

Name: _____

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IB Physics — Practice Exam

Instructions: A calculator is permitted. Answer all questions in the spaces provided and show your working: method marks are awarded even when the final answer is wrong. All data needed are given in the questions.

Time Limit: 60 minutes

Multiple Choice (15 questions)

- [1 point] 1. A stone is released from rest and falls freely with negligible air resistance. It falls a distance h during the first 2.0 s. What distance does it fall during the next 2.0 s?
- A. h
 - B. $2h$
 - C. $3h$
 - D. $4h$
- [1 point] 2. A student of mass 60 kg stands on a weighing scale in a lift. The lift accelerates downwards at 2.0 m s^{-2} . Take $g = 9.8 \text{ m s}^{-2}$. What force does the scale exert on the student?
- A. 120 N
 - B. 468 N
 - C. 588 N
 - D. 708 N
- [1 point] 3. A trolley of mass 2.0 kg moving at 3.0 m s^{-1} collides with a stationary trolley of mass 1.0 kg. The trolleys stick together. What fraction of the initial kinetic energy is lost in the collision?
- A. 0
 - B. $\frac{1}{3}$
 - C. $\frac{1}{2}$
 - D. $\frac{2}{3}$
- [1 point] 4. A uniform horizontal beam of length 4.0 m and weight 200 N rests on two supports, one at each end. A load of weight 400 N is placed on the beam 1.0 m from the left-hand end. What is the force exerted by the right-hand support on the beam?
- A. 100 N
 - B. 200 N
 - C. 300 N
 - D. 400 N

- [1 point] 5. A fixed mass of an ideal gas has pressure p at absolute temperature T and volume V . The volume is halved and the absolute temperature is doubled. What is the new pressure of the gas?
- A. $\frac{p}{4}$
 - B. p
 - C. $2p$
 - D. $4p$
- [1 point] 6. A 2.0 kW heater supplies energy to 0.50 kg of water that is already at its boiling point. The specific latent heat of vaporisation of water is $2.3 \times 10^6 \text{ J kg}^{-1}$. Assuming no energy losses, how long does it take to boil away all of the water?
- A. 290 s
 - B. 575 s
 - C. 1150 s
 - D. 2300 s
- [1 point] 7. The Sun's surface temperature is about 5800 K and its emission spectrum peaks at a wavelength of 500 nm. The spectrum of a different star peaks at 250 nm. Treating both as black bodies, what is the surface temperature of this star?
- A. 2900 K
 - B. 5800 K
 - C. 11 600 K
 - D. 23 200 K
- [1 point] 8. A mass attached to a horizontal spring oscillates with simple harmonic motion of amplitude A on a frictionless surface. At what displacement from the equilibrium position are the kinetic energy of the mass and the elastic potential energy of the spring equal?
- A. $\frac{A}{4}$
 - B. $\frac{A}{2}$
 - C. $\frac{A}{\sqrt{2}}$
 - D. $\frac{\sqrt{3}}{2}A$
- [1 point] 9. An ambulance siren emits sound of frequency 800 Hz. The ambulance moves at 34 m s^{-1} directly towards a stationary observer. The speed of sound in air is 340 m s^{-1} . What frequency does the observer hear?
- A. 727 Hz
 - B. 800 Hz
 - C. 880 Hz
 - D. 889 Hz

- [1 point] 10. Monochromatic light of wavelength 600 nm passes through two narrow slits separated by 0.50 mm. An interference pattern is observed on a screen 2.0 m from the slits. What is the separation of adjacent bright fringes on the screen?
- A. 0.60 mm
 - B. 1.2 mm
 - C. 2.4 mm
 - D. 4.8 mm
- [1 point] 11. A planet has eight times the mass of Earth and twice the radius of Earth. The gravitational field strength at Earth's surface is g . What is the gravitational field strength at the surface of the planet?
- A. $\frac{g}{2}$
 - B. g
 - C. $2g$
 - D. $4g$
- [1 point] 12. A 12 V cell of negligible internal resistance is connected in series with a $4.0\ \Omega$ resistor and a parallel combination of a $6.0\ \Omega$ resistor and a $3.0\ \Omega$ resistor. What is the current in the $3.0\ \Omega$ resistor?
- A. 0.67 A
 - B. 1.3 A
 - C. 2.0 A
 - D. 4.0 A
- [1 point] 13. An electron moves at $2.0 \times 10^6\ \text{m s}^{-1}$ at right angles to a uniform magnetic field of flux density 0.50 T. The magnitude of the charge on the electron is $1.6 \times 10^{-19}\ \text{C}$. What is the magnitude of the magnetic force on the electron?
- A. $8.0 \times 10^{-14}\ \text{N}$
 - B. $1.6 \times 10^{-13}\ \text{N}$
 - C. $3.2 \times 10^{-13}\ \text{N}$
 - D. $6.4 \times 10^{-13}\ \text{N}$
- [1 point] 14. Two energy levels of an atom are $-1.5\ \text{eV}$ and $-3.4\ \text{eV}$. An electron makes a transition from the higher level to the lower level. Using $hc = 1240\ \text{eV nm}$, what is the wavelength of the photon emitted?
- A. 253 nm
 - B. 365 nm
 - C. 653 nm
 - D. 827 nm
- [1 point] 15. Light of wavelength 400 nm is incident on a metal surface whose work function is 2.0 eV. Using $hc = 1240\ \text{eV nm}$, what is the minimum potential difference needed to stop the most energetic photoelectrons?
- A. 1.1 V
 - B. 2.0 V
 - C. 3.1 V
 - D. 5.1 V

Calculations (2 questions)

[10 points] 16. A ball of mass 0.20 kg is projected horizontally at 12 m s^{-1} from the top of a vertical cliff. The top of the cliff is 20 m above a horizontal beach. Air resistance is negligible unless the question states otherwise. Take $g = 9.8\text{ m s}^{-2}$.

[2 points] (a) Calculate the time taken for the ball to reach the beach.

[1 point] (b) Calculate the horizontal distance from the base of the cliff to the point where the ball lands.

[3 points] (c) Determine the speed of the ball just before it reaches the beach.

[2 points] (d) The ball sinks into the sand and comes to rest in 0.050 s . Estimate the average force exerted on the ball by the sand.

- [2 points]** (e) In practice, air resistance is not negligible. Outline the effect of air resistance on (i) the time of flight and (ii) the horizontal distance travelled by the ball.

[10 points] 17. Radon-222, ${}^{222}_{86}\text{Rn}$, is a radioactive gas that decays by alpha emission to an isotope of polonium (Po). The half-life of radon-222 is 3.8 days. In each decay the alpha particle is emitted with a kinetic energy of 5.5 MeV. Take $1\text{ eV} = 1.6 \times 10^{-19}\text{ J}$.

- [1 point]** (a) State what is meant by the half-life of a radioactive nuclide.

- [2 points]** (b) Determine the proton number and the nucleon number of the polonium nuclide formed in the decay.

- [2 points]** (c) A sample initially contains 8.0×10^{18} radon-222 nuclei. Calculate the number of radon-222 nuclei remaining after 19 days.

[1 point] (d) Calculate the kinetic energy of the alpha particle in joules.

[3 points] (e) The radon nucleus is at rest when it decays. Explain, with reference to momentum, why the polonium nucleus recoils, and why its kinetic energy is much smaller than that of the alpha particle.

[1 point] (f) Radon gas is a health hazard when inhaled, yet alpha particles from a source outside the body are usually harmless. Outline why.