

INDEX

| Unit | | Page |
|---------------|--|-----------|
| | SKILLS | 11 |
| | 1.1 Development of science | 11 |
| | 1.2 Scientific research | 12 |
| | 1.2.1 Types of research | 14 |
| | 1.2.2 Variables | 14 |
| | 1.2.3 Mathematical relationships | 15 |
| | 1.2.4 Table | 17 |
| | 1.2.5 Other information to analyse the data | 18 |
| | 1.2.6 Precision and accuracy | 19 |
| | 1.2.7 Conclusion and evaluation | 19 |
| | Exercise 1 | 22 |
| | 1.3 Lab equipment | 26 |
| | 1.3.1 Thermometers | 26 |
| | 1.3.2 Scales | 27 |
| | 1.3.3 Metre stick | 28 |
| | 1.3.4 Measuring cylinders | 28 |
| | 1.3.5 Pipette | 28 |
| | 1.3.6 Burette | 29 |
| | Activity 1 | 30 |
| | Exercise 2 | 32 |
| A | KINEMATICS | 35 |
| Unit 1 | VECTORS | 35 |
| | 1.1 Scalars and vectors | 35 |
| | 1.2 Decomposition into components | 36 |
| | 1.3 Resultant | 40 |
| | Experiment 1 | 43 |
| | Exercise 3 | 45 |
| | Summary of Unit 1 | 53 |
| | Mind maps of Unit 1 | 54 |
| Unit 2 | DISPLACEMENT, VELOCITY AND ACCELERATION | 55 |
| | 2.1 Position | 55 |
| | 2.2 Distance and displacement | 58 |
| | Practical activity 1 | 61 |
| | Exercise 4 | 62 |
| | 2.3 Speed | 63 |
| | 2.4 Velocity | 65 |
| | 2.5 Instantaneous speed and instantaneous velocity | 69 |
| | Exercise 5 | 70 |
| | 2.6 Acceleration | 72 |
| | Exercise 6 | 74 |
| | Summary of Unit 2 | 75 |
| | Mind maps of Unit 2 | 77 |
| Unit 3 | VERTICAL PROJECTILE MOTION | 79 |
| | 3.1 What is a projectile motion? | 79 |
| | 3.2 Gravitational acceleration | 79 |
| | Experiment 2 | 81 |
| | 3.3 Terminal velocity | 83 |
| | 3.4 Equations of motion | 83 |

| | | |
|---------------|---|------------|
| | Exercise 7 | 85 |
| | 3.5 Graphs of motion | 89 |
| | Exercise 8 | 103 |
| | Summary of Unit 3 | 114 |
| | Mind maps of Unit 3 | 116 |
| B | NEWTON'S LAWS | 117 |
| Unit 1 | FORCES | 117 |
| | 1.1 Gravitational force | 118 |
| | 1.2 Normal force (F_N or N) | 118 |
| | 1.3 Applied force | 119 |
| | 1.4 Tension (F_T or T) | 119 |
| | 1.5 Air resistance (F_{air} or F_f) | 119 |
| | 1.6 Friction (f or F_f) | 120 |
| | 1.6.1 Which factors influence the magnitude (size) of the frictional force? | 121 |
| | 1.6.2 Coefficient of friction | 123 |
| | 1.6.3 How to reduce friction | 123 |
| | 1.6.4 Static friction (f_s) | 124 |
| | 1.6.5 Kinetic friction (f_k) | 124 |
| | 1.6.6 Application | 128 |
| | Experiment 3 | 128 |
| | Experiment 4 | 130 |
| | Experiment 5 | 131 |
| | Exercise 9 | 132 |
| | Summary of Unit 1 | 135 |
| | Mind maps of Unit 1 | 137 |
| Unit 2 | FORCE DIAGRAMS, FREE BODY DIAGRAMS | 139 |
| | 2.1 Force diagrams and free body diagrams | 139 |
| | Exercise 10 | 143 |
| | 2.2 Calculate net force with components | 145 |
| | Exercise 11 | 147 |
| | Summary of Unit 2 | 151 |
| Unit 3 | NEWTON'S LAWS OF MOTION | 153 |
| | 3.1 Newton's first law of motion | 153 |
| | 3.1.1 Inertia | 153 |
| | 3.1.2 Applications | 155 |
| | Practical activity 2 | 155 |
| | Exercise 12 | 157 |
| | 3.2 Newton's second law of motion | 159 |
| | Experiment 6 | 170 |
| | Experiment 7 | 174 |
| | Exercise 13 | 176 |
| | 3.3 Newton's third law of motion | 193 |
| | Experiment 8 | 194 |
| | Exercise 14 | 196 |
| | Summary of Unit 3 | 198 |
| | Mind maps of Unit 3 | 199 |

| | | |
|---------------|--|------------|
| C | MOMENTUM, IMPULSE, WORK, ENERGY AND POWER | 203 |
| Unit 1 | MOMENTUM | 203 |
| | 1.1 What is momentum? | 203 |
| | 1.2 Change in momentum | 204 |
| | Exercise 15 | 207 |
| | 1.3 Newton's second law in terms of momentum | 211 |
| | 1.4 Conservation of momentum | 214 |
| | 1.4.1 The law of conservation of momentum | 214 |
| | Experiment 9 | 217 |
| | 1.4.2 Collisions | 220 |
| | Experiment 10 (demonstration) | 222 |
| | Exercise 16 | 224 |
| | Summary of Unit 1 | 227 |
| Unit 2 | IMPULSE | 229 |
| | 2.1 What is impulse? | 229 |
| | 2.2 Applications | 231 |
| | Exercise 17 | 234 |
| | Summary of Unit 2 | 247 |
| | Mind maps of Unit 2 | 248 |
| Unit 3 | WORK, ENERGY AND POWER | 249 |
| | 3.1 Work | 249 |
| | Exercise 18 | 253 |
| | 3.2 Energy | 259 |
| | 3.2.1 Potential energy (E_p) | 259 |
| | 3.2.2 Kinetic energy (E_k) | 260 |
| | 3.2.3 Mechanical energy | 261 |
| | 3.2.4 The work-energy principle | 262 |
| | 3.2.5 Forces | 267 |
| | 3.2.6 Work done through friction | 268 |
| | Exercise 19 | 273 |
| | 3.3 Power | 286 |
| | 3.3.1 What is power? | 286 |
| | Experiment 11 | 287 |
| | 3.3.2 Effectivity of a machine | 289 |
| | Exercise 20 | 290 |
| | Summary of Unit 3 | 295 |
| | Mind maps of Unit 3 | 298 |
| D | GRAVITY AND ELECTRIC FIELDS | 299 |
| Unit 1 | NEWTON'S LAW OF UNIVERSAL GRAVITATION | 299 |
| | 1.1 Newton's law of universal gravitation | 299 |
| | 1.2 Mass and weight | 302 |
| | 1.3 Weightlessness | 302 |
| | 1.4 Relationship between g and G | 303 |
| | Experiment 12 | 304 |
| | Exercise 21 | 306 |
| | Summary of Unit 1 | 311 |
| | Mind maps of Unit 1 | 312 |

| | | |
|---------------|--|------------|
| Unit 2 | ELECTROSTATICS | 313 |
| | 2.1 Forces between charges | 314 |
| | 2.1.1 Magnitude of charges | 315 |
| | 2.1.2 Distance between charges | 316 |
| | 2.1.3 Graphs | 317 |
| | 2.1.4 Coulomb's law | 317 |
| | Exercise 22 | 318 |
| | 2.2 Electric fields | 329 |
| | 2.2.1 Electric field lines | 329 |
| | 2.2.2 Electric field strength (E) | 332 |
| | Exercise 23 | 334 |
| | Summary of Unit 2 | 344 |
| | Mind maps of Unit 2 | 347 |
| E | ELECTRIC CIRCUITS | 349 |
| Unit 1 | OHM'S LAW | 349 |
| | 1.1 Potential difference | 349 |
| | 1.2 Current | 350 |
| | 1.3 Resistance and Ohm's law | 350 |
| | 1.4 Ohmic and non-ohmic conductors | 351 |
| | Experiment 13 | 352 |
| | Experiment 14 | 354 |
| | 1.5 Resistors in series and parallel | 356 |
| | Exercise 24 | 359 |
| | Summary of Unit 1 | 363 |
| | Mind maps of Unit 1 | 365 |
| Unit 2 | POWER AND ENERGY | 367 |
| | 2.1 Energy conversion in a circuit | 367 |
| | 2.2 Power | 368 |
| | Practical demonstration 1 | 371 |
| | Exercise 25 | 374 |
| | 2.3 Cost calculation | 377 |
| | Exercise 26 | 380 |
| | Summary of Unit 2 | 382 |
| | Mind maps of Unit 2 | 383 |
| Unit 3 | INTERNAL RESISTANCE | 385 |
| | 3.1 What is internal resistance? | 385 |
| | Experiment 15 | 388 |
| | Experiment 16 | 393 |
| | 3.2 Applications | 395 |
| | Exercise 27 | 398 |
| | Summary of Unit 3 | 413 |
| F | ELECTRODYNAMICS | 415 |
| Unit 1 | ELECTROMAGNETISM | 415 |
| | 1.1 Magnetic effect of an electric current | 415 |
| | Practical demonstration 2 | 416 |
| | 1.2 Magnetic fields | 418 |
| | 1.3 The motor effect and electric motors | 420 |
| | 1.4 Direct current motors (DC motors) | 422 |
| | Exercise 28 | 423 |

| | | |
|---------------|--|------------|
| | Summary of Unit 1 | 425 |
| | Mind maps of Unit 1 | 428 |
| Unit 2 | ELECTROMAGNETIC INDUCTION | 431 |
| | 2.1 Magnetic flux density | 431 |
| | 2.2 Magnetic flux | 432 |
| | 2.3 Faraday's law | 433 |
| | 2.4 Direction of induced current: Lenz's law | 434 |
| | Practical demonstration 3 | 435 |
| | 2.5 Simple applications | 437 |
| | 2.6 Electromagnetic induction and electric generators | 439 |
| | 2.7 Alternating current generator (alternator) | 442 |
| | 2.8 Transformers | 443 |
| | 2.8.1 The composition of a transformer | 444 |
| | 2.8.2 Functioning of a transformer | 444 |
| | 2.8.3 Power | 445 |
| | Exercise 29 | 447 |
| | Summary of Unit 2 | 456 |
| | Mind maps of Unit 2 | 459 |
| Unit 3 | ALTERNATING CURRENT | 463 |
| | 3.1 Alternating current and the economy | 463 |
| | 3.2 Graphs of potential difference and current for alternating current | 464 |
| | 3.3 Diodes | 465 |
| | 3.3.1 Half wave rectification | 465 |
| | 3.3.2 Full wave rectification | 466 |
| | 3.3.3 Full wave rectifier | 466 |
| | 3.3.4 Uses of rectifiers | 468 |
| | Exercise 30 | 468 |
| | Summary of Unit 2 | 474 |
| | Mind maps of Unit 2 | 476 |
| G | PHOTONS AND ELECTRONS | 477 |
| Unit 1 | PHOTOELECTRIC EFFECT | 477 |
| | 1.1 Properties of electromagnetic waves | 477 |
| | 1.2 Penetrability | 479 |
| | 1.3 What is the photoelectric effect? | 480 |
| | Experiment 17 (demonstration) | 481 |
| | 1.4 Quantum theory | 484 |
| | 1.5 Work function and threshold frequency | 485 |
| | 1.6 Intensity and frequency of light | 490 |
| | Exercise 31 | 492 |
| | Summary of Unit 1 | 506 |
| | Mind maps of Unit 1 | 509 |
| Unit 2 | EMISSION SPECTRA | 511 |
| | 2.1 Emission spectrum | 511 |
| | 2.1.1 Continuous emission spectrum | 511 |
| | 2.1.2 Line emission spectra | 512 |
| | Exercise 32 | 513 |
| | Summary of Unit 2 | 516 |
| | Mind maps of Unit 2 | 517 |

Information pages
Work cited

518
520