GCE A LEVEL

MARK SCHEME

MAXIMUM MARK: 30

SYLLABUS/COMPONENT: 9702/05

PHYSICS
Paper 5 (Planning, Analysis and Evaluation)

Question 1

Planning (15 marks)
Defining the problem (3 marks)
p is the independent variable OR vary p **1**

f is the dependent variable OR measure f and p **1**

Variable to be controlled **1**
    e.g. temperature, frequency of sound source

Methods of data collection (5 marks)

Workable arrangement **2**
    Should include container, source of sound, pump, microphone, CRO
    Doubtful arrangement, poor diagram or one missing detail scores one mark

Method of varying p **1**
    e.g. use of pump to remove air or valve to allow air in

Method of measuring p **1**
    e.g. Bourdon gauge/pressure gauge/manometer

Method of measuring f **1**
    Should include reference to CRO timebase and $f = 1/period$

Method of analysis (2 marks)

Plot f against p^2 **1**

Equation is correct if graph is a straight line through the origin **1**

Safety considerations (1 mark)

Safety precaution, e.g. screen/goggles/fuses **1**

Additional detail (4 marks)

Additional details **4**
    Relevant points might include:
    Second variable to be controlled
    Method of controlling variables
    Specified sound source (e.g. electric bell/buzzer/speaker)
    Use of signal generator with speaker
    Difficulty of detecting quiet sounds at low pressures
    Using CRO y-sensitivity to adjust for sound levels
    Need to seal points where wires pass through bell jar
    Monitor temperature with thermometer

Question 2

Analysis, conclusions and evaluation (15 marks)
Approach to data analysis (1 mark)

(a) $R^2 = c^2E^3$, so expect a straight line <u>through the origin</u>   **1**

Table of results (2 marks)

Table   Column headings   **1**
           R^2 / cm^2 and E^3 / MeV^3
           Allow R^2 (cm^2) and E^3 (MeV^3)

Table   Values of R^2 and E^3 **1**
           16.0   156
           18.9   183
           23.0   221
           25.5   248
           32.5   310
           All correct for one mark.
           3 significant figures required (allow 4 s.f.)

Graph (3 marks)

Graph   Points plotted correctly   **1**
              All five required for the mark

Graph   Line of best fit   **1**
              Must be within tolerances.

Graph   Worst acceptable straight line   **1**
              Must be within tolerances.

Conclusion (4 marks)

(c)(iii)   Gradient of best-fit line   **1**
              The hypotenuse of the Δ must be greater than half the length of the drawn line.
              Read-offs must be accurate to half a small square.
              Check for $\Delta y/\Delta x$ (i.e. do not allow $\Delta x/\Delta y$).

(d)   Gradient = c^2 (= 0.107)   **1**
              Does not have to be explicitly stated: may be implicit from working

(d)   Value of c **1**
              = 0.327 (allow 0.320–0.350)

(d)   Unit of c **1**
              cm MeV$^{-3/2}$

Treatment of errors (5 marks)

Table   Errors in R^2 **1**
                0.4
                0.4   allow 0.5
                0.5   allow 0.4
                0.5
                0.6

Graph   Error bars plotted correctly   **1**

(c)(iii)   Error in gradient   **1**
           Must be calculated using gradient of worst acceptable straight line

(d)   Method of finding error in c **1**
           i.e. limit of error range in c from square root of limit of error range in gradient
           Allow 0.5 x percentage error in gradient

(d)   Value for error in c **1**
           0.009 (allow ± 0.007–± 0.011)