

[3220/435]

1993

SCOTTISH CERTIFICATE OF EDUCATION

PHYSICS (REVISED)

Higher Grade—PAPER II

Wednesday, 19th May—1.30 p.m. to 4.00 p.m.

READ CAREFULLY

1. All questions should be attempted.
2. Enter the question number clearly in the margin beside each question.
3. Any necessary data will be found in the Data Sheet on page two.
4. Care should be taken not to give an unreasonable number of significant figures in the final answers to calculations.
5. Square-ruled paper (if used) should be placed inside the front cover of the answer book for return to the Examination Board.

DATA SHEET

COMMON PHYSICAL QUANTITIES

| Quantity | Symbol | Value | Quantity | Symbol | Value |
|----------------------------|--------|------------------------------------|------------------|--------|------------------------------------|
| Speed of light in vacuum | c | $3.0 \times 10^8 \text{ m s}^{-1}$ | Mass of electron | m_e | $9.11 \times 10^{-31} \text{ kg}$ |
| Charge on electron | e | $-1.60 \times 10^{-19} \text{ C}$ | Mass of neutron | m_n | $1.675 \times 10^{-27} \text{ kg}$ |
| Gravitational acceleration | g | 9.8 m s^{-2} | Mass of proton | m_p | $1.673 \times 10^{-27} \text{ kg}$ |
| Planck's constant | h | $6.63 \times 10^{-34} \text{ J s}$ | | | |

REFRACTIVE INDICES

The refractive indices refer to sodium light of wavelength 589 nm and to substances at a temperature of 273 K.

| Substance | Refractive index | Substance | Refractive index |
|-----------|------------------|-----------|------------------|
| Diamond | 2.42 | Glycerol | 1.47 |
| Glass | 1.51 | Water | 1.33 |
| Ice | 1.31 | Air | 1.00 |
| Perspex | 1.49 | | |

SPECTRAL LINES

| Element | Wavelength/nm | Colour | Element | Wavelength/nm | Colour |
|----------|---------------|-------------|----------------|----------------------|---------------|
| Hydrogen | 656 | Red | Cadmium | 644 | Red |
| | 486 | Blue-green | | 509 | Green |
| | 434 | Blue-violet | | 480 | Blue |
| | 410 | Violet | <i>Lasers</i> | | |
| | 397 | Ultraviolet | <i>Element</i> | <i>Wavelength/nm</i> | <i>Colour</i> |
| | 389 | Ultraviolet | Carbon dioxide | 9550 } 10590 } | Infra-red |
| Sodium | 589 | Yellow | Helium-neon | 633 | Red |

PROPERTIES OF SELECTED MATERIALS

| Substance | Density/ kg m^{-3} | Melting Point/ K | Boiling Point/ K | Specific Heat Capacity/ $\text{J kg}^{-1} \text{ K}^{-1}$ | Specific Latent Heat of Fusion/ J kg^{-1} | Specific Latent Heat of Vaporisation/ J kg^{-1} |
|-----------|--------------------------------|---------------------|---------------------|--|---|---|
| Aluminium | 2.70×10^3 | 933 | 2623 | 9.02×10^2 | 3.95×10^5 | .... |
| Copper | 8.96×10^3 | 1357 | 2853 | 3.86×10^2 | 2.05×10^5 | .... |
| Glass | 2.60×10^3 | 1400 | .... | 6.70×10^2 | .... | .... |
| Ice | 9.20×10^2 | 273 | .... | 2.10×10^3 | 3.34×10^5 | .... |
| Glycerol | 1.26×10^3 | 291 | 563 | 2.43×10^3 | 1.81×10^5 | 8.30×10^5 |
| Methanol | 7.91×10^2 | 175 | 338 | 2.52×10^3 | 9.9×10^4 | 1.12×10^6 |
| Sea Water | 1.02×10^3 | 264 | 377 | 3.93×10^3 | .... | .... |
| Water | 1.00×10^3 | 273 | 373 | 4.19×10^3 | 3.34×10^5 | 2.26×10^6 |
| Air | 1.29 | .... | .... | .... | .... | .... |
| Hydrogen | 9.0×10^{-2} | 14 | 20 | 1.43×10^4 | .... | 4.50×10^5 |
| Nitrogen | 1.25 | 63 | 77 | 1.04×10^3 | .... | 2.00×10^5 |
| Oxygen | 1.43 | 55 | 90 | 9.18×10^2 | .... | 2.40×10^5 |

The gas densities refer to a temperature of 273 K and a pressure of $1.01 \times 10^5 \text{ Pa}$.

