



Student Number: .....

**2002**

**HIGHER SCHOOL CERTIFICATE**

Sample Examination Paper

# PHYSICS

## General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- A data sheet, formula sheets and Periodic Table are provided at the back of this paper

**Total Marks – 100**

**Section I** Pages 2 – 11

**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 – 26
- Allow about 1 hour and 45 minutes for this part

**Section II** Pages 12 – 18

**25 Marks**

- Attempt ONE question from Questions 32 – 36
- Allow about 45 minutes for this section

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**Section I**

**75 Marks**

**Part A – 15 marks**

**Attempt Questions 1 – 15**

**Allow about 30 minutes for this part**

**1**

**Weight is best defined as:**

- A how much of something there is.
- B the mass of an object.
- C the force on an object due to a gravitational field.
- D the attractive force between two objects.

**2**

**The horizontal component of the motion of a projectile on the Earth consists of:**

- A A changing velocity and constant acceleration.
- B A changing velocity and zero acceleration.
- C A constant velocity and changing acceleration.
- D A constant velocity and zero acceleration.

**3**

**The radius of the orbit of some satellites will decrease with time. This is due to**

- A aging of solar panels and therefore a loss of power.
- B the solar wind changing the path of the satellite.
- C loss of momentum because of collisions with particles in the upper reaches of the atmosphere.
- D Attraction of ferromagnetic objects on the satellite towards the magnetic field of the Earth.

4

**The aether model for the transmission of light was adopted because**

- A light was found to have wave characteristics and it was thought waves need a medium in which to propagate.
- B the speed of light was found to be constant.
- C time and distance were found to be relative to the motion of the aether.
- D light was found to have particulate nature and momentum needed to be conserved as it was discovered that light slowed on its journey from the Sun to the Earth.

5

**Oscar has a weight of 675 N on Earth. Calculate his weight on Mars which has an acceleration due to gravity of  $8.9 \text{ ms}^{-2}$ .**

- A 589 N
- B 613 N
- C 656 N
- D 743 N

6

**A transformer has 2000 turns in its primary winding. If it's purpose is to step down the potential difference from 240 V to 3 V, the number of turns in the secondary winding would be:**

- A 25
- B 80
- C 6 000
- D 160 000

7

**AC motors usually produce**

- A high power
- B low power
- C medium power
- D either low or medium power

8

When electricity is fed through the power lines from the generator to the consumer, energy is not lost through

- A heat being given off from the wires
- B heat being generated by eddy currents in the transformers
- C electrons being used up in the appliances
- D heat being generated by moving parts in appliances.

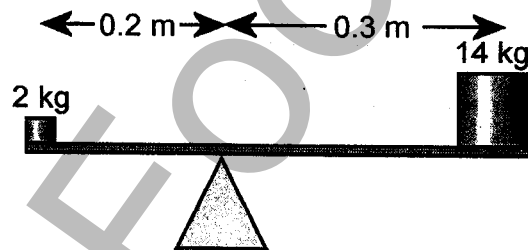
9

The physicist who discovered the generation of an electric current by a moving magnet was

- A Hertz
- B Ampere
- C Galvani
- D Faraday

10

The magnitude of the turning moment in the following diagram would be



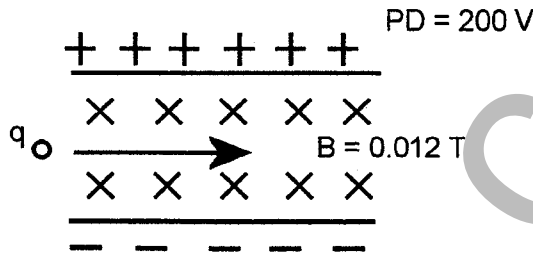
- A 1.2 Nm
- B 3.8 Nm
- C 11.7 Nm
- D 37.2 Nm

11

The energy that is possessed by a photon of light of wavelength 20 nm is

- A  $1.0 \times 10^{-13}$  J
- B  $1.0 \times 10^{-14}$  J
- C  $1.0 \times 10^{-17}$  J
- D  $1.0 \times 10^{-26}$  J

Questions 12 and 13 refer to the following information.



A charged particle is travelling in a straight line between two parallel charged plates and a magnetic field. The magnetic field is 0.012 T and is directed in towards the page. The parallel charged plates are 1 cm apart and have a potential difference of 200 V.

12

The particle is charged

- A positively
- B neutrally
- C negatively
- D but there is not enough information to determine the sign.

13

The velocity of the charged particle is

- A  $4.2 \times 10^2 \text{ ms}^{-1}$
- B  $2.4 \times 10^5 \text{ ms}^{-1}$
- C  $1.7 \times 10^6 \text{ ms}^{-1}$
- D  $5.8 \times 10^7 \text{ ms}^{-1}$

14

**Germanium was used in early transistors because**

- A it had a relatively low melting point and was therefore easier to work with.
- B technologists were unable to produce other semiconductors of suitable purity.
- C it could be doped more easily than other semiconductors.
- D it has a lower volatility than other semiconductors.

15

**The de Broglie model of the atom is best described as**

- A electrons orbiting the atom in fixed energy states
- B electrons orbiting the atom in standing waves.
- C protons and neutrons in the nucleus and electrons surrounding the nucleus.
- D the more massive subatomic particles being made up of quarks and the less massive are leptons.

**Section I (continued)**

**Part B – 60 marks**

**Attempt Question 15 – 31**

**Allow about 1 hour and 45 minutes for this part**

**16**

**Marks**

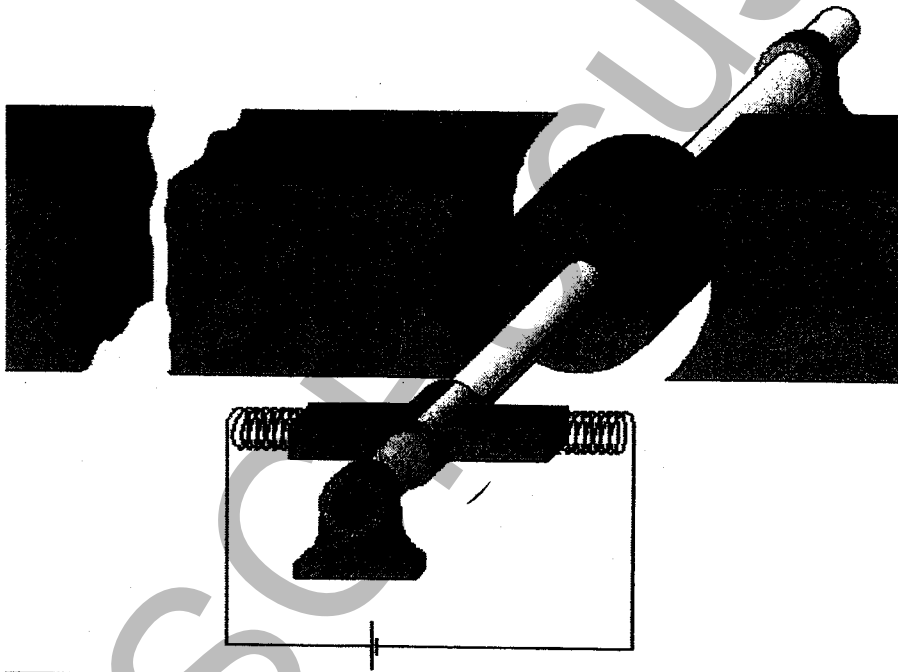
Describe an experiment which you have performed that shows the relationship between the radius of a satellite and the velocity of its motion and qualitatively discuss the results you would expect to obtain from such an experiment. The formula for the linear velocity of an object undergoing circular motion is  $v = 2\pi r/T$

**6**

**17**

The following diagram shows a DC electric motor.

**6**



Describe how the motor works.

**18**

Describe how Lenz's Law has been utilised in improving the efficiency of transformers.

**3**

19

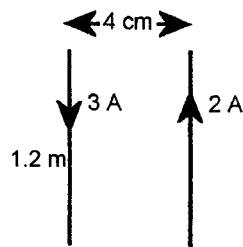
Marks

Describe some of the effects of the development of generators on society.

5

20

The diagram below shows two parallel, current-carrying wires, both of length 1.2 m. One wire is carrying a current of 3 A and the other is carrying a current of 2 A. They are 4 cm apart. Determine the force that is experienced between the two wires.



21

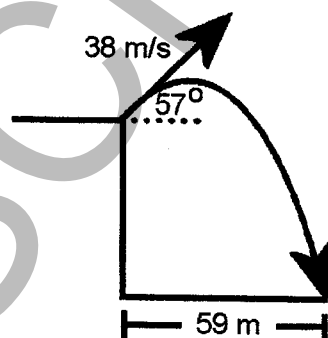
There are different styles of AC induction motors. Outline how movement is created in the induction motor.

3

22

A ball is thrown at speed  $38 \text{ ms}^{-1}$  at an angle of  $57^\circ$  above the horizontal from the top of a cliff. It travels a horizontal distance of 59 m.

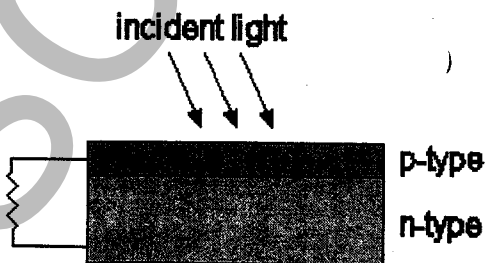
4



Calculate the height of the cliff.



- | <b>23</b>  | <b>Marks</b> |
|--|--------------|
| Currently extended space travel is not viable. Describe reasons why this is the case.  | <b>3</b>     |
| <br><b>24</b>  |              |
| An engineer is part of a mission to travel to a system of planets 6.8 light years away. She will travel to the system at a speed of $0.9c$ . Her twin brother who is part of the settlement crew leaves at the same time but travels at a speed of $0.4c$ . Calculate the age difference between the twins when the brother arrives and determine who will be older? | <b>5</b>     |
| <br><b>25</b>  |              |
| Outline how the Michelson-Morley experiment changed the nature of scientific thinking with regards to motion.  | <b>2</b>     |
| <br><b>26</b>  |              |
| Recall the purpose of a step-up transformer in an electric circuit?  | <b>1</b>     |
| <br><b>27</b>  |              |
| Einstein made a valuable contribution to our understanding of the photoelectric effect. Describe his contribution and explain how it is utilised in one type of technology today.  | <b>7</b>     |
| <br><b>28</b>  |              |
| The following diagram shows a photovoltaic (solar) cell.   | <b>6</b>     |



Describe in detail how the photovoltaic cell works.

29

Marks

Outline how electrons are able to travel unimpeded through YBCO when it is cooled to an extremely low temperature.

3

30

Explain why it was important to use germanium in early transistors.

2

31

Outline two benefits of the development of oscilloscopes for experimental physics and/or the community.

2

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**Section II**

**25 marks**

**Attempt ONE question from Question 32 – 36**

**Allow about 45 minutes for this section**

|                                   | Pages   |
|-----------------------------------|---------|
| Question 32 Geophysics            | 12      |
| Question 33 Medical Physics       | 13      |
| Question 34 Astrophysics          | 14      |
| Question 35 From Quanta to Quarks | 15 – 16 |
| Question 36 The Age of Silicon    | 17 – 18 |

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**Geophysics**

**Marks**

**32a**

Outline what type of information seismic tomography will yield about the Earth.

**2**

**32b**

Describe how a gravity meter works, corrections that need to be made to it and what sort of information it might yield to an archaeologist.

**7**

**32c**

Identify the evidence for a liquid outer core and a solid inner core.

**4**

**32d**

Identify the evidence that supports the idea that the Earth's magnetic field varies over time and explain how the magnetic time scale can be used to determine the age of the oceanic floor.

**6**

**32e**

Define what role have geophysicists played in the monitoring of nuclear test ban treaties?

**2**

**32f**

Summarise the geophysical evidence that supports the theory of plate tectonics.

**4**

**33a**

Computed axial tomography scans have superceded conventional X-rays in their ability to produce an image. Describe how X-rays are produced, how both images mentioned above are created and where a CAT scan would be superior to a conventional X-ray as a diagnostic tool.

7

**33b**

Carbon-11 is an isotope that glucose can be labeled with and is used to study the brain using positron emission tomography. Explain how an image of the brain is produced using positron emission tomography.

5

**33c**

Describe how the Doppler effect works and how it can be used in ultrasonics to determine if a patient has a blood clot.

6

**33d**

Describe why MRI can be used to distinguish between white and gray matter in the brain.

7

**Astrophysics**

**Marks**

**34a**

Discuss the limitations of viewing the stars from the surface of the Earth and one way in which astronomers overcome these limitations.

**6**

**34b**

The star, Canopus has an observable parallax of 10.43 milli arc seconds. Calculate how far away the star Canopus is?

**1**

**34c**

Explain how the absorption spectra of a star is produced and the type of information that the spectra would yield.

**5**

**34d**

A star has an absolute magnitude of 3.78 and an apparent magnitude of 7.92. Calculate the distance the star is from the Earth in parsecs.

**1**

**34e**

Describe why two colour values are used to yield useful information about stars.

**4**

**34f**

Sirius A and Sirius B are binary stars and are observed to be  $3.0 \times 10^9$  km. If the period of their rotation is 18 300 days, Calculate the combined mass of the system.

**2**

**34g**

Explain the process of star death for a star that has a core of mass  $2.5 M_{\odot}$ .

**6**

**From Quanta to Quarks**

**Marks**

**35a**

Summarise Bohr's postulates and outline how they helped explain the visible Hydrogen emission spectrum.

5

**35b**

Calculate by what factor is the wavelength of an electron travelling at  $4 \times 10^5 \text{ ms}^{-1}$  shorter than the wavelength of violet light ( $\lambda = 400 \text{ nm}$ ).

2

**35c**

Outline Davisson and Germer's confirmation of the wave nature of electrons.

2

**35d**

Describe how an image is produced with a transmission electron microscope and explain how this can produce a greater magnification than an optical microscope.

6

**35e**

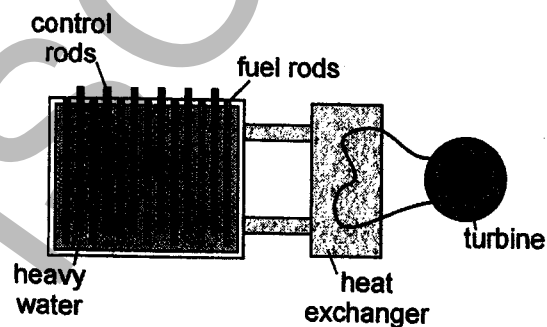
You have investigated the use of isotopes in various industries. Identify an isotope you have studied that is utilised in the medical industry and outline how it is used.

3

**35f**

The diagram below illustrates a nuclear fission reactor.

3



Outline where the electrical energy that the reactor generates comes from.

35g

Marks

The following information is necessary to determine the answer to this question.

4

| Isotope | Atomic mass |
|---------|-------------|
| La-139  | 138.8061    |
| Mo-95   | 94.9057     |
| U-235   | 235.0439    |

U-235 and a neutron react to produce Mo-95, La-139, 2 neutrons and a quantity of another subatomic particle. Identify what the subatomic particle is, calculate its quantity and the energy released in MeV for the reaction.



**The Silicon Age**

**Marks**

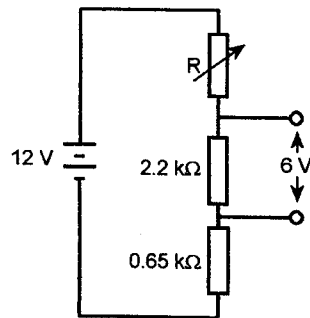
**36a**

Recount why the silicon chip was invented and summarise why its invention was so important to the development of electronics.

**5**

**36b**

The following diagram shows a potential divider.



i Calculate the value of the variable resistor if the desired output voltage is 6V.

**2**

ii Explain how the variable resistor allows a range of voltages to be supplied and Calculate the range of voltages in this potential divider (assume the variable resistor has no maximum resistance).

**3**

36c Describe how a light dependent resistor would be used in a camera.

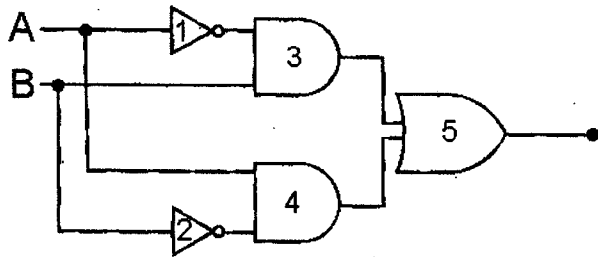
**4**

36d Explain how a light emitting diode works in terms of p and n semiconductors.

**4**

36e The following diagram shows a logic gate.

5



Gates 1 and 2 are NOT gates.

Gates 3 and 4 are AND gates.

Gate 5 is a or gate.

Construct a truth table for each of the five gates.

36f Outline what the difference between an inverting and a non-inverting amplifier is.

2

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