Student Number ……

2012
Trial Examination

HSC Physics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- Write your student number at the top of each page where relevant
- A data sheet and Periodic Table are provided at the back of this paper

Total marks – 100
This examination has TWO SECTIONS, Section I and section II
SECTION I – Total marks 87
This section has two parts **Part A and Part B**
Part A – 20 marks- Multiple Choice
Attempt Questions 1–20

Part B – 67 marks
Longer Answer Questions
- Attempt Questions 21–34

SECTION II – Total marks 13
Option Question
- USE THE SEPARATE OPTION BOOKLET FOR YOUR ANSWERS

Section I:
Part A, Multiple Choice (20 marks)
Answer on the separate multiple choice answer sheet

1. The following data give the acceleration due to gravity on the surface of Earth and Jupiter.

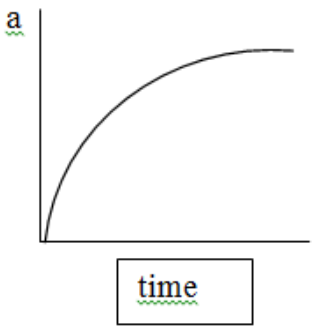
Planet	Acceleration due to gravity (ms^{-2})
Earth	9.8
Jupiter	24.8

If a bag of potatoes on Earth has a weight 49.0 N, the weight of the same bag of potatoes on Jupiter would be

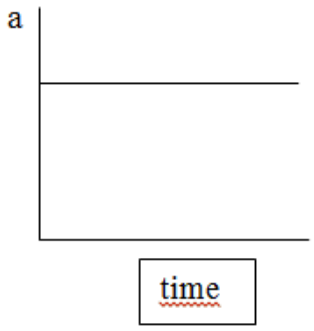
(A) 49.0 N
(B) 124.0 N
(C) 59.6 N
(D) 239.0 N

2. Which of the following *acceleration versus time* graphs best describes the acceleration of a rocket, which is launched from Earth with constant thrust motors?

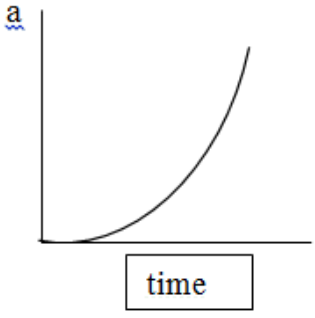
(A)



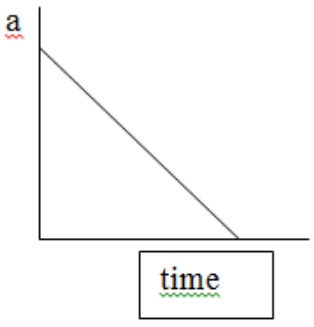
(B)



(C)



(D)

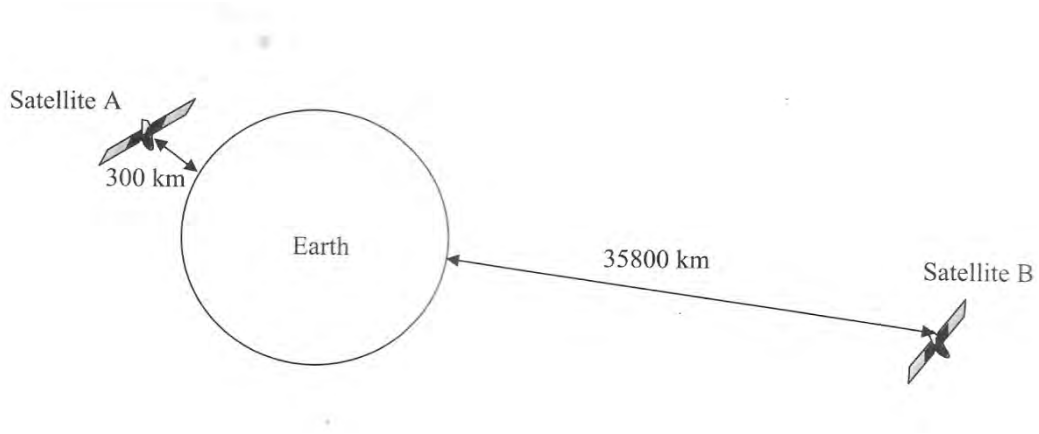


3. The initial velocity required by a space probe to just escape the gravitational pull of the planet is called *escape velocity*.

   Which of the following quantities does **NOT** affect the magnitude of the escape velocity?

   (A) Mass of the planet
   (B) Mass of the space probe
   (C) Radius of the planet
   (D) Universal gravitational constant

4. The diagram below shows two satellites of the same mass and the altitude at which they are orbiting above the Earth. The diagram is not drawn to scale.

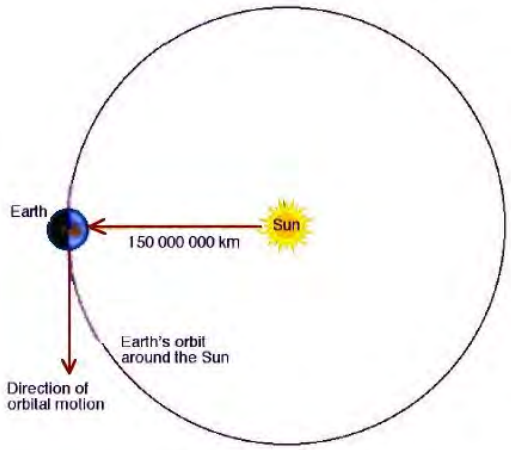


   Choose the most correct statement from the following:
   (A) Satellite B completes one orbit of the Earth in less time than Satellite A
   (B) Satellite A experiences a greater centripetal force than Satellite B
   (C) Satellite B moves at a faster speed than Satellite A
   (D) Satellite A is likely to remain at a fixed position in the sky

5. A spacecraft travelling at 0.95c has a rest mass of 15,872 kg its relativistic mass is closest to:

   (A) 162789 kg
   (B) 15827 kg
   (C) 50831 kg
   (D) 4941 kg

6. The following diagram shows the Earth and its orbit around the Sun.

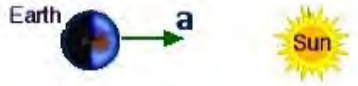


Which of the following diagrams shows correctly the direction of the Earth's acceleration, "a" ?

(A)

(B)

(C)

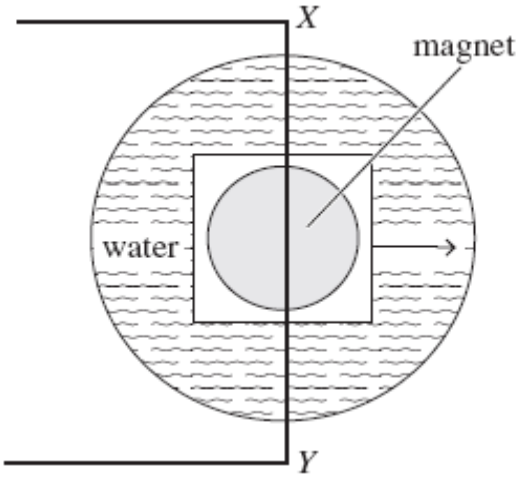


(D)

7. Kepler's Law of Periods $T^2 = kr^3$ shows the relationship between the period and the orbital radius of a planet that revolves around a star. The value k, a constant, can be changed by varying

(A) the period of the planet
(B) the orbital radius of the planet
(C) the mass of the planet
(D) the mass of the star.

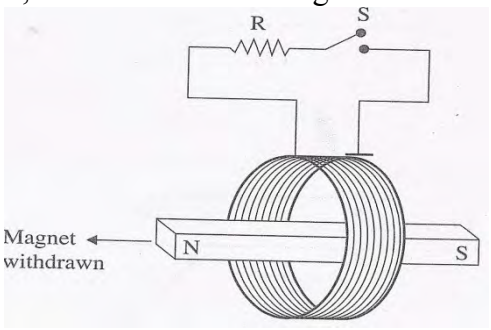
8. A conducting wire was placed over a disc magnet sitting on a piece of foam that was floating in a dish of water.



When the current was passed through the wire the magnet moved to the right, as shown by the arrow.
From this we can conclude that

(A) the current flowed from X to Y and the N pole of the magnet faced up
(B) the current flowed from Y to X and the N pole of the magnet faced up
(C) the current flowed from X to Y and the S pole of the magnet faced up
(D) the electrons flowed from X to Y and the N pole of the magnet faced up

9. A bar magnet is placed at the centre of a large coil. The coil is connected with a switch, S and a resistor, R as shown in the diagram.

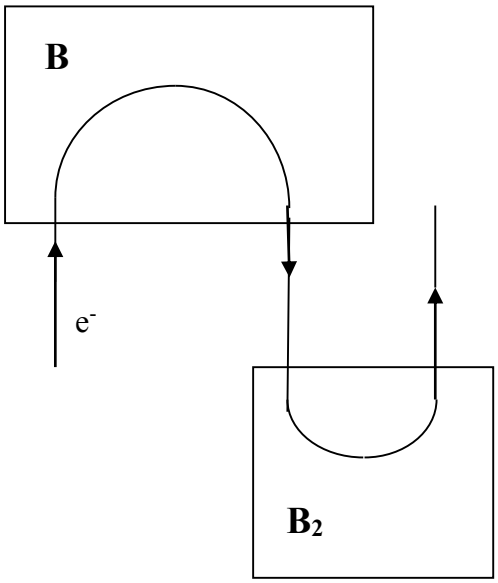


The magnet is withdrawn quickly from the coil as shown. Which of the following observations would be true?

(A) The magnet would be equally easy to remove whether the switch was closed or not.
(B) The magnet would be more difficult to remove when the switch was closed.
(C) The magnet would be attracted to the coil when the switch was open.
(D) The magnet would twist as it was withdrawn when the switch was closed.

Questions 10 and 11 refer to the following

An electron moving at speed v encounters two magnetic fields, $\mathbf{B_1}$ and $\mathbf{B_2}$.
The magnetic fields are restricted to the rectangular areas shown and the electron moves in a semi-circular path through each field as shown in the following diagram.



10. What are the directions of the magnetic fields $\mathbf{B_1}$ and $\mathbf{B_2}$?

	Magnetic field B_1	**Magnetic field B_2**
A	Out of the page	Into the page
B	Out of the page	Out of the page
C	Into the page	Out of the page
D	Into the page	Into the page

11. How does the strength of the magnetic fields $\mathbf{B_1}$ and $\mathbf{B_2}$ compare?
    (A) $\mathbf{B_2}$ is stronger than $\mathbf{B_1}$.
    (B) $\mathbf{B_1}$ is stronger than $\mathbf{B_2}$.
    (C) $\mathbf{B_1}$ and $\mathbf{B_2}$ are equal in strength.
    (D) $\mathbf{B_1}$ and $\mathbf{B_2}$ cannot be compared

12. What is the energy of a photon of blue light with a frequency of 7.0 $x10^{14}$ Hz and a wavelength of 430nm.

(A) $6.63 \times 10^{-34} \times 10^{-9}$ J
(B) $6.63 \times 10^{-34} \times 3 \times 10^{8}$ J
(C) $6.63 \times 10^{-34} \times 430$ J
(D) $6.63 \times 10^{-34} \times 7 \times 10^{14}$ J

13. A set of Christmas tree lights requires 36 V A.C. to operate. They are connected through a transformer to the household 240 V A.C. supply.

If there are 320 turns in the primary coil of the transformer, the number of turns in the secondary coil is

(A) 16
(B) 27
(C) 36
(D) 48

14. Lawrence and William Bragg used X-rays to determine the crystal structure of materials.
Which property of waves was the basis of their technique?

(A) Diffraction
(B) Dispersion
(C) Polarisation
(D) Rarefaction

15. A proton (p) is located between two parallel plates as shown:

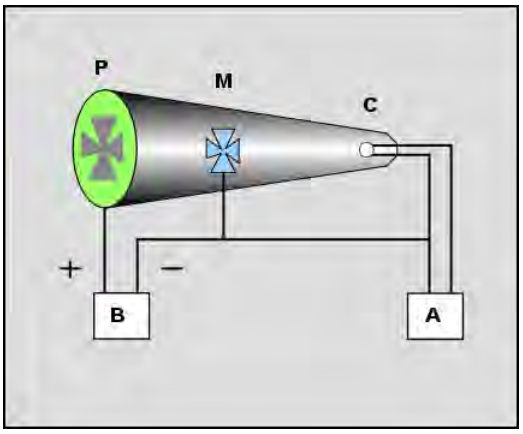
What is the electric field strength at the proton's location?

(A) $1.602 \times 10^{-19} \times 200$ Vm^{-1}
(B) 20000 Vm^{-1}
(C) 10000 Vm^{-1}
(D) 100 Vm^{-1}

16. Which of the following rows correctly shows the dominant charge carriers in metals, semiconductors and superconductors?

	Metal	*Semiconductor*	*Superconductor*
(A)	free electrons	electrons & holes	electron pairs
(B)	free electrons	electron pairs	electrons & holes
(C)	positive charges	electrons & holes	electron pairs
(D)	positive charges	electron pairs	electrons & holes

17. One of the pieces of apparatus used to investigate the properties of cathode rays is known as the "maltese cross." An example is shown below

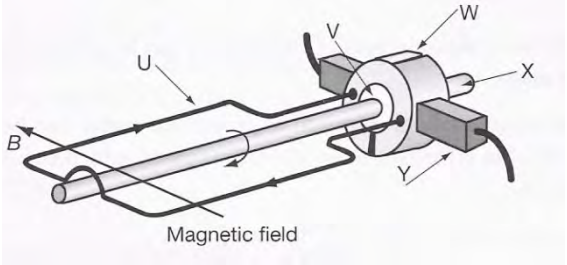


This apparatus demonstrates

(A) That cathode rays travel in straight lines.
(B) That cathode rays are charged particles.
(C) That cathode rays can be deflected by electric fields.
(D) That cathode rays can be deflected by magnetic fields

18. The diagram shows a simple DC motor. The directions of the magnetic field and current are shown. Which choice correctly identifies each labeled component of this motor?

	U	W	X	Y
A.	current	commutator	armature	Brush
B.	coil	rotor	axle	commutator
C.	coil	armature	core	commutator
D.	coil	commutator	axle	brush



19. Problems with thermionic valves led to them being replaced by semiconductor devices such as transistors in the communications and information technology industries.
What development led to this change?

(A) Increased knowledge of the properties of materials.
(B) The discovery of the elements silicon and germanium.
(C) The development of television tubes.
(D) Transistors do not use as much electrical energy as valves

20 . Light falling on the curved metal surface of the photocell produces a potential difference that opposes that voltage of the battery so that no electricity flows through the light bulb.

What changes to the incident light would produce a small flow of electrons through the light bulb from P to Q?

(A) A small decrease in intensity of the incident light.
(B) A small increase in intensity of the incident light.
(C) A small decrease in frequency of the incident light.
(D) A small increase in frequency of the incident light.

2012 Trial Examination **Student Number ……**

Physics

OUTCOME	MARK
Knowledge and Understanding	/67
Planning & Conducting Investigations Q24,25,34 and 38	/14
Problem Solving Q21, 22, 26 and 27	/19
TOTAL	/100

PART A: Answer the multiple choice questions HERE. Circle the letter of the BEST alternative.

1	A B C D	11	A B C D
2	A B C D	12	A B C D
3	A B C D	13	A B C D
4	A B C D	14	A B C D
5	A B C D	15	A B C D
6	A B C D	16	A B C D
7	A B C D	17	A B C D
8	A B C D	18	A B C D
9	A B C D	19	A B C D
10	A B C D	20	A B C D

Section I:
Part B, (67 marks)
Answer in the space provided

21. The range of a projectile is 1.2km. The maximum height it reaches is 218m.
Determine the initial velocity of the projectile (5 marks)

.....

.....

.....

.....

.....

.....

.....

.....

22. A 200kg satellite is orbiting Earth with an altitude of 800km. (4 marks)

(a) Calculate the gravitational force between the satellite and Earth.

.....

.....

.....

(b) Find the orbital speed of this satellite.

.....

.....

.....

23. Identify the consequences of a manned spacecraft failing to achieve the optimum angle for safe reentry into the Earth's atmosphere. (2 marks)

.....

.....

.....

24. You have performed a first-hand investigation to distinguish between an inertial and non inertial frame of reference. (4 marks)

a) Describe a non inertial frame of reference.

.....

.....

b) Describe your investigation and the results/observations you obtained.

.....

.....

.....

.....

.....

.....

25. During your study of Physics, you used data loggers to assist with the collection of data in a first-hand investigation.

Identify an investigation in which you used a data logger and discuss the advantages of its use. (4 marks)

.....

.....

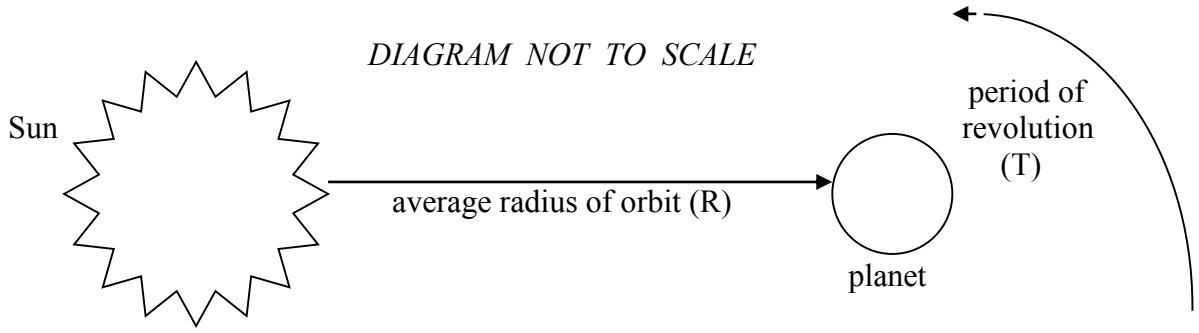
.....

.....

.....

.....

26. Two physics students, Jeremy and Daniel, wanted to use current astronomical data to investigate the relationship between the average radius from the Sun of an orbiting planet (R) and its period of revolution around the Sun (T) as indicated by the diagram and equation below:



Kepler's 3rd (Harmonic) Law states that **R^3 is proportional to T^2**

The data that Jeremy and Daniel used is in the table below. In columns 2 and 3 they noticed that as the radius of orbit (R) increased then the period of revolution (T) also increased.

The R and T values for Mercury and Venus have been used to calculate the corresponding R^3 and T^2 values as shown in the following table.

Planet	**Average radius of orbit, R (in AU)***	**Period of revolution, T (in Earth years)**	**R^3**	**T^2**
Mercury	0.39	0.24	0.059313 = 0.06	0.0576 = 0.06
Venus	0.72	0.62	0.373248= 0.37	0.3844 = 0.38
Mars	1.53			

*the Sun-Earth distance is one astronomical unit (AU)

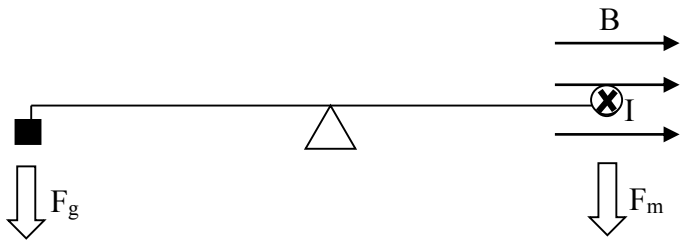
Use your understanding of Kepler's 3rd Law to complete the table above. Show any necessary working below. (3 marks)

……

……

……..

27. An experiment was carried out where the magnetic force on a current-carrying wire was *balanced* by a small mass.



The mass required for balance at each value of current was tabulated.

Current (A)	**Mass ($x10^{-6}$) (kg)**
1	4.2
2	8.5
3	12.8
4	17

(a) On the grid below, plot this data. (4 Marks)

(b) If the wire was 5cm long use the gradient of the graph to determine the strength of the magnetic field. (3 marks)

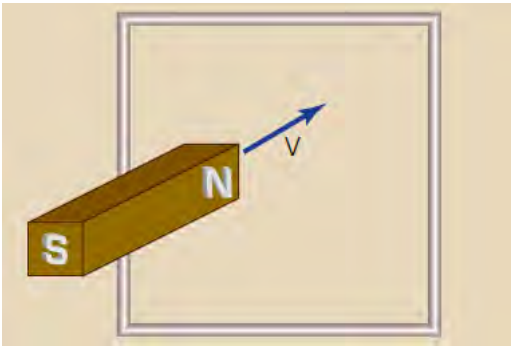
.....

.....

.....

.....

28. Determine the direction of the induced current when the magnet is moved towards the conductor loop as shown in the diagram. Justify your answer. (3 marks)



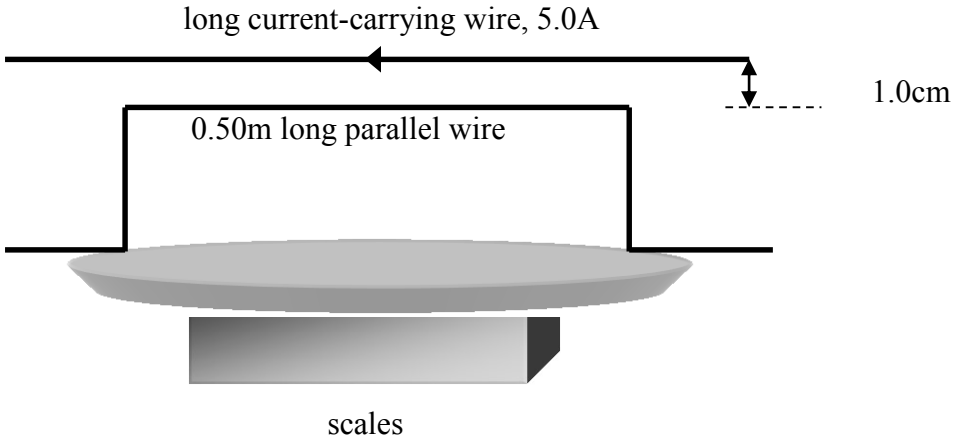
.....

.....

.....

.....

29. In an experiment to indirectly measure the current through a conductor, the following apparatus was constructed.



The conductors are parallel for 0.50m, and are separated by 1.0cm. A current of 5.0A is flowing through the top conductor. When a current flows through the conductor which is resting on the scales, the scales measurement *increases* by 3.50×10^{-4}N.

Calculate the magnitude and direction of the current flowing through the conductor resting on the scales. (3marks)

.....

.....

.....

30. Compare step-up and step-down transformers (3 marks)

.....

.....

.....

.....

31. Induction cookers have flat, easy-to-clean, glassy cooktops. A person needs to boil a quantity of water and has a choice of two saucepans of the same shape and size – one made from high-temperature ceramic (called 'Pyrex') and the other made from metal. Both saucepans have identical wooden handles.

Identify which of the two saucepans the person would choose, and justify your choice by outlining how the induction cooker heats up the water. (3 marks)

.....

.....

.....

.....

32. Westinghouse and Edison competed to supply electricity to the residents of New York in the late 1800s. The system promoted by Westinghouse finally won as it had several advantages over Edison's system.

Discuss the reasons for the success of Westinghouse's system over Edison's. (4 marks)

.....

.....

.....

.....

.....

.....

.....

.....

33. You have performed an investigation to examine the effect on a generated electric current when you vary the distance between the coil and the magnet. (4 marks)

Describe your procedure, outlining the variables you controlled and the results you obtained.

.....

.....

.....

.....

.....

.....

.....

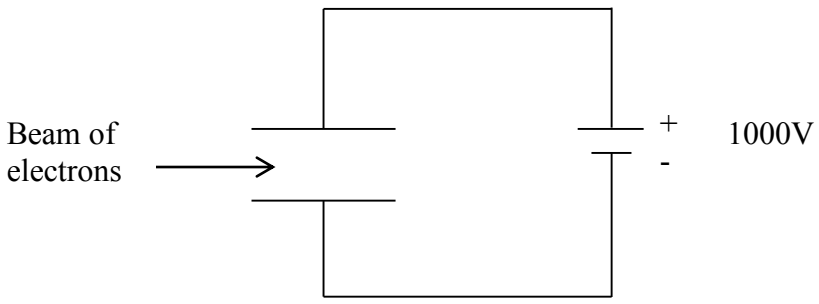
.....

.....

.....

.....

34. A beam of electrons is fired with a velocity of 3.00×10^6 m s^{-1} between the plates as shown. A magnetic field is applied between the plates, sufficient to cancel the force on the electron beam due to the electric field. The distance between the plates is 0.01m.



Calculate the magnitude and direction of the magnetic field required between the plates to stop the deflection of the electron beam (3 marks)

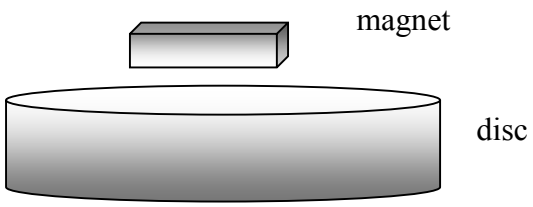
.....

.....

.....

.....

35. The diagram below shows a magnet levitating above a disc.



Explain how this can occur. Include a description of the nature of the disc. (4 marks)

.....

.....

.....

.....

.....

.....

36. Distinguish between a semiconductor and a doped semi conductor. (3 marks)

.....

.....

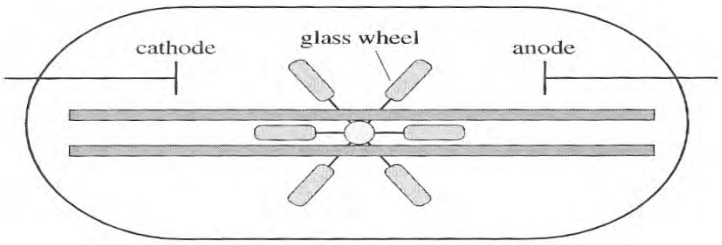
.....

.....

.....

.....

37. In class, you performed an investigation using a discharge tube as shown below.



Describe and account for your observations (2 marks)

.....

.....

.....

38. Assess the impact of the invention of transistors on society. (6 marks)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Section II: Question 39. Quanta to Quarks (13 marks)

Answer these questions in a separate answer booklet.

a) (i) In the Rydberg equation, $\frac{1}{\lambda} = R\left(\frac{1}{n^2_f} - \frac{1}{n^2_i}\right)$, identify what the terms n_f and n_i represent in Bohr's model of the atom. (1 mark)

(ii) Construct a diagram that shows an electron transition, n_i=4 to n_f=2. (2 marks)

(iii) Identify the instrument needed to observe the Balmer series of hydrogen when it is produced in a hydrogen discharge tube. (1 mark)

(iv) Calculate the frequency of the emission line with the longest wavelength in the Balmer series. (3 marks)

b) (i) Describe how the Davisson-Germer experiment supported DeBroglie's Proposal. (3 marks)

(ii) The concept of particles having a wavelength is an abstract concept for our everyday lives. Using a baseball travelling at 25 m/s, quantitatively explain why this concept is rarely apparent to us. (3 marks)