Pearson Edexcel · International A-Level · Physics

Syllabus Checklist · 大纲自查表

Tick one box per statement: ☐ not yet ☐ nearly ☐ confident. 每条打一个勾：尚未掌握 / 快会了 / 有把握。

1. Mechanics and Materials 力学与材料

1.1 Motion graphs and uniform acceleration (statements 1–3) 运动图像与匀加速运动（知识点 1–3）

☐☐☐ be able to use the equations for uniformly accelerated motion in one dimension: $s = (u+v)t/2$, $v = u + at$, $s = ut + \frac{1}{2}at^2$, $v^2 = u^2 + 2as$

☐☐☐ be able to draw and interpret displacement–time, velocity–time and acceleration–time graphs

☐☐☐ know the physical quantities derived from the slopes and areas of displacement–time, velocity–time and acceleration–time graphs, including cases of non-uniform acceleration, and understand how to use the quantities

☐☐☐ CORE PRACTICAL 1: Determine the acceleration of a freely-falling object

1.2 Vectors, resolution and projectile motion (statements 4–7) 矢量、分解与抛体运动（知识点 4–7）

☐☐☐ understand scalar and vector quantities and know examples of each type of quantity and recognise vector notation

☐☐☐ be able to resolve a vector into two components at right angles to each other by drawing and by calculation

☐☐☐ be able to find the resultant of two coplanar vectors at any angle to each other by drawing, and at right angles to each other by calculation

☐☐☐ understand how to make use of the independence of vertical and horizontal motion of a projectile moving freely under gravity

1.3 Forces, Newton's laws and free-body diagrams (statements 8–12, core practical 1) 力、牛顿定律与受力图（知识点 8–12，核心实验 1）

☐☐☐ be able to draw and interpret free-body force diagrams to represent forces on a particle or on an extended but rigid body using the concept of centre of gravity of an extended body

☐☐☐ be able to use the equation $\Sigma F = ma$, and understand how to use this equation in situations where m is constant (Newton's second law of motion), including Newton's first law of motion where $a = 0$, objects at rest or travelling at constant velocity; use of the term terminal velocity is expected

☐☐☐ be able to use the equations for gravitational field strength $g = F/m$ and weight $W = mg$

☐☐☐ know and understand Newton's third law of motion and know the properties of pairs of forces in an interaction between two bodies

1.4 Momentum and its conservation (statements 13–14) 动量及其守恒（知识点 13–14）

☐☐☐ understand that momentum is defined as $p = mv$

☐☐☐ know the principle of conservation of linear momentum, understand how to relate this to Newton's laws of motion and understand how to apply this to problems in one dimension

1.5 Moments and equilibrium (statements 15–16) 力矩与平衡（知识点 15–16）

☐☐☐ be able to use the equation for the moment of a force, moment of force = Fx, where x is the perpendicular distance between the line of action of the force and the axis of rotation

☐☐☐ be able to use the concept of centre of gravity of an extended body and apply the principle of moments to an extended body in equilibrium

1.6 Work, energy, power and efficiency (statements 17–22) 功、能、功率与效率（知识点 17–22）

☐☐☐ be able to use the equation for work $\Delta W = F\Delta s$, including calculations when the force is not along the line of motion

☐☐☐ be able to use the equation $Ek = \frac{1}{2}mv^2$ for the kinetic energy of a body

☐☐☐ be able to use the equation $\Delta Egrav = mg\Delta h$ for the difference in gravitational potential energy near the Earth's surface

☐☐☐ know, and understand how to apply, the principle of conservation of energy including use of work done, gravitational potential energy and kinetic energy

☐☐☐ be able to use the equations relating power, time and energy transferred or work done $P = E/t$ and $P = W/t$

☐☐☐ be able to use the equations efficiency = useful energy output / total energy input and efficiency = useful power output / total power input

1.7 Fluids: density, upthrust and viscous drag (statements 23–26, core practical 2) 流体：密度、浮力与粘滞阻力（知识点 23–26，核心实验 2）

☐☐☐ be able to use the equation density $\rho = m/V$

☐☐☐ understand how to use the relationship upthrust = weight of fluid displaced

☐☐☐ a) be able to use the equation for viscous drag (Stokes' law) $F = 6\pi\eta rv$; b) understand that this equation applies only to small spherical objects moving at low speeds with laminar flow (or in the absence of turbulent flow) and that viscosity is temperature dependent

☐☐☐ CORE PRACTICAL 2: Use a falling-ball method to determine the viscosity of a liquid

1.8 Solid materials: Hooke's law, stress–strain and strain energy (statements 27–32, core practical 3) 固体材料：胡克定律、应力-应变与应变能（知识点 27–32，核心实验 3）

☐☐☐ be able to use the Hooke's law equation $\Delta F = k\Delta x$, where k is the stiffness of the object

☐☐☐ understand how to use the relationships (tensile or compressive) stress = force / cross-sectional area, (tensile or compressive) strain = change in length / original length, and Young modulus = stress / strain

☐☐☐ a) be able to draw and interpret force–extension and force–compression graphs; b) understand the terms limit of proportionality, elastic limit, yield point, elastic deformation and plastic deformation and be able to apply them to these graphs

☐☐☐ be able to draw and interpret tensile or compressive stress–strain graphs, and understand the term breaking stress

☐☐☐ CORE PRACTICAL 3: Determine the Young modulus of a material

☐☐☐ be able to calculate the elastic strain energy Eel in a deformed material sample, using the equation $\Delta Eel = \frac{1}{2}F\Delta x$, and from the area under the force–extension graph; the estimation of area and hence energy change for both linear and non-linear force–extension graphs is expected

2. Waves and Electricity 波与电学

2.1 Wave quantities and graphs (statements 33–37) 波量与图像（陈述 33–37）

☐☐☐ Understand amplitude, frequency, period, speed and wavelength.

☐☐☐ Use the wave equation $v = f\lambda$.

☐☐☐ Describe longitudinal waves in terms of pressure variation and displacement of molecules.

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☐☐☐ Describe transverse waves.

☐☐☐ Draw and interpret graphs representing transverse and longitudinal waves, including standing/stationary waves.

2.2 Superposition and standing waves (statements 38–43, core practicals 4–5) 叠加与驻波（陈述 38–43，核心实践 4–5）

☐☐☐ CORE PRACTICAL 4: Determine the speed of sound in air using a 2-beam oscilloscope, signal generator, speaker and microphone.

☐☐☐ Understand wavefront, coherence, path difference, superposition, interference and phase.

☐☐☐ Use the relationship between phase difference and path difference.

☐☐☐ Understand a standing/stationary wave and how it forms; identify nodes and antinodes.

☐☐☐ Use the speed of a transverse wave on a string: $v = \sqrt{(T/\mu)}$.

☐☐☐ CORE PRACTICAL 5: Investigate effects of length, tension and mass per unit length on frequency of a vibrating string or wire.

2.3 Intensity, refraction and polarisation (statements 44–49) 强度、折射与偏振（陈述 44–49）

☐☐☐ Use intensity of radiation $I = P/A$.

☐☐☐ Understand $n_1 \sin\theta_1 = n_2 \sin\theta_2$ at an interface, with refractive index $n = c/v$.

☐☐☐ Calculate critical angle using $\sin C = 1/n$.

☐☐☐ Predict whether total internal reflection occurs at an interface.

☐☐☐ Understand how to measure the refractive index of a solid material.

☐☐☐ Understand plane polarisation.

2.4 Diffraction and pulse-echo (statements 50–56, core practical 6) 衍射与脉冲回波（陈述 50–56，核心实践 6）

☐☐☐ Understand diffraction and use Huygens' construction to explain waves meeting a slit or obstacle.

☐☐☐ Use $n\lambda = d \sin\theta$ for a diffraction grating.

☐☐☐ CORE PRACTICAL 6: Determine the wavelength of laser light or another light source using a diffraction grating.

☐☐☐ Explain how diffraction experiments provide evidence for the wave nature of electrons.

☐☐☐ Use the de Broglie equation $\lambda = h/p$.

☐☐☐ Understand transmission and reflection at an interface between media.

☐☐☐ Understand how pulse-echo locates an object, and limits from radiation wavelength or pulse duration.

2.5 Photons, photoelectric effect and spectra (statements 57–63) 光子、光电效应与光谱（陈述 57–63）

☐☐☐ Understand electromagnetic radiation in wave and photon models, and how the models developed over time.

☐☐☐ Use $E = hf$ to relate photon energy and wave frequency.

☐☐☐ Understand photon absorption causing photoelectron emission.

☐☐☐ Understand threshold frequency and work function; use $hf = \varphi + \frac{1}{2}mv^2_{max}$.

☐☐☐ Use the electronvolt (eV) for small energies.

☐☐☐ Explain photoelectric evidence for the particle nature of electromagnetic radiation.

☐☐☐ Explain atomic line spectra with discrete energy-level transitions; calculate emitted/absorbed frequencies.

2.6 Current, resistance and circuits (statements 64–73, core practical 7) 电流、电阻与电路（陈述 64–73，核心实践 7）

☐☐☐ Understand current as rate of charged-particle flow; use $I = \Delta Q/\Delta t$.

☐☐☐ Use $V = W/Q$.

☐☐☐ Understand $R = V/I$ defines resistance; Ohm's law $I \propto V$ is a special case at constant temperature.

☐☐☐ Explain current distribution through charge conservation and potential-difference distribution through energy conservation.

☐☐☐ Derive and use series/parallel resistance equations from charge and energy conservation.

☐☐☐ Use $P = VI$ and $W = VIt$; derive and use $P = I^2R$ and $P = V^2/R$.

☐☐☐ Sketch, recognise and interpret current–potential-difference graphs for ohmic conductors, filament bulbs, thermistors and diodes.

☐☐☐ Use $R = \rho l/A$.

☐☐☐ CORE PRACTICAL 7: Determine electrical resistivity of a material.

☐☐☐ Use $I = nqvA$ to explain the large range of resistivities of different materials.

2.7 Potential dividers, sensors and e.m.f. (statements 74–80, core practical 8) 分压电路、传感器与电动势（陈述 74–80，核心实践 8）

☐☐☐ Understand potential variation with distance along a uniform current-carrying wire.

☐☐☐ Understand potential-divider principles; calculate potential differences and resistances.

☐☐☐ Analyse potential dividers with variable resistance, including thermistors and LDRs.

☐☐☐ Define e.m.f. and internal resistance; distinguish e.m.f. from terminal potential difference.

☐☐☐ CORE PRACTICAL 8: Determine e.m.f. and internal resistance of an electrical cell.

☐☐☐ Model temperature-dependent resistance using lattice vibrations and conduction-electron number; apply to metals and negative-temperature-coefficient thermistors.

☐☐☐ Model illumination-dependent resistance using conduction-electron number; apply to LDRs.

3. Practical Skills in Physics I 物理实验技能 I

3.1 Planning valid practical investigations 规划有效的实验探究

☐☐☐ Planning valid practical investigations

3.2 Measurement, recording and uncertainty 测量、记录与不确定度

☐☐☐ Measurement, recording and uncertainty

3.3 Graphs, processing and justified conclusions 图表、数据处理与有依据的结论

☐☐☐ Graphs, processing and justified conclusions

4. Further Mechanics, Fields and Particles 进阶力学、场与粒子

4.1 Impulse and two-dimensional collisions (statements 81–86, CP9–10) 冲量与二维碰撞（陈述 81–86，核心实践 9–10）

☐☐☐ Understand and use impulse $F\Delta t = \Delta p$ (Newton's second law).

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- ☐☐☐ CORE PRACTICAL 9: Investigate the force exerted on an object and its change of momentum.
- ☐☐☐ Apply conservation of linear momentum in two dimensions.
- ☐☐☐ CORE PRACTICAL 10: Use ICT to analyse collisions between small spheres, such as ball bearings on a table top.
- ☐☐☐ Determine whether a collision is elastic or inelastic.
- ☐☐☐ Derive and use $E_k = p^2/(2m)$ for a non-relativistic particle.

4.2 Circular motion (statements 87–91) 圆周运动（陈述 87–91）

- ☐☐☐ Express angular displacement in radians and degrees, and convert between them.
- ☐☐☐ Understand angular velocity and use $v = \omega r$ and $\omega = 2\pi/T$.
- ☐☐☐ Use vector diagrams to derive $a = v^2/r = r\omega^2$ and use these equations.
- ☐☐☐ Understand that a resultant centripetal force produces and maintains circular motion.
- ☐☐☐ Use $F = ma = mv^2/r = mr\omega^2$.

4.3 Electric fields and potential (statements 92–99) 电场与电势（陈述 92–99）

- ☐☐☐ Define an electric field as a region where a charged particle experiences a force.
- ☐☐☐ Define and use electric field strength $E = F/Q$.
- ☐☐☐ Use Coulomb's law $F = Q_1Q_2/(4\pi\varepsilon_0 r^2)$.
- ☐☐☐ Use $E = Q/(4\pi\varepsilon_0 r^2)$ for a point charge.
- ☐☐☐ Understand the relation between electric field and potential.
- ☐☐☐ Use $E = V/d$ for parallel plates.
- ☐☐☐ Use $V = Q/(4\pi\varepsilon_0 r)$ for a radial field.
- ☐☐☐ Draw and interpret field lines and equipotentials for uniform and radial fields.

4.4 Capacitors and RC circuits (statements 100–104, CP11) 电容器与 RC 电路（陈述 100–104，核心实践 11）

- ☐☐☐ Define capacitance $C = Q/V$ and use the equation.
- ☐☐☐ Derive stored energy $W = \frac{1}{2}QV$ from the area under a potential-difference–charge graph; derive and use $W = \frac{1}{2}CV^2$ and $W = Q^2/(2C)$.
- ☐☐☐ Draw and interpret resistor–capacitor charge/discharge curves and understand the time constant RC.
- ☐☐☐ CORE PRACTICAL 11: Use an oscilloscope or data logger to display and analyse capacitor p.d. during charging and discharging through a resistor.
- ☐☐☐ Use $Q = Q_0 \exp(-t/RC)$; derive and use corresponding current and p.d. equations and their logarithmic forms.

4.5 Magnetic forces and induction (statements 105–110) 磁场力与电磁感应（陈述 105–110）

- ☐☐☐ Understand magnetic flux density B, flux φ and flux linkage $N\varphi$.
- ☐☐☐ Use $F = Bqv\sin\theta$ and apply Fleming's left-hand rule to charged particles.
- ☐☐☐ Use $F = BIl\sin\theta$ and apply Fleming's left-hand rule to conductors.
- ☐☐☐ Understand what affects induced e.m.f. when a coil and permanent magnet move relatively.
- ☐☐☐ Understand what affects induced e.m.f. when current changes in another linked coil.
- ☐☐☐ Use Faraday's law and the combined Faraday–Lenz equation e.m.f. $= -d(N\varphi)/dt$.

4.6 Nuclear structure, accelerators and tracks (statements 111–117, 120) 原子核结构、加速器与径迹（陈述 111–117，120）

- ☐☐☐ Understand nucleon (mass) number and proton (atomic) number.
- ☐☐☐ Explain large-angle alpha-scattering evidence for the nuclear model and the historical change in atomic models.
- ☐☐☐ Understand thermionic electron emission and acceleration using electric and magnetic fields.
- ☐☐☐ Understand electric/magnetic fields in linacs, cyclotrons and detectors; detector detail limited to ionisation and deflection principles.
- ☐☐☐ Derive and use $r = p/(BQ)$ for a charged particle in a magnetic field.
- ☐☐☐ Apply charge, energy and momentum conservation to particle interactions and interpret tracks.
- ☐☐☐ Explain why high energies are needed to investigate nucleon structure.
- ☐☐☐ Understand significant relativistic increases in particle lifetime; relativistic equations are not required.

4.7 Particles, antiparticles and conservation (statements 118–119, 121–124) 粒子、反粒子与守恒定律（陈述 118–119，121–124）

- ☐☐☐ Use $\Delta E = c^2\Delta m$ in matter/antimatter creation and annihilation.
- ☐☐☐ Use MeV/GeV for energy and MeV/c^2 or GeV/c^2 for mass and convert to SI.
- ☐☐☐ Classify baryons (three quarks), mesons (quark/antiquark), fundamental leptons and photons; know model symmetry predicted the top quark.
- ☐☐☐ Use particle properties to deduce corresponding antiparticle properties and vice versa.
- ☐☐☐ Use charge, baryon-number and lepton-number conservation to assess interactions.
- ☐☐☐ Write and interpret particle equations from supplied symbols.

5. Thermodynamics, Radiation, Oscillations and Cosmology

热力学、辐射、振荡与宇宙学

5.1 Heating, phase change and thermistor calibration (125–128, CP12–13) 加热、相变与热敏电阻校准（125–128，核心实践 12–13）

- ☐☐☐ Heating, phase change and thermistor calibration (125–128, CP12–13)

5.2 Ideal gases and molecular kinetic energy (129–132, CP14) 理想气体与分子动能（129–132，核心实践 14）

- ☐☐☐ Ideal gases and molecular kinetic energy (129–132, CP14)

5.3 Binding energy, fission and fusion (133–136) 结合能、裂变与聚变（133–136）

- ☐☐☐ Binding energy, fission and fusion (133–136)

5.4 Radiation, background and decay (137–142, CP15) 辐射、背景与衰变 (137–142, CP15)

- ☐☐☐ Radiation, background and decay (137–142, CP15)

5.5 Simple harmonic motion, graphs and energy (143–147, 149–150, CP16) 简谐运动、图像与能量 (143–147, 149–150, CP16)

- ☐☐☐ Simple harmonic motion, graphs and energy (143–147, 149–150, CP16)

5.6 Forced oscillations, resonance and damping (148, 151–153) 受迫振动、共振与阻尼 (148, 151–153)

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☐☐☐ Forced oscillations, resonance and damping (148, 151–153)

5.7 Gravitational fields and orbits (154–160) 引力场与轨道 (154–160)

☐☐☐ Gravitational fields and orbits (154–160)

5.8 Stellar radiation, distances and evolution (161–168) 恒星辐射、距离与演化 (161–168)

☐☐☐ Stellar radiation, distances and evolution (161–168)

5.9 Doppler shifts and cosmology (169–171) 多普勒效应与宇宙学 (169–171)

☐☐☐ Doppler shifts and cosmology (169–171)

6. Practical Skills in Physics II 物理实验技能 II

6.1 Planning A2 investigations A2 探究规划

☐☐☐ Planning A2 investigations

6.2 Implementation and measurement critique 实施与测量评估

☐☐☐ Implementation and measurement critique

6.3 Compounded uncertainties and justified conclusions 复合不确定性与合理结论

☐☐☐ Compounded uncertainties and justified conclusions

6.4 Log graphs and linearisation 对数图与线性化

☐☐☐ Log graphs and linearisation

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