UNIVERSITY OF JOHANNESBURG

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED PHYSICS AND ENGINEERING MATHEMATICS

NATIONAL DIPLOMA IN ANALYTICAL CHEMISTRY

MODULE PHYSICS 2 PHY2ZAT

CAMPUS **DFC**

JULY SUPPLEMENTARY EXAMINATION

DATE 28/07/2016	**SESSION: 8:00 – 11:00**
ASSESSOR	**DR. J. CHANGUNDEGA**
INTERNAL MODERATOR	**DR. L. REDDY**
DURATION 3 HOURS	**MARKS 120**

NUMBER OF PAGES: 16 PAGES, INCLUDING 2 INFORMATION SHEETS

INSTRUCTIONS: **MULTIPLE CHOICE GRID PAPER**
CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT)

SECTION A
ANSWER ALL QUESTIONS ON THE GRID PAPER PROVIDED

QUESTION A1
In the photoelectric effect experiment, why does red light not cause the emission of an electron though blue light can?

A The photons of red light do not have sufficient energy to eject an electron.
B The electric field of the red light oscillates too slowly to eject an electron.
C Red light contains fewer photons than blue, not enough to eject electrons.
D The red light does not penetrate far enough into the metal electrode.

QUESTION A2
Which of the following phenomena is best explained by treating light as a wave?

A The threshold frequency in the photoelectric effect
B The emission of only certain wavelengths of light by an excited gas
C The limited resolution of a light microscope
D None of the above

QUESTION A3
According to the Heisenberg's Uncertainty Principle, if we know the x-position of a particle precisely, we cannot know its precise:

A y-position
B x-momentum
C y-momentum
D energy

QUESTION A4
Which of the following ideas of the Bohr model is not retained in the modern theory of atomic structure?

A Electrons can absorb or emit energy only in whole numbers of photons.
B Atoms have a central positively charged nucleus.
C Electrons move around the nucleus as planets orbit the sun.
D Most of the volume of an atom is empty space.

QUESTION A5
The idea that no two electrons can have exactly the same set of quantum numbers is expressed in the:

A Heisenberg's probability position.
B Pauli exclusion principle.
C Plank's constant
D Bohr's model.

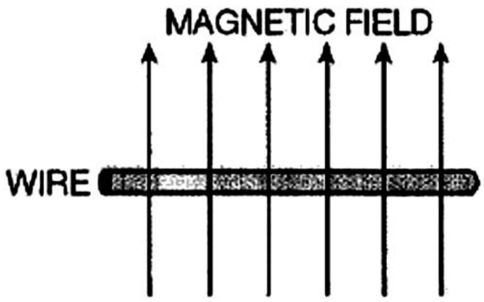
QUESTION A6
Which set of quantum numbers cannot occur together to specify an orbital?

A $n = 2, l = 1, m_l = -1, m_s = ½$
B $n = 3, l = 2, m_l = 0, m_s = ½$
C $n = 3, l = 3, m_l = 2, m_s = ½$
D $n = 4, l = 3, m_l = 0, m_s = ½$

QUESTION A7
Which of the following statements is correct?

A Earth's geographic north pole is the magnetic north.
B The north pole of a magnet points towards the Earth's magnetic south pole.
C Like poles of a magnet attract each other and unlike poles repel.
D The SI unit of the magnetic field is the gauss.

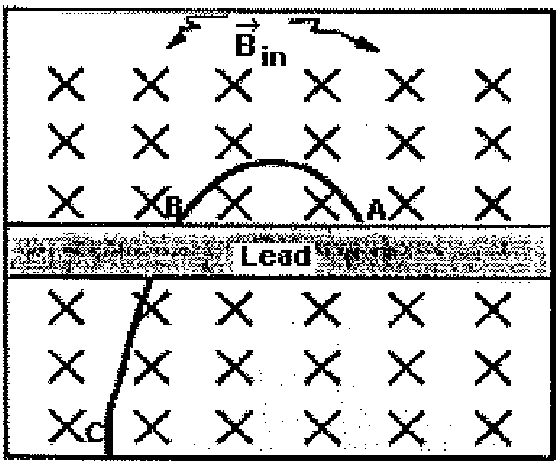
QUESTION A8
The diagram below shows a current-carrying wire located in a magnetic field that is directed towards the top of the page.



The magnetic force on the wire is directed out of the page. In the wire, the electron flow is directed toward the

A right
B top of page
C left
D bottom of page

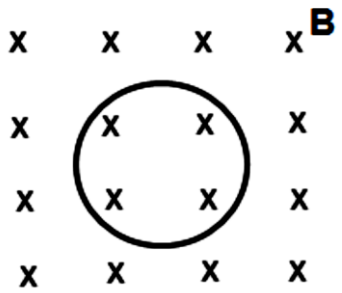
QUESTION A9
The path ABC in the diagram was followed by a charged particle in a cloud chamber.



If the magnetic field is directed into the page, the particle is

A positively charged and moved from A to C
B negatively charged and has moved from C to A
C positively charged and has moved from A to C
D negatively charge and has moved from A to C

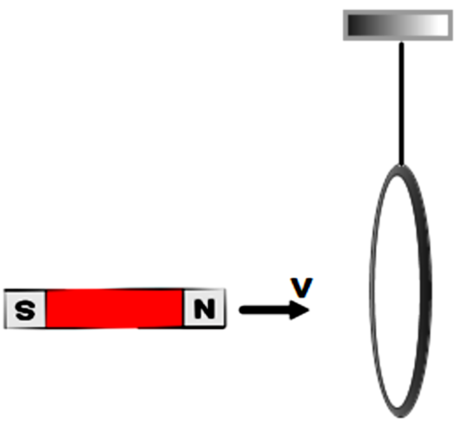
QUESTION A10
A loop of wire is placed in a perpendicular magnetic field as shown in the diagram.



Suddenly, the magnitude of the magnetic field begins to increase, what is the direction of the induced current in the loop?

A Clockwise
B Counter-clockwise
C Out of the page
D Into the page

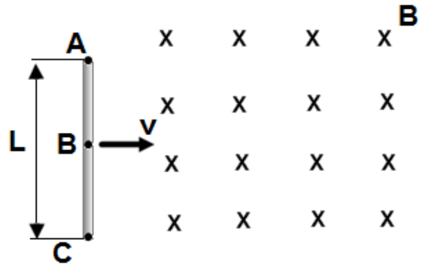
QUESTION A11
A bar magnet is moved towards a vertical conducting ring that is suspended at the end of a string. What happens to the ring during the time when the magnet approaches it?



A The ring will tend to turn in clockwise direction.
B The ring will tend to turn in counter-clockwise direction.
C The ring will move toward the magnet.
D The ring will move away from the magnet.

QUESTION A12

In the diagram, a metal rod with a length of L moves at a constant velocity through a uniform magnetic field of magnitude B. The magnetic field is perpendicular to the rod.



Which of the following is true about the electric potential in the rod?

A Point A has higher potential.
B Point B has higher potential.
C Point C has higher potential.
D Point A and C have the same potential.

QUESTION A13

Which of the following pairs of light sources are incoherent?

A The light from the two car headlights of one car.
B The light from one light source and its reflection from a plane mirror.
C The light from two slits uniformly illuminated by the same source
D Two light waves reflected by a soap film, one from the front and the other from the back surface of a soap film.

QUESTION A14

A two-slit interference pattern is formed using monochromatic laser light with a wavelength of 640 nm. At the second maximum from the central maximum, what is the path-length difference between the light coming from each of the slits?

A 640 nm
B 320 nm
C 960 nm
D 1280 nm

QUESTION A15

One microscope slide is placed on top of another with their left edges in contact and a human hair is placed under the right edge of the top slide. As a result there is a wedge of air between the two slides. An interference pattern results from the arrangement. At the left edge of the slides, there is a

A Dark fringe.
B Bright fringe.
C A fringe but it is impossible to tell which kind.
D No interference.

QUESTION A16

Scientists investigating the count rate from a radioactive source observed that the count rate fluctuates. What do these fluctuations imply about the nature of radioactive decay?

A It involves atomic nuclei.
B It is predictable.
C It is random.
D It is spontaneous.

QUESTION A17

What is not conserved in the emission of nuclear radiation?

A charge
B momentum
C the total number of neutrons
D the total number of nucleons

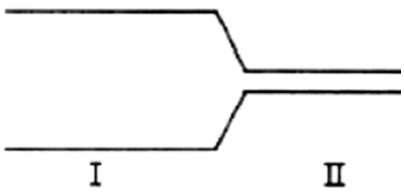
QUESTION A18

Radon-222 is the start of a decay chain that forms bismuth-214 by alpha and beta emission. For the decay of each nucleus of radon, how many α−particles and β−particles are emitted?

A 1 α−particle and 1 β−particle
B 2 α−particles and 1 β−particle
C 1 α−particle and 2 β−particles
D 2 α−particles and 2 β−particles

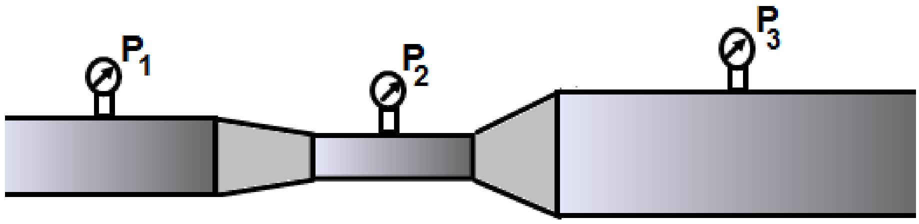
QUESTION A19

A fluid flows steadily through the pipe shown in the diagram. Which of the following Statement is true?



A The mass flow rate in section I is higher than the mass flow rate in section II.
B The pressure is higher in section II.
C The fluid slows down as it passes through section II.
D The total energy of the fluid is the same in sections I and II.

QUESTION A20
The diagram shows a venturimeter that has three sections with different radii. Which of the following is true about the pressure readings?



A P1 > P2 > P3
B P1 < P2 < P3
C P2 < P1 < P3
D P1 < P2 > P3

QUESTION A21
An ideal fluid flows through a long horizontal circular pipe. One region of the pipe has a radius R. The pipe then widens to a radius 2R. What is the ratio of the fluid's speed in the region of radius R to the speed of the fluid in region with radius 2R

A ¼
B ½
C 2
D 4

QUESTION A22
Both an astronaut and an observer on Earth measure the time taken for a spaceship to travel from Earth to a star. Who measures the proper time for the journey?

A The astronaut.
B The observer on Earth.
C None of them.
D More information is needed to answer the question.

QUESTION A23
The predictions of Special Relativity appear strange to us because:

A they only apply to the behaviour of microscopic particles, like electrons
B they apply only to non-living objects such as clocks and rods, and not to human beings
C they are only noticeable at speeds much higher than we normally experience
D they only apply to large objects such as planets.

QUESTION A24
As the speed of an object increases and approaches the speed of light, the relativistic momentum of the object

A will increase.
B will decrease.
C will not change.
D cannot be determined with the information provided.

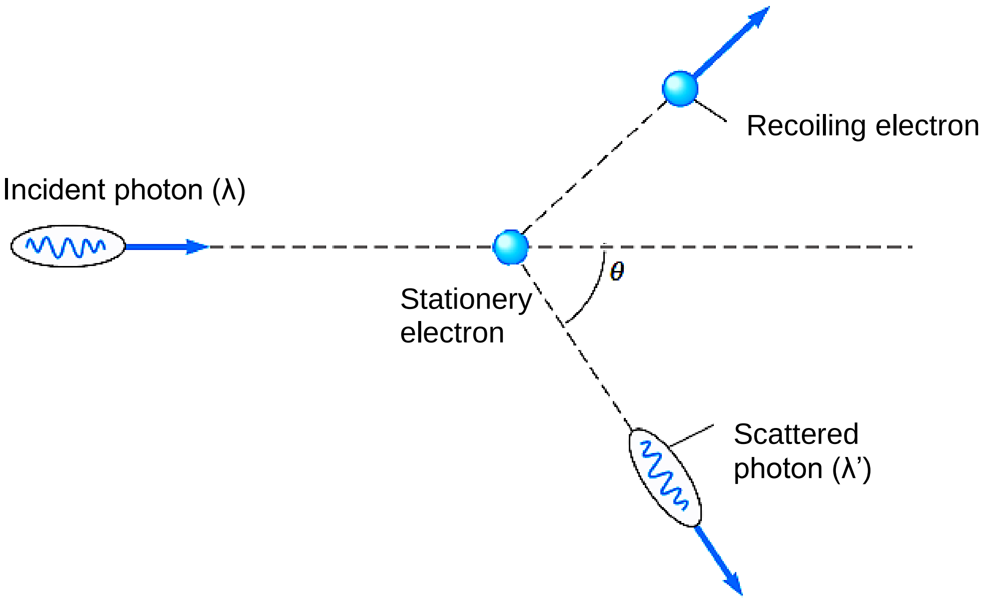
SUB-TOTAL : SECTION A [48]

SECTION B
ANSWER ALL QUESTIONS IN THE ANSWER BOOK PROVIDED

QUESTION B1

1.1. Calculate the de Broglie wavelength of a 0.05 eV neutron. (6)

1.2. With reference to the diagram, briefly describe the 'Compton effect'. (3)

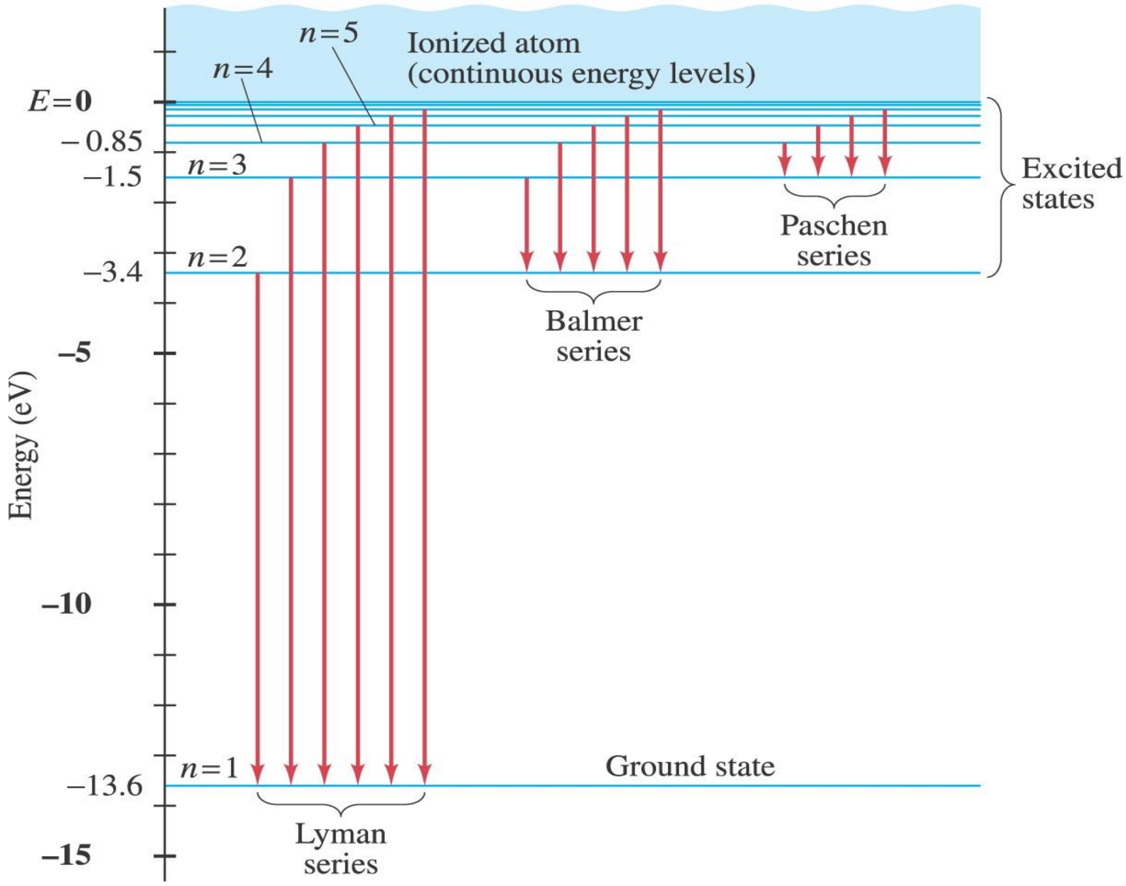


[9]

QUESTION B2

2.1. In Rutherford's experiment, a thin foil of heavy atoms (gold atoms), were bombarded by the alpha particles. If a thin foil of light atoms such as aluminium had been used instead, what difference would you expect in the observations compared to Rutherford's observations using gold? Justify your answer (4)

2.2. The diagram shows part of the Hydrogen line spectrum.



Evaluate the wavelength of the photon that is emitted when the Hydrogen electron undergoes a transition from n = 4 to n = 2. (5)

[9]

QUESTION B3

3.1. An alpha particle has a charge of 2e ($e = 1.6 \times 10^{-19}$ C) and is moving at right angles to a magnetic field B = 0.27 T with a speed of 6.15×10^{5} m s^{-1}. Determine the force acting on this charged particle. (4)

3.2. A particle has mass m and charge +q and is travelling with speed v through a vacuum. The initial direction of travel is parallel two charged metal plates, as shown in Diagram (a).

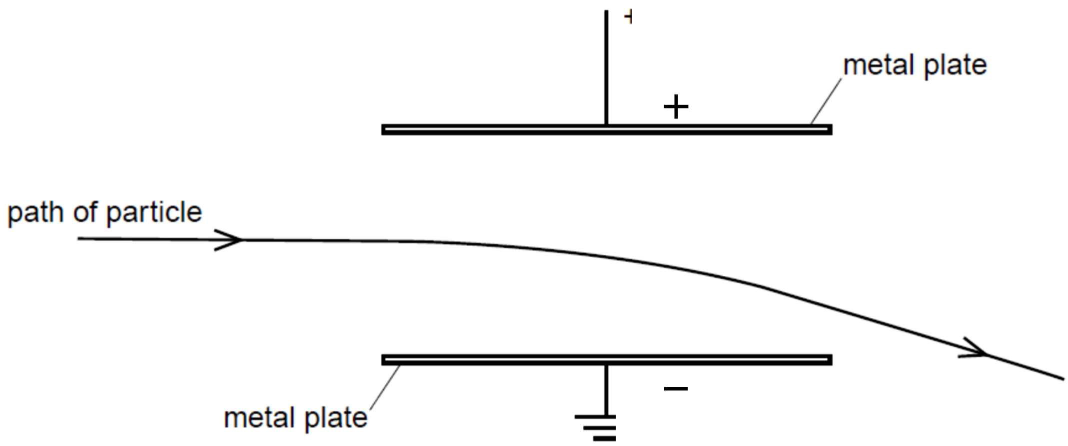


Diagram (a)

The particle passes between the plates and emerges beyond them, as shown in diagram (a).

A uniform magnetic field is now formed in the same region between the metal plates. The magnetic field strength is adjusted so that the positively charged particle passes without deviation between the plates, as shown in Diagram (b).

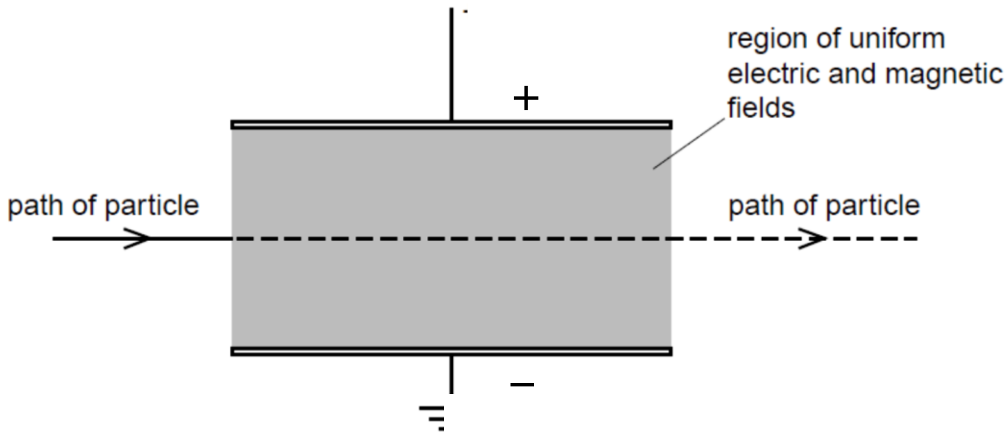


Diagram (b)

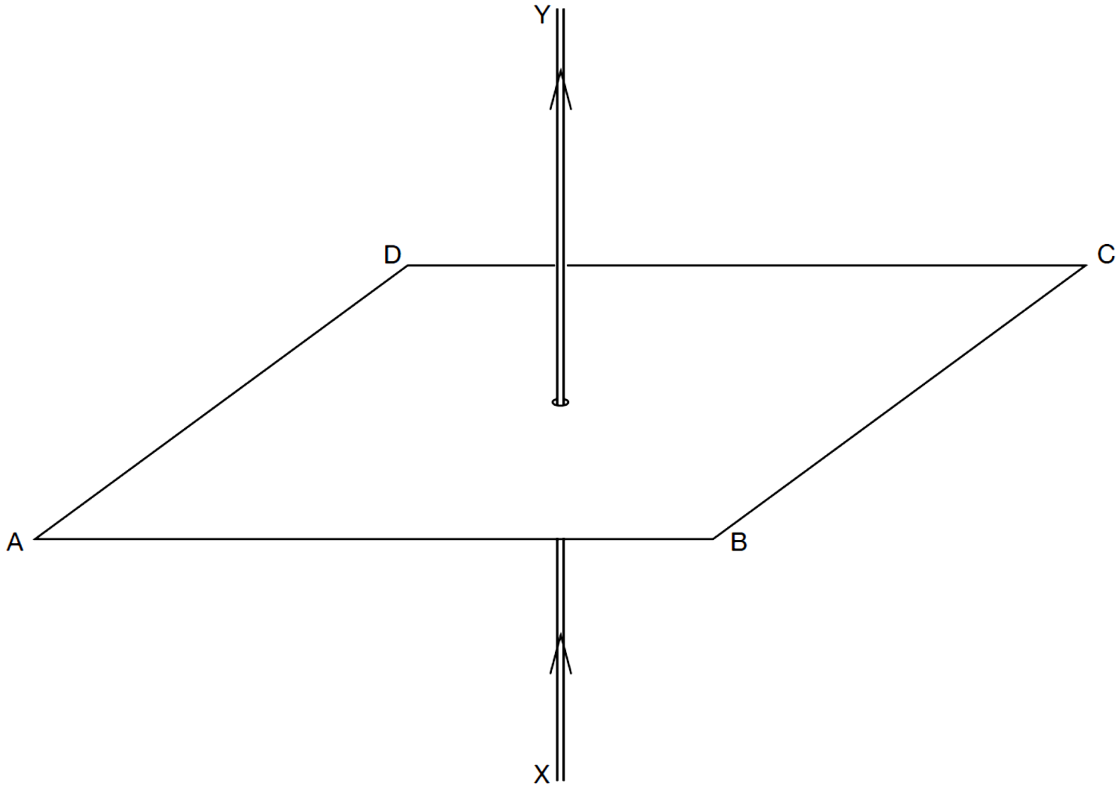
3.2.1. State the direction of the magnetic field. (2)

3.2.2. Explain why the positively charged particle passes without deviation between the plates. (3)

[9]

QUESTION B4

4.1. The current in a long, straight vertical wire is in the direction XY, as shown in the diagram.



On your own copy of the diagram, sketch the pattern of the magnetic field on the plane ABCD due to the current-carrying wire. Draw at least six field lines. (3)

4.2. A point P is located 1,9 cm from the wire in Question 4.1. If the current flowing in the wire is 1,7 A, calculate the magnetic field density at point P. (4)

4.3. State *Lenz' law*. (2)

[9]

QUESTION B5

5.1. The curved surface of a plano-convex glass lens is placed on a flat glass plate. The radius of curvature of the convex surface is 40 cm. The plane surface of the lens is illuminated at normal incidence with monochromatic light and Newton's rings are observed by reflection. If the light has a wavelength of 720 nm. Determine the radius of the third order bright ring. (5)

5.2. State two reasons why it is much easier to perform interference experiments with a laser than with an ordinary light source? (2)

5.3. Distinguish between *transverse* and *longitudinal* waves. (2)

[9]

QUESTION B6

6.1. An intravenous (IV) system which is often referred to as the 'drip' is supplying saline solution to a patient at the rate of 0,120 $cm^3 \, s^{-1}$ through a needle of radius 0,150 mm and length 2,50 cm. What pressure is needed at the entrance of the needle to cause this flow, assuming the viscosity of the saline solution to be the same as that of water (1×10^{-3} Ns m^{-2})? The pressure of the blood in the patient's vein is 8,00 mm Hg. (5)

6.2. In terms of fluid flow, draw a diagram to illustrate

6.2.1. streamline flow. (2)

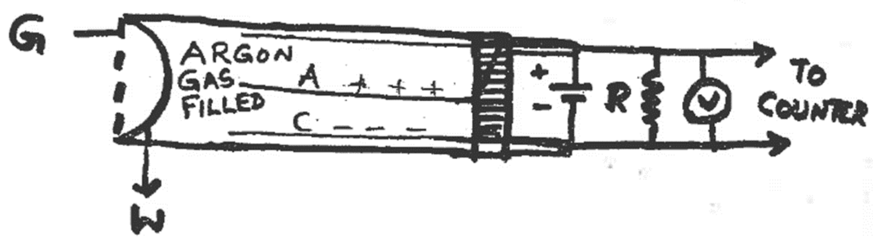
6.2.2. turbulent flow. (2)

[9]

QUESTION B7

7.1. A chemical separation of the Lead isotope Pb–214 from its radioactive parent is completed at 10:00 am. This lead isotope decays with a half-life of 27 minutes. At 11:00 am, there are 8 x 106 nuclei of Pb–214 remaining. How many will remain at 11:54 am? (5)

7.2. The diagram shows a sketch of the Geiger counter.



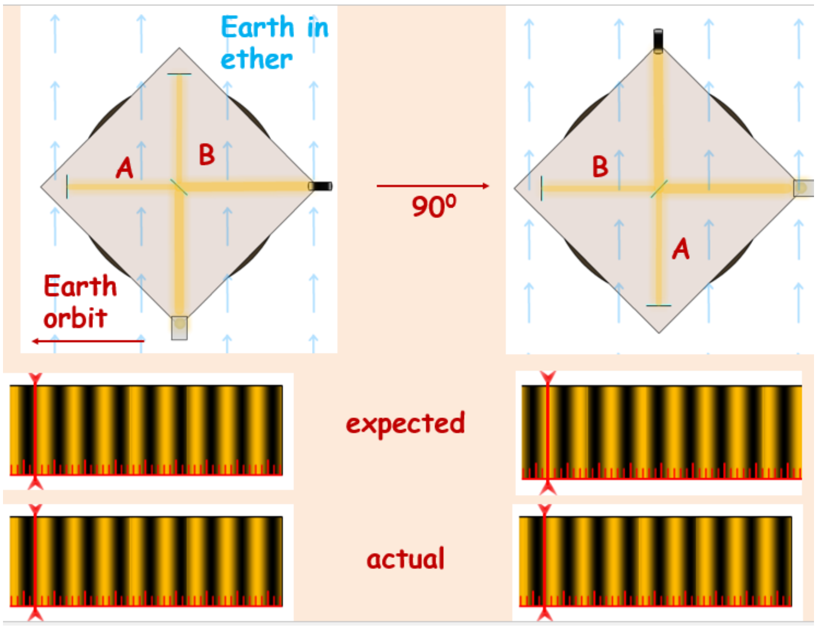
Name the parts G, W, A and C. (4)

[9]

QUESTION B8

8.1. An electron has a speed v = 0,850c. Determine the electron's relativistic mass. (4)

8.2. With reference to the diagrams below, briefly describe the aim, method and conclusion of the Michelson-Morley experiment. (5)



[9]

SUB-TOTAL : SECTION B [72]

TOTAL [120]