

TEACHER'S NAME: _____

CANDIDATE NUMBER: _____

BAULKHAM HILLS HIGH SCHOOL

TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

2002

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
- A data sheet, formulae sheets and Periodic Table are provided at the Back of this paper

Total mark - 100

Section I

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 - 68 marks

- Attempt Questions 16 - 33
- Allow about 2 hours for this part

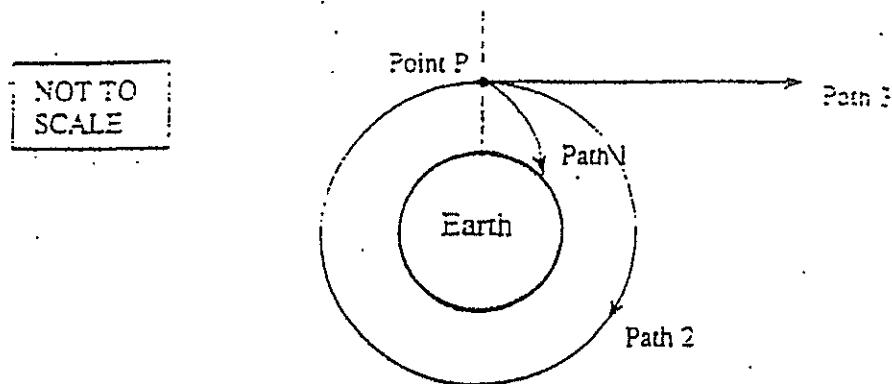
Section II

17 marks

- Attempt Questions 34 - 37
- Allow about 30 minutes for this section

PART A
(85 MARKS)

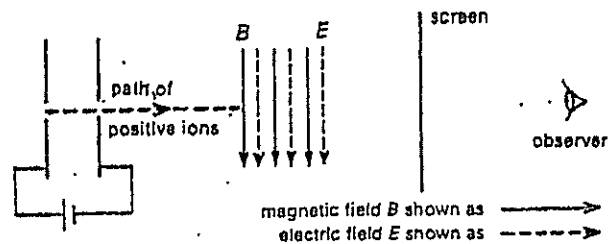
1. A mass is projected horizontally from a point P above the Earth's surface. Three possible pathways are shown for this projectile.



If the projectile follows path 2, instead of the other paths, we can conclude that:

- (A) Point P must have been above the equator
(B) The friction due to the atmosphere was too high for it to follow path 1
(C) The horizontal velocity of the projectile was too low for it to follow path 3
(D) The projectile experienced no gravitational pull towards the Earth because point P is too far above the Earth's surface.
2. Rocket ship Alpha has a mass of 14 500 kg as measured on Earth. Rocket ship Alpha then travels out across space and positions itself near a wormhole where its weight is measured as 7.28×10^7 N. What is the acceleration due to gravity near the wormhole?
- (A) $5.02 \times 10^3 \text{ m s}^{-2}$
(B) $1.06 \times 10^{12} \text{ m s}^{-2}$
(C) $1.99 \times 10^{-4} \text{ m s}^{-2}$
(D) $2.00 \times 10^{-2} \text{ m s}^{-2}$
3. Name the scientist that first put forward the idea that projectile motion was the resultant of two component motions at right angles to each other.
- (A) Einstein
(B) Galileo
(C) Kepler
(D) Newton
4. Kepler's Law of Periods $T^2 = kr^3$ shows a 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

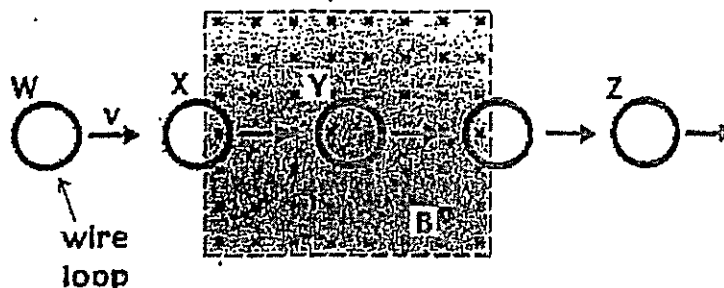
5. The Russian space station which was orbiting Earth for many years eventually crashed into the Earth. This occurred because of:
- (A) a reduction in its orbital velocity due to friction from the magnetosphere
 - (B) a reduction in its orbital velocity due to friction from the atmosphere
 - (C) an increase in its orbital velocity due to a stronger gravitational force
 - (D) a reduction in its orbital velocity causing the gravitational force to increase
6. In an early form of mass spectrograph design by J.J. Thomson, a beam of positively charged ions was accelerated and then passed through parallel electric and magnetic fields before striking a screen, as shown.



To an observer viewing the screen, in what direction would the spot be deflected?

- (A) Down and to the left
 - (B) Down and to the right
 - (C) Up and to the left
 - (D) Up and to the right
7. Laminations are used in the core of transformers. Which of the following statements best describes their function?
- (A) They reduce the magnetic fields that penetrate the secondary coil
 - (B) They reduce eddy currents, which cause heating of the core
 - (C) They reduce eddy currents, which reduce the primary core current
 - (D) They reduce the back EMF induced in the primary coil
8. Hertz was able to successfully demonstrate that:
- (A) The speed of radio waves is independent of the medium that carries them
 - (B) Radio waves are a type of electromagnetic radiation
 - (C) Radio waves consist of photons of lower energy than light waves
 - (D) The waves used in wireless communication are radio waves

9. A metal ring is passed with a constant velocity v through a rectangular region enclosing a magnetic field as shown in the following diagram, beginning at W and ending at Z.

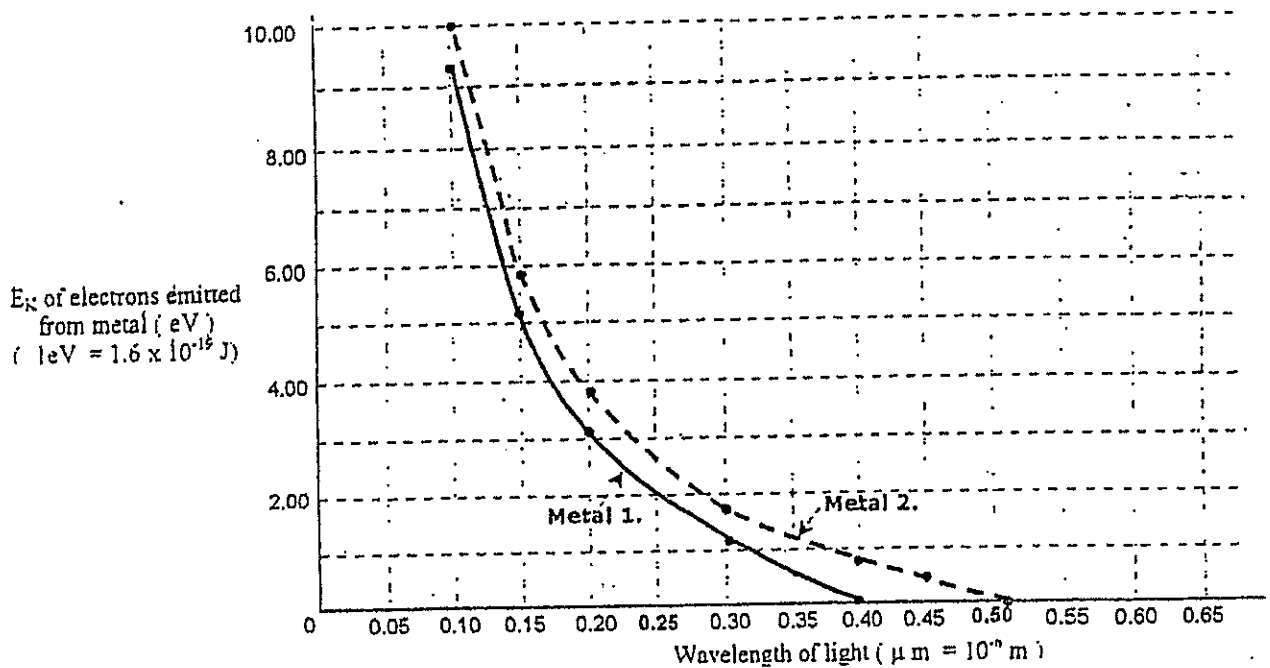


A current flows around the coil when it is in the labeled positions

- (A) W, X, Y and Z
 (B) X and Y only
 (C) Y only
 (D) X only
10. Which of the following will not increase the total force between two parallel current carrying conductors
- (A) Using two longer wires
 (B) Increasing the current in one of the wires
 (C) Increasing the separation of the wires
 (D) Increasing the current in both of the wires
11. Doping:
- (A) increases the resistance of the semiconductors
 (B) decreases the resistance of semiconductors
 (C) decreases the number of charge carriers
 (D) is called intrinsic semi-conductors
12. Which of the following gives the main reason why X-rays, rather than UV or visible light, are normally used to investigate crystal structure.
- (A) X-rays can pass easily through crystals
 (B) The atomic separation in crystals is usually similar to the wavelength of X-rays
 (C) Each X-ray photon has more energy than in the case of either UV or visible light
 (D) Electrons can more easily be released from atoms by X-rays

13. Which of the following is correct for a p-type semiconductor and describes how it is different from an n-type semiconductor?
- (A) a p-type has positive holes as the major charge carrier
 - (B) a p-type has negative electrons as the major charge carrier
 - (C) a p-type uses extrinsic conduction rather than intrinsic conduction
 - (D) a p-type contains similar numbers of positive holes and free electrons

14. The following graph shows results collected on the kinetic energy of electrons that were emitted from TWO metals as the wavelengths of the light source was changed.



Considering the graph, which of the following statements is correct?

- (A) the greater the kinetic energy of the electrons the shorter their wavelengths
 - (B) the work-function for Metal 1 is greater than the Metal 2.
 - (C) the intensity of the light used for Metal 2 was greater than the intensity used with Metal 1.
 - (D) the slope of the line represents Planck's constant.
15. Superconductors:
- (A) have zero resistance near 0 K
 - (B) have zero resistance near 0 C
 - (C) attract magnetic fields
 - (D) have resistance between that of conductors and insulators

PART B

Marks

16. Calculate the weight of a 90 kg man in each of the following situations:

- (i) On the surface of the Earth
- (ii) In the space shuttle in orbit at an altitude of 400 km above the surface of the Earth
- (iii) On the surface of the planet Mars

1

2

2

Body	Mass (kg)	Radius (km)
Earth	5.97×10^{24}	6 378
Mars	6.42×10^{23}	3 397

(i) _____

(ii) _____

(iii) _____

17. The maximum g-force experienced by astronaut Alan Shepherd during the first US manned space flight was 6.3 "g".

(i) What was the maximum acceleration experienced by Shepherd? (Assume that the acceleration due to gravity remained constant during the flight.)

1

(ii) Assuming that the rocket supplied a constant thrust during launch. Describe why the g-forces would have increased during the launch. (Again assume that the acceleration due to gravity remained constant during the flight.)

2

(i) _____

(ii) _____

18. A communications satellite in a geostationary orbit has a period of 23 hours 56 minutes and 4 seconds.

(i) Explain why a period that is 3 minutes and 56 seconds less than 24 hours is required to keep a satellite in orbit above the same point on the surface of the Earth.

1

(ii) Calculate the radius of such an orbit.

2

(iii) A geostationary satellite orbits above the outer Van Allen radiation belt. State two problems associated with a communications satellite being in such a high altitude orbit.

2

(i) _____

(ii)

(iii)

19. High performance jet fighters that are capable of traveling faster than the speed of sound have very streamlined shapes, usually with pointed noses to assist them penetrate through the air. In contrast, during re-entry into the Earth's atmosphere, space craft present a blunt surface to the atmosphere. (The space shuttle keeps its nose well up and presents its flat underbelly to the atmosphere.)

Explain why it is advantageous for space craft to descent through the atmosphere blunt side first.

2

20. The famous experiment conducted by Michelson and Morley was designed to detect the motion of the Earth relative to the luminiferous aether. Although the aether had never been detected it was generally accepted that it must exist.

(i) Why was it that scientists thought that the aether must exist.

2

(ii) The Michelson-Morley experiment failed to detect the motion of the Earth through the aether but the experiment is now not viewed as a failure. The result could not be explained at the time and now the experiment is seen as being a most important experiment. Why is it regarded as such and how was the null result of the Michelson-Morley experiment eventually explained?

2

(i) _____

(ii) _____

21. The principle of relativity states that an observer in an inertial frame of reference cannot perform any experiment or make an observation to determine whether he is at rest or moving with a uniform velocity. Einstein added that the speed of light in a vacuum has the same value for any observer in an inertial frame of reference regardless of the motion of the observer.

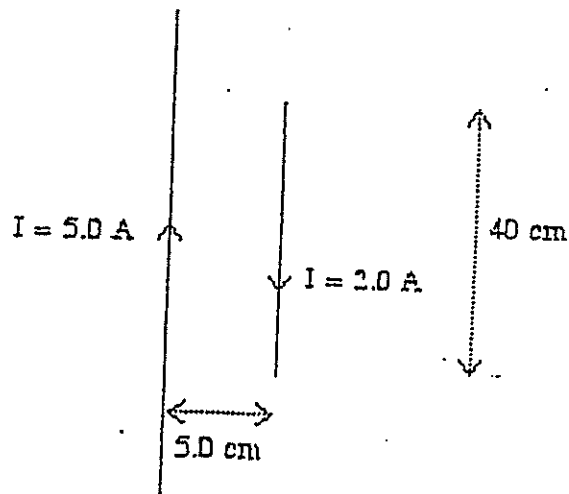
The fact that the speed of light in a vacuum was constant for these observers has some interesting consequences.

Consider a consequence, associated with time and show how observers in different inertial frames of reference will not agree on the observations made in each other's frames of reference.

(You may discuss this or perform calculations to indicate how observations made by one are viewed by the other.)

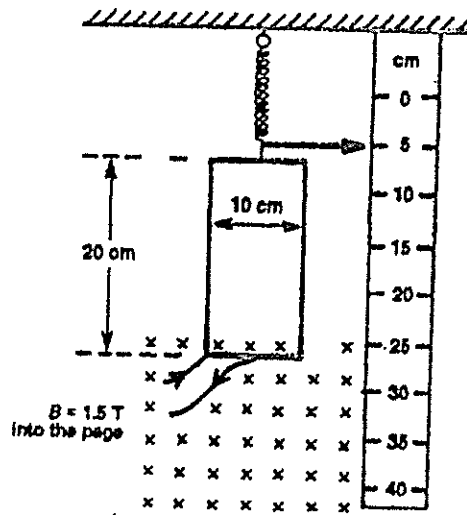
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22. A conductor 40 cm long lies 5.0 cm from and parallel to a long wire carrying a current 5.0 A.



The current in the shorter wire is 2.0 A and is in the opposite direction to the other current. Determine the magnitude and direction of the force between the two conductors.

23. A spring with a pointer attached is set up as shown. With nothing further attached the spring the pointer reads zero. A coil of 10 turns and a mass of 0.1 kg is then attached to the end of the spring, as shown. The lower edge of the coil is perpendicular to a uniform magnetic field of magnetic flux density 1.5 T. With no current flowing around the coil the pointer reads 5 cm as shown.



- (i) What would the pointer read if there was a clockwise current of 2A in the coil? 2
 (ii) With this current in the coil what would be the resultant force acting on the coil? 3

(i) _____

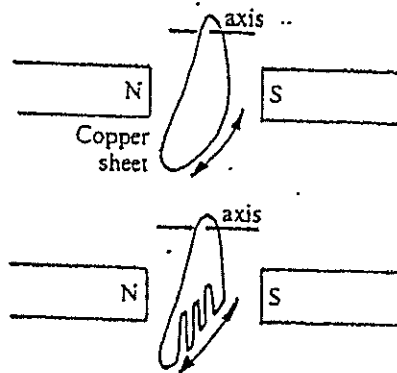
(ii) _____

24. Describe how the motor effect (the force on a current carrying conductor in a magnetic field) is utilized in the operation of galvanometer.

25. Describe an investigation that you carried out to demonstrate the principle of an AC induction motor

4

26. This question refers to the diagram



A student sets up an experimental as shown. A copper sheet is allowed to swing in a vertical plane between the poles of two strong bar magnets. The number of swings made by the sheet before it stops is two. A second similar sheet of the same mass but with pieces cut from it is found to make eight swings before it stops. Account for the difference.

3

27. Relate Lenz's law to the production of back emf in an electric motor.

4

28. Define a black body.

1

29. Explain how Planck interpreted black body radiation.

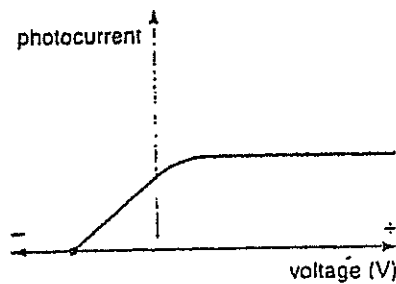
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30. Discuss evidence for the particle nature of light as proposed by Einstein

4

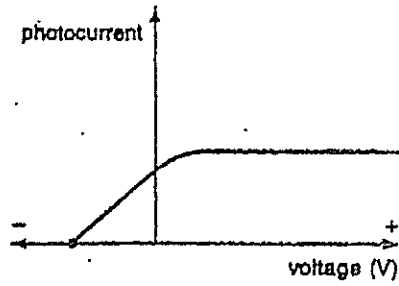
31. The curve below shows how the current measured in a photoelectric effect experiment depends on the potential difference between the anode and cathode.

8

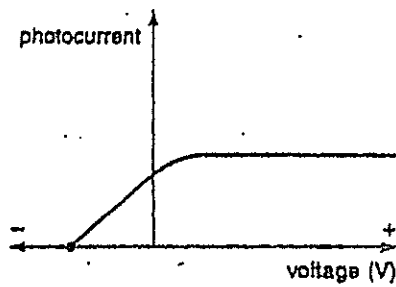


(a) Explain the curve – why does it reach a constant maximum value at a certain positive voltage, and why does it drop to zero at a certain negative voltage?

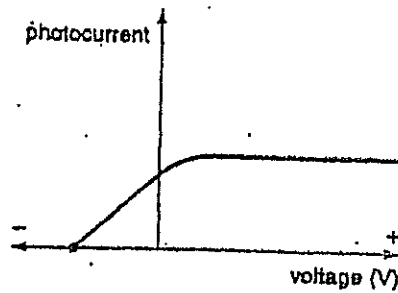
intensity of the light was increased.
Explain your reasoning.



- (c) Draw another graph on the diagram below to show what would happen if the frequency of the light was increased.
Explain your reasoning.



- (d) If the material of the cathode was changed, but the light was not changed in any way, sketch the curve that would be obtained. Explain your reasoning.



- 32 An experiment is carried out with a photoelectric cell using the circuit shown in Figure 1. By varying the intensity and frequency of the light used, and by varying the voltage and polarity of the d.c. power supply, the graphs shown in Figure 2 were obtained.

3

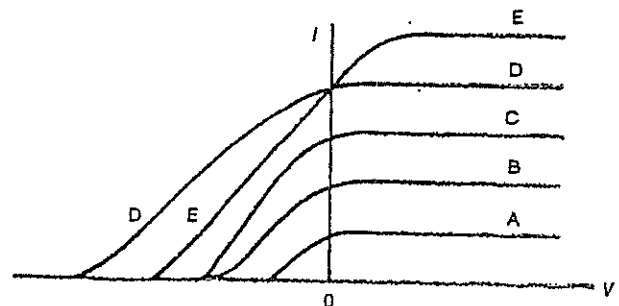
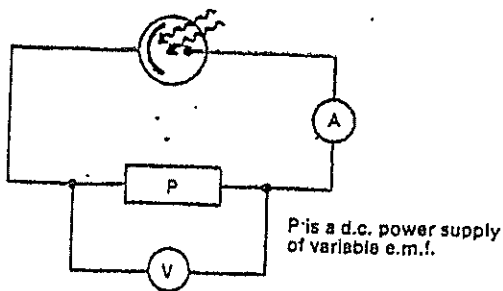


Figure 1.

Figure 2.

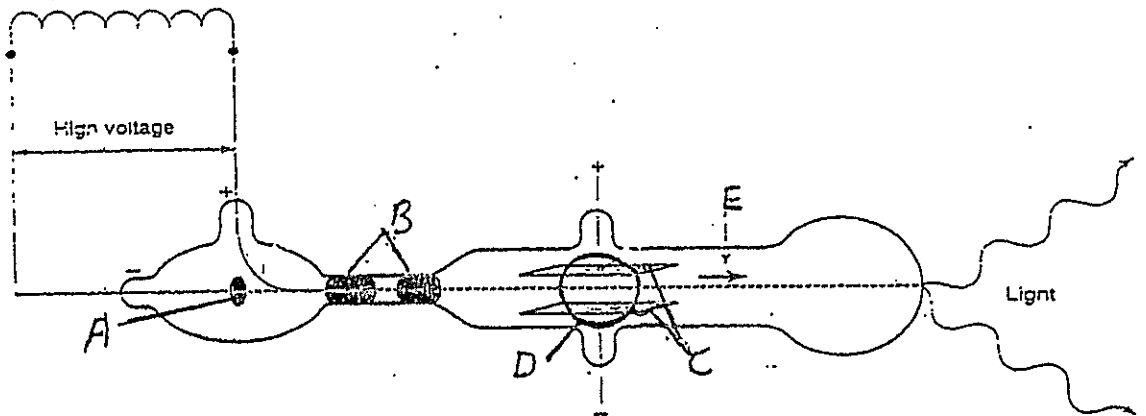
- (a) Which *two* of the five curves (A, B, C, D, E) in Figure 2 correspond to incident light of the same frequency but of different intensities?

(b) Which of the curves corresponds to the highest frequency of light used?

(c) Which of the curves corresponds to the situation where the highest energy electrons are ejected from the photoelectric surface?

33. J J Thomson used the first cathodes ray tube to measure the charge to mass ratio of an electron. Complete the table below by identifying the labeled parts and their function.

Secondary coil of an induction coil



Name of labeled part	function
A	
B	
C	
D	
E	

34. An electron is accelerated through a voltage of 10kV in a cathodes ray tube. Calculate the wavelength of the electron.

2

37 The diagram below shows an energy level diagram for the hydrogen atom.

Using this diagram :

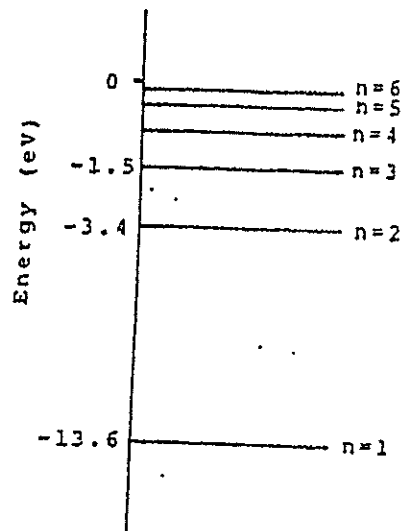
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- (a) A beam of electrons moves through a container of hydrogen gas. Explain what would happen if those electrons had energies of:
- (i) 9 eV
 - (ii) 11 eV
- (b) On the diagram, mark in the energy level changes which would produce the first three lines of the visible (Balmer) series of spectral lines.

(a) (i)

(ii)

(b)



END OF PAPER