widzia(t)* in spoken Arabic (Jassem 1987, 1993)) 'a scale; a weight; a weight for gold' where /q/ became /g/; or *wasaq* 'a weight; a camel's load' where /s & q/ merged into /g/.

Wide (width, widen) via Old English *wid* 'broad, long', German *weit* from Arabic *faDee* 'wide' in which /f & D/ turned into /w & d/; or *ba3eed* 'far' via lexical shift and turning /b & 3/ into /w & Ø/.

Yard via Old English *gerd* 'rod, stick, length measurement' from Arabic *qarTa(at)* 'a rod; a cutting (of wood)' in which /q & T/ became /g & d/; *yad* 'hand' via /r/-insertion; or *dhiraa3* 'arm' via reversal and turning /dh & 3/ into /d & y (g)/.

Zero (*cipher, decipher, decipherment*) via Old French *cifre*, Modern French *chiffre*, Latin *cifra/zephirum*, Italian *cifra* 'nought, zero' from Arabic *Sifr* 'zero, empty', *Saffar* (v) in which /S

& f/ merged into /z/. Zero and one are the basis of computer language without which there would be no computers, internet, or digital revolution. See **cipher**.

Zillion is a new coinage with an indefinite numerical meaning, consisting of /z/, the last Roman alphabet, from Arabic zai 'letter /z/' and the second syllable of million above.

Zodiac (*zoo; cycle*) via Latin *zodiacus* from Greek *zodiakos* (*kyklos*) 'lit., circle of little animals' of (i) *zodiaion*, dim. of *zoion* 'animal' from Arabic *Zaiwan* 'animal' where /2/ became /z/ (Jassem 2013g) and (ii) *kyklos* from Arabic *lakka(t)* 'a circular object; something tied circularly' via reordering. See **cycle**.

To sum, the total number of mathematical and computational terms amounted to 190, all of which have true Arabic cognates: i.e., 100%.

4. DISCUSSION

The above results clearly demonstrate that *mathematical* and *computational* terms in Arabic, English, German, French, Latin, Greek, and Sanskrit are true cognates because of their similar or identical forms and meanings. Their differences, however, are due to natural and plausible causes and different courses of phonetic, morphological and semantic change. The ratio of shared vocabulary between Arabic and English, for example, in this study amounted to 100%, which exceeds Cowley's (1997: 172-173) 100 word list-based classification according to which an 80% ratio indicates membership to the same language- i.e., dialects.

Thus the results are in harmony with all the findings of previous studies (Jassem 2012a-f, 2013a-q, 2014a-f) in which English, German, French, Latin, Greek, Sanskrit and Arabic were all found to be rather dialects of the same language, let alone the same family. Moreover, they lend further support to the lexical root theory which has been found as adequate for the present analysis as it was for the previous ones. The main principle which states that Arabic, English, German, French, and the so-called Indo-European languages on are not only genetically related but also are dialects of the same language is, therefore, theoretically and verifiably sound and empirically true. Retracing English *mathematical* and *computational* terms to true Arabic cognates clearly attests to that on all planes of analysis: phonetic, morphological, grammatical, and semantic.

Of all the levels, the semantic one needs some further clarification in which the following patterns emerged. First, lexical stability was the general pattern where most words here maintained their basic meanings across the languages. Secondly, the recurrence of lexical convergence in the data was due to formal and semantic similarity between Arabic words, on the one hand, and their English cognates, on the other. For example, *mark*, *cardinal*, *gram*, and many more might each derive from several Arabic words, all formally and semantically similar. Although only one cognate might be the ultimate source in the end, there is no need for the time being to specify which one it is. The reader may decide which one to take or let. Likewise, semantic multiplicity was abundant, where some English words had more than one meaning, which might have more than one likely Arabic cognate; for instance, *amount*, *quantity*, *figure*, *mile* (*mille*), *plus* (*plural*), *odd*, *even* may have different meanings each, each of which derives from formally and semantically similar Arabic words (see above). Fourthly, lexical shift was also common as in *calculator*, *abacus*, *eight*, *nine*, *pentagon*, and so on (see 3. above). Lexical divergence also took place in words like *latitude* which might derive from Arabic *Tool* 'length' via reversal. Finally, lexical variability was noted in those words which had different forms in Latin and French *quatre* (*quarter*) vis-à-vis English and German *four/vier* (*pair*) which derived from two Arabic cognates: i.e., *qeeraaT* 'quarter' and *rub3* 'four(th)' (see above). This happened within the same language such as the different words for *hundred* in Arabic and *thousand* in Latin. Lexical split affected *mile* (*million*, *myriad*) which came from Arabic *m'iat*, *mi'aat* (pl.), and *mi'een* (pl.) 'hundred' and *cent* (*hundred*, *kant*) which derived from Arabic *hind* (*hindeed*, *hunaidat*) 'hundred' (see above); Arabic *markoo* 'small; large' split into *micro* and *macro* via reordering.

What are the implications and significance of such findings? Jassem (2014a-b, 2014e) has already elaborated on that at some length which can be summed here briefly. First, they signify that Arabic, English, German, French, and so on are dialects of the same language for their words have similar or identical forms and meanings (cognates), with Arabic being the source or parent

language because of its phonetic capacity and complexity and lexical multiplicity and variety. Furthermore, they indicate that all such languages belong to the same culture, which spread over the same geographical area which initially centered somewhere in the middle between all of them which later spread concentrically outwards. They, therefore, imply that the so-called proto-Indo-European language (and so-called homeland) hypothesis is definitely fictitious work which should, subsequently, be rejected outright because all English, German, and French words, for instance, are traceable to Arabic sources. Finally, they show, as a result, that there is no need to reconstruct an old world language; rather that proto-language has survived into today's languages here, the closest descendant of which is Arabic for the above reasons. For example, while Latin and French has *quatre* (*quarter*) against *four/vier* (*pair*) in English and German, Arabic has both which can only be explained that the last is the source language. So one can say that early (prehistoric) man, or Adam and Eve for the matter, spoke a language which is not too far removed or different from English, German, Latin, Greek, Sanskrit, or Arabic, the last of which is the nearest, closest, and likeliest spatially, temporally, and, above all, structurally. The differences amongst such languages are the consequence of the operation of the forces of language change phonetically, morphologically, grammatically, and semantically as well as orthographically.

5. CONCLUSION AND RECOMMENDATIONS

The main results of the study were as follows:

- 1) The 190 *mathematical* and *computational terms* in English, German, French, Latin, Greek, Sanskrit and Arabic are true cognates with the same or similar forms and meanings, whose differences are due to natural and plausible causes and different courses of phonetic, morphological, and lexical change.
- 2) The lexical root theory has been adequate for the analysis of the close genetic relationships between *mathematical* and *computational terms* in Arabic, English, German, French, Latin, Greek, and Sanskrit according to which they are all dialects of the same language.
- 3) Phonetically, the main changes included substitution, reversal, reordering, split, and merger; lexically, the recurrent patterns were stability, convergence, multiplicity, shift, split, and variability; the abundance of convergence and multiplicity emanate from the formal and semantic similarities between Arabic words from which English and European words stemmed in the first place.
- 4) The phonetic capacity and complexity, huge lexical variety and multiplicity of Arabic *mathematical* and *computational terms* compared to those in English and Indo-European languages point to their Arabic origin in essence.
- 5) Finally, the current work supports Jassem's (2012a-f, 2013a-q, 2014a-f) calls for further research into all language levels, especially lexis or vocabulary. Also the application of such findings to language teaching, lexicology and lexicography, translation (Jassem 2014d), cultural (including anthropological and historical) awareness, understanding, and heritage is badly needed to promote and expedite constructive cooperation and acculturation.

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