

Baulkham Hills High School

2022 Trial Higher School Certificate Examination

Physics

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- A data sheet, formulae sheet and Periodic Table are provided

Total Marks: 100

Section I – 20 marks (pages 2-8)

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

Section II – 80 marks (pages 9-21)

- Attempt Questions 21-33
- Allow about 2 hours and 25 minutes for this section

Section I

20 marks

Attempt Questions 1–20

Allow about 35 minutes for this section

Use the Section I answer sheet for Questions 1-20.

1. Rachel is driving her car at a constant speed around a curve of fixed radius on her way home from Physics tutoring.

Which of the following correctly describes the acceleration of Rachel's car?

	<i>Magnitude</i>	<i>Direction</i>
A)	Constant	Constant
B)	Constant	Changes
C)	Changes	Constant
D)	Changes	Changes

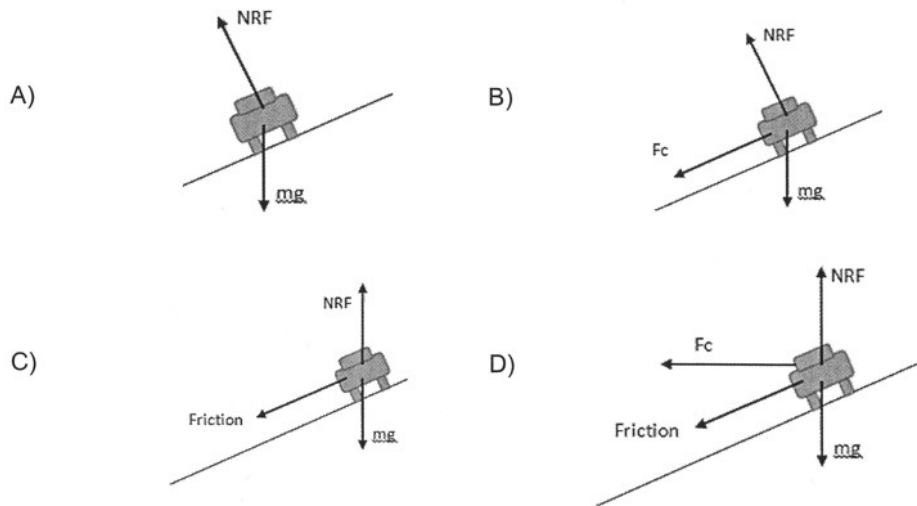
2. Yatha, while calibrating a spectrometer attached to a telescope, records a hydrogen line in the Balmer series with a wavelength of 656.28 nm. Later, a star is observed, and its spectrum is analysed and the same hydrogen line in this spectrum is recorded as 680 nm.

Which of the following statements is correct?

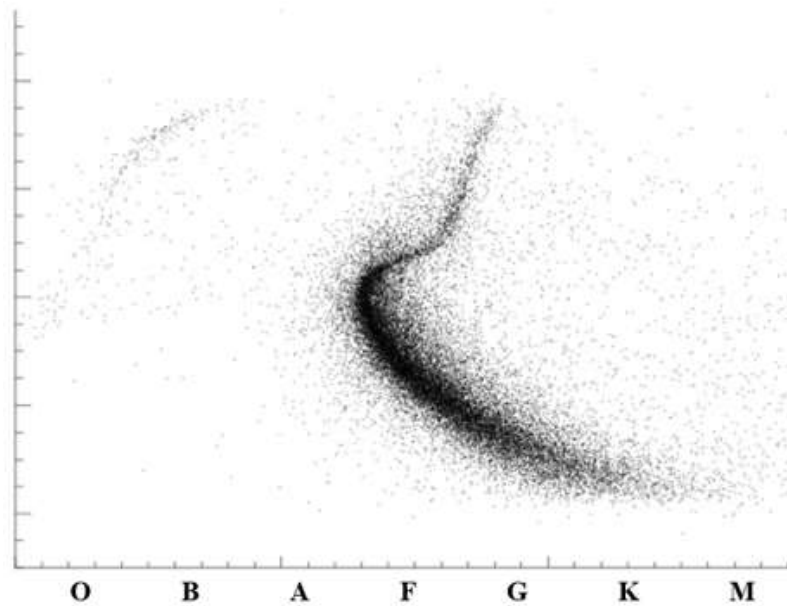
- A) The star is blue shifted and moving towards us.
- B) The star is red shifted and moving towards us.
- C) The star is red shifted and moving away from us.
- D) The star is blue shifted and is moving away from us.
3. According to Max Planck, which characteristic of an object determined the peak wavelength of radiation emitted by a hot object?
- A) The type of material the objects is made of.
- B) The temperature of the object.
- C) The type of material and its temperature.
- D) The temperature of the object and its shape.

4. Ravindu is driving his father's black SUV around a banked circular track. The height of the SUV above the ground stays constant.

Which of the following correctly shows the forces acting on the SUV?



5. The individual stars in a single star cluster are plotted on a Hertzsprung-Russell diagram as shown below.



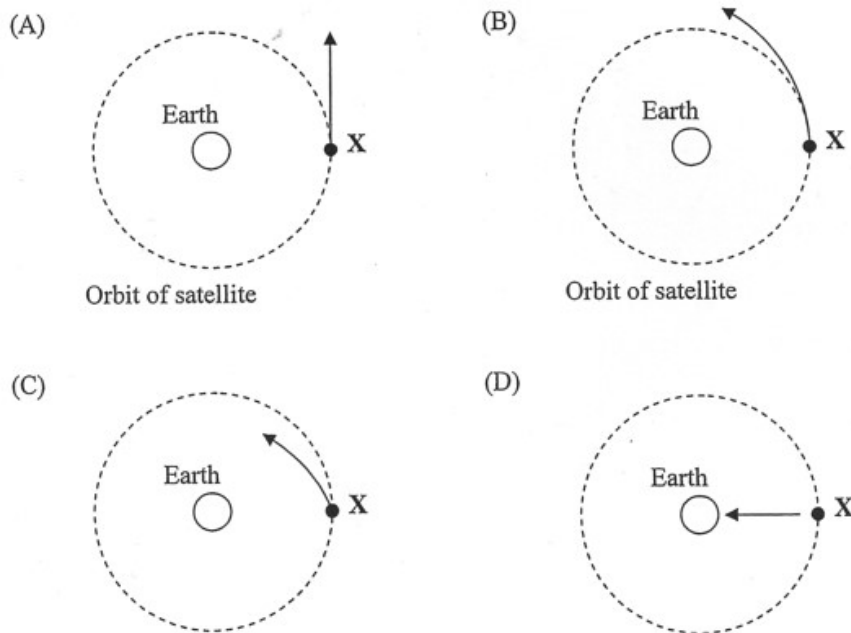
The relative under-representation of O and B type stars is most likely due to:

- (A) the cluster being too young for these stars to have formed yet.
- (B) too much gas and dust existing between the stars preventing such stars from forming.
- (C) these stars having depleted their hydrogen fuel and becoming red giants.
- (D) the main sequence stars that formed in the cluster were not sufficiently large.

6. What was Schrodinger's main contribution to the current model of the atom?
- A) Diffraction experiments verifying the wave properties of electrons.
 - B) His work was the basis of the Bohr model of the atom.
 - C) His wave equations were very important in the development of modern quantum mechanics.
 - D) He was the first to apply quantum ideas to the understanding of the atom.

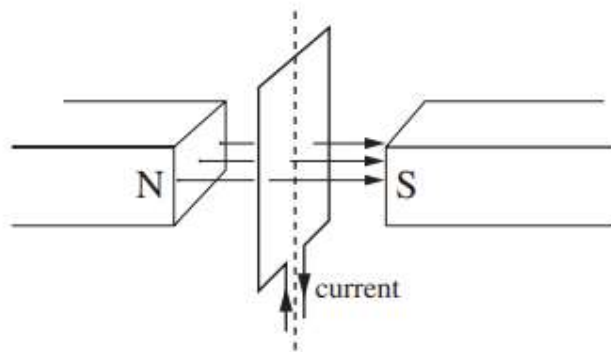
7. A satellite is in a stable geostationary orbit around the Earth.

Which of the options below best shows the satellite's path if the gravitational force on it was somehow removed when it was at point X?



8. A reason that the observations from the Geiger-Marsden experiment were unexpected at the time was that:
- A) atoms were believed to have a positive nucleus.
 - B) atoms were thought to be capable of reflecting alpha particles.
 - C) electrons were believed to be orbiting the nucleus.
 - D) atoms were thought to have the negative charges embedded throughout a continuous positive fluid.

9. Two masses have a gravitational force of 12 N between them, If the distance is doubled, what would be the new gravitational force between them?
- A) 3 N
B) 6 N
C) 12 N
D) 24 N
10. How much work is done on an electron being accelerated between two charged plates with a voltage drop of 20V?
- A) 8×10^{-19} J
B) 3.2×10^{-18} J
C) 6.4×10^{-18} J
D) 8×10^{-17} J
11. The diagram below shows a DC electric motor, but when a current flows through the coil, it does not turn.



- Which of the following is required so that the coil turns?
- A) The starting point of the coil must be changed.
B) The magnetic field must be reduced.
C) The magnitude of the current must be increased.
D) The direction of the current must be reversed.
12. Stirling observed that a space probe at rest is 40 m long. However, when he sees the space probe travelling in space was only 32 m long.

What was the speed of the space probe relative to Stirling?

- A) 0.60 c
B) 0.75 c
C) 0.80 c
D) 1.25 c

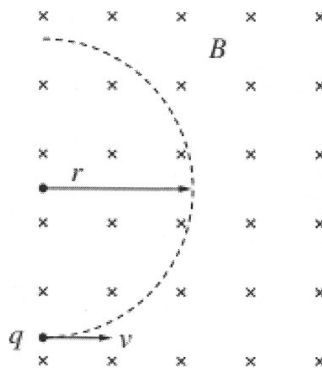
13. A Physics student who did not pay attention in class got a flat tyre on their way to tutoring after school. In order to change the tyre, they had to undo the wheel nuts using the wheel wrench shown below.



Knowing that the student did not listen in class, which of the following shows that they have the poorest understanding possible of how to undo the wheel nuts with a minimum applied force?

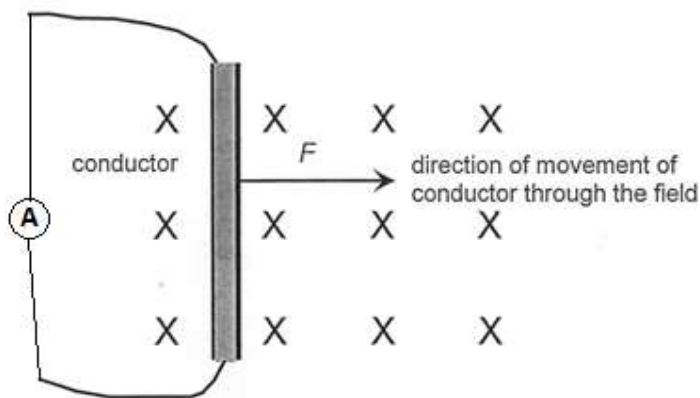
- A) The force should be applied at right angles to the wheel wrench at the smallest distance possible from the wheel nut.
 - B) The force should be applied at 45° to the wheel wrench at the smallest distance possible from the wheel nut.
 - C) The force should be applied at right angles to the wheel wrench at the middle distance along the tyre lever.
 - D) The force should be applied at right angles to the wheel wrench at the largest distance from the wheel nut possible.
14. Photons of wavelength λ are incident on a metallic surface in a vacuum. The number of photons incident on the surface per second is n . No electrons are emitted from the surface.
- Which of the following actions is more likely to cause electrons to be emitted from the surface?
- A) Decrease the frequency of the incident light.
 - B) Decrease the wavelength, λ , of the incident light.
 - C) Increase the number of photons per second, n , incident on the surface.
 - D) Change to a different metallic surface.
15. Maxwell's equations apply to the:
- A) particle model of light only.
 - B) particle and wave models of light.
 - C) explanation of the photoelectric effect.
 - D) wave model of light only.

16. A charged particle, q , enters a uniform magnetic field B at velocity v . The particle follows a circular path of radius r , as shown below.



If the magnitude of the magnetic field was doubled and the other variables were kept constant, what would the new radius be?

- A) $r/4$
 - B) $r/2$
 - C) $2r$
 - D) $4r$
17. A conductor, which is connected to an ammeter, is moved by a force F through a magnetic field, as shown below.



The direction of the conventional current in the conductor and the reason why it must be in this direction is:

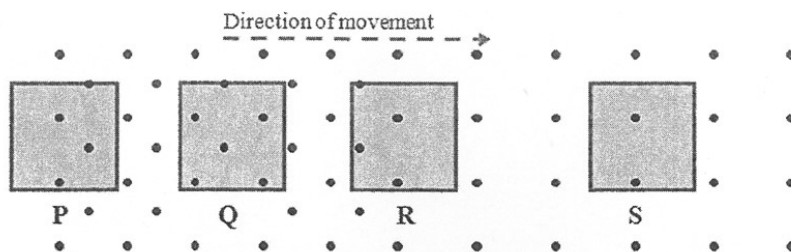
	<i>Direction</i>	<i>Reason</i>
A)	Up the page	The motor effect
B)	Up the page	The law of conservation of energy
C)	Down the page	The law of conservation of energy
D)	No current	There is not a complete circuit

18. Michelson and Morley expected to see a change in the interference pattern in their experiment, yet they obtained a null result. Why did they obtain a null result?
- A positive result would violate the principle of relativity.
 - The Earth's speed through space is too small compared to the speed of light for the experiment to give a significant result.
 - Any variation in the speed of light could be explained by experimental errors.
 - Einstein had proven that the speed of light was a constant in a particular medium.
19. UV light with a wavelength of 2×10^{-7} m hits a metal which then emits photoelectrons with a maximum kinetic energy of 3.98 eV.

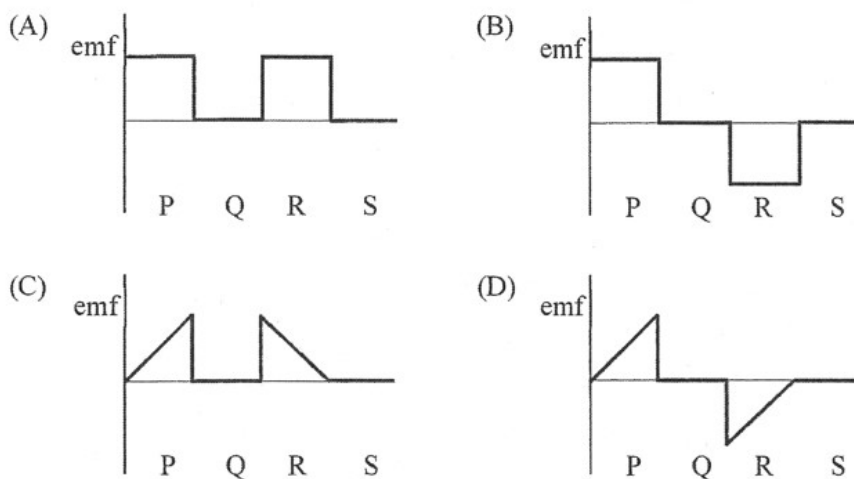
What was the metal?

	<i>Metal</i>	<i>Work function (eV)</i>
A)	A	7.2
B)	B	7.0
C)	C	6.5
D)	D	6.1

20. Danindu moves a square copper plate at a constant speed through a magnetic field, as shown below.



Which of the following best shows the emf induced in the plate?



TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

Section II Answer Booklet

--	--	--	--	--	--	--	--	--	--

Student Number

--	--	--	--	--	--	--	--	--	--

teacher Name

80 marks

Attempt Questions 21-33

Allow about 2 hours and 35 minutes for this section

- Instructions**
- Write your teacher's name and student number at the top of this page.
 - Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
 - Show all relevant working in questions involving calculations.
 - Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Select the response which best answers the question and indicate your choice by placing an 'X' over A, B, C or D on the grid below

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

Question 21 (10 marks)

Mars is the only other planet in our solar system where it is realistically possible to send humans to live. NASA aims to launch astronauts to Mars by the late 2030s or early 2040s and two ex BHHS students, Arya and Karan, were selected to be on the first mission.

Use the following information about Mars to answer the following questions.

Mass	$6.39 \times 10^{23} \text{ kg}$
Diameter	$6.679 \times 10^6 \text{ m}$
Atmosphere	Negligible

- a) Calculate the acceleration due to gravity that Arya and Karan would experience on the surface of Mars. 2

.....

.....

.....

.....

- b) Arya and Karan decide to test their understanding of projectile motion that they learnt at school. They throw a food cannister of 1.25 kg upward at an angle of 25° to the horizontal with an initial velocity of 2.5 ms^{-1} .
Calculate:

- (i) The maximum distance from the centre of Mars that the food cannister reaches. 2

.....

.....

.....

.....

- (ii) How far the food cannister lands from where they threw it, assuming that it was thrown at a height 2m above the ground and that the ground was level. 4

.....

.....

.....

.....

.....

.....

.....

- c) Calculate the minimum velocity that they would need to throw the food cannister vertically if it was to just escape Mars' gravitational field. 2

.....

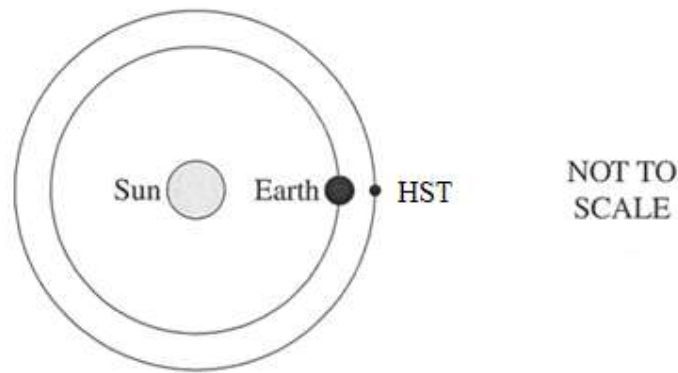
.....

.....

.....

Question 22 (3 marks)

In 1990, the Hubble Space Telescope (HST) was placed in orbit around the Earth. Earth and Hubble follow the orbits shown below, with identical orbital periods. This appears to contradict Kepler's law of periods. 3



Fully explain why it is possible for the HST to orbit the Sun with the same orbital period as the Earth.

.....

.....

.....

.....

.....

.....

.....

Question 23 (9 marks)

During experiments with the Large Hadron Collider (LHC), Tim and Lincy accelerated protons to travel at $2.2 \times 10^6 \text{ ms}^{-1}$. The LHC has a diameter of $8 \times 10^3 \text{ m}$.

- a) Calculate the De Broglie wavelength of these protons. **2**

.....

.....

.....

.....

- b) Calculate the momentum of a proton at that speed and the force required to keep it on a circular path. **4**

.....

.....

.....

.....

.....

.....

.....

- c) Assess the validity of the following statement:

Particle accelerators cannot accelerate particles to any speed beyond the speed of light. **3**

.....

.....

.....

.....

.....

.....

.....

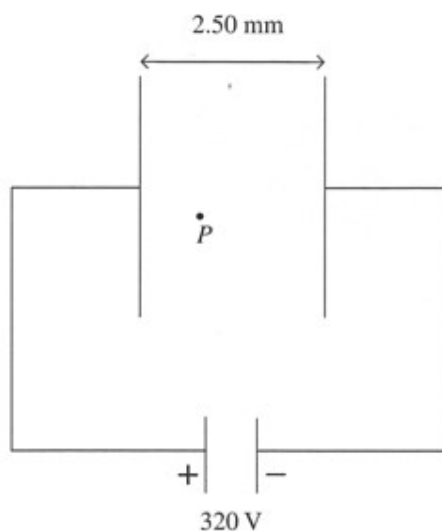
.....

.....

.....

Question 24 (4 marks)

The diagram below shows two parallel plates 2.50 mm apart. They are connected to a power supply which produces a potential difference of 320 V. An electron is at rest at point P .



- a) Calculate the force acting on the electron.

2

.....

.....

.....

.....

.....

.....

- b) Describe quantitatively the effect of the field on the electron's motion.

2

.....

.....

.....

.....

Question 25 (3 marks)

Describe ONE experiment conducted by a scientist that provided a previously unknown property of the electron. **3**

.....

.....

.....

.....

.....

.....

.....

Question 26 (8 marks)

Harini wants to charge her mobile phone in class and so she plugs the charger into the power point on her desk which provides a 240 V AC supply. The transformer in the charger converts this to an output of 6V DC. The phone draws a 1 A current on the charger when it is being charged.

- a) Determine the current drawn by the charger on the 240 V power supply. **2**

.....

.....

.....

- b) Use a labelled diagram in the space below to model the structure of the transformer. **2**

Question 26 continues over page...

Question 26 continued...

- c) Explain TWO methods that could maximise the charger's transformer efficiency.

4

.....

.....

.....

.....

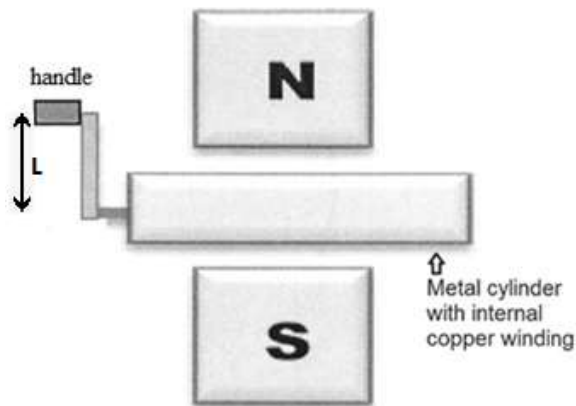
.....

.....

.....

Question 27 (3 marks)

Tharsiha uses a handle to rotate a cylinder containing multiple copper windings between two permanent magnets, as shown below. When the cylinder is rotated, an emf is generated across the copper windings.



Describe and explain *quantitatively* how doubling the handle length (L) will change the emf generated in the copper windings in the cylinder if she continues to turn it at the same angular velocity.

3

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 28 (10 marks)

- a) Clearly explain the production of absorption spectra by the atmosphere of stars. **3**

.....

.....

.....

.....

.....

.....

.....

.....

- b) Describe clearly how the study of a star's spectrum can give us information about TWO specific features of that star. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 28 continues over page...

Question 28 (continued)

- c) Outline Hubble's observations and their significance in terms of our understanding of the nature of the universe. **3**

.....

.....

.....

.....

.....

.....

.....

Question 29 (3 marks)

For electricity to be transmitted over large distances between generators and households, transformers are used. Two transmissions take place over the same transmission lines at different times:

Transmission A: 28 kV AC
Transmission B: 280 kV AC

Compare the power losses that occur in transmissions A and B. Include relevant equations and calculations in your response. **3**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 30 (7 marks)

- a) With the aid of a labelled diagram, outline Bohr's model of the atom and state the limitations of the model. 4

.....

.....

.....

.....

.....

.....

.....

.....

- b) Outline experimental evidence that supported ONE of Bohr's postulates and explain how the experimental evidence provided this support. 3

.....

.....

.....

.....

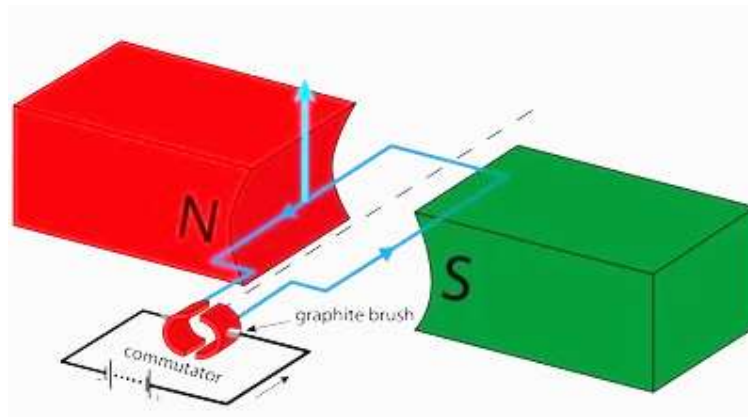
.....

.....

.....

.....

Question 31 (5 marks)



Fully explain the production of torque in the device shown above. In your answer, refer to the diagram and include two relevant graphs.

5

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

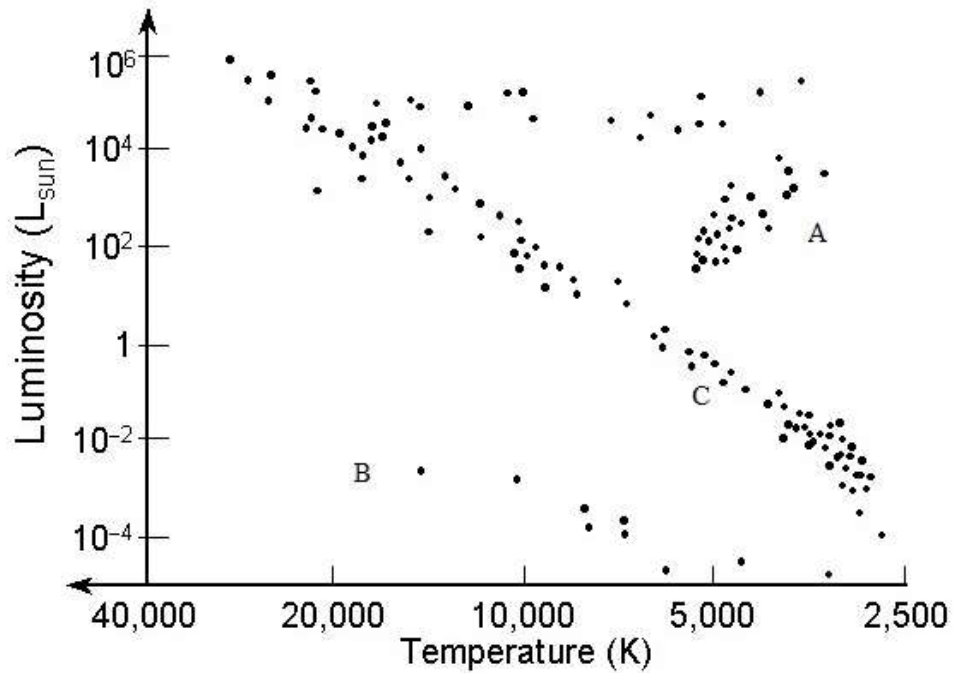
.....

.....

.....

Question 32 (6 marks)

In 1911 Ejnar Hertzsprung and in 1913 Henry Norris Russell independently plotted the luminosity of stars versus their surface temperatures, as shown below. This represented a major step towards an understanding of stellar evolution.



- a) Identify the predominant nuclear reactions involved in the three groups A, B and C. 3

.....

.....

.....

- b) With reference to the diagram above, outline the stellar evolution of the Sun. 3

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 33 (9 marks)

What evidence supports the classical wave model of light and what predictions can be made using this model?

In your answer, include a relevant diagram and state TWO observations concerning light that are unable to be explained by the classical model.

[illegible]

END OF PAPER

This image shows a full page of a document template designed for handwriting practice or general note-taking. It consists of approximately 28 evenly spaced horizontal dotted lines across the entire width of the page. The background is plain white, and there are no margins, headers, footers, or other markings present.

[illegible]

Question 21 (10 marks)

JC

Mars is the only other planet in our solar system where it is realistically possible to send humans to live. NASA aims to launch astronauts to Mars by the late 2030s or early 2040s and two ex BHHS students, Arya and Karan, were selected to be on the first mission.

Use the following information about Mars to answer the following questions.

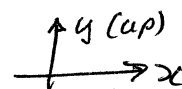
Mass	$6.39 \times 10^{23} \text{ kg}$
Diameter	$6.679 \times 10^6 \text{ m}$
Atmosphere	Negligible

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

- a) Calculate the acceleration due to gravity that Arya and Karan would experience on the surface of Mars.

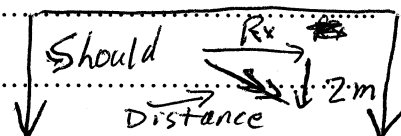
① - Formula + Sub $g = F/m = GM/R^2 = \frac{(6.67 \times 10^{-11})(6.39 \times 10^{23})}{(6.679 \times 10^6 / 2)^2} = 3.8218$
 ① - Correct Ans + Units -3.82 m s^{-2}

- b) Arya and Karan decide to test their understanding of projectile motion that they learnt at school. They throw a food cannister of 1.25 kg upward at an angle of 25° to the horizontal with an initial velocity of 2.5 ms^{-1} . Calculate:



- (i) The maximum distance from the centre of Mars that the food cannister reaches.

① - Formula $V_y^2 + U_y^2 + 2a_y s_y$; $V_y = 0$; $s_y = -U_y^2 / 2a_y$
 ① - Sub + Ans. $= -(2.5 \sin 25)^2 / (-2 \times 3.8218) = 0.146 \text{ m}$
 ↑ includes all signs correct, $a = -3.8218$



- (ii) How far the food cannister lands from where they threw it, assuming that it was thrown at a height 2m above the ground and that the ground was level.

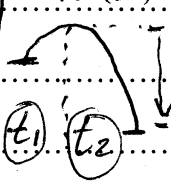
Method (I) all at once $s = ut + \frac{1}{2}at^2$; $\frac{1}{2}at^2 + ut - s = 0$ $t = \frac{-u \pm \sqrt{u^2 - 4(\frac{1}{2}a)(-s)}}{2(\frac{1}{2}a)}$
 $\therefore t = -1.0565 \pm (1.0565^2 - 2(-3.8218)(2.00))^{1/2} / (-3.8218)$
 Require +ve time $\therefore t = (-1.0565 - 4.0501) / (-3.8218)$
 $\therefore t = 1.3362$ AND $R = U_x T = 2.5 \cos 25 \times 1.3362 = 3.0 \text{ m}$

② - clear path to ans { * Formula
* Sub with signs

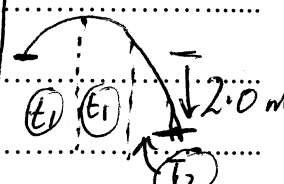
① - correct ans for t supported by working

① - $R_x = U_x t$ * formula + Sub + working + Ans

Method (II)



Method (III)



- c) Calculate the minimum velocity that they would need to throw the food cannister vertically if it was to just escape Mars' gravitational field.

2

① - Correct Formula $V = \sqrt{\frac{2GM}{r}}$

① - Correct Substitution and answer $V = \frac{2 \times 6.67 \times 10^{-11} \times 6.39 \times 10^{23}}{(6.679 \times 10^6)^{1/2}}$

$$= 5.05228 \times 10^3$$

$$= 5,052 \text{ m/s.}$$

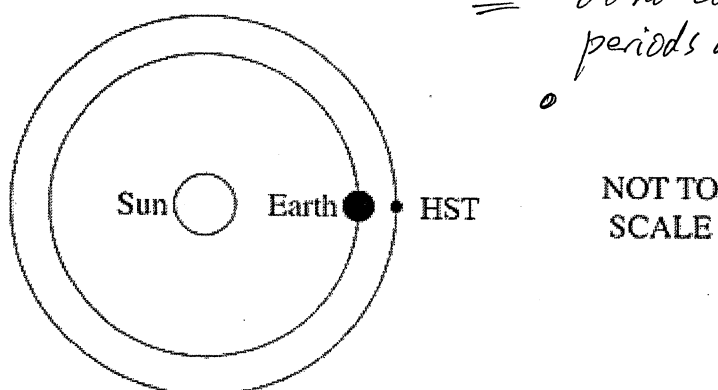
Question 22 (3 marks)

In 1990, the Hubble Space Telescope (HST) was placed in orbit around the Earth. Earth and Hubble follow the orbits shown below, with identical orbital periods. This appears to contradict Kepler's law of periods.

JC

Notes • do not confuse law of periods with law of constant Area.

3



Fully explain why it is possible for the HST to orbit the Sun with the same orbital period as the Earth.

① - Reference to ~~Hubble's~~ ^{Kepler's} Law of Periods, writes equation per data sheet

$$R^3/T^2 = GM/4\pi^2$$

① - Some reasonable attempt based on physical principles.

• Relative strength of $F(\text{from sun}) < F(\text{from Earth})$, therefore HST will orbit Earth and therefore follows Earth around sun.

• Kepler's Law applies HST to Earth and also $M = \text{Earth mass}$, while Kepler's Law "Earth" Sun, $M = \text{Sun mass}$

• States diagram is not accurate as HST is not in its own orbit about sun, but is circling Earth



① - Makes a judgement re contradicts/dos not contradict Kepler's Law & 2nd or regarding orbital period of ~~Earth~~ ~~HST~~ Earth and HST about the Sun

Question 23 (9 marks)

During experiments with the Large Hadron Collider (LHC), Tim and Lincy accelerated protons to travel at $2.2 \times 10^6 \text{ ms}^{-1}$. The LHC has a diameter of $8 \times 10^3 \text{ m}$.

- a) Calculate the De Broglie wavelength of these protons.

2

$$\lambda = \frac{h}{mv}$$

working ①

correct answer ① with correct unit

$$\frac{6.626 \times 10^{-34}}{1.673 \times 10^{-27} \times 2.2 \times 10^6} = \underline{\underline{1.8 \times 10^{-13} \text{ m}}}$$

- b) Calculate the momentum of a proton at that speed and the force required to keep it on a circular path.

4

$$P = \frac{m_0 v}{\sqrt{1 - \frac{v^2}{c^2}}} \quad \text{①}$$

$$F_c = \frac{mv^2}{r} \quad \text{①}$$

$$F = 2.2 \times 10^{-18} \text{ N} \quad \text{①}$$

$$\text{① } P = 3.7 \times 10^{-21} \text{ kgms}^{-1}$$

NB. If a statement like 'not relativistic speed' $\Rightarrow$ 1 mark.

If a calculation was done to show why, then 2 marks

- c) Assess the validity of the following statement:

Particle accelerators cannot accelerate particles to any speed beyond the speed of light.

3

① mass/momentum $\uparrow$ to infinite amount

① $\therefore$ energy or force required to accelerate it is also infinite

① assessment of quotation $\therefore$ not possible

Question 24

- (a) Working - $F = qE = q \cdot V/d$
ANS with correct unit - $2.05 \times 10^{-14} \text{ N}$
- (b) 1 Mark - only stating the direction of the force on the electron's motion
2 Marks - correct answer including a quantitative description using $f = ma$.
ANS: $2.25 \times 10^{-16} \text{ ms}^{-2}$

Question 25

Criteria

- 1 Mark** Clear description of how the experiment was conducted
- 2 Mark** Clear outline of the observations
- 3 Mark** Clearly relates observations to characteristics of electron discovered

- Notes:
- When discussing experiments such as cathode ray you must outline how the cathode ray functioned in the experiment.
 - Must describe how observations are tied to the outcome - using equations is a MUST (ie. Millikan's oil drop experiment - $qE = mg$)

- Describe ONE experiment conducted by a scientist that provided a previously unknown property of the electron. 3

Millikan's oil drop experiment showed the property that electrons were the principle quantized value of charge. He sprayed atomised oil drops, which became charged due to friction with the air & nozzle, into an E field. He adjusted the strength of the E field until the oil drops would remain suspended }
 $\Rightarrow F_E = mg, qE = mg, e = \frac{mg}{E}$ through this, he noticed that the charge on each oil drop was an integral value of a base value of about $1.6 \times 10^{-19} \text{ C}$. Hence, he was able to discover that electrons were the basic principle of basic charge.
 fundamental charge.

Question 26 (8 marks)

Question 26

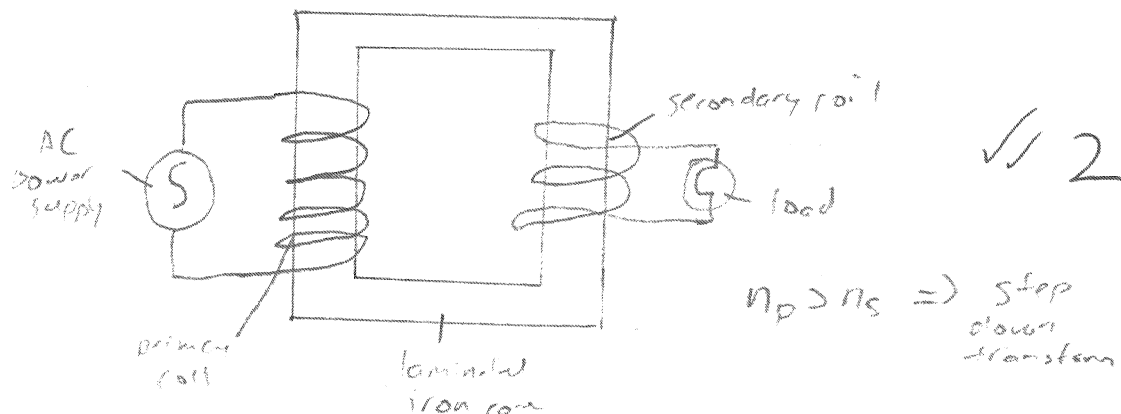
- (a) Working: $P = V_1 I_1 = V_2 I_2$
ANS with units: $2.5 \times 10^{-2} \text{ A}$
- (b) 1 Mark: Correct set up of primary and secondary coil (as per part a)
2 Marks: 1 mark AND all parts drawn correctly labelled
- (c) 1 Mark for each method (lamination, flux linkage)
1 Mark for explaining how each of the methods increases efficiency

NOTES:

- Laminations do not prevent eddy currents they only decrease the size
- In discussing flux linkage you must explain the connection between the secondary and primary coils
- If suggesting primary and secondary coil are to be laid over the top of each other you must state insulation is used between the coils or over one to prevent conduction between the two

b) Use a labelled diagram in the space below to model the structure of the transformer.

2



c) Explain TWO methods that could maximise the charger's transformer efficiency.

- ① Laminated core: A laminated core is made of alternating slabs of metal core and thin sheets of insulating material, which are parallel to direction of flux. This minimises the size of eddy currents on the iron core and hence reduces energy loss to resistive heat loss in the iron core, improving efficiency.
- ② Thicker wires: Increasing the cross-sectional area of the wires used will decrease their resistance ($R = \frac{\rho l}{A}$) where A increases and ρ, l are constant. This minimises power loss ($P_{\text{loss}} = I^2 R$) and hence improves efficiency.

Question 27

1 mark for each of the following points

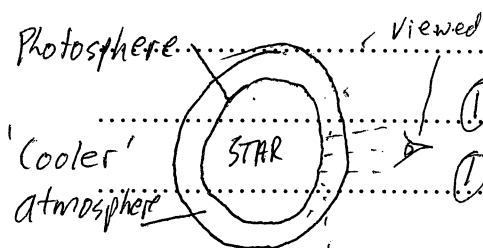
- Handle increases in length therefore the torque experienced can increase
- Clearly explains that if the angular velocity remains the same the metal cylinder will rotate at the same speed
- Explains application of Faradays law and thus emf **remains the same**

NOTES: If a student answered that the emf will change this can only receive **ONE** mark if they have correctly outline the relationship with handle length and torque.

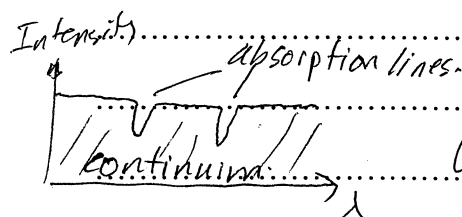
Question 28 (10 marks)

a) Clearly explain the production of absorption spectra by the atmosphere of stars.

3



- ① Black body continuum of photosphere
- ① In cooler atmosphere, electron in atom absorbs photon equal to energy level difference of atom's 'orbital' and then relaxes by re-emitting photon of same frequency/wavelength
- ① re-emitted photons go in all directions, some in original direction, so now have dark lines relative to unaffected continuum



b) Describe clearly how the study of a star's spectrum can give us information about TWO specific features of that star.

4

- | | |
|-----------------------------|------------|
| ① for effect/feature | } info one |
| ① for description of effect | |
| ① for effect/feature | } info two |
| ① for description of effect | |

Features include

- chemical composition - absorption (or emission) spectra compared with known spectrum on Earth.
- translational (radial) velocity - Red shift of spectral line moving away
blue shift moving toward
- Rotational velocity of star - if rotating axis perpendicular to our line of sight, broadened spectral lines of side move to (blue shift) away (red shift).
- Pressure of gas outer star - Collisions perturb energy levels of atoms therefore allowing various $\Delta E = hf$
- peak of continuous black body spectrum, Wein's law $T\lambda = b$ gives temperature of star.
- Did accept spectral classes as long as reason explained this shows different intensities for same temperature

Question 28 continues over page...

Question 28 (continued)

5C

- c) Outline Hubble's observations and their significance in terms of our understanding of the nature of the universe.

3

- ① - Discovered Red Shift of Absorption Spectra of other Galaxies.
- ① - Discovered Red shift which gives velocities were proportional to distance
- ① - Deduced expansion of universe. (Lead to hypothesis of Big Bang)

Also accepted

- ① - showed ^{some} nebula were actually galaxies
- ① - Solved question whether the Milkyway was only galaxy in universe.
- ① - Showed universe was extremely large.

Question 29 (3 marks)

For electricity to be transmitted over large distances between generators and households, transformers are used. Two transmissions take place over the same transmission lines at different times: ($P_{in A} = P_{in B}$)

$$P_{lost} = I^2 R$$

$$P_{initial} = I_{in} V_{initial} \therefore I_{in} = \frac{P_{in}}{V_{in}}$$

Transmission A: 28 kV AC

Transmission B: 280 kV AC

$$P_{LA} = I_A^2 = \left(\frac{P_{in A}}{V_{in A}} \right)^2 \therefore \frac{P_{LA}}{P_{LB}} = \left(\frac{V_{in B}}{V_{in A}} \right)^2 = \left(\frac{280}{28} \right)^2 = 100$$

Compare the power losses that occur in transmissions A and B. Include relevant equations and calculations in your response.

- ① - Correct equations: $P_{loss} = I^2 R$; Initial Power $P_A = I_A V_A = P_B = I_B V_B$ must be specified 3
- ① - Correct substitution and calculation (CE if applicable)
- ① - Correct answer $P_{lost}(A) = 100 P_{lost}(B)$ (CE if applicable)

Notes ① $P_{lost} = \frac{\Delta V^2}{R}$ should not be used. (can be used for parallel systems)

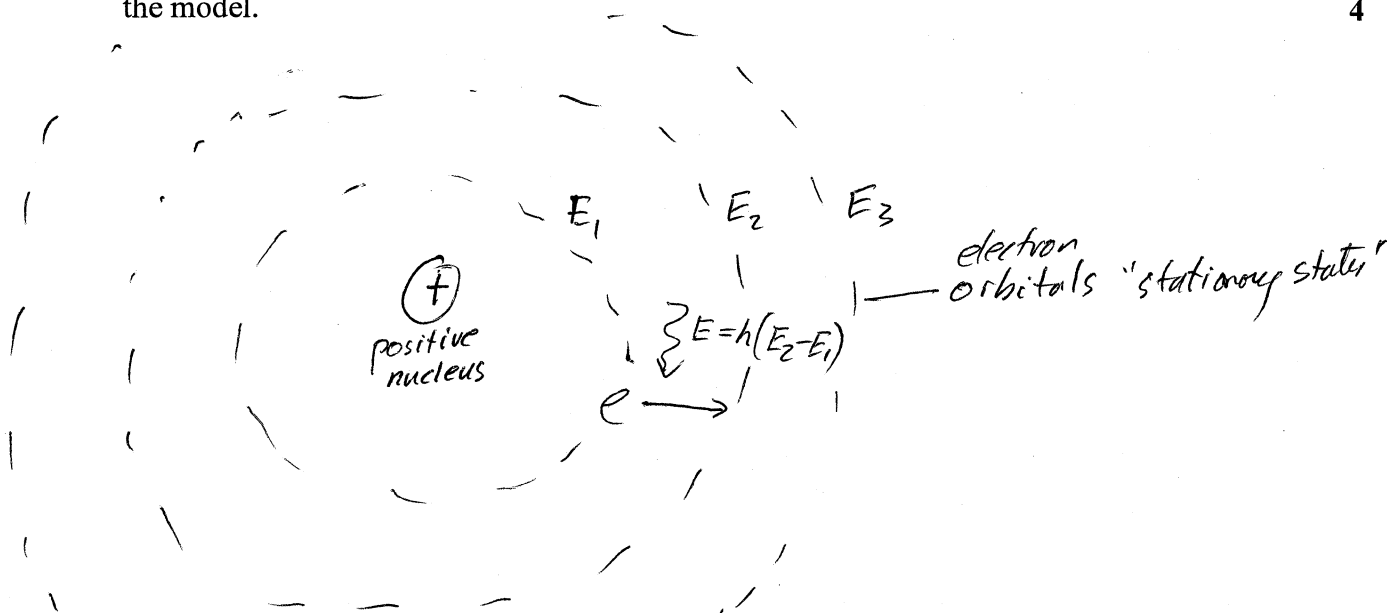
- ② $P = VI$ is valid at all points along transmission line, but P and V decrease with distance. We only know Power at start is equal, that is $P_A = P_B$ only at the start. R and I are constants.

$$P_{lost} = \Delta P = \Delta V I = (V_i - V_f) I$$

- ③ Must not confuse (1) Power at a point, $P = VI$ where V is the Voltage with respect to ground, with (2) $V = IR$ where V is the voltage drop across the line $= \Delta V = V_i - V_f$ and we do not know V_f in this problem. (it will be different for A and B)
- ④ Cannot say $P_{lost} = \frac{\Delta V^2}{R} = \frac{280^2}{R}$ because this would mean $V_f = 0$, and therefore 100% of power has been lost!!
- ⑤ Incorrect and contradictions lose mark(s)

Question 30 (7 marks)

- a) With the aid of a labelled diagram, outline Bohr's model of the atom and state the limitations of the model. 4



① - labelled diagram

① - Coupled with description - Discrete energy levels, stationary states, electrons jump between levels while absorbing or emitting photon
 $\Delta E = hf$, no radiation of EMR

① - 2 limitations OF BOHR MODEL

(positive nucleus was Rutherford's model, not accepted)

- b) Outline experimental evidence that supported ONE of Bohr's postulates and explain how the experimental evidence provided this support. 3

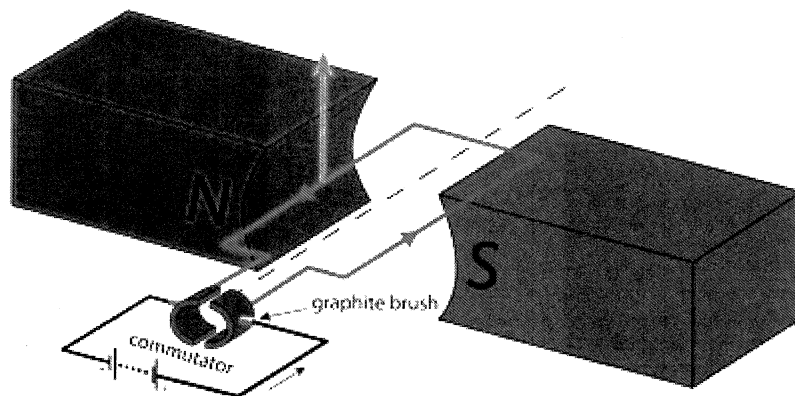
① - states postulate clearly

① - states supporting experiment

① - clearly explains link between postulate and experiment

- easiest example is hydrogen spectra, from discharge tube of H_2 . $\Delta E = hf$
- If Davisson/Germer you need to show clear connection between wavelength of electron and standing wave on 'circumference' of orbitals.
- gold foil experiment not accepted, as this was Rutherford's, which was used by Bohr.

Question 31 (5 marks)



Fully explain the production of torque in the device shown above. In your answer, refer to the diagram and include two relevant graphs.

5

① Motor effect - stated or described

① Torque explained properly

① Reference to diagram

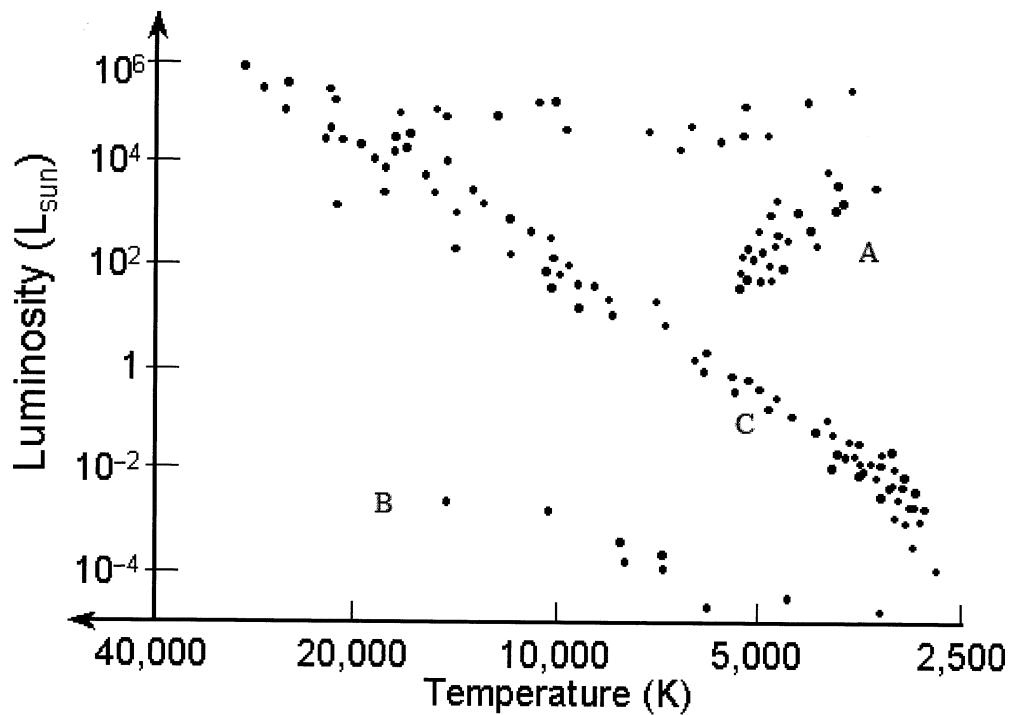
② Relevant graphs 2 = both present + a link to text

1 = a correct graph or 2 graphs
but no link.

* One must be a torque graph.

Question 32 (6 marks)

In 1911 Ejnar Hertzsprung and in 1913 Henry Norris Russell independently plotted the luminosity of stars versus their surface temperatures, as shown below. This represented a major step towards an understanding of stellar evolution.



- a) Identify the predominant nuclear reactions involved in the three groups A, B and C. 3

A = triple alpha or CNO in outer layers
 B = none
 C = proton-proton NOT "CNO" or " $H \rightarrow He$ "

- b) With reference to the diagram above, outline the stellar evolution of the Sun. 3

① main sequence $\rightarrow$ red giant (+ reason why)
 ① red giant $\rightarrow$ white dwarf (+ reason why)
 ① Reference to diagram

lose mark(s) for incorrect reason/description

Question 33 (9 marks)

What evidence supports the classical wave model of light and what predictions can be made using this model?

In your answer, include a relevant diagram and state TWO observations concerning light that are unable to be explained by the classical model. 9

• classical wave model

① - Newton vs Huygens idea / debate

① - why wave model accepted - eg. Focault, Young's expt. etc.

• observations

① diffraction - description of how it works (basic)

① - predictive statement - formula essential

① polarisation - "

① - "

• relevant diagram

① present

① linked to / referred to in text

• two unexplainable observations

- BBR

- Photoelectric effect

} 2 for link

NB other legit ones accepted

MY OBSERVATIONS

• Know the syllabus - enquiry questions etc.

• Don't get sidetracked into other info that is not really needed.

• The HSC examines are testing the SYLLABUS content.

END OF PAPER