

Physics

Practice Questions

GCSE & A-Level
AQA



Instructions

Individual, exam-style questions

The questions contained in this booklet match the style of questions that are typically asked in exams. This booklet is not however, a practice exam. Elevate's research with top students identified that top students do more practice questions than anyone else. They begin the process of testing their knowledge early in the year.

Therefore, we have provided exam-format questions that are sorted by topic so that you can answer them as you learn the information, rather than waiting until the very end of the year to complete exams.

Comments, questions?

Let us know if you need any further advice by visiting www.elevateeducation.com. You can comment on any of our material, or head to the FAQ section and ask us a question. Also, you can find us on social media so you can stay up to date on any brand new tips we release throughout the year.

Other information

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GCSE Topics 1-3

1. What is the difference between transverse and longitudinal waves?
 - a. Give one example of each type of wave.
 - b. Explain what is meant by the amplitude of a wave.
 - c. Explain what is meant by the wavelength of a wave.

2. There are a total of 426 escalators across all the London Underground stations. Each escalator requires a power of 14.5 kW to run and they run for 20 hours per day.
 - a. If electricity costs 15p per kilowatt-hour (kW-hr), how much does it cost, in total, to run all the London Underground escalators per week? How much does it cost per year?
 - b. 1 kW-hr of electricity generated by a coal-fired power station typically produces 0.9 kg of CO₂. What is the total CO₂ emitted per week? How much is emitted in a year?
 - c. If escalators were run for 18 hours per day rather than 20 hours per day, (i), how much money would be saved in running costs per year? and, (ii), how much less CO₂ would be emitted per year?
 - d. Give one environmental reason why running the escalators for less time would be a good idea.

3. There are three main types of radiation that radioactive substances can emit: Alpha, beta and gamma radiation. Explain the difference between ionic and covalent bonds.
 - a. Describe what is emitted by the radioactive substance in each case.
 - b. Discuss the relative dangers of all three types of radiation.
 - c. Two types of radiation are affected by the presence of a magnetic field. Which two are these and how are they affected?

4. A nuclear reaction is process in which the energy or composition of an atomic nucleus is altered. Nuclear fission, nuclear fusion are examples of nuclear reactions.

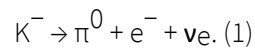
- a. Explain the main differences between nuclear fission and nuclear fusion.
 - b. Name the main two substances used in nuclear fission reactors.
 - c. Explain what is mean by the term chain reaction and draw a labelled diagram showing how chain reaction in a nuclear reactor may occur.
5. Optical fibres are thin glass fibres through which light can be transmitted.
- a. Optical fibres are widely used in communication. Give one other use of optical fibres.
 - b. The light inside an optical fibre is contained by total internal reflection. Explain what is meant by this. You should use the term critical angle in your explanation.
 - c. The refractive index of glass is 1.52, what is the critical angle of a glass optical fibre?

AS Level

Particles & Radiation

1. Question 1

- Give two differences between hadrons and leptons and give two examples of each.
- Hadrons are categorised into two groups. Name these two groups and give their corresponding quark compositions.
- The K^- meson can decay via the following decay process:



What interaction is responsible for this process? State one quantity that is conserved in this process and one quantity that is not.

2. Question 2

- What is meant by the term isotope?
- $^{14}_6\text{C}$ is a radioactive isotope of carbon and can decay via beta minus decay into nitrogen. Write down the decay equation representing this process including all the decay products.
- What is the specific charge of the nitrogen nucleus?

Electromagnetic Radiation & Quantum Phenomena

- ### 3. Question 3 -
- When photons of frequency f are incident on a material, electrons with kinetic energy E_k are emitted. This behaviour is described by the photoelectric equation, $hf = \phi + E_k. (2)$

- ϕ is the work function of the material. Explain the physical meaning of this quantity.

- b. If the energy of the incident photons is lower the work function of a material, no electrons are emitted. Explain the difference between ionisation and excitation.
 - c. Why do electrons emitted by photoelectric absorption have a range of kinetic energies up to a maximum value?
 - d. The work function of silicon is 4.72 eV. If UV light of wavelength $\lambda = 209 \text{ nm}$ is incident on a the surface of silicon, what is the maximum kinetic energy of the electrons emitted?
4. Question 4- In the famous two-slit experiment, electrons are fired through two parallel slits in an otherwise opaque plate and the electrons are then detected on a screen behind the plate.
- a. An interference pattern is observed on the screen. What does this suggest about the nature of electrons?
 - b. Electrons in a double-slit experiment are travelling at $6.3 \times 10^5 \text{ ms}^{-1}$. Calculate the de Broglie wavelength of the electrons.
 - c. Alpha particles emitted in the radio active decay of radium have a kinetic energy of 4.74 MeV. Calculate their de Broglie wavelength.

Current Electricity

5. Question 5- An AC current supply has an output RMS voltage of 18 V supplied at a frequency of 50 Hz. (i) Calculate the peak voltage of the mains supply.
- a. The voltage supply is connected to a resistive wire with a resistivity of $2.44 \Omega\text{m}$. The wire is 72 cm long and has a cross section of 0.243 cm^2 . Calculate the resistance of the wire and hence calculate the peak power dissipated in the wire.
 - b. The wire is then cooled with liquid helium down from room temperature to 4 K. At this point the resistance in the wire suddenly drops to zero. What does this suggest about the material the wire is made from?
 - c. Give one technological application of materials that exhibit this property.

A2 Level

Further Mechanics

1. Question 1 - Two trains, A and B, have masses $m_A = 3.2 \text{ kg}$ and $m_B = 4.1 \text{ kg}$ respectively.
The trains collide inelastically on a frictionless track and stick together. After the collision the trains move together.
 - a. Which quantity is conserved in both elastic and inelastic collisions?
 - b. Kinetic energy is not conserved in inelastic collisions. Where is the kinetic energy dissipated?
 - c. Train A has an initial velocity $v_A = 4 \text{ ms}^{-1}$ and collides with a stationary train B ($v_B = 0$). After the collision they move together with velocity v_{AB} . Calculate v_{AB} .

Gravitation

2. Question 2 - Geosynchronous orbits have an orbital period such that an observer on Earth will observe the satellite at the same point in the sky after one day.
[Required data for question: Earth's mass - $M_C = 6.00 \times 10^{24} \text{ kg}$; Earth's radius - $R_C = 6.40 \times 10^6 \text{ m}$]
 - a. Geostationary orbits are a special case of geosynchronous orbits. Explain what is meant by a geostationary orbit.
 - b. Show that the required altitude of a geostationary orbit is $3.58 \times 10^7 \text{ m}$.
 - c. Calculate the orbital velocity and period of the orbit.

Electric Fields

3. Question 3

- a. In words, state Coulomb's law describing the force between two point charges in a vacuum and write down the corresponding equation. Define all the terms in the equation.
- b. Two negative charges each have charge $Q = ae$, where a is a constant and e is the electron charge. The charges are placed 50 nm apart and the force between them is 1.87×10^{-12} N. Calculate a .
- c. What is the electric potential experienced by each of the charges due to the presence of the other charge?
- d. How much work is required to increase the distance between the charges to 150 nm?

Electric Fields

4. Question 4

- a. Write down the equation describing the charge on a capacitor as it discharges. Write the equation in terms of the initial charge Q_0 and a time constant $\tau = RC$.
- b. Explain the physical significance of the time constant.
- c. For an initial charge $Q_0 = 0.65$ C, what is the charge on the capacitor after a time $t = 5\tau$?
- d. Sketch a graph of charge against time for a capacitor discharging from an initial charge of $Q_0 = 0.65$ C. Mark on your graph the value of Q at $t = \tau, 2\tau$ and 5τ .

5. Question 5: A circular coil of 15 turns is placed in 1.2 T magnetic field with the normal to the plane of the coil at an angle θ to the direction of the field. The coil radius is 35 cm.

- a. In words, state Faraday's law for induced emf in a coil and write down the corresponding equation. Define all the terms in the equation.



- b. The flux linkage passing through the coil is 6.2 Tm^2 . Calculate θ .
- c. The coil is rotated until the normal to the plane of the coil is perpendicular to the field direction. What is the flux linkage now?
- d. The coil is now uniformly rotated at an angular frequency of $\omega = 2.4 \text{ rad s}^{-1}$. What emf is induced in the coil?

