Student Number

Exam Choice

2008

TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Approved calculators may be used
- Write your student number in the space provided

Total marks – 100

Section I Pages 2 - 19

75 marks
This section has two parts, Part A and Part B

Part A – 15 marks
- Attempt Questions 1-15
- Allow about 30 minutes for this part

Part B – 60 marks
- Attempt Questions 16-30
- Allow about 1 hour and 45 minutes for this part

Section II Pages 20 - 28

25 marks
- Attempt **ONE** Question from Questions 31-35
- Allow about 45 minutes for this section

Section I

75 marks

Part A – 15 marks
Attempt Questions 1-15
Allow about 30 minutes for this part

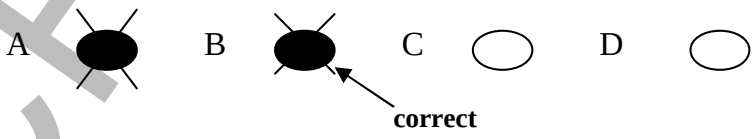
Use the multiple-choice answer sheet.

Select the alternative A,B,C or D that best answers the question. Fill in the response oval completely.

Sample: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word **correct** and drawing an arrow as follows.



1 The value of acceleration due to gravity on three planets, **A**, **B**, and **C** as well as the planets' masses and radii are given in the table.

Planet	Acceleration due to gravity (ms^{-2})	Radius of planet (m)	Mass of planet (kg)
A	9.8	6.370×10^{6}	6.0×10^{24}
B	9.8	3.190×10^{6}	1.5×10^{24}
C	??	1.274×10^{7}	1.20×10^{25}

The acceleration due to gravity on the surface of planet **C** would be closest to:

(A) $2.5\ m\ s^{-2}$

(B) $4.9\ m\ s^{-2}$

(C) $9.8\ m\ s^{-2}$

(D) $19.6\ m\ s^{-2}$

2 Galileo's analysis of projectile motion differed from that of previous ideas in that:

(A) Galileo realised that projectiles travel in circular paths.

(B) Galileo analysed the vertical acceleration and the horizontal acceleration of projectiles simultaneously.

(C) the motion of the projectile was always relative to the person observing it.

(D) Galileo realised that the vertical and horizontal motions of projectiles could be analysed separately.

3 A space probe orbits a newly discovered planet at an altitude of 100km above its surface. The planet has the same mass as Earth, but the probe's orbital period is 1.00 hour. The radius of this new planet is closest to:

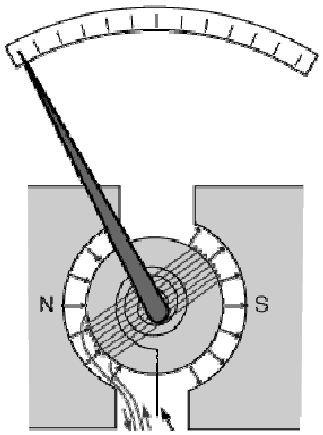
(A) 1.3×10^{20}m

(B) 5080 km

(C) 4980 km

(D) 4100 km

4 A diagram of a galvanometer appears below:



source: http://hyperphysics.phy-astr.gsu.edu/hbase/magnetic/galvan.html

The working principle of such a meter is:

(A) the magnets are made stronger when more current flows.

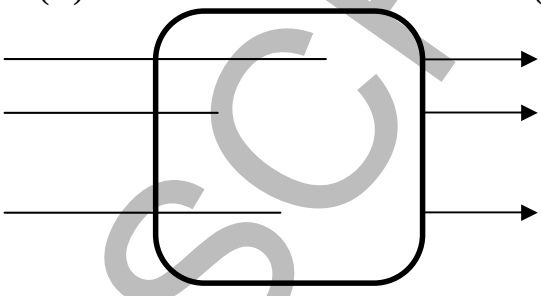
(B) the greater the current the faster the meter rotates.

(C) the greater the voltage the more the meter moves.

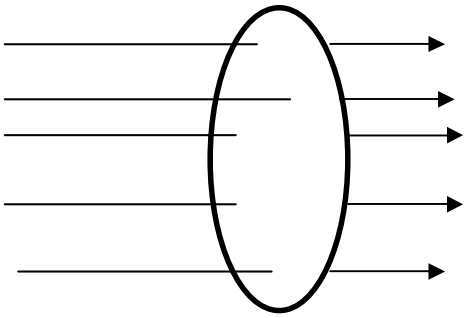
(D) the greater the current the more torque is produced against the spring.

5 Of the following diagrams, which one shows the greatest magnetic flux through the loop?

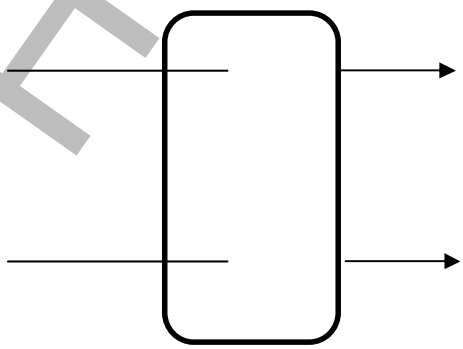
(A)



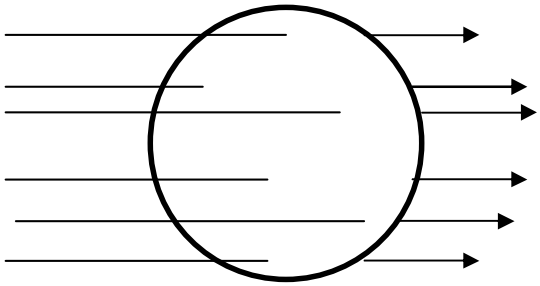
(B)



(C)



(D)



6 A new type of motor has no back EMF induced when it is running. This new motor is compared to a similar motor that does have normal back EMF.

The new type of motor without back EMF would:

(A) have less torque than the normal motor.

(B) likely burn out.

(C) spin slower than a normal motor.

(D) start up faster than a normal motor.

7 One of the arguments used by Edison in the competition with Westinghouse to supply electricity to cities was:

(A) Edison's form of electricity was promoted as being safer than Westinghouse's.

(B) Edison's electricity did not need power stations within the cities.

(C) light globes would only work on Edison's form of electricity.

(D) Westinghouse's system could not have the voltage changed easily.

8 An advantage of AC induction motors is that:

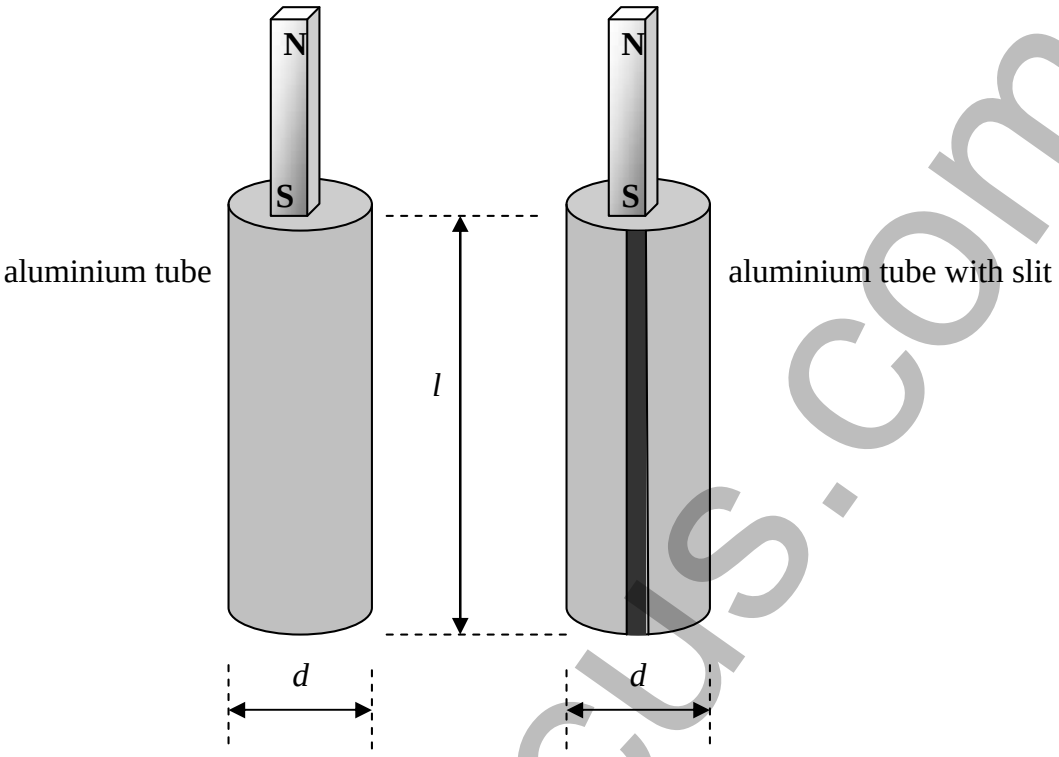
(A) they don't need magnets to work.

(B) their speed does not change under load.

(C) they can work on either AC or DC.

(D) they have less moving parts in contact with each other.

9 An investigation was performed to compare the rate at which a magnet would fall through an aluminium tube and an identical aluminium tube with a slit cut out of it, as shown:



When released simultaneously:

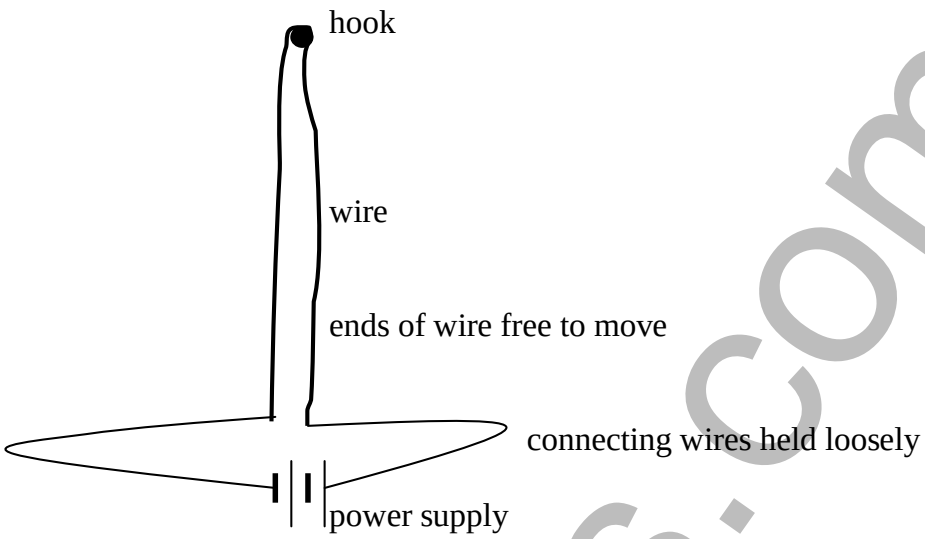
(A) the two magnets would take the same time to fall.

(B) the magnet on the left would stop in the tube.

(C) the magnet on the right would fall through the tube first.

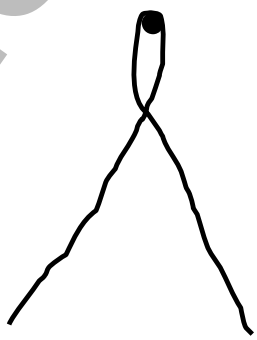
(D) the magnet on the left would fall through the tube first.

10 A length of wire is held vertically as shown. The ends of the wire are free to move and are connected to the terminals of a 12V DC power supply. When the power is switched on, which sketch best represents what will happen to the wire?



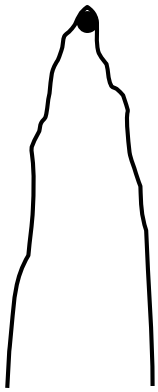
(A)

(B)



(C)

(D)



11 A charged particle is fired horizontally with a velocity ***v***, into a region where there exists a horizontal magnetic field. The particle continues to move through the magnetic field undeflected.

The effect due to gravity is ignored.

An explanation for the charged particle being undeflected could be that the:

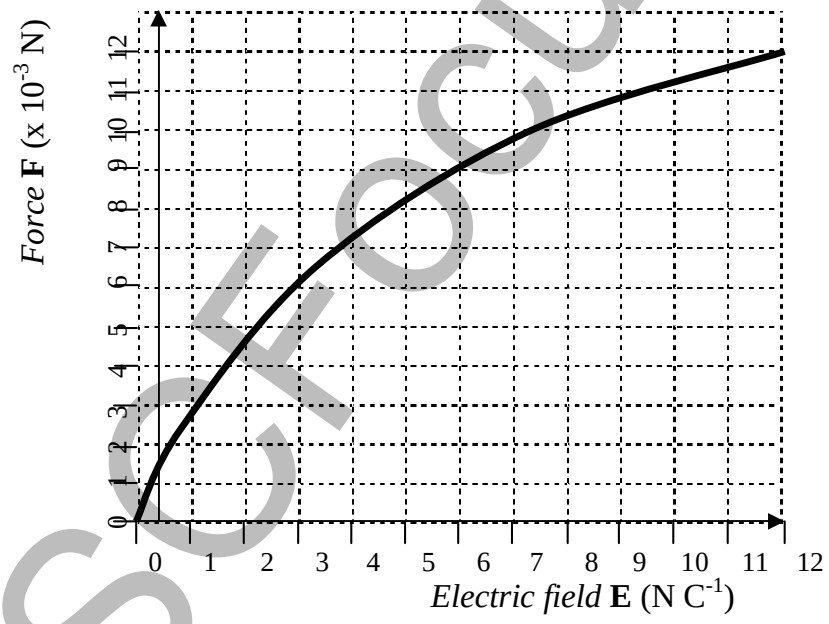
(A) particle's charge is positive.

(B) magnetic field is perpendicular to the particle's velocity.

(C) particle's mass is zero.

(D) particle's velocity is parallel to the direction of the magnetic field.

12 An investigation was performed to measure the force **F** on a charged object as the electric field **E** was varied. The results were plotted on a graph of **F** versus **E** which is shown below.



The graph shows that:

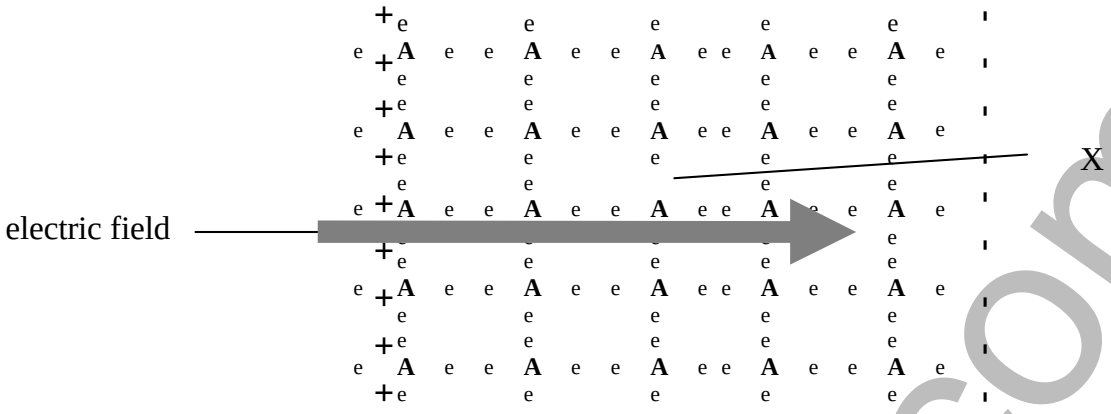
(A) the magnitude of the charge was 1.0×10^{-3} C.

(B) the force was proportional to the electric field.

(C) the particle was losing charge as the electric field was strengthened.

(D) the particle was gaining charge as the electric field was strengthened.

13 A small section of a doped semiconductor material is shown in the diagram. The small "e"s represent valence electrons while the "A"s represent the nucleus of atoms.



An electric field is applied across the ends of the material, directed left to right.

In which direction will the feature labelled "X" move?

(A) right

(B) left

(C) up

(D) down

14 The Braggs were able to determine the structure of crystals because:

(A) for the first time their microscope could magnify sufficiently to see atoms.

(B) they used reflected electrons to form an image of the atoms in the crystals.

(C) they used the interaction of X-rays to infer the separation of atoms in the crystals.

(D) they were the first to recognise metals as having a crystal lattice structure.

15 An investigation was performed to determine the number of teaspoons of sugar that can dissolve in a beaker of water.

Appropriate ways in which the *reliability* and the *validity* of the investigation could be improved and ensured respectively are:

	Ways to improve reliability	*Ways to ensure validity*
(A)	give the exact volume of the amount of sugar used in each teaspoon	use pure sugar
(B)	state the temperature of the water used	use sugar cubes not loose sugar
(C)	test over a range of volumes of water	use distilled water
(D)	repeat the experiment	stir each time a teaspoon of sugar is added

Part B – 60 marks
Attempt Questions 16-30
Allow about 1 hour and 45 minutes for this part.

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Marks

Question 16 (2 marks)

During your study of Physics, you used technology to assist collection of data in a first-hand investigation or investigations.

Identify the technology used in any *one* of these investigations and explain why it was suitable or effective in its role. **2**

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Question 17 (6 marks)

(a) Explain how, when an object has its gravitational potential energy increased, work must be done. **2**

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(b) Calculate the work done when an object with a mass of 5.0×10^2 kg is moved from the surface of the Earth to an altitude of 300km. (The radius of the Earth is 6370km). **2**

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Question 17 continues on page 12.

Marks

Question 17 (continued)

(c) Explain why your answer to question 17 (b) is not equal to the actual work done on a satellite with the same mass when it is launched into Earth orbit. **2**

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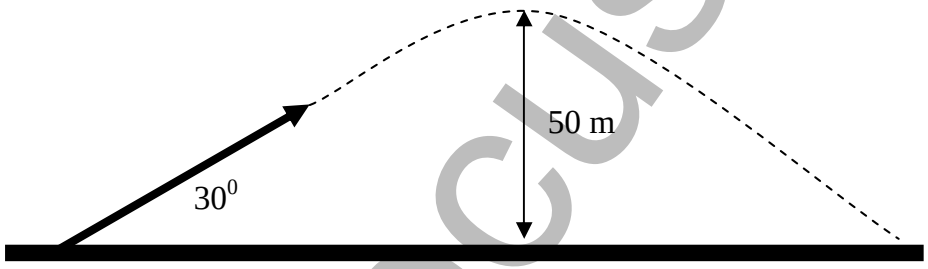
Question 18 (6 marks)

A projectile is launched at an angle of 30^0 to the horizontal over level ground. It reaches a maximum height of 50.0 m.



(a) By considering its maximum height, find the vertical component of the projectile's initial velocity. **2**

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(b) Calculate the time of flight for this projectile **2**

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Question 18 continues on page 13.

Marks

Question 18 (continued)

(c) Explain **how** the range of this projectile could be found. (*You do not need to find the range.)* **2**

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Question 19 (4 marks)

One consequence of Einstein's Theory of Special Relativity is the concept of the relativity of simultaneity.

Explain how the relativity of simultaneity proposes that events which are observed to occur simultaneously in one frame of reference may not be observed to occur simultaneously in another, equally valid frame of reference, yet both observations are deemed to be "correct". **4**

Use an example to illustrate your answer.

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Marks

Question 20 (4 marks)

(a) Describe a first-hand investigation you performed to demonstrate the motor effect, including any observations that were made. **3**

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(b) Define the motor effect. **1**

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Question 21 (2 marks)

Michael Faraday's discovery of electromagnetic induction was made with a *moving* magnet near a conductor.

Explain why the magnet must be moving in order to produce an electric current in Faraday's discovery. **2**

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Marks

Question 22 (2 marks)

Outline *one* advantage and *one* disadvantage of AC generators when compared to D.C. generators. **2**

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Question 23 (5 marks)

Discuss the impact of the development of transformers on society. **5**

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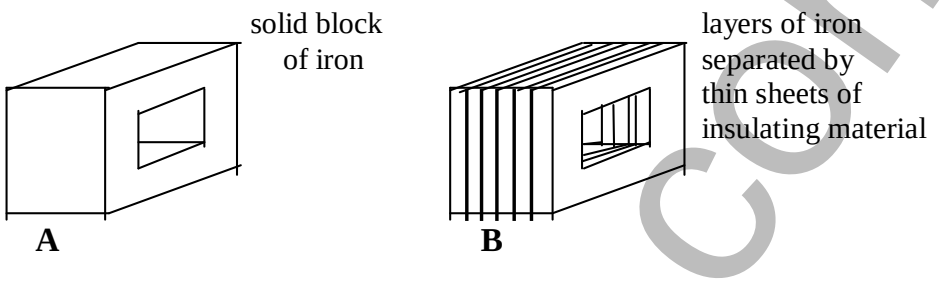
Marks

Question 24 (3 marks)

Transformers need to be as efficient as possible, however they produce some heat.

Explain the difference in the heat production between two otherwise identical transformers **A** and **B** which both use iron cores. The cores are shown below. **3**



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Question 25 (4 marks)

In an attempt to avoid global warming, the Earth is moved to an orbit around the Sun which is twice the original average radius.

(a) Describe quantitatively the effect on the length of one year on Earth that this change would cause. **3**

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(b) Give *one* reason why this change to the length of a year would occur. **1**

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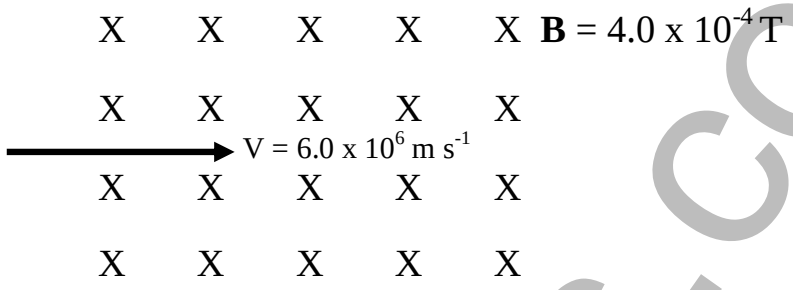
Marks

Question 26 (3 marks)

By equating the force on a moving charged particle with centripetal force, calculate the radius of the curvature of the path of an electron when it enters a uniform magnetic field (**B** = 4.0 x 10^{-4} T) with a velocity of 6.0 x 10^{6} m s^{-1} perpendicular to the magnetic field as shown below. **3**

The effects of gravity can be ignored.



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Question 27 (4 marks)

Quantum theory eventually led to the solving of the puzzle of black body radiation.

(a) Outline the problem with black body radiation that classical physics could not explain. **2**

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(b) Describe the hypothesis proposed by Planck which resolved the problem with black body radiation. **2**

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Marks

Question 28 (5 marks)

An electron moving with a speed of 3.7×10^7 m s^{-1} is stopped, converting all of its kinetic energy into a single photon, which is emitted.

(a) What was the kinetic energy of the electron? **2**

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(b) What is the frequency of the emitted photon? **3**

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Question 29 (6 marks)

Describe how shortcomings in available communication technology led to an increased knowledge of the properties of materials, particularly semiconductors, leading to the invention of the transistor. **6**

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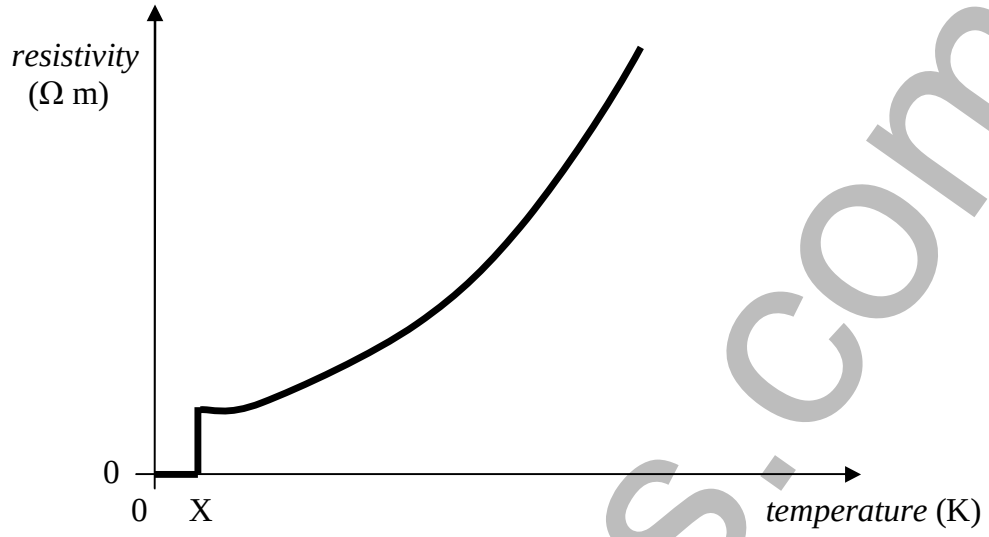
Marks

Question 30 (4 marks)

The graph below shows the resistivity versus temperature for a Type I superconductor.



With reference to the superconductor's lattice structure and the behaviour of the conducting electrons moving through the material, explain the nature of the graph, particularly at the temperature labelled "X". **4**

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Section II

25 marks
Attempt ONE question from Questions 32-36

Allow about 45 minutes for this section

Answer the question in a writing booklet.
Show all relevant working in questions involving calculations.

Marks

Question 31 Geophysics (25 marks)

(a) (i) Identify the property of rocks that allows them to change shape without breaking or cracking. **1**

(ii) Describe the meaning of the term "radiometric" when applied to a method used in geophysics. **2**

(b) In an investigation similar to one in which the mass of the Earth is calculated, a satellite was placed in orbit around the Moon. The satellite's orbital radius of 2.50×10^6 m gave it a period of 1.12×10^4 s.

Given the above information, calculate the mass of the Moon. **3**

(c) (i) Using a diagram to illustrate your answer, describe the differences in the paths of P waves and S waves as they travel through the Earth. **3**

(ii) Discuss the uses of seismic methods in the search for oil and gas. **5**

(d) Identify *one* area of current research in the field of Geophysics and describe this research, including its potential benefits to society. **4**

(e) During the study of Geophysics, an investigation was performed to model how the inclination of the Earth's magnetic field varies with latitude.

(i) Describe the dependent and independent variables that were relevant in performing this investigation. **2**

(ii) Identify any one variable which needed to be kept constant during the investigation. **1**

(f) Describe the method used to calculate the rate of spreading of an ocean floor using a magnetic polarity time scale and a magnetic anomaly profile. **4**

Marks

Question 32 Medical Physics (25 marks)

(a) (i) Identify the source of ultrasound that is transmitted from the transducer. **1**

(ii) Describe the property of materials that makes ultrasound imaging possible. **2**

(b) (i) Calculate the acoustic impedance of fat given: density of fat = 952 kg m^{-3} and the ultrasound velocity in fat = 1.45 x 10^3 m s^{-1}. **1**

(ii) Given the acoustic impedance of water = 1.43 x 10^6 kg m^{-2} s^{-1}, calculate the ratio of the reflected intensity to the original intensity for ultrasound at an interface between water and fat. **2**

(c) (i) Certain properties of some radioisotopes make them suitable for use in medical applications to obtain scans of organs.

Describe these properties and, in general terms, compare them to the properties of other radioisotopes which are not suitable for obtaining scans of organs. **3**

(ii) Describe how the positron emission tomography (PET) technique is used for the diagnosis of diseases including cancer. **5**

(d) Identify *one* area of current research in the field of medical physics and describe this research, including its potential benefits to society. **4**

(e) (i) The procedure undertaken to produce a bone scan involves the use of potentially harmful materials. Outline the risks to the operator and to the patient in obtaining a bone scan. **2**

(ii) If procedures such as bone scans have inherent dangers associated with them, explain why they are still used in medicine. **1**

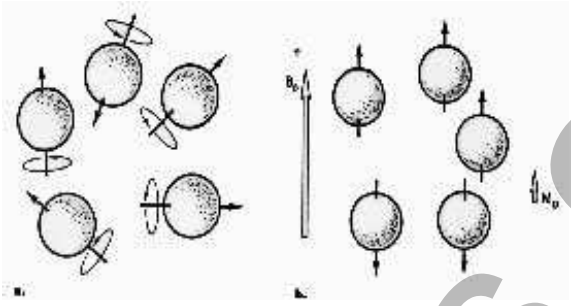
Question 32 continues on page 23.

Marks

Question 32 (continued)

(f) Magnetic resonance image (MRI) scans are able to provide images of sensitive organs of the body, including the brain.

The diagram below shows nuclei spinning (left) and nuclei aligned (right).



(i) Explain how the nuclei come to be in the state shown on the right when MRI scans are being produced. **2**

(ii) Describe what must be done to the nuclei shown on the right to make them *precess* as they spin. **2**

Marks

Question 33 Astrophysics (25 marks)

(a) (i) Outline the reasons why many space observatories have been placed into Earth orbit. **2**

(ii) Identify *one* way in which ground-based observatories can have their resolutions improved. **1**

(b) The position of a star is found by photographing it against background stars just before dawn on 1st June. On 1st December, the same star is photographed just after sunset. Its position was found to have changed by 0.08 arcseconds.

By first finding the star's parallax angle, calculate the distance to this star in parsecs. **3**

(c) (i) Different types of spectra are produced by stars, galaxies, emission nebulae and quasars. Identify the types of spectra produced by each of these objects. **3**

(ii) Account for the production of absorption spectra and show why, for the same element, the characteristic wavelengths are the same as those found in emission spectra. **5**

(d) Identify *one* area of current research in the field of Astrophysics and describe this research, including its potential benefits to society. **4**

(e) (i) Identify *two* of the risks associated with performing a first-hand investigation to examine spectra produced in discharge tubes and reflected sunlight. **2**

(ii) For *one* risk identified in question (e) (i), describe a precaution that was taken so as to minimise this risk. **1**

(f) *"We are the stuff of stars. If not for the stars that are now long gone, we would be mere puffs of gas."*

Assess this quote by describing the synthesis of elements in stars. **4**

Marks

Question 34 From Quanta to Quarks (25 marks)

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

(ii) Outline the significance of the Balmer series to the development of Bohr's model of the atom. **2**

(b) Show that the wavelength of a 57.0g tennis ball served with a speed of 50.0 m s^{-1} is not a significant factor in the game. **3**

(c) (i) Natural radioactivity can cause the transmutation of some isotopes.

By referring to one example, describe how transmutation can occur. A nuclear reaction should be used to show this. **3**

(ii) Describe the concept of mass defect and outline its role in keeping nuclei from disintegrating. **5**

(d) Identify *one* area of current research in the field of nuclear physics and describe this research, including its potential benefits to our understanding of matter. **4**

(e) (i) Outline *two* precautions that should be taken when handling sources of nuclear radiation. **2**

(ii) Identify why it is acceptable to have certain sources of radioactivity in smoke detectors placed inside homes. **1**

(f) Discuss the role of quarks and leptons in the standard model of matter. **4**

Marks

Question 35 The Age of Silicon (25 marks)

(a) (i) Identify *one* desirable optical property of silica. **1**

(ii) Outline the role of silica in optical fibres. **2**

(b) Discuss the advantages of electronic circuits over electric circuits. **3**

(c) Explain the role of the input transducers in a digital camera. **3**

(d) Over the last 30 years, the density of transistors contained on a silicon chip has consistently increased exponentially. The graph shows how this has happened.

(i) Explain why the graph is not expected to continue in this manner for the next 30 years. **2**

(ii) Outline the effect that this may have on computing power over the next 30 years. **2**

Question 35 continues on page 27.

Marks

Question 35 (continued)

(e) Identify *one* area of current research in the field of electronics and describe this research, including its potential benefits to society. **5**

(f) (i) Write the logical expression for the following truth table: **1**

A INPUT	B INPUT	C OUTPUT
1	1	1
1	0	0
0	1	0
0	0	0

(ii) Describe any precautions that need to be taken to ensure the safety of microprocessors when they are being handled or replaced. **2**

(g) Assess the changes that occurred to computers when the first solid state devices replaced thermionic devices in their circuits. **4**