H2 PHYSICS
COMPILATION OF QUALITATIVE QUESTIONS

Italicised explanations are derived from the definitions

TOPIC 1: MEASUREMENT

Definitions
- Base unit, derived unit
- Base quantity, derived quantity
- Scalar, vector (2022)

Distinguish between accuracy and precision. (2016)
State the feature of the graph that indicates the presence of random error and systematic error. (2013)
State why, by drawing a line of best fit for the data points, the effect of random error is reduced. (2013)
How repeating measurements and taking average increases precision (reduce % uncertainty)

TOPIC 2: KINEMATICS

Definitions
- Distance, displacement, speed, velocity, acceleration (2015)
- Parabolic motion

Describe the motion of the block down the slope. (2021)
Explain why the object undergoes parabolic motion (in some field of force).
Effect of air resistance on motion. (2014, 2015)
Suggest why, for the falling steel ball, air resistance may be neglected. (2015)
Explain why the object reaches a constant (terminal) velocity. (2018)

TOPIC 3: DYNAMICS

Definitions
- Newton's three laws of motion
- Linear momentum, impulse (2013)
- Principle of conservation of linear momentum

Explain why object travels at constant speed due to friction. (2020)
Explain why force acts on rocket.
Explain why two objects in elastic collision are never stationary. (2017, 2020)
Explain if collision is elastic or inelastic. (2017)
State what is meant by inelastic collision by reference to the speed and energy of the two objects. (2020)
By reference to the direction of the impulse, explain why, for the initial speed of the sphere to be in a horizontal direction, the centres of the spheres are on the same horizontal level at the time of collision. (2020)

TOPIC 4: FORCES

Definitions
- Hooke's law (2018)
- Centre of gravity
- Moment, couple, torque
- Principle of moments (2018)
- Equilibrium – translational, rotational
- Upthrust

Explain why a force does not produce any moments at pivot.
Explain why a force is required to act on the bar at a point to keep the bar in equilibrium / explain why the force is not vertical / explain why the force has a horizontal component. (2016, 2018)
State the two conditions required for a body to be in equilibrium / state and explain whether a given system is in equilibrium. (2015, 2019)
Explain origin of upthrust. (2013, 2020)

Drawing of free body diagram.
Drawing of forces on bar in equilibrium. (2016)

TOPIC 5: WORK, ENERGY AND POWER

Definitions
- Work done
- Principle of conservation of energy
- Power

State the energy changes in mass-spring system. (2015)

TOPIC 6: CIRCULAR MOTION

Definitions
- Radian (2014)

Explain why an object undergoes uniform circular motion e.g. charged particle in magnetic field. (2013, 2015, 2018, 2020, 2021)

TOPIC 7: GRAVITATIONAL FIELD

Definitions
- Field of force (2014, 2020)
- Newton's law of gravitation
- Gravitational field (2017, 2018)
- Gravitational field strength
- Gravitational potential energy
- Gravitational potential (2013, 2014, 2020)
- Geostationary orbit

By reference to the diameters of the stars, suggest why Newton's law of gravitation may be used to calculate the force between them. (2018)
Similarities and differences between gravitational and electric force / field / potential. (2021)
Explain why near Earth surface, gravitational field strength is approximately constant, equal to acceleration of free fall. (2021)
Explain negative sign of gravitational potential. (2021)
Explain effect of changing radius of orbit of satellites on GPE and KE. (2013)
Explain why, near surface of Earth, gravitational field strength is approximately constant / equal to acceleration of free fall. (2021)
Use energy considerations to determine whether the rock falls to surface of planet, or goes into orbit around planet, or travels off into space. (2019, 2021)
State advantages and disadvantages of geostationary satellites.

Drawing of gravitational field lines.

TOPIC 8: TEMPERATURE AND IDEAL GASES

Definitions
- Ideal gas (2018)

State what is meant by thermal equilibrium of two bodies, by reference to temperature and movement of thermal energy. (2017)
Explain how molecular movement causes the pressure exerted by a gas. (2022)
Basic assumptions of kinetic theory of gases. (2020, 2022)
Explain why mean velocity of atoms of gas is zero. (2020)

TOPIC 9: FIRST LAW OF THERMODYNAMICS

Definitions
- Specific heat capacity, specific latent heat (2015)
- Internal energy (2013, 2018, 2021)
- First Law of Thermodynamics (2014, 2015, 2018)

Compare evaporation and boiling. (2016)
Explain why internal energy of ideal gas is directly proportional to thermodynamic temperature. (2017)
Use first law to explain why specific heat capacity of ideal gas measured at constant volume is different to specific heat capacity measured at constant pressure. (2015, 2017)
Applications of first law.

TOPIC 10: OSCILLATIONS

Definitions
- Displacement, amplitude (2016)
- Angular frequency (2014)
- Simple harmonic motion (2015, 2016, 2018)
- Damped oscillation
- Forced oscillation
- Resonance

Explain why object undergoes simple harmonic motion. (2013, 2016)
Describe restoring force in the system. (2016)
Describe interchange between kinetic and potential energy during simple harmonic motion.
Explain why amplitude of oscillation decreases with time. (2013)
Use graph to explain why mass is oscillating, oscillations are not simple harmonic. (2015, 2018)

TOPIC 11: WAVE MOTION

Definitions
- Progressive wave, transverse and longitudinal wave (2015, 2019)
- Displacement, frequency, wavelength, amplitude, speed (2015)
- Polarisation (2017, 2019)

Determine frequency of sound using c.r.o.
Explain why only transverse waves can be polarised / why sound wave cannot be polarised. (2019)

TOPIC 12: SUPERPOSITION

Definitions
- Principle of superposition (2014)
- Stationary wave
- Diffraction (2018, 2020, 2021)
- Rayleigh criterion (2017, 2019)
- Coherent waves (2013, 2019)

Explain formation of stationary wave. (2020, 2022)
Distinguish between stationary and progressive wave. (2022)
Describe change in appearance of diffracted wavefronts when slit made more narrow. (2013)
Explain changes to observed diffraction pattern / interference fringes when … (2013, 2015, 2018, 2019)
When white light is incident on a single slit, central fringe is coloured at the edges and has a white central region. Explain this observation. (2018)
Explain nature of interference between two waves at a point. (2017)
Describe how resultant amplitude varies along the line. (2017)
Conditions required for two-source interference fringes to be observed. (2017, 2020)
State relation between a and D for two-source interference formula to be valid. (2013)

Drawing of stationary wave.
Drawing of diffraction pattern. (2013)
Drawing of nodal and antinodal lines of two-source interference. (2013)

TOPIC 13: ELECTRIC FIELDS

Definitions
- Coulomb's law
- Electric field
- Electric field strength
- Electric potential (2016, 2019)

Suggest why it may be assumed that the proton and nucleus behave as point charges. (2019)
Use *V-r* / *E-r* graph to explain whether spheres have charges of same or opposite sign. (2014, 2021)
Use the fact that field strength is negative of potential gradient at that point. (2014)

Drawing of electric field lines.

TOPIC 14: CURRENT OF ELECTRICITY

Definitions
- Electromotive force, potential difference (2019)
- Resistance, resistivity (2011, 2014)
- Ohm (2016)
- Ohm's law

Explain how I–V graph shows change in resistance with p.d. / Explain I–V characteristics of ohmic resistor, semiconductor diode, filament lamp, NTC thermistor
Explain why current in filament lamp is greatest when the current is first switched on. (2021)
Distinguish between e.m.f and p.d. using energy considerations.
Suggest why, when the switch is closed, the lamp is lit almost immediately and yet free electrons in wire move at less than 1 mm s^{-1}. (2013)

TOPIC 15: D.C. CIRCUITS

TOPIC 16: ELECTROMAGNETISM

Definitions
- Magnetic field
- Magnetic flux density, Tesla (2015, 2018, 2020, 2021)

Explain forces between current-carrying conductors, predict direction of forces
Predict direction of force on charge moving in magnetic field
Describe and analyse deflections of beams of charged particles by uniform electric and uniform magnetic fields.
Explain helical motion. (2014)
Explain how electric and magnetic fields can be used in velocity selection for charged particles

Drawing of magnetic flux pattern. (2017)

TOPIC 17: ELECTROMAGNETIC INDUCTION

Definitions
- Magnetic flux, magnetic flux linkage (2018)
- Faraday's law (2013, 2017, 2019, 2020)
- Lenz's law

Explain applications of EMI: changes in magnetic flux (linkage), cutting of magnetic flux, rotating disk.
Factors affecting magnitude of induced e.m.f.
Explain alternating e.m.f. induced. (2014)

TOPIC 18: ALTERNATING CURRENT

Definitions
- r.m.s value (2017, 2018, 2019)
- Ideal transformer (2017)

Explain principle of operation of transformer. (2016, 2017)
Explain sources of power loss from transformer. (2017)
Explain why high voltage used for transmission of electrical energy.
Explain the use of diode for half-wave rectification of a.c.

TOPIC 19: QUANTUM PHYSICS

Definitions
- Photon (2015, 2016, 2018, 2019, 2020)
- Photoelectric effect (2013)
- Threshold frequency, stopping potential (2018)
- Ground state, excited state
- Excitation, ionisation
- Heisenberg uncertainty principle

Explain how photoelectric effect provides evidence for particulate nature of EM radiation. (2021)
Explain photoelectric phenomena in terms of photon energy and work function energy.
Use theory of particulate nature of EM radiation to explain why there is a threshold frequency for photoelectric effect. (2013)
Explain why there is minimum potential difference (stopping potential) for electrons to be emitted. (2015)
Explain why stopping potential is independent of intensity, photoelectric current is proportional to intensity at constant frequency.
Explain why there is a maximum photoelectric current. (2015)
Explain why only photons of certain frequencies can cause excitation.
Explain how interference provides evidence for wave nature of electrons / explain why electrons produce concentric rings after passing through graphite film. (2017)
Explain emission and absorption line spectra / explain how spectral lines provide evidence for existence of discrete electronic energy levels in isolated atoms. (2016, 2020, 2021)
Explain features of X-ray spectrum.

TOPIC 20: NUCLEAR PHYSICS

Definitions

- Mass defect, binding energy (2020)
- Nuclear fusion, fission (2019)
- Radioactive decay, spontaneous, random (2014, 2018, 2019)
- Activity, decay constant, half-life (2020, 2022)

Explain how results of Rutherford α-particle scattering experiment show the existence and small size of nucleus (2016, 2017)
Describe structure of atom.
Explain why a nuclear reaction is energetically possible.
Explain existence of neutrino in β-decay using conservation of energy and momentum. (2022)
Discuss direct and indirect effects of ionising radiation on living tissues and cells.