

# Sample Exam PHYS1008

Name:

Student Number:

## Section A: Multiple Choices Questions

(Circle the correct answer)

- In a conductor charges are
  - fixed in place
  - free to move
  - are always neutral
  - are always positive
- The presence of a dielectric in a capacitor
  - decreases the electric field between plates
  - decreases current through the capacitor
  - decreases the distance between the plates
  - decreases the area of the plates
- According to Kirchhoff's rule the net voltage change around any circuit loop must be
  - increasing
  - decreasing
  - zero
  - maximum
- The stimulating photon in a stimulated emission in the hydrogen atoms has
  - The same phase as the emitted photon
  - Half the energy of the emitted photon
  - Infinite momentum
  - Twice the frequency of the emitted photon
- According to Kirchhoff's node rule the total current entering a node must be
  - Zero
  - Negative
  - Same as that leaving the node
  - Proportional to the resistance of the node
- An electron is in the  $n=2$  energy level. How many quantum states could this electron have?
  - 4
  - 8
  - 16
  - 32

7. There are two RC circuits, one with  $(R_1, C_1)$  and the other with  $(R_2, C_2)$  where  $C_1=C_2$  and  $R_1=2R_2$ . The time to fully charge  $C_1$  is
- Longer than  $C_2$
  - Shorter than  $C_2$
  - Same as for  $C_2$
  - Depends on the current
8. As the distance from a current carrying wire increases the magnetic field must
- Decrease
  - Increase
  - Remain constant
  - Switch direction
9. In an AC circuit the reactive of the capacitor changes with
- Current
  - Voltage
  - Frequency
  - Phase angle
10. When a light ray travels from an medium with a lower index of refraction to one of higher index of refraction, the angle of refraction with respect to the normal
- Gets larger
  - Gets smaller
  - Goes to  $90^\circ$
  - Goes to  $0^\circ$
11. Light, incident on a metal surface, at with a frequency just above the threshold frequency will
- Free electrons from the metal surface
  - Create a current in the metal surface
  - Reflect with a different frequency
  - Induce a magnetic field
12. The peak of intensity of radiation coming from a blackbody depends on what?
- The temperature of the blackbody
  - The size of the blackbody
  - The charge of the blackbody
  - The magnetic field of the blackbody
13. What effect does a diode have on the current in an AC circuit?
- Amplifies the current
  - Reduces the current
  - Blocks current in a specific direction
  - Converts it to heat

14. The intensity of EM radiation is proportional to
- Its rms velocity squared
  - Square root of the electric energy
  - The negative of the magnetic field
  - The rms electric field squared
15. A path difference of three halves of a wavelength between two coherent light beams with equal frequencies produces
- Complete constructive interference
  - Complete destructive interference
  - Beat patterns
  - Diffraction patterns
16. The all images produced in a single converging lens with objects at the focal length are
- real images
  - on the same side of the lens as the object
  - inverted
  - same size as the objects
17. In order to adjust the magnification of a standard compound microscope one must adjust what parameter?
- The focal length of the objective
  - The focal length of the eyepiece
  - The distance between objective and eyepiece
  - The frequency of illuminating light
18. What is the effect of increasing the number of windings (or turns) in a solenoid?
- Current is increased
  - Current is decreased
  - Magnetic field is increased
  - Magnetic field is decreased
19. What is the role of the iris in the human eye?
- It adjusts to increase the far point
  - It adjusts to decrease the near point
  - It adjusts to change the amount of light entering the eye
  - It enhances separation of light into individual wavelengths
20. The amplitude of the E field in an EM wave is observed to have decreased since its creation what else can we conclude about the wave?
- The speed must have slowed as well
  - The amplitude of the B must have increased to compensate
  - The power of the source must be decreasing
  - The intensity of the wave is decreased over some distance.

## Section B: Simple Calculation Questions

- 1. Enter answer in given area, perform calculations in space provided as these may be included as part of the mark, additional space in exam booklet.**
  - 2. Clearly mark your questions.**
  - 3. Include the equations to be used in your calculations**
  - 4. Use 3 significant figures and scientific notation when appropriate.**
  - 5. Be sure to include the appropriate units for all answers**
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1. How many electrons must be transferred to an object to give it  $-30 \text{ nC}$  of charge?
  2. A parallel plate capacitor has  $0.15 \text{ mm}$  gap between its plates with a  $20\text{V}$  potential difference, what is the electric field between the plates?
  3. How far apart must 2 electrons be if the force between them is  $1.0 \times 10^{-12} \text{ N}$ ?
  4. What is the acceleration experienced by an electron due in a  $2200 \text{ N/C}$  electric field?
  5. What is the magnitude of the force on a proton in an electric field of  $600 \text{ N/C}$ ?
  6. A capacitor has square plates of  $2.0 \text{ cm}$  length, separated by  $1.2 \text{ mm}$ . If the gap is filled by a plastic slab with dielectric constant of  $1.35$ , what is the capacitance?
  7. How much potential energy will an electron gain if it moves through a potential difference of  $800 \text{ V}$ ?
  8. The electric field between two plates connected to a  $45 \text{ V}$  battery is  $600 \text{ V/m}$ . What is the distance between the plates?
  9. It takes  $6.0 \text{ J}$  of energy to move a  $2.0 \text{ mC}$  charge from one plate of a  $60 \mu\text{F}$  capacitor to the other. What charge is on each plate?
  10. A steady current of  $2.5\text{A}$  flows in a wire connected to a battery, after  $4 \text{ min}$  the battery is disconnected and the current stops. How much charge has passed through the wire?
  11. Three resistors,  $10\Omega$ ,  $20\Omega$  and  $25\Omega$ , are in parallel in a circuit what is their equivalent resistance?
  12. What is the magnitude and direction of the electric field midway between two point charges,  $-15\mu\text{C}$  and  $12\mu\text{C}$  that are  $8.0 \text{ cm}$  apart
  13. Two  $1 \text{ C}$  charges experience a repulsive electrostatic force of  $2.5 \text{ N}$ , what is the distance between the two charges

14. Two protons in a  $^{238}\text{U}$  nucleus are  $6.0 \times 10^{-15}$  m apart, what is the mutual potential energy between these protons?
15. An electron in a hydrogen atom is in the 6<sup>th</sup> energy level a photon of what frequency is required for emission for the electron to drop to the ground state (1<sup>st</sup> energy level)?
16. What is the wavelength of a  $4.1 \times 10^{18}$  Hz X-ray?
17. A capacitor has a potential difference of 3.0 V and capacitance of 35.1  $\mu\text{F}$ , what is the charge on the capacitor?
18. An electron with kinetic energy of 4.5 keV is scattered off of a lead atom, what is the minimum frequency of an X-ray produced as a result of the scatter?

## Section C: Longer Calculation Questions

1. An electron is placed at rest on the negative surface of a two charged plates. If the electric field is 1500 N/C between the plates and the distance between plates is 1.2 mm, what is the electron's velocity when it strikes the other plate?
2. Light of 560 nm and 730 nm is incident on a diffraction grating with 6000 slits/cm. What is the distance between the  $m=1$  maxima of the two wavelengths on a screen 1.2 m away?
3. How much energy is released when a  $^{232}\text{U}$  nucleus (mass = 232.037156 u) decays to a  $^{228}\text{Th}$  (mass = 228.028741 u) nucleus by alpha emission (mass = 4.002603 u)
4. The distance between two converging lens is 25 cm, each with a focal length of 12 cm. If an object is place 18 cm to the right of the right most lens what is it magnification in the lens system?
5. Two light bulbs with resistances of 100  $\Omega$  and 200  $\Omega$  respectively are connected in series with a 2.5 V EMF. How much power is dissipated through each light bulb?
6. A calcium ion ( $q=2e^+$ ,  $m=66.4 \times 10^{-27}$  kg) is accelerated through a potential different of 12 kV and then injected to a magnetic field of 0.85 T. What is the radius of the orbit of the resulting trajectory in the field?