

SOLUTIONS MANUAL

Engineering Materials I

An Introduction to Properties, Applications and Design, 3rd edn

Solutions to Examples

- 2.1. (a) For commodity A $P(t) = C_A \exp \frac{r_A}{100} t$,
and for commodity B $Q(t) = C_B \exp \frac{r_B}{100} t$,

where C_A and C_B are the current rates of consumption ($t = t_0$) and $P(t)$ and $Q(t)$ are the values at $t = t$. Equating and solving for t gives

$$t = \frac{100}{r_B - r_A} \ln \left(\frac{C_A}{C_B} \right).$$

- (b) The doubling time, t_D , is calculated by setting $C(t = t) = 2C_0$, giving

$$t_D = \frac{100}{r} \ln 2 \approx \frac{70}{r}.$$

Substitution of the values given for r in the table into this equation gives the doubling times as 35, 23 and 18 years respectively.

- (c) Using the equation of Answer (a) we find that aluminium overtakes steel in 201 years; polymers overtake steel in 55 years.

- 2.2. Principal conservation measures (see Section 2.7):

Substitution

Examples: aluminium for copper as a conductor; reinforced concrete for wood, stone or cast-iron in construction; plastics for glass or metals as containers. For many applications, substitutes are easily found at small penalty of cost. But in certain specific uses, most elements are not easily replaced. Examples: tungsten in cutting tools and lighting (a fluorescent tube contains more tungsten, as a starter filament, than an incandescent bulb!); lead in lead-acid batteries; platinum as a catalyst in chemical processing etc. A long development time (up to 25 years) may be needed to find a replacement.

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