APPENDIX E

FLOATING AND SINKING
LEVELS OF CONCEPTUALIZATION and RELATED KNOWLEDGE

LEVELS OF CONCEPTUALIZATION: COORDINATION OF ROLES OF OBJECT AND IMMERSION LIQUID

[0] Representation of the phenomenon that does not incorporate the properties of both object and liquid

[1] Representation of the phenomenon that incorporates the properties of both object and liquid

[2] Representation of the Phenomenon in terms of density of the object but not incorporating density of the immersion liquid.

[3] Representation of the Phenomenon in terms of density of the object and density of the immersion liquid.

[4] Representation of the Phenomenon in terms of an unspecified or incorrect relationship between the density of the object and the density of the immersion liquid.

[5] Representation of the phenomenon in terms of a correct mathematical relationship between densities [i.e. An object will float if its density is less than the density of the fluid in which it is immersed]

APPENDIX E

RELATED KNOWLEDGE

`K2' - Knowledge Related to Floating and Sinking (FLO)

#1-Measurement of Weight:

[0] DOES NOT FORMALLY MEASURE WEIGHT

[1] USES MEASUREMENT INSTRUMENT

[2] USES MEASUREMENT INSTRUMENT CORRECTLY AND EXPRESSES THE UNITS OF MEASUREMENT CORRECTLY

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#2- Volume -- Nominal Knowledge

[0] DOES NOT SPONTANEOUSLY USE THE TERM `VOLUME'

[1] SPONTANEOUSLY USES THE WORD `VOLUME'

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#3- Measurement of Volume - Solid

[0] DOES NOT FORMALLY MEASURE VOLUME OF SOLIDS

[1] USES AN INSTRUMENT TO MEASURE VOLUME OF SOLIDS

[2] USES A CORRECT FORMULA TO MEASURE VOLUME OF SOLIDS

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#4- Measurement of Volume - Liquid

[0] DOES NOT FORMALLY MEASURE VOLUME OF LIQUIDS

[1] USES AN INSTRUMENT TO MEASURE VOLUME OF LIQUIDS

[2] USES A CORRECT FORMULA TO MEASURE VOLUME OF LIQUIDS

APPENDIX E

`K2' - Knowledge Related to Floating and Sinking

#5-Knowledge of Ratio - Nominal

[0] DOES NOT SPONTANEOUSLY USE THE TERM `RATIO'

[1]   SPONTANEOUSLY USES THE TERM `RATIO'

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#6-Knowledge of Ratio - Functional

[0] DOES NOT FORMULATE RATIOS

[1] FORMULATES RATIOS

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`K2' - Knowledge Related to Floating and Sinking

#7-Knowledge of Proportions - Nominal

[0] DOES NOT SPONTANEOUSLY MENTION `PROPORTIONS'

[1] SPONTANEOUSLY USES THE TERM `PROPORTION/S'

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#8-Knowledge of Proportions - Functional

[0] DOES NOT FORMULATE PROPORTIONS

[1] FORMULATES PROPORTIONS

APPENDIX E

D2 - Floating and Sinking (FLO) continued

#9. Density of the Object

[0] NO CONCEPT OF DENSITY APPLIED TO TASK OBJECTS

[1] INTUITIVE NOTION OF DENSITY (This is typically expressed by subjects as `weight' but is actually s an undifferentiated amalgam of mass and volume)

[2] MASS AND VOLUME DIFFERENTIATED BUT INADEQUATELYU CONCEPTUALIZED (mass is typically expressed as `weight' and volume as `size' or `surface area')

[3] MASS AND VOLUME DIFFERENTIATED AND ADEQUATELY CONCEPTUALIZED

[4] MASS AND VOLUME INTEGRATED AS ATTRIBUTES OF OBJECTS BUT NOT EXPRESSED MATHEMATICALLY

[5] RELATIONSHIP OF MASS AND VOLUME EXPRESSED MATHEMATICALLY BUT NOT AS A RATIO

[6] RELATIONSHIP OF MASS AND VOLUME CONCEPTUALIZED AS A RATIO

[7] DENSITIES OF OBJECTS CALCULATED AS RATIOS OF MASS AND VOLUME

APPENDIX E

D2 - Floating and Sinking (FLO) continued

#10 Density of the Liquid

[0] NO CONCEPT OF DENSITY APPLIED TO TASK LIQUIDS

[1] INTUITIVE NOTION OF DENSITY (This is typically expressed by subjects at this level as `weight' but is actually is an undifferentiated amalgam of mass and volume)

[2] MASS AND VOLUME DIFFERENTIATED (mass is typically expressed by subjects at this level as `weight' and volume as `size')

[3] MASS AND VOLUME INTEGRATED AS ATTRIBUTES OF LIQUIDS BUT NOT EXPRESSED MATHEMATICALLY

[4] RELATIONSHIP OF MASS AND VOLUME EXPRESSED MATHEMATICALLY BUT NOT AS A RATIO

[5] RELATIONSHIP OF MASS AND VOLUME CONCEPTUALIZED AS A RATIO

[6] DENSITIES OF LIQUIDS CALCULATED AS RATIOS OF MASS AND VOLUME

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`K2' - Knowledge Related to Floating and Sinking

#11-Knowledge of Density - Nominal

[0] DOES NOT SPONTANEOUSLY USE THE WORD DENSITY

[1] SPONTANEOUSLY USES THE WORD DENSITY