

St John Baptist De La Salle Catholic School, Addis Ababa
Grade 10 Physics Final Examination
4th Quarter

June, 2022

Notes, and use of other aids is **NOT** allowed. Read all directions carefully and write your answers in the space provided. To receive full credit, you must show all of your work. **Give the answer in the answer sheet provided.**

Useful Constants

- $e = 1.6 \times 10^{-19} \text{C}$ - elementary charge $m_e = 9.11 \times 10^{-31} \text{kg}$ - mass of an electron
- $m_p = 1.673 \times 10^{-27} \text{kg}$ - mass of a proton $\mu_0 = 4\pi \times 10^{-7} \frac{\text{H}}{\text{m}}$ - permeability of free space
- $\epsilon_0 = 8.85 \times 10^{-12} \frac{\text{F}}{\text{m}}$ - permittivity of free space $G = 6.672 \times 10^{-12} \frac{\text{Nm}^2}{\text{kg}^2}$ - gravitational constant
- $N_A = 6.022 \times 10^{23} \frac{1}{\text{mol}}$ - Avogadro's number $a_g = 10 \text{m/s}^2$ - acceleration due to gravity
- $\sin 60^\circ = \cos 30^\circ = \frac{\sqrt{3}}{2}$ **AND** $\sin 30^\circ = \cos 60^\circ = \frac{1}{2}$
- $\sin 37^\circ = \cos 53^\circ = 0.6$ **AND** $\sin 53^\circ = \cos 37^\circ = 0.8$
- $\sin 45^\circ = \cos 45^\circ = \frac{\sqrt{2}}{2}$ **AND** $\sin 90^\circ = \cos 0^\circ = 1$ **AND** $\sin 0^\circ = \cos 90^\circ = 0$

Name: _____ Roll Number: _____ Section: _____ Time Allowed: **1:45 hr**

Multiple Choice Questions

1. The bouncing of light rays when it encounters a different medium is defined as:
A. reflection [**Correct Answer**] B. refraction C. diffraction D. interference
2. Lenz's law follows from the conservation of which of the quantities listed below?
A. Charge B. Mass C. Energy [**Correct Answer**] D. Momentum
3. In which case does a full wave rectification occur?
A. By using a single P-N junction diode
B. By using a P-N junction diode along with a capacitor
C. By using a bridge rectifier [**Correct Answer**]
D. By using a transistor
4. What are the properties of images created using diverging mirrors?
A. Virtual B. Diminished C. Inverted D. A & B [**Correct Answer**]

5. A generator supplies 100V to the primary coil of a transformer. The primary has 50 turns and the secondary has 500 turns. The secondary voltage is:
 A. 1000V [**Correct Answer**] B. 500V C. 100V D. 10V
6. In an electric circuit at home, a student wanted to use a fuse to safeguard her radio set that has a 5V transformer supply. If the fuse operates at a maximum of 6W, how should it be connected?
 A. In parallel with the radio next to the transformer
 B. In series with the radio before the main input [**Correct Answer**]
 C. In parallel with the radio before the main input
 D. In series with the radio next to the transformer

7. A pin stands erect 10cm from a converging mirror of focal length 20cm. How far apart are the pin and its image?

$$\frac{1}{S_i} = \frac{1}{f} - \frac{1}{S_o}$$

$$\frac{1}{S_i} = \frac{1}{20cm} - \frac{1}{10cm}$$

$$\frac{1}{S_i} = \frac{1-2}{20cm} = \frac{-1}{20cm}$$

$$S_i = -20cm$$

Thus, 20cm + 10 cm = 30 cm

- A. 10cm B. 30cm [**Correct Answer**] C. 20cm D. 7cm
8. A long solenoid has 1000 turns uniformly distributed over a length of 0.40m. What current is required in the windings to produce a magnetic field of $\pi \times 10^{-4}$ T at the center of the solenoid?

$$B = \frac{\mu_0 NI}{L}$$

$$I = \frac{BL}{\mu_0 N} = \frac{\pi \times 10^{-4}T \times 0.4m}{4\pi \times 10^{-7}H/m \times 1000} = \frac{4 \times 10^{-5}Tm}{4 \times 10^{-4}H/m}$$

$$I = 0.1A$$

- A. 0.01A B. 1.0A C. 0.1A [**Correct Answer**] D. 10A
9. When discussing Power generated by hydroelectric dams, we saw quantities being expressed in units of KWh, what physical quantity does the unit represent?
 A. Power B. Charge C. Energy [**Correct Answer**] D. Current
10. An input of direct current is sent into an unknown electrical device and when current emerges out of the device, the output current is direct. What device could the unknown be?
 A. Inverter B. Rectifier C. Bridge Rectifier D. Inductor [**Correct Answer**]
11. What is the inductive time constant of a circuit with a resistance of 100K Ω and L=20mH?
 A. 2K Ω s B. 20 Ω s C. 2 Ω s D. 200 Ω s [**Correct Answer**]

$$\tau_L = \frac{L}{R} = \frac{20 \times 10^{-3}s}{100 \times 10^3}$$

12. What is the unit of magnetic flux density?
 A. T/m² B. Tm C. T/m D. Tm²
 [**Correct Answer**] : T

13. The objective of adding impurities to a semiconductor crystal is to:

- A. decrease the resistance of the crystal [**Correct Answer**]
 B. increase the number of minority carriers
 C. decrease the number of majority carriers
 D. make the crystal impure
14. The emission of conduction electrons from the hot meta in a Fermi valve is known as:
 A. Charger emission B. Thermionic emission [**Correct Answer**] C. Photoelectric emission
 D. Electron emission
15. The period of a transverse electromagnetic wave is 1ms, what is its frequency?

$$f = \frac{1}{T} = \frac{1}{10^{-3}s} = 1000Hz = 1Khz$$

- A. 100Hz B. 1KHz [**Correct Answer**] C. 1Hz D. 100m
16. A transformer on a pole near to a factory steps the voltage down from 3600V to 220V. What is the current in the primary coil when the transformer delivers 900KW to the factory?

$$P = IV \implies I = \frac{P}{V} = \frac{9 \times 10^5 W}{3.6 \times 10^3 V} = 2.5 \times 10^2 A$$

The primary idea in this questions is that the power delivered is the input power since power is conserved.
 A. 0.25A B. 4.1A C. 250A [**Correct Answer**] D. 220A

17. If a mirror produces a real image that is four times as large as the object and the object is located 24cm from the mirror, what is the focal length of the mirror?

$$M = -\frac{S_i}{S_o}$$

$$S_i = -MS_o$$

$$S_i = -4 \times 24cm = -96cm$$

But since the image is real, $S_i = 96cm$

$$\frac{1}{f} = \frac{1}{S_i} + \frac{1}{S_o}$$

$$\frac{1}{f} = \frac{1}{96cm} + \frac{1}{24cm}$$

$$\frac{1}{f} = \frac{1+4}{96cm}$$

$$\frac{1}{f} = \frac{5}{96cm}$$

$$f = \frac{96cm}{5} = 19.2cm$$

- A. 4cm B. 8.2cm C. 6cm D. 4.8cm

Correct Answer: 19.2cm

18. A stove that draws 10A current from a 220V line is used for five hours. If the charge of the electricity used is 20 cents per kilowatt-hour, what is the cost of electrical energy consumed?

$$P = IV = 10A \times 220V = 2200W = 2.2KW$$

$$E = Pt = 2.2KW \times 5hours$$

$$E = 11KWh$$

$$1KWh \implies 20 \text{ c}$$

$$11Kwh \implies \text{cost}$$

$$\text{cost} = 220 \text{ c}$$

220 cents is equal to 200 cents(2 Birr) and 20 cents added which effectively gives us 2 Birr and 20 cents

- A. 1 Birr and 10 cents B. 2 Birr and 20 cents [**Correct Answer**] C. 55 cents D. 1 Birr
19. which of the following logic gates are equivalent?
 A. An **AND** and a **NOT-NAND** [**Correct Answer**] B. An **OR** and a **NOT** C. An **AND** and a **NAND** D. A **NOT** and an **XOR**

20. When a P-N junction is forward biased:

- A. The depletion layer size decreases [**Correct Answer**]
 B. Current can not flow through the diode
 C. The depletion layer size increases
 D. Electrons flow from the P-type to the N-type

21. In a CRO, the distance between the crests of the signal is 4cm. The time base is set at 10ms/cm and the gain control is set at 4V/cm. If the vertical distance between the crests is 8cm, what is the period of the wave?

$$T = \text{time base} \times \text{wave length}$$

$$T = 10ms/cm \times 4cm = 40ms = 40 \times 10^{-3}s = 0.04s$$

- A. 25s B. 0.4s C. 2.5s D. 0.04s [**Correct Answer**]
22. What is the magnetic field strength at the center of the solenoid of 200 turns and 4cm long when it is carrying a current of 2A?

$$B = \frac{\mu_0 NI}{L}$$

$$B = \frac{4\pi \times 10^{-7} H/m \times 200 \times 2A}{0.04m}$$

$$B = 4\pi \times 10^{-3} T$$

$$B = 1.256 \times 10^{-2} T$$

- A. 1.256 T B. $1.256 \times 10^{-3} T$ C. $1.256 \times 10^{-2} T$ [**Correct Answer**] D. $1.256 \times 10^{-4} T$
23. A coil consists of 2 turns of wire. Each turn is a square of side 40cm and a uniform magnetic field is directed into the plane and it changes from 0 to 0.5T in 0.25 s, what is the magnitude of the induced EMF?

$$\varepsilon = N \frac{\Delta\phi}{\Delta t}$$

$$A = (0.4m)^2 = 0.16m^2$$

$$\varepsilon = 2 \frac{(0.5T - 0T) \times 0.16m^2}{0.25s}$$

$$\varepsilon = 0.64V$$

- A. 0.64V [**Correct Answer**] B. 0.32V C. 6400V D. 3200V
24. What is the name given to waves spreading when they pass through a gap or face an obstacle?
A. Reflection B. Refraction C. Diffraction [**Correct Answer**] D. Interference
25. A transistor is used to amplify current and can also be used as a switch. A transistor has two junctions and what is the terminal at the middle of the junction called?
A. Emitter B. Collector C. Transistor D. Positive Terminal
[**Correct Answer**]: Base
26. The energy stored in the inductor of an RL circuit is given by:
A. $E \frac{1}{2} VQ$ B. $E \frac{1}{2} VR$ C. $E \frac{1}{2} LI^2$ [**Correct Answer**] D. $E \frac{1}{2} VI$
27. The operation of a transformer can be explained based on which of the following laws?
A. Right Hand Rule B. Lenz's Law C. Faraday's Law of Induction [**Correct Answer**] D. Fleming's Left Hand Rule
28. Why is the rectification by a single diode half-wave?
A. The current that is allowed to pass is only when the diode is forward biased. [**Correct Answer**]
B. The current that is allowed to pass is only when the diode is reverse biased.
C. The diode bias changes as the current changes its terminals
D. The current goes through 2 cycles each run
29. How is an electromagnetic field produced?
A. A steady current B. A moving charge C. Electrostatic fields D. Accelerating charges
[**Correct Answer**]
30. Cathode ray tubes and oscilloscopes can be used to measure everything given below but:
A. Period B. Frequency C. Field Strength [**Correct Answer**] D. Voltage

Problems

31. Show that V/H and A/s are the same by doing a dimensional analysis.

$$H = \Omega s$$

$$V/H = \frac{V}{\Omega s} = \frac{V}{\Omega} \frac{1}{s} = A/s$$

QED

32. Calculate the induced EMF as a result of inductance when the current changes from 6A to 14 A in 4 seconds and the inductance is 10H. What will the induced EMF do?

$$\varepsilon = L \frac{\Delta I}{\Delta t} = 10H \times \frac{14A - 6A}{4s}$$

$$\varepsilon = 20V$$

33. Plot a signal for a CRO for a signal of frequency 100Hz and maximum voltage 6V if the gain control is 2V/cm and time base is 1ms/cm.

Left for reader

34. Calculate the inductive time constant of a circuit which has an inductor with an inductance of 6mH and a resistor of resistance 300Ω . If the EMF supplied by the battery is 60V, calculate the time needed for the current to drop to 0.1A. ($\ln 0.5 = -0.693$)

$$\tau_L = \frac{L}{R} = \frac{6 \times 10^{-3} H}{300 \Omega} = 2 \times 10^{-5} s$$

We know that:

$$I(t) = \frac{\varepsilon}{R}(1 - e^{-\frac{t}{\tau_L}})$$

$$0.1A = \frac{60V}{300\Omega}(1 - e^{-\frac{t}{\tau_L}})$$

$$0.1A = 0.2A(1 - e^{-\frac{t}{\tau_L}})$$

$$0.5 = e^{-\frac{t}{\tau_L}}$$

$$\ln 0.5 = \ln e^{-\frac{t}{\tau_L}}$$

$$-0.693 = \frac{-t}{\tau_L}$$

$$t = 0.693 \times 2 \times 10^{-5} s = 1.386 \times 10^{-5} s$$

35. An object of height 5cm is placed in front of a convex mirror of radius 40 cm 25 cm away from the mirror. Determine the height of the image, how far it is from the mirror, whether it is real or virtual and whether it is upright or inverted.

The first thing we can calculate from here is the distance of the image.

$$\frac{1}{S_i} = \frac{1}{f} - \frac{1}{S_o}$$

$$\frac{1}{S_i} = \frac{1}{-20cm} - \frac{1}{25cm}$$

$$\frac{1}{S_i} = \frac{5 - (-4)}{-100cm}$$

$$\frac{1}{S_i} = \frac{9}{-100cm}$$

$$S_i = -\frac{100cm}{9}$$

We can see that the image that is formed is behind the mirror thus, virtual.

$$M = \frac{h_i}{h_o} = -\frac{S_i}{S_o}$$

$$h_i = -h_o \frac{S_i}{S_o}$$

$$h_i = -5cm \times \frac{\frac{-100}{9cm}}{25cm}$$

$$h_i = \frac{20cm}{9}$$

From this we can see that the image is upright since h_i is positive and since $h_i < h_o$, the image is diminished.