

Selection Examination to “ToshTech” technical university in PHYSICS

Notes on the Sample Examination Paper

Applicants should keep in mind that the tasks included in the sample examination do not cover all content elements that will be assessed in the actual versions of the Selection Examination. The list of content topics is provided in the Selection Examination specification document.

The sample examination is intended to give any applicant and the wider public an idea of the structure of the Selection Examination, the number of tasks, their format, and the overall level of difficulty of the examination.

ATTENTION

The sample examination contains several example tasks for some positions of the Selection Examination. In the actual examination, only one task will be presented for each position. The values of constants and reference information will be provided in a separate section.

Sample Examination, 2026

Part 1

Answers to Tasks 1–10

Complete the given task and write your answer on Answer Sheet No. 1 to the right of the corresponding task number. Units of measurement are not required.

1. A car starts moving from rest and travels with a constant acceleration of 3 m/s^2 . Find the distance travelled by the car during the first 4 s. Give your answer in metres.

OR

1. A boat is moving downstream. The speed of the boat relative to the water is 12 km/h, and the speed of the current is 3 km/h. Find the speed of the boat relative to the shore. Give your answer in km/h.

OR

1. A car is moving at a speed of 25 m/s and begins braking with an acceleration of 5 m/s^2 . How many seconds will it take for the car to come to a stop? Give your answer in seconds.

2. A body of mass 4 kg is acted upon by a horizontal force of 20 N. The coefficient of friction between the body and the surface is 0.2. Take the acceleration due to gravity to be 10 m/s^2 . Find the acceleration of the body. Give your answer in m/s^2 .

OR

2. A spring with spring constant 200 N/m is stretched by 5 cm. Find the elastic force. Give your answer in newtons.

OR

2. A body of mass 2 kg is moving at a speed of 4 m/s. After the action of a constant force, its kinetic energy increases by 36 J. Find the final speed of the body. Give your answer in m/s.

3. A vessel of volume 0.05 m^3 contains 2 moles of an ideal gas at a temperature of 300 K. Find the gas pressure. Take the universal gas constant to be $8.31 \text{ J/(mol}\cdot\text{K)}$. Give your answer in kilopascals.

OR

3. A gas is at a pressure of 100 kPa and a temperature of 300 K. After being heated to 450 K, its volume increases by a factor of 1.5. Find the final pressure of the gas. Give your answer in kilopascals.

OR

3. An ideal gas occupies a volume of 2 m^3 at a pressure of 100 kPa. After compression, its volume becomes 0.5 m^3 , while the temperature remains constant. Find the final pressure of the gas. Give your answer in kilopascals.

4. A gas receives 800 J of heat and performs 300 J of work. Find the change in the internal energy of the gas. Give your answer in joules.

OR

4. Water of mass 1 kg cools from 80°C to 30°C . The specific heat capacity of water is $4200 \text{ J}/(\text{kg}\cdot^\circ\text{C})$. Find the amount of heat released by the water. Give your answer in kilojoules.

OR

4. A heat engine receives 1000 J of heat from the heater and transfers 700 J of heat to the cooler. Find the efficiency of the heat engine. Give your answer as a percentage.

5. Two identical point charges of 3 nC each are located at a distance of 3 cm from each other. Find the force of interaction between the charges. Take the proportionality constant in Coulomb's law to be $9 \cdot 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$. Give your answer in micronewtons.

OR

5. The work done by an electric field in moving a charge of 5 mC between two points is 10 J. Find the potential difference between these points. Give your answer in volts.

OR

5. A charge of $4 \mu\text{C}$ moves along the direction of a uniform electric field of strength 3 kV/m through a distance of 50 cm. Find the work done by the electric field. Give your answer in millijoules.

6. A resistor of resistance 4Ω is connected to a voltage source of 12 V. Find the current in the circuit. Give your answer in amperes.

OR

6. Two resistors with resistances of 6Ω and 12Ω are connected in parallel and connected to a voltage source of 12 V. Find the current supplied by the source. Give your answer in amperes.

OR

6. An electric kettle with a power rating of 2 kW operates for 3 minutes. Find the work done by the electric current. Give your answer in kilojoules.

7. The period of oscillation of a simple pendulum is 2 s. Find the frequency of oscillation. Give your answer in hertz.

OR

7. The frequency of a wave is 50 Hz, and its propagation speed is 100 m/s. Find the wavelength. Give your answer in metres.

OR

7. A wave propagates with a speed of 50 m/s. During 4 s, the source makes 40 complete oscillations. Find the wavelength. Give your answer in metres.

8. An object is placed 30 cm from a converging lens with a focal length of 15 cm. Find the distance from the lens to the image. Give your answer in centimetres.

OR

8. A light ray strikes the boundary between two media at an angle of 40° to the normal. The angle of refraction is 25° . Find the refractive index of the second medium relative to the first. Assume that $\sin 40^\circ = 0.64$ and $\sin 25^\circ = 0.42$. Round your answer to two decimal places.

OR

8. Monochromatic light with a wavelength of 500 nm falls on a diffraction grating with a grating spacing of $2 \cdot 10^{-6}$ m. Find the order of the maximum observed when $\sin \varphi = 0.5$. Give your answer as a number.

9. An electron in a hydrogen atom transitions from a higher energy level to a lower one. A photon with energy $3.2 \cdot 10^{-19}$ J is emitted. Take Planck's constant to be $6.4 \cdot 10^{-34}$ J·s. Find the frequency of the radiation. Give your answer in units of 10^{14} Hz.

OR

9. The frequency of a spectral line is $6 \cdot 10^{14}$ Hz. Take the speed of light to be $3 \cdot 10^8$ m/s. Find the wavelength of the radiation. Give your answer in nanometres.

OR

9. The energy of an electron in the ground state of a hydrogen atom is -13.6 eV. Find the wavelength of the photon emitted when the electron transitions from the third energy level to the second energy level. Assume that $hc = 1240$ eV·nm. Give your answer in nanometres.

10. The work function of electrons in a metal is 2 eV. Light with photon energy of 5 eV falls on the surface of the metal. Find the maximum kinetic energy of the photoelectrons. Give your answer in electron-volts.

OR

10. The half-life of a radioactive substance is 8 hours. What fraction of the original amount of the substance will remain after 24 hours? Give your answer as a decimal fraction.

OR

10. The nucleus of an atom has a mass number of 238 and an atomic number of 92. After one α decay, find the mass number of the resulting nucleus. Give your answer as a number.

Part 2

ATTENTION

Use Answer Sheets No. 2 to record your solutions and answers for Tasks 11–14. Write your solution as completely and in as much detail as possible. Remember that even if you are unable to solve the problem completely, you may receive partial credit for significant progress toward the solution, provided that such progress meets the established marking criteria.

11. Two bodies move along the same straight line toward each other. The mass of the first body is 2 kg and its speed is 5 m/s. The mass of the second body is 3 kg and its speed is 2 m/s.

After a perfectly inelastic collision, the bodies continue moving together as a single object.
Find the speed of the bodies after the collision.

12. A heat engine receives 2000 J of heat from the heater during one cycle and has an efficiency of 30%.

1. Find the work performed by the engine during one cycle.
2. Find the amount of heat transferred to the cooler.
3. By what percentage must the efficiency of the engine be increased so that, with the same amount of heat received from the heater, the work performed during one cycle becomes 800 J?

13. A battery with an EMF of 24 V and an internal resistance of 1Ω is connected to a circuit consisting of two resistors with resistances of 6Ω and 12Ω connected in parallel. Determine the efficiency of the source of current. Assume that the useful work is the heat generated in the resistors.

14. Light with a wavelength of 500 nm falls on a diffraction grating with a grating spacing of $2 \cdot 10^{-6}$ m. Determine the number of diffraction maxima that can be observed on the screen.