



**CHRIST HIGH SCHOOL PLOT 5, CHS  
STREET, KM 32, ABUJA-KEFFI ROAD  
UKE, NASARAWA STATE**

**END OF SECOND TERM  
EXAMINATION 2023/2024  
ACADEMIC SESSION**

**SUBJECT: PHYSICS**

**CLASS: SS 3**

**TIME: 2 Hours 45 minutes**

**NAME.....**

**CANDIDATE'S ADMISSION NO.**

**INSTRUCTION**

**Write your name and number in the space  
provided on your answer booklet. Write  
your name on any extra sheet used.**

**Answer all questions in Section A**

**Answer eight (8) questions in Section B  
(five from part I and three from part II)**

**At the end of the examination, staple all  
your work securely together.**

**FOR EXAMINER'S USE**

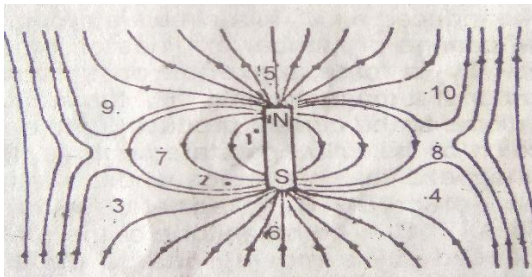
**Total Score:**

**+**

## OBJECTIVE

1. Which of the following colours of surfaces will radiate heat energy best?
  - A. Red
  - B. White
  - C. Black
  - D. Yellow
  - E. Blue
2. Which of the following statements is not correct for a light ray passing through a rectangular glass block which is surrounded by air?
  - A. It suffers a displacement at the point of emergence
  - B. Emerges parallel to the incident ray
  - C. Is partly reflected at the point of incidence
  - D. Is deviated at the point of emergence
  - E. Is reflected in block
3. The angle of deviation of light of various colours passing through a glass prism decreases in the order of
  - A. Blue, orange and red
  - B. Red, blue and orange
  - C. Blue, red and orange
  - D. Red, orange and blue
  - E. Orange, blue and red
4. The change of the direction of a wave front as a result of a change in the velocity of the wave in another medium is called
  - A. Refraction

- B. Reflection
  - C. Diffraction
  - D. Interference
  - E. Polarization
5. Which of the following radiations have the highest frequency?
- A. Radio waves
  - B. Light waves
  - C. X – rays
  - D. Infra-red rays
  - E. Ultraviolet rays



6. The diagram above shows the magnetic field around a bar magnet which has its N- Pole pointing north. The neutral points in the field are likely to occur at
- A. 1 and 2
  - B. 3 and 4
  - C. 5 and 6
  - D. 7 and 8
  - E. 9 and 10

7. A negatively charged rod is brought near the cap of a gold – leaf electroscope. The cap is earthed momentarily while the rod is near to it. The rod is then removed. Which of the following is correct?
- A. The cap will be positively charged and the negatively charged leaves will diverge
  - B. The cap will be negatively charged and the positively charged leaves will diverge
  - C. The cap and the leaves will be positively charged
  - D. The cap and the leaves will be negatively charged
  - E. The leaves will not diverge the cap has been earthen
8. In a domestic circuit, electrical appliances and lamps are arranged in parallel across the mains so as to enable the
- A. Same current to flow through the electrical appliances and the lamps
  - B. Maximum energy to be consumed at least cost
  - C. Same fuse to be used for the electrical appliances and the lamps
  - D. Voltage across the appliances not to be affected when the lamps are switched on and off
  - E. Heat losses to be minimized.
9. Lenz's law of electromagnetic induction states that
- A. Electromotive force is induced in a circuit whenever there is change in the magnetic flux linked with the circuit
  - B. The induced current in a conductor is in such a direction as to oppose the change producing it
  - C. The induced e.m.f in a circuit is proportional to the rate of change of number of lines of force linking the circuit

- D. A force is exerted on a current carrying conductor in a magnetic field
- E. The induced e.m.f is proportional to the current producing the magnetic flux

10. Which of the following statements is not correct?

- A. A magnetic field is a region where a magnetic force can be detected.
- B. Magnetic fields are scalar quantities
- C. The magnitude of the magnetic force experienced by a moving charge depends on the speed on the charge
- D. The angle between the direction of the earth's magnetic field and the horizontal is called the angle of dip
- E. Iron fillings can be used to trace out the magnetic field around a bar magnet.

11. Calculate the energy stored in 2 $\mu$ F capacitor if the potential difference between the plates is 40V

- A.  $3.2 \times 10^{-2}$ J
- B.  $1.6 \times 10^{-3}$ J
- C.  $8.0 \times 10^{-4}$ J
- D.  $4.0 \times 10^{-4}$ J
- E.  $2.0 \times 10^{-4}$ J

12. What is the electric potential at a point distance r from a proton of charge q placed in a medium of permittivity  $\epsilon_0$ ?

A.  $\frac{Q^2}{4\pi r^2 \epsilon_0}$

B.  $\frac{q}{4\pi r^2 \epsilon_0}$

C.  $\frac{Q^2}{4\pi r \epsilon_0}$

D.  $\frac{qr}{4\pi \epsilon_0}$

E.  $\frac{4\pi \epsilon_0}{2r}$

13. Which of the following statements is correct about cathode rays? They are fast moving

A. Atoms

B. Ions

C. Neutrons

D. Protons

E. Electrons

14. Which of the following gives rise to the line spectra obtained from atoms?

A. Kinetic energy of a moving atom

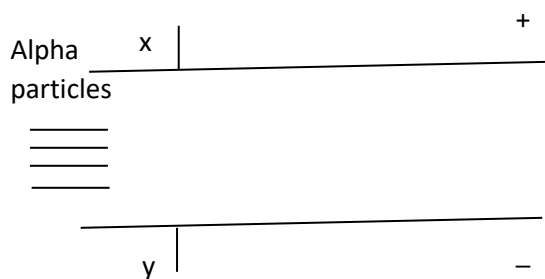
B. Potential energy of an electron inside an atom

C. Change of an electron from a higher to a lower level in the atom

D. Disturbed proton in the nucleus

E. Excitation of an electron in the atom

15.



A stream of alpha particles is projected into an electric field between two plates X and Y as shown in the diagram above. Which of the

following is true, the particles are

- A. Accelerated and they continue in a straight line
- B. Directionally reversed at the end of the plates
- C. Deflected towards plate Y
- D. Attracted by both plates
- E. Deflected towards plate X

16. An element whose half-life is 3 years has  $N$  atoms. How many atoms would have decayed after 9 years

- A. 1  $N$  atom
- B.  $\frac{1}{3}N$  atoms
- C.  $\frac{2}{3}N$  atoms
- D.  $\frac{5}{6}N$  atoms
- E.  $\frac{7}{8}N$  atoms

17. When the nucleus of uranium atom is split into two fragments of nearly equal mass the sum of the masses of the fragments is less than the mass of the original nucleus. This difference is a measure of the

- A. Experimental error in calculating the separate masses
- B. Change of momentum of each fragment

- C. Potential energy lost
- D. Nuclear energy released
- E. Kinetic energy lost.

18. A sheet of paper is placed in the path of a beam of radiations from radioactive source. Which of the following radiations will pass through the paper?

- I.      alpha radiation
  - II.     Beta rays
  - III.    Gamma rays
- A. I only
  - B. II only
  - C. III only
  - D. II and III only
  - E. I, II and III

19. The process by which a metal, heated to high temperature, gives off electrons from its surface is known as

- A. Photoelectric emission
- B. Thermionic emission
- C. Radioactive emission
- D. Field emission
- E. Secondary emission

20. Which of the following statement is not correct

- A. The carriers of electricity in a metal are electrons
- B. The carriers of electricity in an electrolyte are positive and negative ions
- C. The carrier of electricity in a semiconductor are electrons and ions



- D. The carriers of electricity in a semiconductor are electrons and holes
  - E. The addition of impurities to a semiconductor affects its conductivity.
21. Which of the following statement is correct
- A. The resistance of a pure conductor increases with temperature
  - B. The resistance of a semiconductor increases with rise in temperature
  - C. The resistance of a semiconductor decreases with rise in temperature
  - D. The conductivity of a semiconductor increases with rise in temperature
  - E. The conductivity of a pure conductor decreases with rise in temperature
22. The angle at which a projectile must be fired to cover maximum range is
- A. 35
  - B. 45
  - C. 55
  - D. 65
  - E. 90
23. The inverse of the time required for a wave to complete one full cycle is called
- A. Wavelength
  - B. Frequency
  - E. Period
  - F. Amplitude
  - G. Speed
24. The magnetic force on a charge moving in a magnetic field is given by
- A.  $F = V(q \times B)$
  - B.  $F = q(V \times B)$

B.  $F = B(V \times q)$

C.  $F = (B \times q)V$

D.  $F = B(q \times V)$

25. An *a.c* generator can be converted to a *d.c* generator by replacing the

A. Commuter with an armature

B. Armature with a commutator

C. Commutator with slip rings

D. Slip rings with a commutator

E. Slip rings with armature

26. Which of the following waves require a material medium?

A. Light wave

B. X-ray

C. Gamma ray

D. Sound wave

D. Infrared ray

27. What is the difference between a node and an antinode for a transverse wave?

A. The wavelength

A. Twice the wavelength

B. Three quarters of the wavelength

C. One-half of the wavelength

D. Thrice the wavelength

28. A radio station broadcasts at a frequency of 600 KHz. If the speed of light in air is  $3 \times 10^8 \text{ ms}^{-1}$ , calculate the wavelength of the radio wave.

A.  $22.0 \times 10^3 \text{ m}$

B.  $5.0 \times 10^2 \text{ m}$

- C.  $5.0 \times 10^5$  m
- D.  $11.8 \times 10^{11}$  m
- E.  $10 \times 10^{10}$  m

29. Consider the wave equation  $10\sin 7(x - 50t)$ . what does the number 10 in the equation represent?

- A. Acceleration
- B. Speed
- C. Amplitude
- D. Wavelength
- E. Frequency

30. Arrange the following electromagnetic waves in their increasing order of wavelength, Infra-red rays, visible rays, radio waves and x-rays.

- A. Radio waves, Infra- red ray, Visible rays, X-rays
- B. X-rays, Visible rays, Infra –red rays, Radio waves
- B. Visible rays, X –rays, Radio waves, Infra-red rays.
- C. X- rays, Infra-red rays, Visible rays, Radio waves.
- D. X- rays, Infra-red rays, Radio waves, Visible rays

31. Which of the following radiation is of nuclear origin?

- A. X- rays
- B. Visible –rays
- C. Radio waves
- D. Gamma rays.
- E. Ultra-violet rays

32. What is the gravitational potential due to a molecule of mass  $M$  at a distance  $r$  from it?

A.  $\frac{GM}{r^2}$

B.  $\frac{GM}{r}$

C.  $\frac{GM^2}{r}$

D.  $\frac{GM^2}{r^2}$

E.  $\frac{MG^2}{r^2}$

33. Calculate the escape velocity for a rocket fired from the earth's surface at a point where the acceleration due to gravity is  $10\text{m/s}^2$  and the radius of the earth is  $6.0 \times 10^6\text{m}$

A.  $7.8 \times 10^3 \text{ m/s}$

B.  $1.1 \times 10^4 \text{ m/s}$

C.  $3.5 \times 10^7 \text{ m/s}$

D.  $6.0 \times 10^7 \text{ m/s}$

E.  $2.0 \times 10^4 \text{ m/s}$

34. Calculate the force acting on an electron carrying a charge of  $1.6 \times 10^{-19}\text{C}$  in an electric field of intensity  $5.0 \times 10^8 \text{ N/C}$  is

A.  $6.7 \times 10^{-29}\text{N}$

B.  $8.0 \times 10^{-11}$

C.  $3.1 \times 10^{27}\text{N}$

D.  $4.6 \times 10^{-6}\text{N}$

E.  $7.2 \times 10^{-6}\text{N}$

35. A 50Hz a.c circuit has a voltage of 220V and a current of 5.0A as its effective value. Determine the peak values of the voltage and its current.

- A. 311.0v and 1.71A
- B. 331.0v and 7.10A
- C. 311.00v and 7.10A
- D. 7.10v and 311.00A
- E. 7.10v and 331.0A

36. In an ac circuit the peak value of the potential difference is 180V. what is the instantaneous potential differences when the phase angle is  $45^\circ$ .

- A. 45 v
- B. 90 v
- C.  $90\sqrt{2}$  v
- D. 180 v
- E.  $(90/\sqrt{2})$  v

37. A voltage supplies of 12V r.m.s and frequency of 90Hz is connected to a  $4\Omega$  resistor. Calculate the peak value of the current.

- A. 48.8A
- B. 30.0A
- C. 27.5A
- D. 4.2A
- E. 2.6A

38. A  $2\mu\text{F}$  capacitor is in series with a resistor of  $5000\Omega$ . A voltage of 5V r.m.s and frequency,  $f = 100\text{Hz}$  is connected to them. What is the capacitive reactance?

- A.  $795.5\Omega$
- B.  $895.5\Omega$

- C.  $1795.0\Omega$
- D.  $2005.0\Omega$
- E.  $2200.0\Omega$

39. At what frequency will 20uf capacitor have a reactance of 500 ohms?

- A.  $\frac{90\text{Hz}}{\pi}$
- B.  $\frac{80\text{Hz}}{\pi}$
- C.  $\frac{70\text{Hz}}{\pi}$
- D.  $\frac{60\text{Hz}}{\pi}$
- E.  $\frac{50\text{Hz}}{\pi}$

40. The overall opposition of a mixed circuit containing a resistor, an inductor and or a capacitor is called

- A. resistance
- B. reactance
- C. inductance
- D. capacitance
- E. impedance

41. In a series L-C circuit, the inductance and the capacitance are 0.5H and 20μF respectively. Calculate the resonance frequency of the circuit

- A. 24.2Hz
- B. 36.7Hz
- C. 50.3Hz
- D. 60.5Hz
- E. 70.4Hz

42. An ammeter connected to an a.c circuit records 5.5A. What is the peak value of the current?

- A. 7.8A
- B. 7.1A
- C. 3.9A
- D. 3.0A
- E. 2.5A

43. When compared, the r.m.s value is ..... the peak value.

- A. greater than
- B. same
- C. lower than
- D. inversely proportional to
- E. all of the above

44. Calculate the peak voltage of a mains supply of r.m.s value of 220V.

- A. 112v
- B. 150v
- C. 222v
- D. 311v
- E. 220v

45. The maximum displacement of a particles of a wave from their equilibrium positions is called?

- A. Wave velocity
- B. Period
- C. Amplitude
- D. Wavelength
- E. frequency

46. what is the difference between a node and an antinode for a transvers wave?

- A. The wavelength
- B. Twice the wavelength
- C. Three quarter of the wavelength
- D. One-half of the wavelength
- E. Thrice the wavelength

47. Which of the following is not a mechanical wave?

- A. Wave propagated in a stretched string
- B. Waves in closed pipes
- C. Radio waves
- D. Water waves
- E. Sound waves

48. If  $V$  is the velocity of a wave,  $\lambda$  its wavelength and  $T$  its period, the  $V$ ,  $\lambda$  and  $T$  are related by the expression

- A.  $\lambda = VT$
- B.  $\lambda = \frac{V}{T^2}$
- C.  $T^2 = \lambda V$
- D.  $V = \lambda T$
- E.  $V = \frac{T}{\lambda}$

49. Transverse and longitudinal waves travelling in the same direction in a medium differ essentially in their?

- A. Wavelength
- B. Amplitude
- C. Frequency



D. Direction of vibration of the particles of the medium

E. Period of vibration of the particles of the medium

50. Which of the following is not a property of longitudinal waves?

A. Compression

B. Period

C. Amplitude

D. Wavelength

E. Frequency

51. A rod or spoon appears bent or broken when it is partially immersed in water due to

A. Reflection

B. Refraction

C. Diffraction

D. Polarization

E. Interference

52. All are precautions taken when conducting an optical experiment except

A. Ensuring the image focused on the screen is blurry

B. Avoiding error due to parallax in measuring with the metre rule

C. Ensuring a proper alignment of object, lens or mirror, and screen

D. Ensuring a sharp image is properly focused on the screen

E. Optical pins should be vertical and well-spaced

53. A radioactive substance has a half-life of 3 days. If a mass of 1.55g of this substance is left after decaying for 15 days, determine the original value of the mass

A. 49.6g

B. 37.2g

C. 24.8g

D. 12.4g

E. 8.4g

54. Which of the following is usually used to cause fission in an atomic reactor?

A. alpha particles

B. beta particles

C. electrons

D. neutrons

E. gamma rays

55. A substance has a half-life 30mins after 60mins the count rate was observed to be 400. What was its count rate at zero time.

A. 200

B. 1200

C. 1600

D. 2400

E. 3000

56. A nuclide  $^{202}_{84}\text{Y}$  emits in succession an  $\alpha$ -particle and  $\beta$ -particle. The atomic number of the resulting nuclide is

A. 198

B. 83

C. 82

D. 80

E. 85

57. If a nucleus  ${}^3_1\text{H}$  decays, a nucleus of  ${}^3_2\text{H}$  is formed accompanied with the emission of

- A. beta particles
- B. gamma particle
- C. alpha particle
- D. X-rays
- E. None of the above

58. The count rate of radioactive substances diminishes from 600 to 150 in 60 secs. Determine the half life of the substance

- A. 15 secs
- B. 30 secs
- C. 45 secs
- D. 60 secs
- E. 70 secs

59. A radioactive substance have a half-life of 20hrs. what fraction of the original radioactive nuclide will remain after 80hrs

- A.  $1/32$
- B.  $1/16$
- C.  $1/8$
- D.  $15/16$
- E.  $1/3$

60. a material of mass  $1.0 \times 10^{-2} \text{ kg}$  undergoes fission process which decreases its mass by 0.02%. calculate the amount of energy released in the process

[ $c = 3 \times 10^8 \text{ m/s}$ ]

A.  $1.8 \times 10^{20}\text{J}$

B.  $1.8 \times 10^{13}\text{J}$

C.  $1.8 \times 10^{11}\text{J}$

D.  $1.8 \times 10^{10}\text{J}$

E.  $1.8 \times 10^{19}\text{J}$

61. In a nuclear reaction the mass defect is  $2.0 \times 10^{-8}\text{g}$ . Calculate the energy released, given velocity of light is  $3 \times 10^8\text{m/s}$ .

A.  $9.0 \times 10^{07}\text{J}$

B.  $1.8 \times 10^{08}\text{J}$

C.  $1.8 \times 10^{09}\text{J}$

D.  $9.0 \times 10^{-10}\text{J}$

E.  $9.0 \times 10^{-11}\text{J}$

62. When an atom is in ground state, it is said to be

A. excited

B. stable

C. ionized

D. radioactive

E. absorbing energy

63. In which of the following transitions is the largest quantum of energy liberated by an hydrogen atom, when the electron changes energy level?

A.  $n=2$  to  $n=1$

B.  $n=2$  to  $n=3$

C.  $n=3$  to  $n=2$

D.  $n=1$  to  $n=2$

E.  $n=4$  to  $n=3$

64. Which of the following give rise to the line spectra obtained from atoms.

A. change of electron from a higher to lower energy level

B. potential energy of the electron inside an atom

C. Excitement of an electron in the atom

D. Splitting of the nucleus

E. None of the above

65. A 90KV is applied across an x-ray tube. Calculate the maximum velocity of the electrons produced. [ $m_e = 9.11 \times 10^{-31} \text{Kg}$ ,  $e = 1.6 \times 10^{-19} \text{C}$ ]

A.  $4.2 \times 10^8 \text{m/s}$

B.  $1.8 \times 10^8 \text{m/s}$

C.  $4.2 \times 10^5 \text{m/s}$

D.  $1.8 \times 10^5 \text{m/s}$

E.  $1.8 \times 10^5 \text{m/s}$

66. The nucleon number and the proton number of a neutral atom are 238 and 92 respectively. What is the number of neutrons in the atom?

A. 146

B. 330

C. 73

D. 52

E. 38

67. Which of the following is called photo electric effect.

A. two electrons are created from a quantum of light

B. metals absorb quanta of light and then emits electrons

- C. a high energy emits photon as it is slowed down
- D. radioactive decay
- E. electron accelerated by a high voltage

68. The minimum frequency that can cause photo emission of electrons from metal surface is known as

- A. wavelength of the incident light
- B. threshold frequency
- C. frequency of the incident light
- D. threshold wavelength
- E. threshold energy

69. The maximum kinetic of the photo electrons depend on

- A. work function
- B. frequency of the incident ray
- C. intensity of the incident ray
- D. wavelength of the incident ray
- E. threshold frequency

70. The minimum energy required to liberate an electron from a metallic surface is

- A. ionization energy
- B. work function
- C. kinetic energy
- D. threshold frequency
- E. threshold wavelength

71. When a metal is heated to a high temperature and electrons are emitted from its surface, this is known as \_\_\_\_\_

- A. photoelectric emission

B. thermionic emission

C. field emission

D. secondary emission

E. Primary emission

72. The term electrical discharge means

A. voltage in a gas

B. current in a liquid

C. current in a gas

D. voltage in a liquid

E. voltage in fluid

73. Which of the following is an application of glow discharge phenomena?

A. filament lamp

B. fluorescent lamp

C. cathode ray oscilloscope

D. electron microscope

E. x-ray tube

74. Which of the following is an application of hot cathode emission.

A. filament lamp

B. cathode ray oscilloscope

C. electron telescope

D. Binoculars

E. Discharge tube

75. Which of the following contributed to conduction in a gas? (i) molecules (ii) electrons (iii) ions

- A. I only
- B. II only
- C. I and III only
- D. II and III only
- E. III only

76. Which of the following are not complimentary variables?

- A. Energy and time
- B. energy and position
- C. Energy and mass
- D. Velocity and position
- E. All of the above

77. The duality of matter implies that matter?

- A. exist as particle of dual composition
- B. has momentum and energy
- C. has both wave and particle property
- D. is made up of dual materials
- E. exist as light and wave

78. According to quantum theory, electromagnetic wave is transmitted in tiny bundles of energy called

- A. photons
- B. electrons
- C. neutrons
- D. protons
- E. quanta



79. Which of the following factors does not support the wave model of light?

- A. Diffraction
- B. Interference
- C. Refraction
- D. Photo emission
- E. None of the above

80. The energy associated with the photon of a radio transmission at  $3 \times 10^5 \text{ Hz}$   
( $h = 6.60 \times 10^{-34} \text{ Js}$ )

- A.  $1.30 \times 10^{-29} \text{ J}$
- B.  $2.00 \times 10^{-29} \text{ J}$
- C.  $1.30 \times 10^{-28} \text{ J}$
- D.  $2.00 \times 10^{-28} \text{ J}$
- E.  $3.2 \times 10^{-29} \text{ J}$

## THEORY QUESTIONS PART 1

**Attempt any five (5) questions from this part                      15 marks**

1. State **three** observable phenomena in which light behave like particle and explain one (3marks)
2. Compare and contrast, alpha and beta radiation (3marks)
3. a. What is reactance (1mark)  
b. Calculate the frequency at which a 5 micro farad capacitor will have a reactance of 3000 ohms (2marks)
4. a. What are photo-electrons (1mark)  
b. A metal has a work function of 3.5eV. Calculate its threshold frequency given ( $h = 6.6 \times 10^{-34} \text{ Js}$ ,  $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$ ) (2marks)
5. a. What are x-rays (1mark)  
b. Distinguish between soft and hard x-rays (2marks)

6. a. Define threshold wavelength ( $1\frac{1}{2}$  marks)
- b. Define work function ( $1\frac{1}{2}$  marks)
7. An electron jumps from one energy level to another in an atom radiating  $9.0 \times 10^{-19}\text{J}$ . If  $h = 6.6 \times 10^{-34}\text{Js}$  and  $C = 3.0 \times 10^8\text{m/s}$ , what is the wavelength of the radiation? (3marks)
8. a. Draw a wave from diagram for an a.c and label the points at which the current is zero and maximum respectively. (1mark)
- b. Determine the effective value of an a/c if its peak value is 15A. (2marks)

**PART II: attempt any three (3) questions from this part 15 marks**

9. a. Explain the term peak value and r.m.s. value as they apply to a.c circuit (1mark)
- b. Determine the r.m.s. value of the current in an a.c circuit with a  $5.5\mu\text{F}$  capacitor across a  $220\text{V}_{\text{r.m.s}}$ , 50Hz. (2marks)
- c. In a.c circuit the peak value of the potential difference is 180v. What is the instantaneous p.d when it has reached  $1/8^{\text{th}}$  of a cycle (2marks)
10. An a.c circuit consist of a resistor  $100\Omega$ , an inductor 20H and a capacitor  $5.0\mu\text{F}$  connected in series. If the source has  $220\text{V}_{\text{r.m.s}}$ , 50Hz across it, calculate;
  - (i). the impedance (2marks)
  - (ii). the current flowing in the circuit (2marks)
- b. Draw a vector diagram of the relationship of I and V for an a.c. circuit containing
  - (i) a pure inductor ( $\frac{1}{2}$  mark)

(ii) a pure capacitor  $\left(\frac{1}{2}\text{mark}\right)$

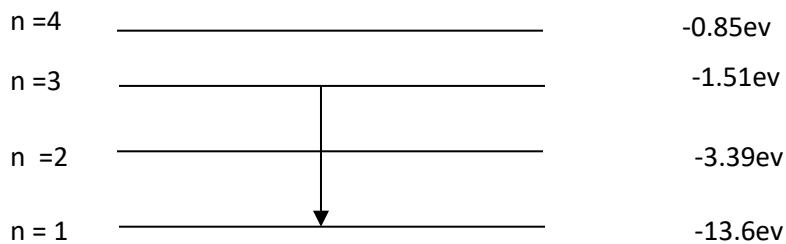
11.a. What is radioactivity? (1mark)

b. Differentiate between nuclear fission and fusion (2marks)

c. If the half life of a radioactive substance is  $2.45 \times 10^8\text{s}$ , determine its decay constant (2marks)\_

12. What do you understand by energy quanta (1mark)

(b)



The diagram above illustrates an electron transition from energy level  $n = 3$  to  $n = 1$ .

Given [ $1\text{eV} = 1.6 \times 10^{-19}\text{J}$ ;  $h = 6.6 \times 10^{-34}\text{Js}$ ;  $c = 3.0 \times 10^8\text{ms}^{-1}$ ]. Calculate the

(i) change in energy of the photon (1mark)

(ii) frequency of the photon (1mark)

(iii) wave length of the photon (2mark)

13. State Heisenberg uncertainty principle (1mark)

b. Draw a labeled diagram of a x-ray tube showing the essential parts (3marks)

c. Give two properties of x-rays (1mark)

