PENRITH HIGH SCHOOL

2013

TRIAL EXAMINATION

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 and a Periodic Table are provided
- Write your name at the top of every page

Total Marks – 100

Section I Pages 1 - 23

75 marks

This section has two parts Part A and Part B

Part A – 20 marks

- Attempt Questions 1-20
- Allow about 35 minutes for this part

Part B –70 marks

- Attempt Questions 20 to 29
- Allow about 2 hours for this part

Section II **10 marks**

- Allow about 25 minutes for this section

Name …….. Teacher…….

PHYSICS 2013 TRIAL HSC EXAMINATION **Part A Answer Sheet**

Name…… **Teacher……**

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

Instructions for answering questions in Section 1

- Complete your answer in either blue or black pen
- Multiple choice

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

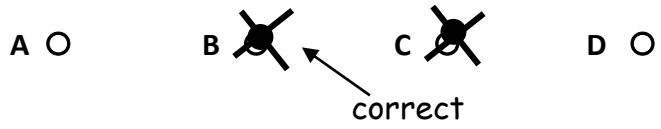
Sample 1: 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

A ○ **B** ● **C** ○ **D** ○

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

A ○ **B** ⊗ **C** ● **D** ○

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.



Section 1 Multiple Choice

1. The gravitational potential energy of a given mass is known at both Earth's surface and at a fixed distance above Earth.

   What CANNOT be determined by comparing these two values of gravitational potential energy?

   (A) The mass of the earth
   (B) The speed of rotation of Earth
   (C) The escape velocity of a satellite from Earth
   (D) The work done in moving between the two points

2 What is the main cause of orbital decay of a satellite in low Earth orbit?

   (A) Tidal effects of the Moon
   (B) The Sun's gravitational field
   (C) Friction between the atmosphere and the satellite
   (D) The interaction of the solar wind with the satellite

3 A 2000kg satellite in a circular orbit around the planet Saturn has a period of 380 hours. If the mass of Saturn is 5.7×10^{26} kg, what is the radius of the satellite's orbit?

   (A) 5.1×10^{6} km
   (B) 5.1×10^{6} m
   (C) 1.2×10^{9} km
   (D) 1.2×10^{9} m

4. An astronaut is in a spacecraft travelling at half the speed of light (c/2). He measures the length of the spacecraft to be 50.0 metres. A person is on the surface of a planet that the spacecraft passes; this person also measures the length. What length will the person on the planet measure the spacecraft to be?

   (A) 43.3 m
   (B) 70.7 m
   (C) 57.7 m
   (D) 35.4 m

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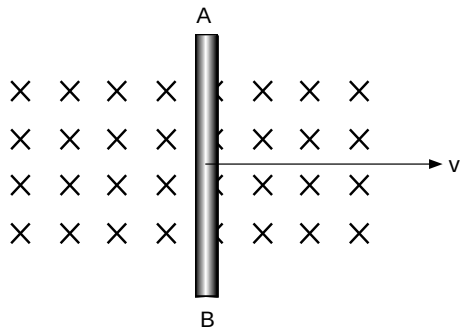
5. Rockets are often launched from locations near the equator. This is because:

(A) less fuel is required by the rocket to gain the necessary height above the ground.
(B) there are few landmasses in equatorial regions, thus reducing the chances of harm to populated regions.
(C) the necessary initial 'horizontal' component of the rockets velocity is a maximum at the equator.
(D) the centripetal force and therefore the gravitational force acting on the rocket is easier to overcome if launched equatorially.

6. A conductor is moved as shown relative to an external magnetic field:



As a result, *electrons* in the conductor:

(A) move towards A
(B) move towards B
(C) move only in the direction of v
(D) do not move

7. A student carried out a series of tests on number of different types of` solar cell.

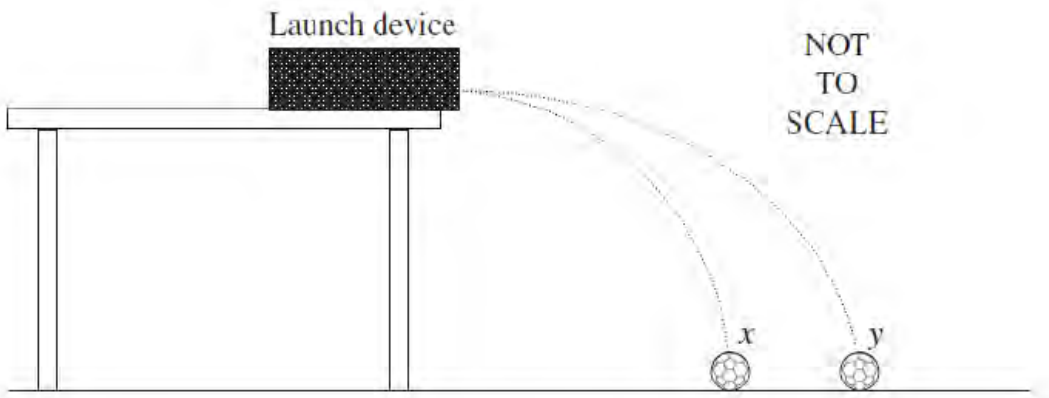
Which of the following would increase the validity of the results?

(A). Carrying test by using one solar cell and changing one variable.
(B). Repeating the test carried out and recording results which are similar.
(C). Repeating the test carried out and recording results which are inconsistent.
(D). Repeat the test but each time changing only the type of solar cell.

8. What is the role of a transformer at an electrical power station?

(A). To reduce heating in the transmission lines by stepping up the voltage.
(B). To reduce heating in the transmission lines by stepping up the current.
(C). To increase heating in the transmission lines by stepping up the voltage.
(D). To increase heating in the transmission lines by stepping up the current.

9. A device launches two identical balls (x and y) simultaneously in a horizontal direction from the same height. The results are shown.



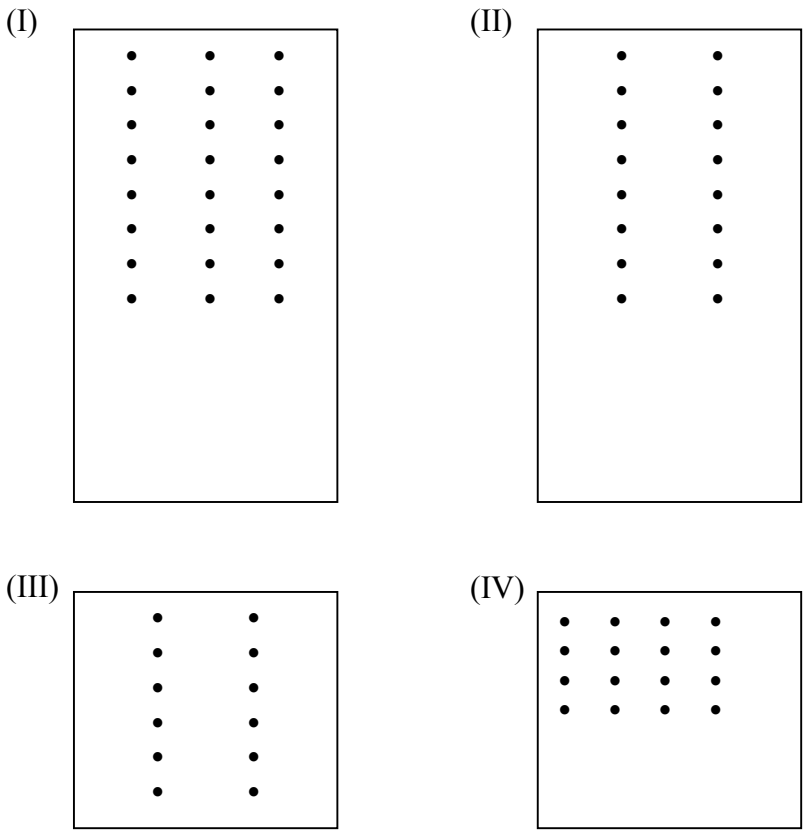
Which statement correctly describes what happened?

(A). x hits the ground before y as it is closer to the launch site.
(B). y hits the ground before x as it has a higher launch velocity.
(C). x and y hit the ground simultaneously as they have the same velocity.
(D). x and y hit the ground simultaneously with different velocities.

10. The force exerted on a pair of parallel current-carrying wires is

(A). Inversely proportional to the square of the separating distance .
(B). Directly proportional to the square of the separating distance.
(C). Directly proportional to the separating distance.
(D). Inversely proportional to the separating distance.

11. Which rectangle contains the greatest magnetic flux *and* field strength?



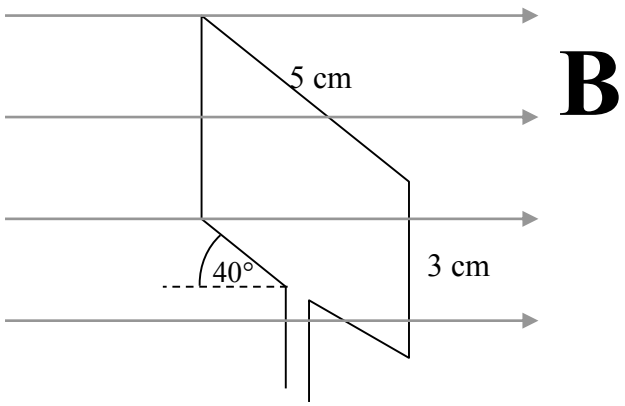
	Flux	**Field Strength**
(A)	I	I
(B)	III	II
(C)	IV	IV
(D)	I	IV

12. A student conducted a first hand investigation carefully following a valid procedure. The results of the investigation showed that the student's hypothesis was not correct.

The least appropriate conclusion that the student may come to is that the:

(A). the student's original assumption in the hypothesis might need changing.
(B). the results of the investigation were not recorded correctly
(C). the procedure must have had hidden flaws.
(D). the investigation must be repeated until results which match the hypothesis are eventually obtained.

13. The coil of a motor is made up of 300 parallel turns. It is placed in a magnetic field of strength 0.5 T. A current of 2 A flows through the coil. Calculate the *torque* on the coil, at the angle shown:



(A) 0.29 Nm

(B) 0.34 Nm

(C) 0.45 Nm

(D) 5.79 Nm

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?

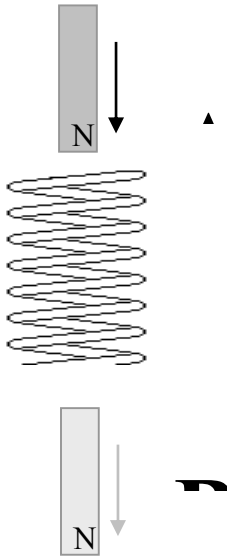
(A) Diffraction

(B) Dispersion

(C) Polarisation

(D) Rarefaction

15. A bar magnet is dropped through a vertical solenoid, as shown.



What pole/s would be induced in the *top* of the solenoid as the magnet goes through from position A to B?

(A) north the whole time

(B) south the whole time

(C) north then south

(D) south then north

16. . An *n*-type semiconductor is produced when silicon crystal is doped with small quantities of phosphorus.

How will this doping change the crystal's electrical conductivity?

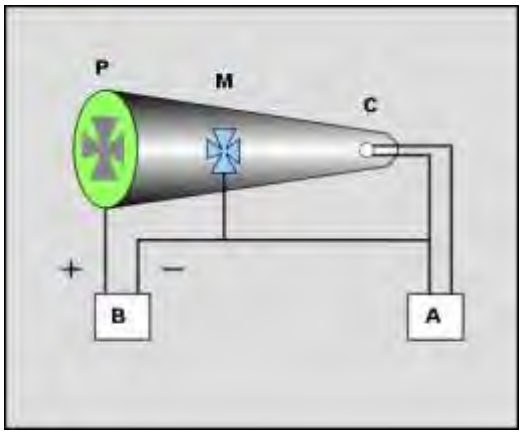
(A). The conductivity will decrease because there are fewer holes in the valence band.

(B). The conductivity will increase because there are more electrons in the conduction band.

(C). The conductivity will increase because there are more holes in the valence band.

(D). The conductivity will decrease because there are fewer electrons in the conduction band.

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) Cathode rays travel in straight lines.

(B) Cathode rays are charged particles.

(C) Cathode rays can be deflected by electric fields.

(D) Cathode rays can be deflected by magnetic fields.

18. Which of the following statements is true regarding cathode ray tubes?

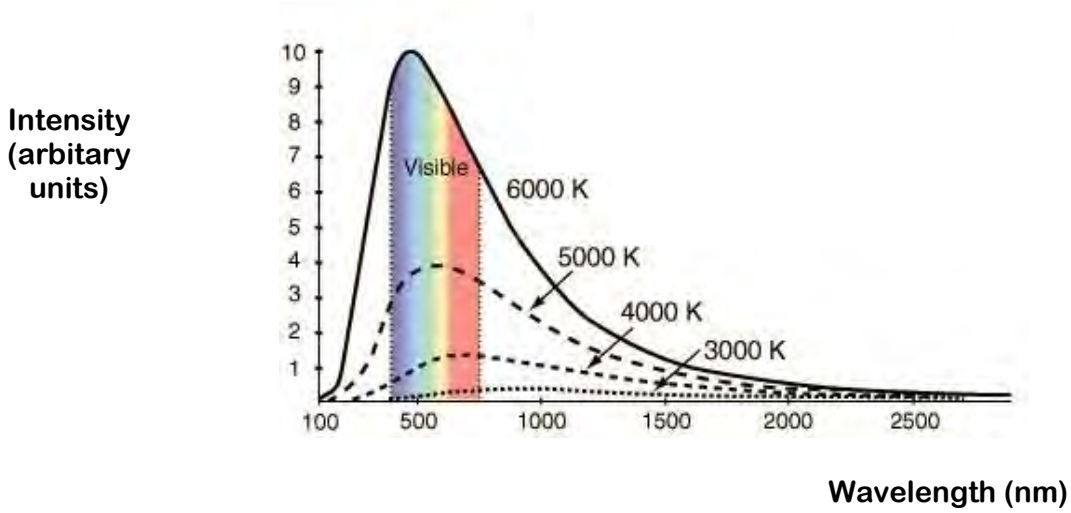
(A). Electrons are emitted from the anode and are accelerated towards the cathode.

(B). The applied electric and magnetic fields must be in opposite (antiparallel) directions.

(C). The tube must contain a perfect vacuum to work properly.

(D). Electrons are emitted from the cathode and are accelerated towards the anode.

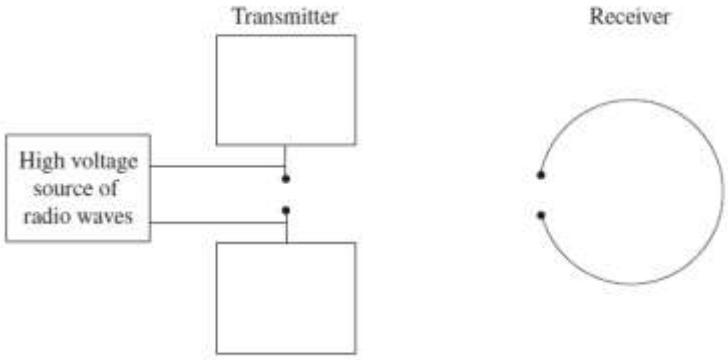
19. The family of curves below shows the relationship between the intensity of black body radiation and its wavelength for various Kelvin temperatures.



Who was the first to correctly explain this relationship?

(A). Planck, in 1900, when he suggested energy at the atomic level was quantised.
(B). Einstein, in 1905, when he suggested light was a stream of particles called photons.
(C). Rutherford, in 1911, when he suggested the nuclear model of the atom.
(D). Bohr, in 1913, when he suggested electrons exist in stationary states.

20 Heinrich Hertz used a set-up similar to the one below to investigate the production and detection of electromagnetic radiation.



Which of the following observations was not consistent with the work of Hertz?

(A). The speed of the radio waves was measured to be the speed of light.
(B). Ultraviolet light light was produced by the spark gap of the receiver.
(C). The electromagnetic wave emitted by the transmitter was detected by the receiver.
(D). The natural oscillator frequency of the receiver loop had to match the frequency of the transmitter to receive the signal.

2013 PHYSICS TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Name:_____

Teacher:_____

Part B – 70 marks
Attempt questions 21-29
Allow about 1 hour and 35 minutes for this part

Answer the questions in the spaces provided

Show all relevant working in questions involving calculations.

Question 21 (6 marks)

(a) Explain the relationship between the current in the primary coil and the current in the secondary coil of an **ideal** step-down transformer in relation to the conservation of energy. **2**

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(b) Discuss the origins of unwanted heat production in transformers and ways in which these can be overcome. **4**

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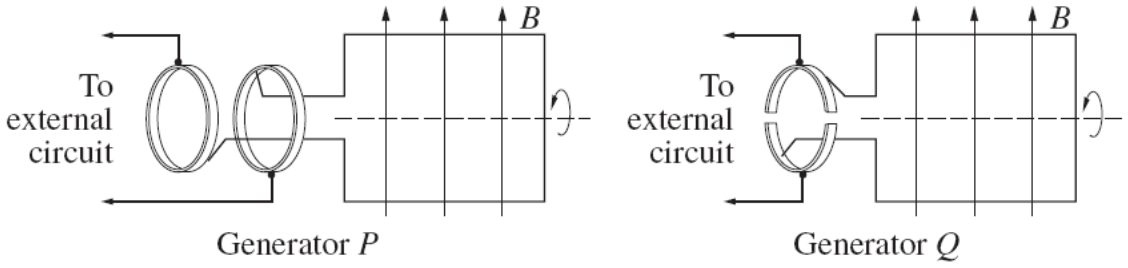
Question 22 (6 Marks)

Two types of generator are shown in the diagram below.



(a) **Identify** which is the AC generator. **1**

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(b) **What feature** of the AC generator did you use to identify it? **1**

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(c) **Explain** how the feature you identified produces alternating current**.** **2**

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(d) **Identify** the function of the split-ring in the DC generator. **2**

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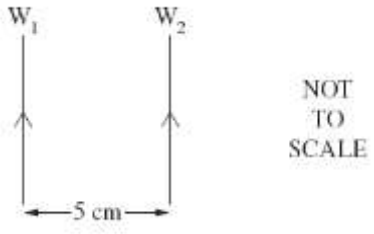
Question 23 (6 Marks)

Two identical wires, W_1 and W_2, each 3.5 m in length, are positioned as shown. They carry identical currents in the direction indicated.



(a) Identify the direction of the force which W_2 experiences as a result of the current in W_1. **1**

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(b) Calculate the current in each wire, given that the two wires experience a force of 3.0×10^{-4} N. **2**

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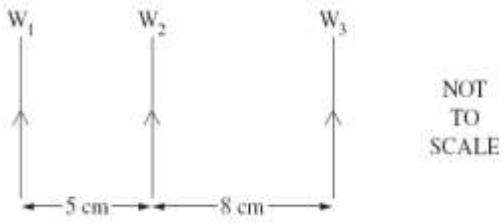
(c) A third wire, W_3, carrying a smaller current, is now placed as shown. **3**



Outline qualitatively the forces on W_2 as a result of the currents in W_1 and W_3.

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Question 24 (6 Marks)

A satellite of mass 275 kg is launched from Earth's surface into a uniform circular orbit of radius 9.5×10^6 m.

(a) Calculate the magnitude of the gravitational potential energy E_p of the satellite. **1**

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(b) From this uniform circular orbit, the satellite can escape Earth's gravitational field when its kinetic energy is equal to the magnitude of the gravitational potential energy. **3**
Use this relationship to calculate the escape velocity of the satellite.

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(c) Outline the effect of Earth's rotational motion upon the launch of this satellite. **2**

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Question 25 (6 Marks)

Muons are very short-lived particles that are created when energetic protons collide with each other. A beam of muons can be produced by very-high-energy particle accelerators.

The high-speed muons produced for an experiment by the Fermilab accelerator are measured to have a lifetime of 5.0 microseconds. When these muons are brought to rest, their lifetime is measured to be 2.2 microseconds.

(a) Name the effect demonstrated by these observations of the lifetimes of the muons. **1**

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(b) Calculate the velocity of the muons as they leave the accelerator. **3**

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(c) Outline ONE other piece of evidence supporting Einstein's theory of relativity **2**

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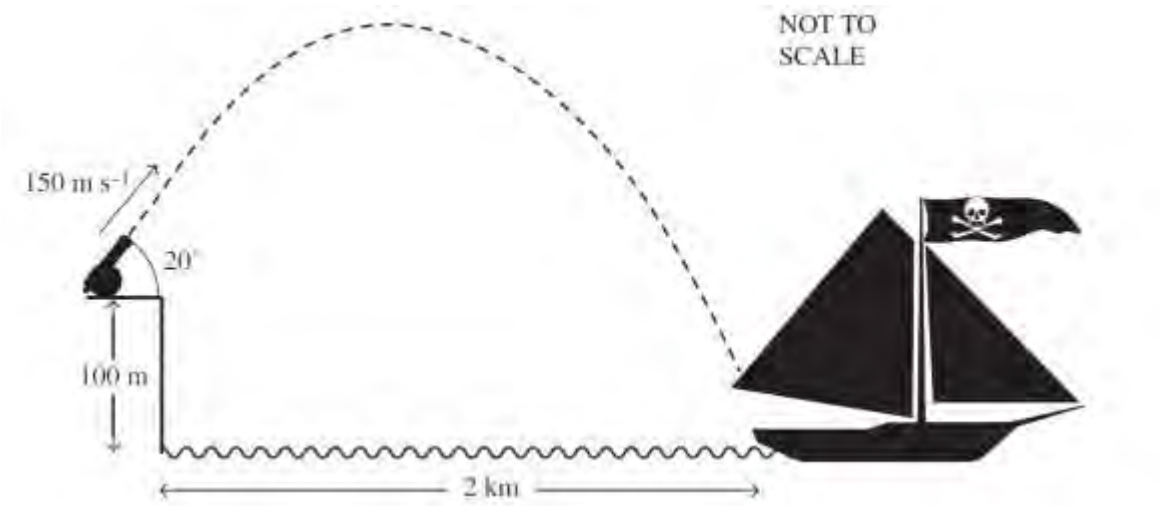
Question 26 (10 marks)



An enemy ship was sailing 2 km from the coast. A cannon on a 100 metre-high cliff fired a cannon ball at an angle of 20° to the horizontal, at a speed of 150 ms-1.

(a) Determine the vertical and horizontal components of the initial velocity. **2**

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(b) Calculate the time taken for the cannon ball to reach the maximum height and hence the maximum height of the cannon ball above the water. **3**

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Question26 is continued on the next page.

Question 26 (continued)

(c) Calculate the range of the cannon ball and hence determine how far from the ship the cannon ball landed. **3**

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(d) Describe an adjustment of the cannon that is necessary for a cannon ball to be able to hit the ship. **2**

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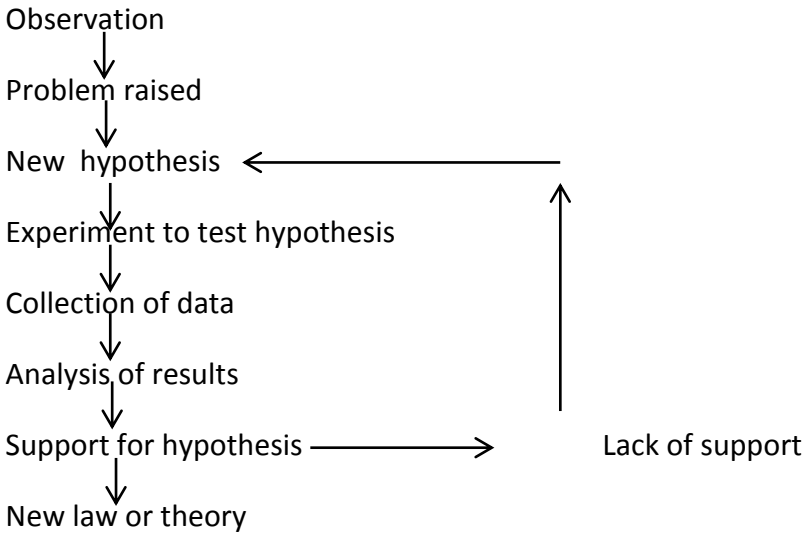
Question 27 (6 Marks)

This flowchart represents one model of scientific method used to show the relationship between theory and the evidence supporting it.



Question 27 is continued on the next page.

Question 27 (continued)

Evaluate the famous experiments conducted by Michelson & Morley to measure the relative velocity of the Earth through the aether as an application of this model of scientific method. **6**

Question 28 (6 Marks)

In the past 50 years electrical technology has developed from the widespread use of thermionic devices to the use of solid state devices.

(a) List THREE disadvantages of thermionic devices that led to their replacement. **3**

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(b) Outline TWO advantages of using semiconductors, with reference to an application. **3**

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Question 29 (6 Marks)

A photo-electric device was used to measure the kinetic energy of electrons (expressed as electro-volts) emitted from a metal at different wavelengths of visible light. The following data was obtained:

Colour	Wavelength (nm)	Voltage (eV)
Blue	430	1.15
Yellow	500	0.72
Orange	520	0.58
Red	580	0.31

(a). Explain quantitatively why the eV measurement for blue-coloured light is larger than it is for red-coloured light: **2**

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Question 29 is continued on the next page.

Question 29 (continued)

(b). Convert the experimental data to appropriate units, then use the grid on the following page to graphically obtain the Work Function for the metal in the photoelectric device. **4**

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Question 30 (6 marks)

a) Outline the benefits of "doping" semiconductors: **3**

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b) During your course you performed a first-hand investigation to model the behaviour of semiconductors.

Outline a model you studied and include as part of your answer, a labelled diagram to illustrate features of your model. 3

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Question 31 (6 marks)

a) The Cooper pair state is responsible for superconductivity, as described in the BCS theory developed by John Bardeen, Leon Cooper, and John Schrieffer for which they shared the 1972 Nobel Prize.

With the aid of a diagram outline how superconductivity occurs. **3**

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b) In class you watched a demonstration of the Meissner Effect. **3**

Explain why a magnet is able to hover above a superconductor?

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Physics *Section II* 10 marks

*Do **either** Question 32 OR Question 33*

Allow about 25 minutes for this part

Answer the questions in a writing booklet. Extra writing booklets are available.

Show all relevant working in questions involving calculations.

Question 32: Medical Physics *(14 marks)*

Marks

(a) The velocity of sound and density of a number of different types of body Tissues (and air) are shown in the table: **2**

Material	*Velocity* (ms^{-1})	*Density* ($kg\ m^{-3}$)
Fat	1450	952
Muscle	1590	1075
Bone	4080	1908
Air	330	1.3

(i) Calculate the acoustic impedances of sound in muscle tissue and in bone. **2**

(ii) Determine the fraction of the original signal that is reflected for the boundary between muscle and bone. **2**

(iii) Comment upon your result making reference to the difference between the acoustic impedances in the two materials. **2**

(c) Describe how the principles of acoustic impedance and are applied to ultrasound. Illustrate your answer with an appropriately labelled scientific diagram: **4**

Question 33: Quanta to Quarks (10 marks)

a) (i) Compare Davisson and Germer's experiment using electrons with **Bragg's** experiment using x-rays. Identify the physical insights gained in each experiment. **6**

(ii) State de Broglies's hypothesis **2**

(iii) Explain how this hypothesis relates to Bohr's postulates. **2**

END OF EXAMINATION.

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

Q21a	Explains relationship between current in primary and secondary coils and the number of turns in each coil **OR** identifies using **equation** States the law of conservation of energy and includes **equations** to show energy conservation in an ideal transformer	2
	Identifies relationship between current in primary and secondary coils and the number of turns in each coil **OR** states Law of conservation of energy including **equations** to show energy conservation in an ideal transformer	1
Q21b	Discusses two sources of unwanted heat in a transformer **AND** describes two ways of overcoming this heat production	4
	Identifies two sources of unwanted heat in a transformer **AND** Identifies two ways of overcoming this heat production	3
	Identifies two sources of unwanted heat in a transformer **OR** Identifies two ways of overcoming this heat production OR Identifies one source of unwanted heat in a transformer **AND** Identifies one way of overcoming this heat production	2
	Identifies one source of unwanted heat in a transformer **OR** Identifies one way of overcoming this heat production	1

Q22a	Identifies generator P as the AC generator	1
Q22b	Names the slip ring as the identifying feature	1
Q22c	Outlines that generator uses rotation to create a change of flux between a magnetic field and a current carrying wire generates an EMF Identifies that the current reverses direction as the motion of the coil relative to the magnetic field changes Identifies that slip rings fixed to the shaft provide a constant connection (via brushes) of that alternating current to the external circuit	2
	Identifies that alternating current produced by coil is supplied by fixed slip rings into external circuit.	1
Q22c	Identifies that split rings provide for electrical connections of coil to alternate **AND** thus feeding current to external circuit in a constant direction	2
	Identifies that split rings provide for electrical connections of coil to alternate **OR** identify that split rings feed current to external circuit in a constant direction	1

Q23a	Identifies the direction of force correctly as being to the left	1
Q23b	Shows use of the correct equation and correctly substitutes given data to correctly calculate current with units	2
	States correct current or uses correct process to give incorrect current	1
Q23c	Correctly predicts the direction of the resultant force **AND** identifies the factors which determine force as size of current and distance apart **AND** therefore determines the relative contribution of the force of W1 and W3	3
	Correctly predicts the direction of the resultant force **AND** Identifies the relative contributions of the force of W1 and W3	2
	Correctly predicts the direction of the resultant force **OR** identifies the factors which determine force as size of current and distance apart **OR** therefore determines the relative contribution of the force of W1 and W3	1

Q24a	Uses the correct equation to calculate the GPE with units $Ep = -Gm_1m_2/r = -1.2 \times 10^{10}J$	1
Q24b	Writes correct equations for GPE and KE and equates the two **AND** correctly rearranges and cancels out to derive the correct expression for v **AND** correctly substitutes to calculate the correct answer with units $v=9.2 \times 10^3\ ms^{-1}$	3
	Writes correct equations for GPE and KE and equates the two **AND** correctly rearranges and cancels out to derive the correct expression for v **OR** correctly equates an expression for v and calculates the correct answer with units	2
	Writes the correct answer with units **OR** Writes correct equations for GPE and KE and equates the two **incorrectly** to derive an expression for v	1
Q24c	Relates how the rocket can gain angular momentum from the rotational motion of the Earth if the launch is done at the equator and in the direction of Earth's rotation **AND** thus requiring less fuel to reach escape velocity	2
	Relates how the rocket can gain angular momentum from the rotational motion of the Earth if the launch is done at the equator and in the direction of Earth's rotation **OR** rocket gains speed due to Earths rotation, thus requiring less fuel to reach escape velocity	1

Q25a	Identifies the relativistic effect as time dilation	1
Q25b	Uses the correct equation, correctly substituted to calculate the correct velocity with units $v+ 2.7 \times 10^8\ ms^{-1}$	3
	Uses the correct equation, correctly substituted to calculate the correct velocity **without** units **OR** Shows working to correctly calculate the velocity with units	2
	Correctly calculates the velocity	1
Q25c	Correctly outlines a piece of evidence **and** identifies the concept it supports	2
	Correctly outlines one piece of evidence	1

Q26a	Shows working to correctly calculate Ux and Uy with units $Uy = 51.3\ ms^{-1}$ and $Ux = 140.95\ ms^{-1}$	2
	Shows correct working OR gives correct values for Ux and Uy	1
Q26b	Uses values calculated in Q26a and correct equation to correctly calculate t and uses that value to correctly calculate maximum height. **above water.** Both answers given with correct units t= 5.24 s Max height= 234.28m	3
	Uses values calculated in Q26a to calculate t and uses that value to calculate maximum height. Either an error in one step causes incorrect value/s or answers given with correct units or forgets to add height of cliff	2
	Shows correct method in part of the process to calculate t or height	1
Q26c	Uses correct equation to calculate the range of the ball with units and determines distance from ship t=12.15s Δx=1712.55 m 287.45m from ship	3
	Correctly calculates the range of the ball and determines distance from ship or uses incorrect time to do correct calculation	2
	Shows the correct method to calculate range	1

Q27	Evaluates M& M by: • Identifying the aim of the experiment • Describing the hypothesis and rationale for this method • Describing and commenting on the experimental setup and procedure in relation to validity, reliability and accuracy • Identifies the consistently null result leading to adjustments to procedure and further experimentation • Lack of support for hypothesis eventually leads to development of a new hypothesis • Makes a judgement based on the above criteria	6
	Analyses M& M by looking at • the aim of the experiment • the experimental setup and procedure in relation to validity, reliability and accuracy • the result leading to adjustments to procedure and further experimentation • scientific impact of the experiment	4-5
	Discusses M&M by mentioning some of the following: Aim, method, procedure used, results obtained and	2-3
	Gives correct information about M&M experiment	1

Q28a	Lists three disadvantages of thermionic devices	3
	Lists two disadvantages of thermionic devices	2
	Lists onedisadvantage of thermionic devices	1
Q28b	Correctly outlines two advantages of semiconductors with reference to a relevant application	3
	Names two advantages of semiconductors	2
	Names one advantage of semiconductors	1

Q29a	Uses calculated values and equation $E=hc/\lambda$ to show difference in voltage between blue and red light	2
	Relates wavelength to the energy of light	1
Q29b	Graphs data with ALL of the following: • relevant heading • eV on y axis and frequency on x axis • labels and units shown correctly • y axis shows range into negative sufficient to show y-intercept • data points correctly plotted as crosses • correct line of best fit drawn to represent data • identifies that work function corresponds to y-intercept • W= 3.37 E-19 J or 2.104 eV	4
	Graphs data with MOST of the following: • eV on y axis and frequency on x axis • labels and units shown correctly • y axis shows range into negative sufficient to show y-intercept • data points correctly plotted as crosses • correct line of best fit drawn to represent data	3

	• identifies that work function corresponds to y-intercept	
	Graphs data with SOME of the following: • relevant heading • eV on y axis and frequency on x axis • labels and units shown correctly • y axis shows range into negative sufficient to show y-intercept • data points correctly plotted as crosses • correct line of best fit drawn to represent data • identifies that work function corresponds to y-intercept	2
	Draws a graph which represents the data	1

Q30a	Identifies what "doping" is and outlines two benefits of the process	3
	Outlines two benefits of "doping"	2
	Outlines one benefit of "doping"	1
Q30b	Outlines a relevant model and uses a labelled diagram to link features of that model to behaviour of semiconductors	3
	Identifies a relevant model including a diagram	2
	Identifies a model	

Q31a	Uses a correct diagram to outline the interactions between coopers pairs of electrons and the crystalline lattice of a superconducting material	3
	Uses a diagram to outline the movement of electrons as pairs through the superconductor	2
	Outlines the movement of electrons through superconductor	1
Q32b	Describes that when a superconductor is **below** critical temperature in the presence of an external magnetic field - the internal magnet field is expelled from its core causing the magnet to levitate : mention induced current in the superconductor	3
	Outlines that a magnetic field across a superconductor causes expulsion of the external field causing the magnet to levitate.	2
	Outlines levitation using relevant terms	1

Q32a(i)	Uses the correct equation, correctly substituted to calculate acoustic impedance of muscle and bone, with units	2
	Correct calculation of impedance of muscle and bone without showing working or without units or one is incorrect	1
Q32(ii)	Uses correct equation to calculate the fraction of reflected signal (as a fraction or %)	2
	Correct fraction calculated without showing equation or working	1
Q32(iii)	Identifies implications that large reflection would enable successful imaging of muscle tissue but only indicates presence of bone not detailed imaging of the bone	2
	Makes a relevant comment on the implications for imaging	1
Q32(c)	Explains that acoustic impedance(the extent to which materials transmit sound) depends on two factors, density and velocity of sound in a material Links the acoustic impedance time taken for a sound wave to travel to an interface and proportion reflected can be used to determine the properties and location of tissues within the body Correct and relevant labelled diagram	4
	Identifies that acoustic impedance(the extent to which materials transmit sound) depends on two factors, density and velocity of sound in a material Mentions time taken for a sound wave to travel to an interface and proportion reflected Correct and relevant labelled diagram	3
	Mentions density, velocity and reflection Includes diagram	2
	Mentions density, velocity **OR** reflection	1

Q33a)(i)	Shows extensive knowledge and detail	6
	Compares set up including two of the following: • Beam, target, detector, pattern • Pattern includes physical insights • Describes dependant and independent variables • Detail of how beam is produced and Identifies crystal structure and matter wavelength	4-5
	Describes set up including some of: Beam, target, detector, pattern and Identifies crystal structure or matter wavelength	3-2
	Identify these are physics experiments	1
(ii)	States de Broglie's hypothesis	2
	Includes wavelength concept	1
(iii)	Explains standing wave condition limits possible orbitals	2
	Identifies a postulate	1