Penrith High School

Year 12
Trial Examination
2010

Physics

General Instructions

- Reading time – 5 minutes
- Exam time – 3 hrs
- Draw diagrams in pencil
- Board-approved calculators may be used
- Write using blue or black pen
- Answers written in pencil will be disqualified from review
- A Data and Formulae Sheet is provided at the end of this paper.

Total marks (100)

Section I

There are Two Parts

Part A – Twenty 1-Mark Multiple Choice Questions

Total marks (20)

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

Part B - Free Response Questions

Total marks (55)

- Attempt Questions 21 – 32
- Allow about 1 hour and 40 minutes for this part

Section II

Total Marks (25)

- Allow about 45 minutes for this part

The Exam Paper and all other materials used must be submitted at the end of the examination.

STUDENT'S NAME: _____

Section I: Part A – Instructions for Multiple Choice Questions

Use the multiple-choice answer sheet provided.

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

Example 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 this by writing the word 'correct' and drawing an arrow as follows:

Students may detach the answer sheet. However, it is the student's responsibility to re-staple it to the examination paper with a name on it.

Marks cannot be awarded if the sheet is lost.

Total marks (20)
Attempt Questions 1 – 20
Allow about 35 minutes for this Part

Answer Sheet

Part A

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) ⬭
18.	(A) ⬭	(B) ⬭	(C) ⬭	(D) ⬭
19.	(A) ⬭	(B) ⬭	(C) ⬭	(D) ⬭
20.	(A) ⬭	(B) ⬭	(C) ⬭	(D) ⬭

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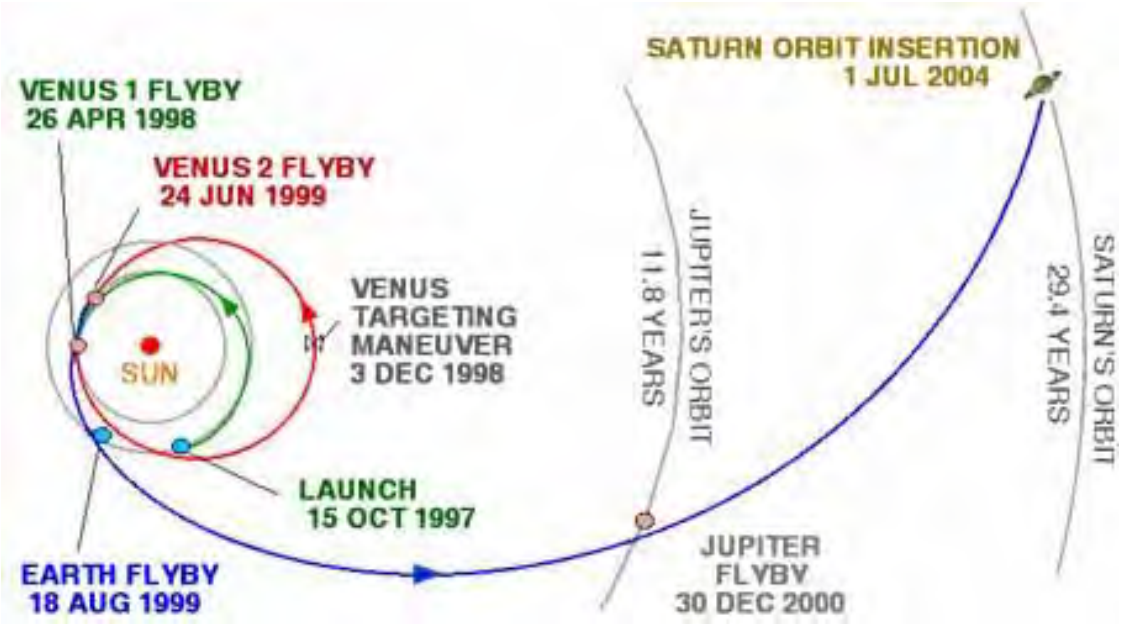
Section I Part A: Twenty 1 – Mark Multiple Choice Questions

1. The diagram below shows the trajectory of the space probe Cassini that recently went into orbit around Saturn.



Which of the following is the most important reason for its path?

(A) It was the most direct route
(B) It benefited from gravitational assists to increase the probe's speed
(C) It allowed Cassini to take pictures of other planets
(D) It was the computed path so as to reduce the fuel consumed at launch

2. The Space Shuttle takes approximately 1.5 hours to orbit the Earth. If the radius of the earth is 6 400 km, calculate the altitude of the shuttle.

(A) 2.8×10^4 m
(B) 2.6×10^5 m
(C) 3.8×10^5 m
(D) 6.7×10^6 m

3. 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

4. A child standing still in the centre of a roundabout watches a car drive with constant speed around the roundabout.

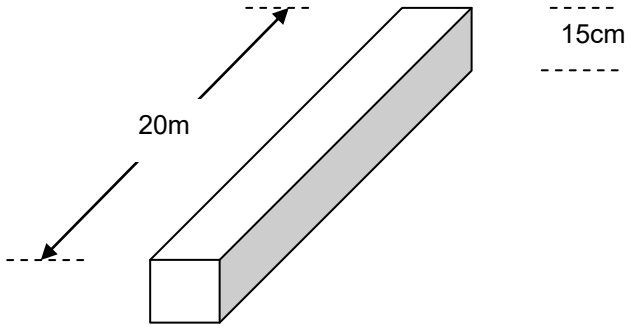
   The frames of reference experienced by the child and driver are respectively;

   (A) Both inertial
   (B) Both non-inertial
   (C) The child's frame is inertial but the driver's frame in non-inertial
   (D) The child's frame in non-inertial and the driver's frame is inertial

5. A charged pion that decayed in 10^{-8} seconds in its own rest frame traveled 30 metres in the laboratory before decaying. The pion's speed was closest to:

   (A) 0.43×10^8 m/s
   (B) 2.84×10^8 m/s
   (C) 2.90×10^8 m/s
   (D) 2.98×10^8 m/s

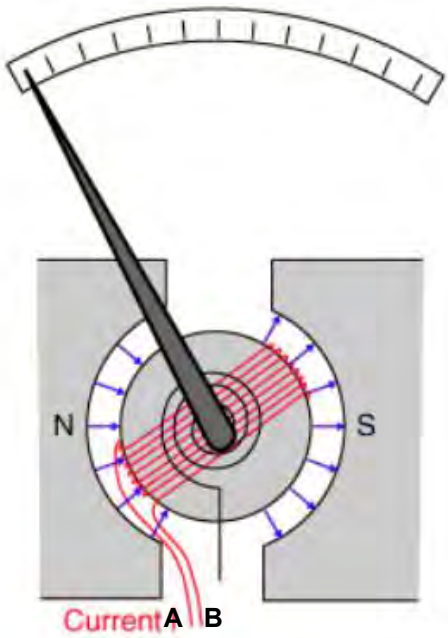
6. Charged particles can travel through an evacuated space inside a hollow rectangular conduit that has a length of 20m and a height of 15cm.



   A charged particle that travels through the conduit at 10^8 ms^{-1} would measure the area of the shaded side of the conduit as being:

   (A) 283 m^2
   (B) 3.0 m^2
   (C) 2.83×10^{-2} m^2
   (D) 2.66×10^{-2} m^2

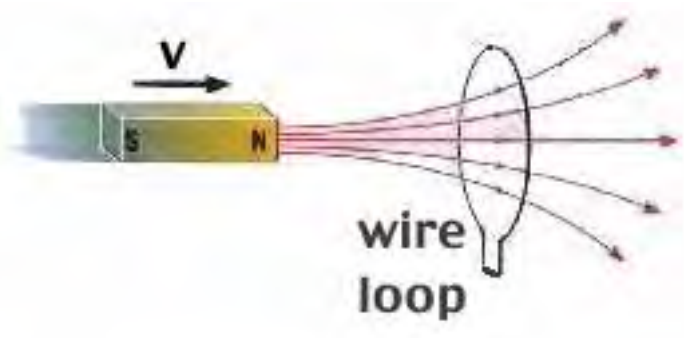
7. The diagram below shows a moving coil galvanometer.



The pointer will deflect to the right if;

(A) the ac current enters at A
(B) the dc current enters at B
(C) the dc current returns from A
(D) the ac current returns from B

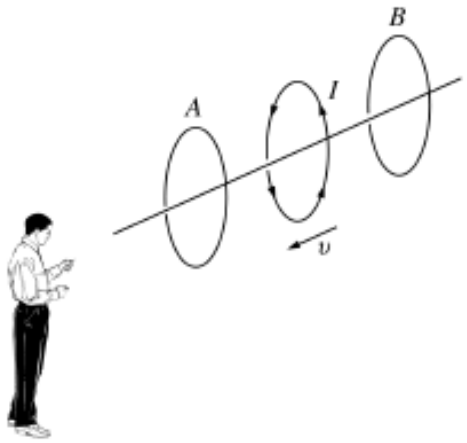
8. The following diagram shows a loop of wire towards which a magnet is moved in the direction shown.



A correct statement is that;

(A) An emf will not be induced in the loop because it is a closed circuit
(B) An anticlockwise emf will be established in the loop
(C) A clockwise emf will be established in the loop
(D) The magnetic flux density of the magnet experienced by the loop decreases

9. Three wire loops and an observer are positioned as shown in the figure below.

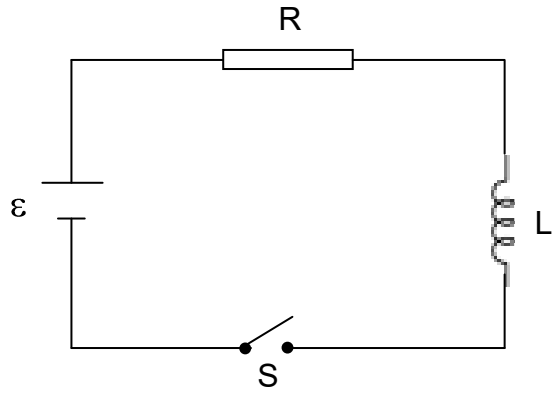


From the observer's point of view, a current I flows anticlockwise in the middle loop as that loop moves towards the observer with a velocity of v ms^{-1}. Loops A and B remain stationary.

This same observer would notice that:

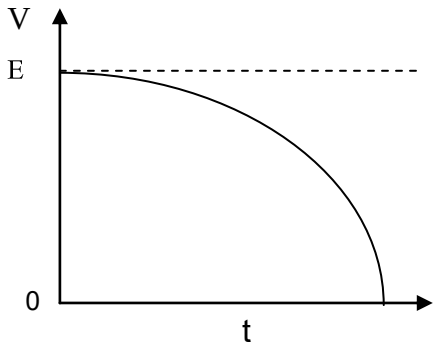
(A) clockwise currents are induced in loops A and B
(B) anticlockwise currents are induced in loops A and B
(C) a clockwise current is induced in loop A, but an anticlockwise current is induced in loop B
(D) an anticlockwise current is induced in loop A, but a clockwise current is induced in loop B

10. In the diagram below, the switch S is closed at time t = 0 such that a current flows through a circuit that consists of a resistor (R) in series with a coil (L).

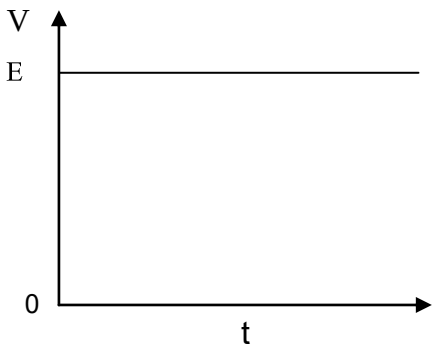


Which of the following diagrams best represents the potential difference (V) across the resistor as seen on an oscilloscope when the switch is closed?

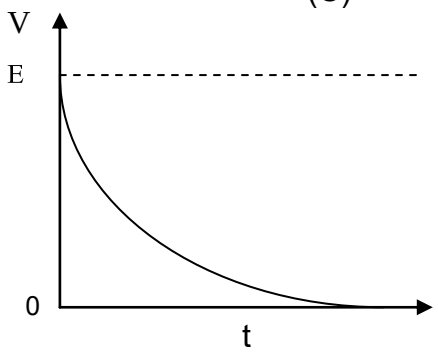
(A)



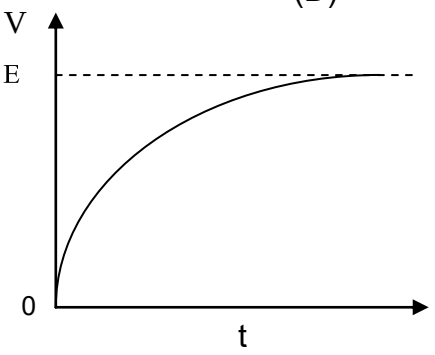
(B)



(C)

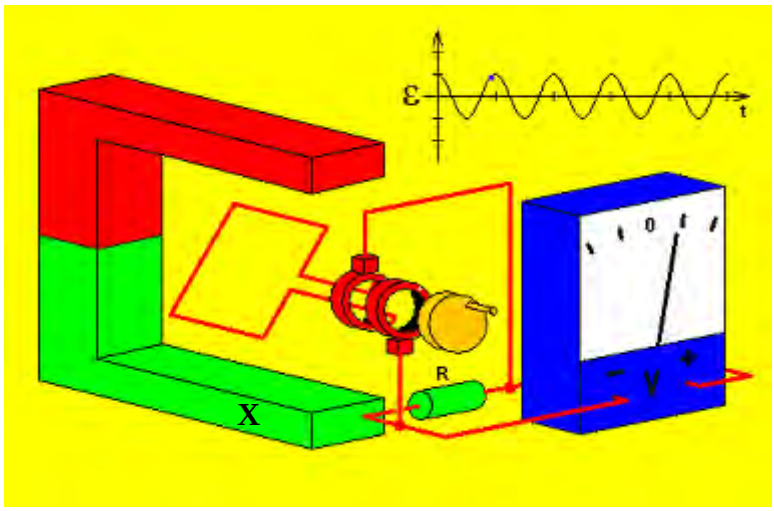


(D)



11. The diagram below shows a DC generator.

Determine the pole that must be placed at X and the direction of the rotation in order for the generated current to flow as indicated.

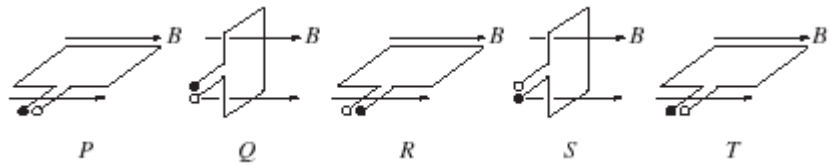


	X	Direction of Rotation
(A)	N	clockwise
(B)	N	anticlockwise
(C)	S	clockwise
(D)	S	anticlockwise

12. During the late 19th century George Westinghouse and Thomas Edison had very different ideas about how large scale supply of electricity could be achieved.
The option that correctly identifies Edison and Westinghouse's opinions on how electricity should be delivered is;

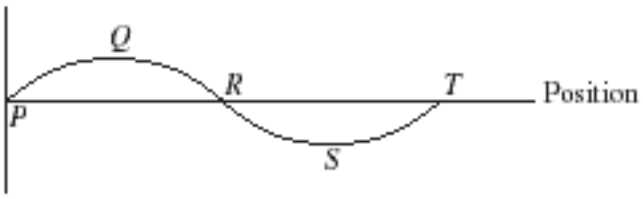
	Thomas Edison	George Westinghouse
(A)	AC	Batteries
(B)	DC	AC
(C)	Batteries	DC
(D)	AC	DC

13. The coil of an AC generator rotates at a constant rate in a magnetic field as shown.

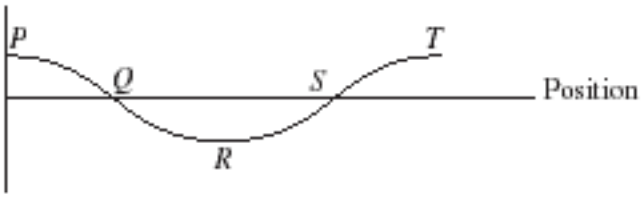


Which of the following diagrams represent the curves of change of flux and induced emf against position?

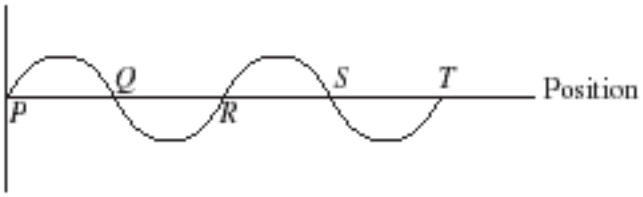
A



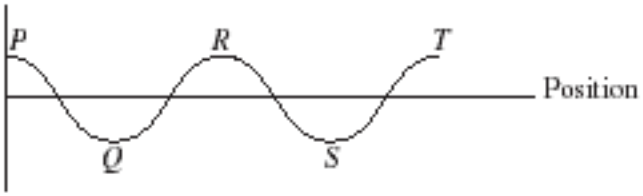
B



C



D



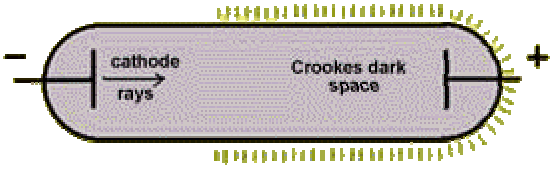
(A) A and B
(B) B and C
(C) C and D
(D) A and D

14. The following four images, labeled W through Z, indicate how the glow discharge characteristics of an inert gas change as the pressure inside the tube is decreased.

W

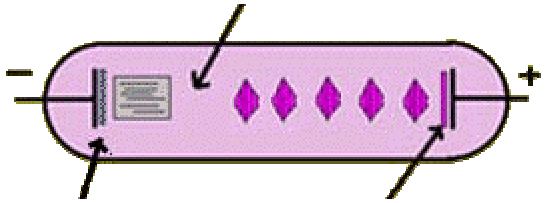
Faraday dark space

X

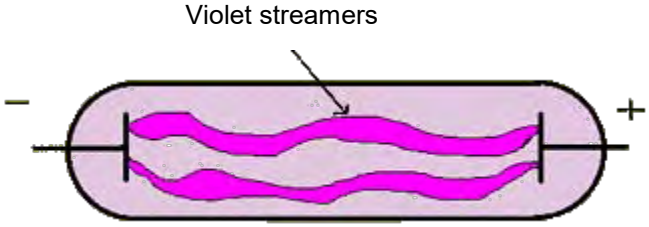


Glass with fluorescence

Y



Z



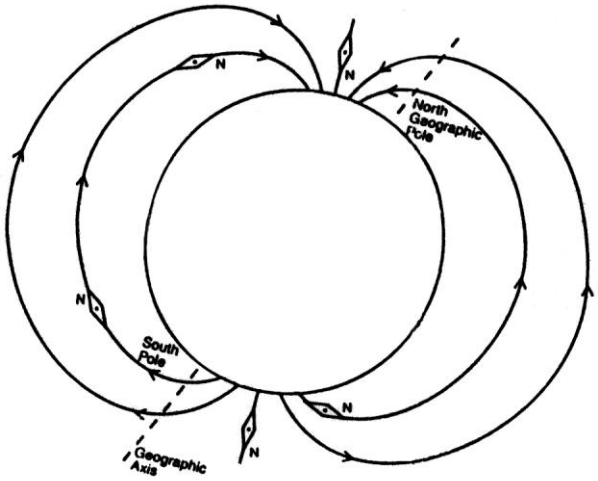
Unfortunately, the order of the images is incorrect.

When placed in the correct order from highest to lowest pressure, the images are:

(A) X, Y, W, Z
(B) Z, W, Y, X
(C) W, X, Y, Z
(D) W, X, Y, Z

15. An aircraft flies over the Geographical North Pole from right to left as seen on the diagram.

    The most significant electromagnetic affect on the aircraft would be;

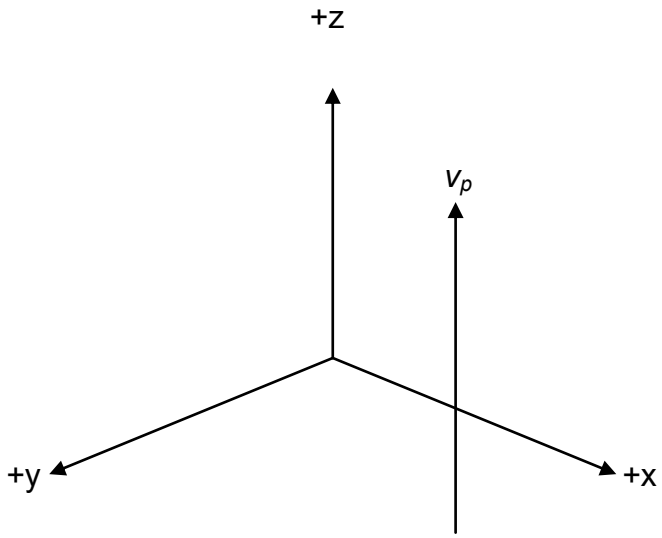


(A) zero
(B) the front of the aircraft would become charged due to encountering friction between itself and the atmosphere
(C) The right wing would become more negatively charged than the left wing
(D) The left wing would become more negatively charged than the right wing

16. A proton moves with a uniform velocity of v_P ms^{-1} in the +z direction after being accelerated from rest through a potential difference V. The proton then passes through a region where a uniform electric field E acts towards the +x direction while at the same time a uniform magnetic field B acts towards the -y direction. The direction of the proton's trajectory is not affected.

    The diagram shows the proton's path as it passes through the crossed electric and magnetic fields.

    Should the experiment be repeated using a potential difference of 2V, then the proton would be:

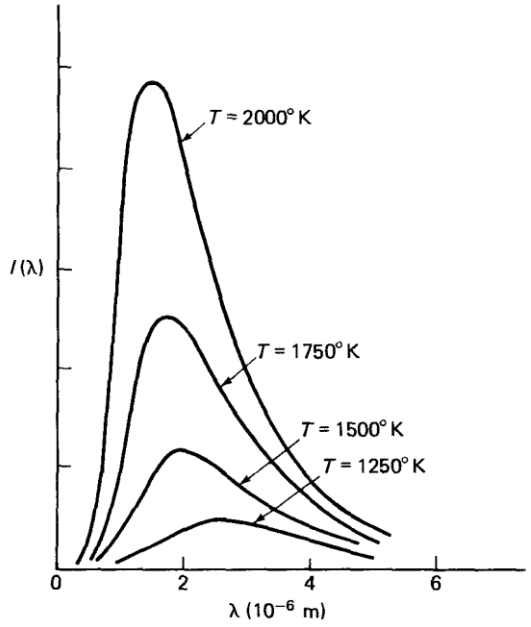


    (A) undeflected
    (B) deflected in the +x direction
    (C) deflected in the -x direction
    (D) deflected in the –y direction

17. Distinguish between the cathode ray tubes used in oscilloscopes and those used in televisions.

    (A) Only in televisions are the electrons deflected by magnetic fields
    (B) Only in televisions are the electrons accelerated by electric fields
    (C) Only in oscilloscopes are the electrons produced by thermionic emission
    (D) Only in oscilloscopes are the electrons projected onto a fluorescent screen

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



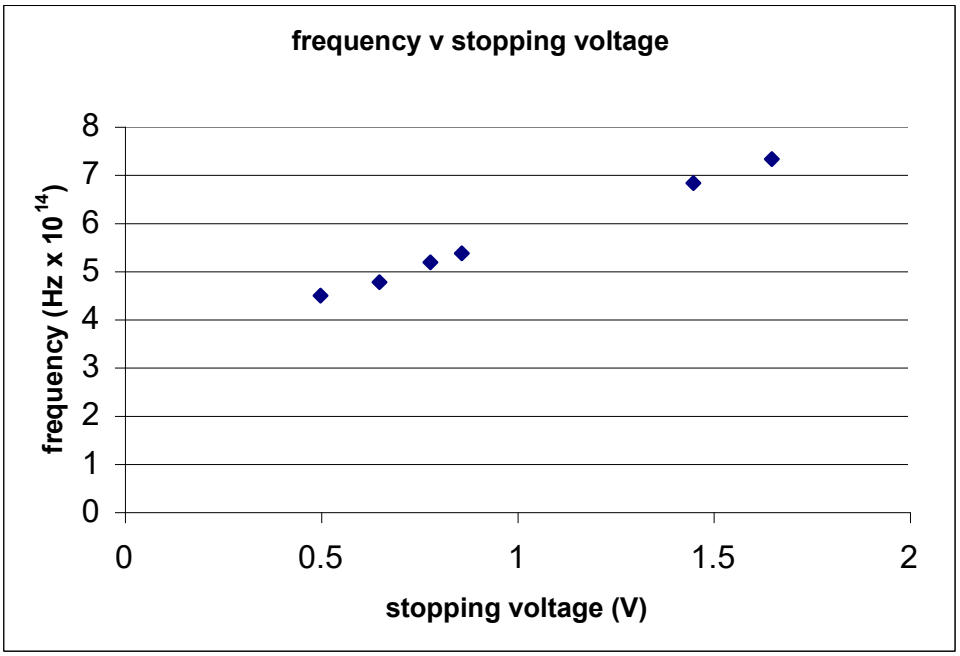
The successful explanation of black body radiation was important to the development of atomic theory because at the time;

(A) It showed that electrons in solids behaved exactly as particles in a gas
(B) It confirmed the existence of the electron as a particle
(C) It showed that electrons of high energy produce a continuous energy spectrum predicted by classical physics
(D) It suggested the existence of a previously unknown entity that could transfer energy

19. The cathode of a photoelectric cell is illuminated successively by light of different frequencies. The equation that describes the experiment is;

$$qV = hf - \Phi$$

A plot of the frequencies of light against the stopping potentials is shown below.



From the graph, the threshold frequency and the work function of the metal can be calculated as:

(A) 3.2×10^{14} Hz
(B) 2.1×10^{-19} J
(C) 3.2 Hz
(D) 2.1 J

20. The following image shows a magnet hovering above a superconducting disk.

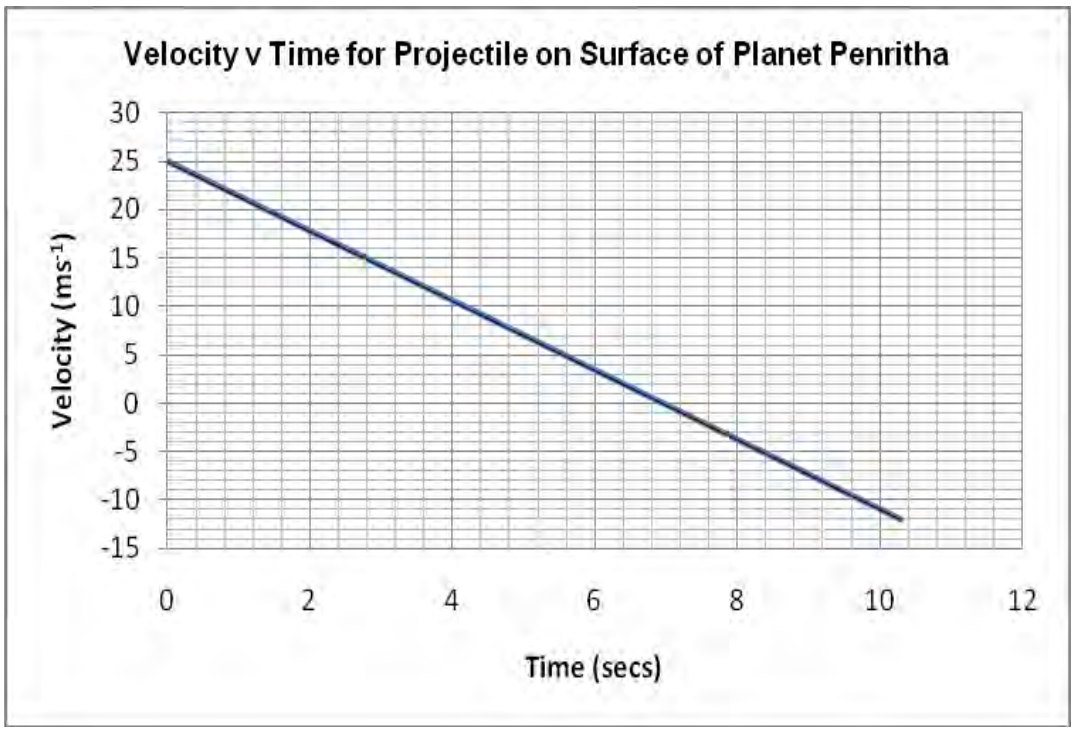
The magnet hovers due to:

(A) Induced eddy currents inside the magnet produce a change of flux that induces the formation of an oppositely directed magnetic field inside the disk
(B) The existence of superconducting currents in the magnet
(C) The expulsion of the disk's magnetic field by induced fields inside the magnet
(D) The formation of supercurrents inside the disk that produce an internal magnetic field that expels the field of the magnet

Section 1: Part B – Twelve Free Response Questions: Answer All Questions

21. (a) Outline Galileo's contribution to our understanding of projectile motion(14.1f) 2m

The following graph shows the variation in vertical velocity when an object is projected from the surface of Penritha, a planet in the solar system of Boloneus.

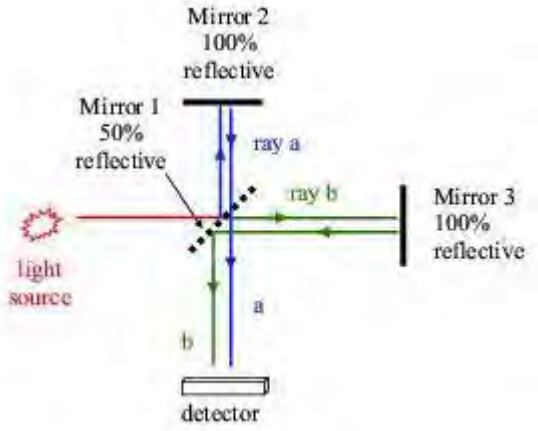


(b) Calculate the gravitational field strength of Penritha. 2m

(c) The experimenter stopped recording the projectile's velocity data just after 10 seconds. Calculate the vertical displacement of the object relative to the surface of the planet at this instant. 2m

22. Demonstrate your knowledge of the term 'g forces' and use it to explain the forces that act on an astronaut. 6m

23. The following image is similar to the optical bench used in the Michelson-Morley experiment.

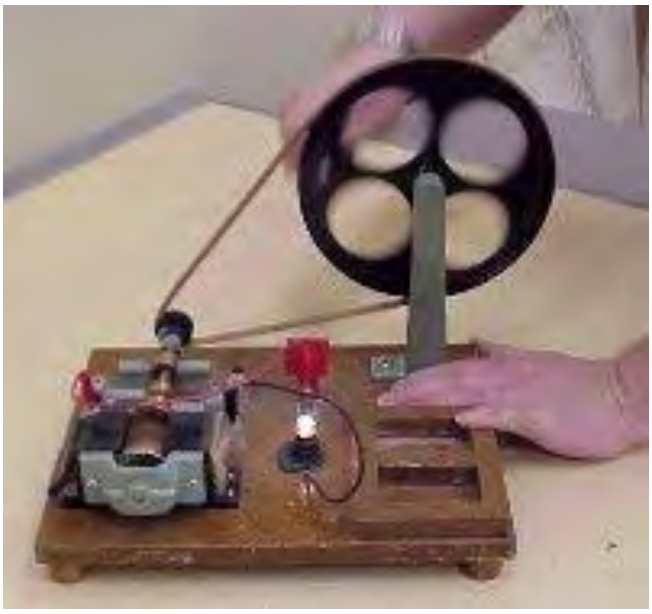


Evaluate the Michelson-Morley experiments against your knowledge of scientific method. 4m

24. (a) Define a scientific theory (H2). 2m

(b) Some of Einstein's predictions based on relativity were unsupported by evidence for many years. 4m
Use these predictions to clarify the relationship between theory and the evidence supporting it.

25. The following image is that of a Dynamo.



Evaluate the suitability and effectiveness of this technology for its role in comparing the structure and function of a generator to the structure and function of an electric motor (11.3c) 5m

26. Design and illustrate an investigation that would allow valid and reliable data and information to be collected to confirm the operating principles of a transformer (11.2c). 4m

27. Use diagrams and equations to help you describe the purpose of transformers in overcoming issues related to the large-scale distribution of power. 5m

28. Identify an inference that could be drawn from observing cathode rays and explain how it could be justified (14.1b). 2m

29. (a) Define a scientific model. 2m

(b) Use a model to explain why moving charged particles in a magnetic field experience a force. 3m

30. Identify the key features of the particle model of light. 3m

31. Outline the properties of materials that were significant to the invention of the transistor (H1). 4m

32. You researched many physics concepts using a range of resources, including the internet. 5m

    Explain how you assessed the accuracy of the information you selected and outline the strategies you used to distinguish the quality of the information presented in scientific literature compared to that presented in more popular media (12.3a, 12.4f).

Section II: Question 33 Astrophysics – 25 Marks

Free Response Questions: Answer All Questions

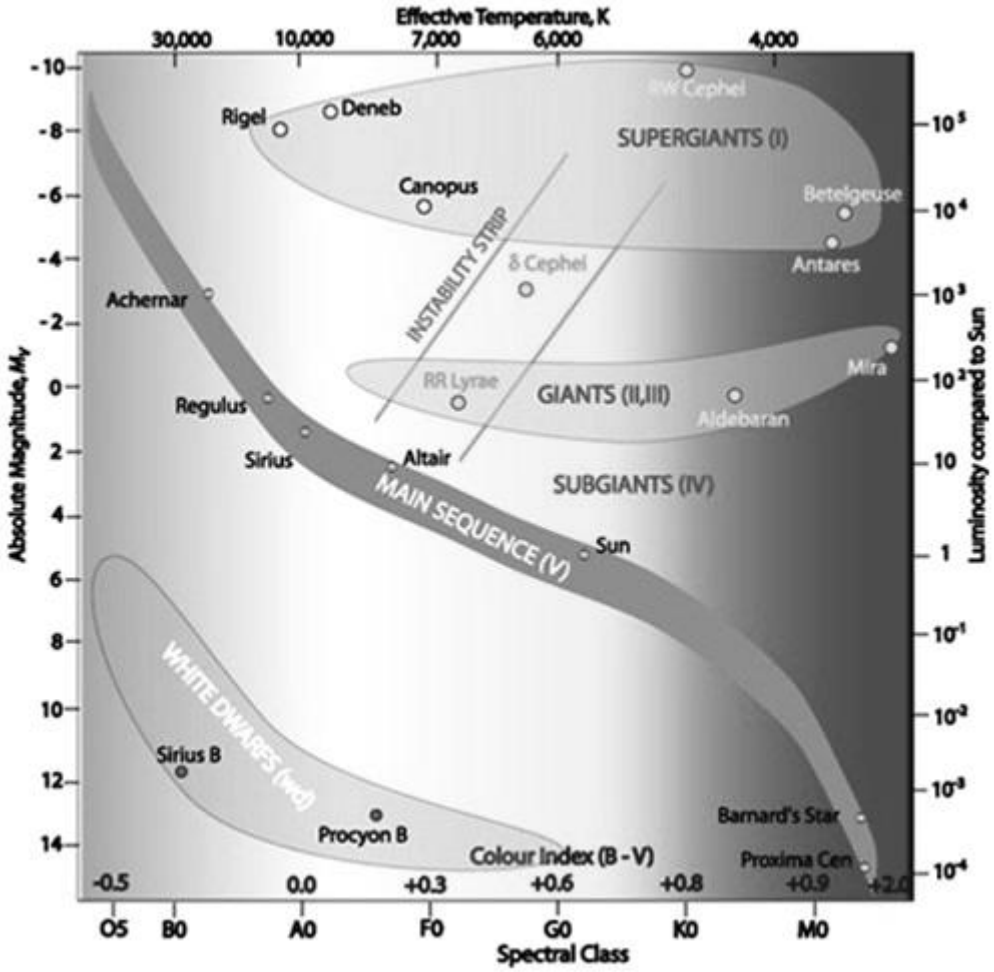
Allow about 45 minutes for this section

(a.i) Report how an investigation performed in class enabled you to distinguish between 'resolution' and 'sensitivity' when applied to telescopes. 2m

(a.ii) Clarify what is meant by trigonometric parallax. 2m

(a.iii) State two limitations of trigonometric parallax measurements made from the earth and outline the improvements in parallax measurements made by specific space-based telescopes. 4m

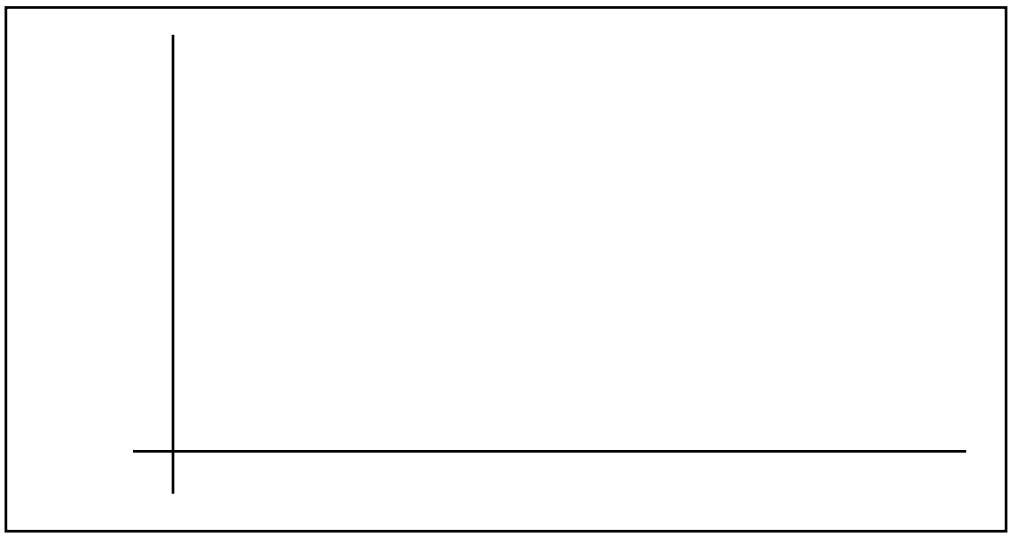
(b) Parts of this question make use of the Hertzsprung-Russel diagram.



(b.i) Antares is a red supergiant with a radius approximately 800 times that of the sun. Observations measure its parallax as 5.4×10^{-3} arcsecs. 4m
Use this information and the HR diagram above to calculate the apparent visual magnitude of Antares.

(b.ii) Antares has a colour index of 1.87. Calculate how much brighter the star appears through the 'visual' filter than the 'photographic' filter. 3m

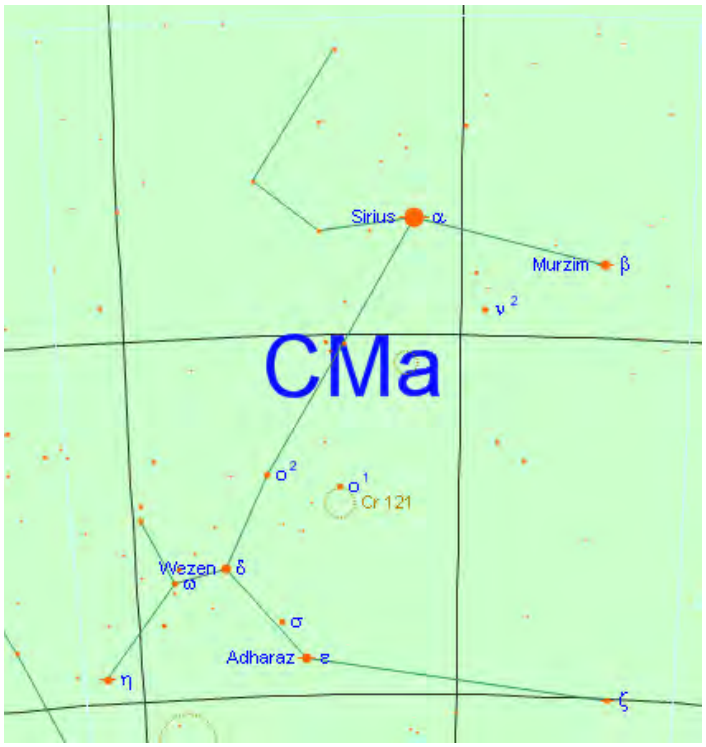
(b.iii) Use your knowledge of the relationship of the colour index to sketch the possible blackbody curve for Antares. 2m



(b.iv) Compare photoelectric methods with photographic methods in photometry. 3m

(c.i) Explain the importance of binary stars in determining stellar masses. 2m

(c.ii) Sirius is actually a binary star system, consisting of a white main sequence star of spectral type A1V, termed Sirius A, and a faint white dwarf companion of spectral type DA2, termed Sirius B. The distance separating Sirius A from its companion varies between 8.1 and 31.5 AU.



(c.iii) Calculate the total mass of the system and estimate the mass of Sirius B if its velocity is 2.5 times that of Sirius A. 3m

End of Exam