**FORM FOUR PHYSICS**

**MID-TERM EXAM**

**NOVEMBER 2021**

**TIME: 1 HOUR 15 MIN**

**INSTRUCTIONS**

Answer all questions in the spaces provided.

1. a) Define the term principal focus as used in thin lenses. (2mks)

**- This a point on the principal axis where rays parallel and close to it coverage after refraction for a convex lens and appears to diverge from for a concave lens.**

b) A four times magnified virtual image is formed by an object place 12cm from a converging lens. Calculate the position of the image and the focal length of the lens. (4mks)

**i) Image distance 4 = v**

 **m = 4 = v 12**

 **4 √**

 **U = 12cm = 48cm**

**ii) Focal length**

**Since the image formed in virtual, then V is negative**

**I = I + I I = - 1 + 4**

**f u v f 48 f = 16cm**

**1 = 1 + 1 1 = 3 = 1**

**f 12 -48 f 48 16**

2. a) Describe how x-rays are produced. (2marks)

**Fast moving electrons from the cathode which are thermionically emitted are stopped by a metal target. Part of their K.E is converted to X-rays.**

b) Differentiate between hard X-rays and soft X-rays. (2mks)

**i) Hard X-rays have very short wave length while soft X-rays have relatively longer wavelength.**

**ii) Hard are produced by a high acceleration voltage while soft are produced by low accelerating voltage.**

**iii) Hard has a high penetrating power while soft has low penetrating power.**

c) An X-ray tube is operating with an anode potential of 25kV and a current of 20 m A.

i) Calculate the number of electrons hitting the target per second. (3mks)

**Current I = 20 m A = 20 x 10-3A 20 x 10-3 =n**

 **1.6 x 10-19**

**Q = it also Q = en n = 1.25 x 1017 electrons**

**20 x 10-3 x 1 = 1.6 x 10-19 x n**

**Where n is the number of electron**

ii) Determine the average velocity with which the electron strike the target (e = 1.6 x 10-19c, mass of electron = 9.1 x 10-31kg) (3mks)

**ev = ½ m√ 2 V2 = 8.791 x 1015**

**1.6 x10-19 x25, 000 = ½ x 9.1 x 10 -31 x √2 V = 9.376 x 107m/s**

**4 x 10-15 = 4.55 x 10-31 x √2**

**4 x 10-15 = V2**

**4.55 x 10-31**

3. a) Define the term threshold frequently. (1mk)

**This is the minimum frequency of the radiation that would cause omission of electrons from a metal surface.**

b) The figure below shows a set up used to demonstrate photoelectric effect using a photocell.

 Uv A

 A

 Vacuum

 + -

I) Explain why current flow when uv is shown on the part labeled A. (2mks)

**The electrons on the surface of the cathode absorb the u.v light and are dislodged from the metal surface. The emitted electrons are then attracted to the anode causing the current to flow.**

ii) Explain why u.v and not infrared radiation is used. (1mk)

**Infrared has lower frequency than u.v therefore has low energy.**

iii) Give one reason why the photocell is evacuated. (1mk)

**To minimize the chances of the emitted electrons colliding with air which will reduce their kinetic energy.**

d) In an experiment to observe photo-electric emission from a clean caesium surface, the following readings were observed.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Stopping potential (v)  | 0.6 | 1.0 | 1.4 | 1.8 | 2.2 |
| Frequency (x1014)Hz | 6 | 7 | 8 | 9 | 10 |

i) Plot a graph of stopping potential (vs) against frequency. (4mks)

 From the graph;

ii) Threshold frequency of the surface **(4.5 x 1014Hz)** (1mk)

iii) Threshold wavelength of the surface (c = 3.0 x 108 m/s) **(6.66 x 10-7m)** (2mks)

iv) Planck’s constant **(6.56 x 10 -34 js)** (2mk)

v) Work function of the surface in ev **(1.845ev)** (1mk)

4. a) Give two properties of cathode rays. (2mks)

**- Travells in a straight line**

**- Possesses kinetic energy**

**- Deflected by both electric and magnetic fields**

b) The figure below shows the trace on the screen of an ac signal connected to the y – plates of a CRO with the time base on:



Given that the time base control is 5ms/div and y- gain is at 100v/div, determine

a) The frequency of the a.c. (3mks)

**Time base control = 5ms/div**

**Number of divisions covered = 8**

**Total time = 5 x 8 = 40ms**

 **= 40 x 10-3 sec**

**Number of cycles = 2**

**Periodic time = 20 x 10-3 sec**

**F = 1/T = 1 = 50Hz**

 **20 x 10-3**

b) The peak voltage of the input signal. (2mks)

**Y – gain = 100 v/div**

**Dif lection = 3 div from zero level**

**Peak voltage = Y – gain x number of division**

 **= 100 x 3**

 **= 300 v**

5. a) Define the term electromagnetic induction. (1mk)

**This is the production of electricity/ voltage in a conductor situated in a changing field or a conductor moving through a stationary magnetic field.**

b) Give two factors that affects the magnitude of the induced Emf; (2mks)

**- Strength of the magnet**

**- Number of turns in the coil**

**- Speed at which the wire cut the field.**

c) A transformer with primary coil of 400 turns and secondary coil 200 turns in connected to 240v a.c mains. Calculate the secondary voltage. (2mks)

**VP = NP**

**Vs Ns**

**240 = 400 Vs = 120V**

 **Vs 200**

6. a) Describe how the following factors affects the centripetal force of a body. (2mks)

i) Mass of the body.

**The bigger the mass the bigger centripetal force.**

ii) Radius of the path.

**The smaller the radius of the path, the bigger the centripetal force.**

b) A car of man 1200kg moving round a bend of radius 50m. If the coefficient of friction between the road and then tyre is 0.8, calculate the maximum speed at which the car should be driven at for it not to skid on the bend. (3mks)

**U = fr = fr Fr = mv2 v2 = 400**

 **R mg r**

**Fr = ymg 9600 = 1200 x v2 v = 20m/s**

 **50**

 **= 0.8 x 1200 x 10 v2 = 9600 x 50**

 **= 9600N 1200**

7. The following reaction is part of a radioactive series. Identify the radiation X and determine the values C and Z. (3mks)

21083A x 210 84B a czQ

**X – Beta practice**

**C – 206**

**Z - 82**