

**‘2017 Examination Package’ -  
Trial Examination 1 of 9**

**STUDENT NUMBER**

Figures

Words

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# PHYSICS

## Units 3&4 – Written examination

**(TSSM’s 2008 trial exam updated for the current study design)**

Reading Time: 15 minutes

Writing Time: 2 hour and 30 minutes

### QUESTION & ANSWER BOOK

#### Structure of Book

| Section | Number of questions | Number of questions to be answered | Number of marks |
|---------|---------------------|------------------------------------|-----------------|
| A       | 20                  | 20                                 | 20              |
| B       | 17                  | 17                                 | 110             |
|         |                     |                                    | Total 130       |

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, and rulers, up to 2 pages of pre written notes and an approved **scientific calculator**.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape, graphics calculators

#### Materials supplied

- Question and answer book of 31 pages (including a multiple choice answer sheet for **Section B**).
- Formula Sheet.

#### Instructions

- Print your name in the space provided on the top of this page.
- All written responses must be in English.

**Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.**

## SECTION A – Multiple Choice

### Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple choice questions.

Choose the response that is **correct** and that **best answers** the question

A correct answer **scores** 1; an incorrect answer scores 0

Marks will not be deducted for incorrect answers

Unless indicated the diagrams in this book are **not** drawn to scale

Take the value of  $g$  to be  $9.8 \text{ ms}^{-2}$

### Question 1

What is true about the field lines of all electric, magnetic, and gravitational fields? They

- A. Form loop
- B. Radiate from charges or masses
- C. Show the path that a particle will follow
- D. Never cross

### Question 2

The direction of the force on a current carrying wire placed in a magnetic field depends on

- A. The direction of current
- B. The direction of the field
- C. The direction of the current as well as the field
- D. Neither the direction of the current or the field

### Question 3

Which of the following best matches the voltage required to accelerate an electron to 6% of the speed of light? Ignore any relativistic effects.

- A. 921 V
- B.  $1.02 \times 10^{-14} \text{ V}$
- C. 256 kV
- D.  $2.46 \times 10^{-15} \text{ V}$

### Question 4

Sara is operating a small scale experiment, deflecting an electron beam with magnets. She accelerates the beam to 1% of the speed of light. The magnetic field can be assumed to be perpendicular to the path of the electrons.

Which of the following best describes the field strength required to generate a radius of 2.1mm?

- A.  $2.7 \times 10^{-11} \text{ T}$
- B.  $8.1 \times 10^{-3} \text{ T}$
- C. 8.1 T
- D. 0.81 T

SECTION A – continued  
**TURN OVER**

**Question 5**

Which of the following best estimates the magnitude of the force on a single electron in the beam?

- A.  $3.9 \times 10^{-15} \text{ N}$
- B. 2.44 N
- C.  $3.9 \times 10^{-13} \text{ N}$
- D. None of the above

**Question 6**

The gravitational field strengths at the surfaces of the Earth and the Moon are  $9.8 \text{ N kg}^{-1}$  and  $1.7 \text{ N kg}^{-1}$  respectively. If the mass of the Earth is 81 times the mass of the Moon, what is the ratio of the radius of the Earth to the radius of the Moon?

- A. 3.7
- B. 5.8
- C. 14
- D. 22

**Question 7**

A 1.2-kg object moving with a speed of  $8.0 \text{ ms}^{-1}$  collides perpendicularly with a wall and emerges with a speed of  $6.0 \text{ ms}^{-1}$  in the opposite direction. If the object is in contact with the wall for 2.0 ms, what is the magnitude of the average force on the object by the wall?

- A. 9.8 kN
- B. 8.4 kN
- C. 7.7 kN
- D. 9.1 kN

**Question 8**

A block of mass  $4m$  can move without friction on a horizontal table as shown in Figure 1. This block is attached to another block of mass  $m$  by a string that passes over a frictionless pulley. If the masses of the string and the pulley are negligible, what is the magnitude of the acceleration of the descending block?



**Figure 1**

- A.  $g/5$
- B.  $g/4$
- C.  $g/3$
- D.  $g$

**SECTION A – continued  
TURN OVER**

**Question 9**

The Michelson-Morley experiment was designed to:

- A. Measure the speed the Earth moves through the aether
- B. Accurately measure the speed of light
- C. Test Einstein's theory of relativity
- D. Show it is impossible to travel faster than light

**Question 10**

Terry wishes to build an electronic circuit to enable him to run a DC radio from mains supply. The mains supply is providing 240 V RMS AC. The turns ratio of the transformer is  $N_p : N_s = 20 : 1$

The value of the AC voltage after it is transformed is:

- A. 6 V
- B. 12 V
- C. 18 V
- D. 24 V

**Question 11**

Because of the Doppler Effect, sound coming from a moving source

- A. Seems louder than if the source was not moving.
- B. Are of higher frequency if the sound source is moving away from the observer.
- C. Have a lower frequency if the sound source is moving toward the observer.
- D. Have a higher frequency if the sound source is moving toward the observer.

**Question 12**

An electromagnetic wave is generated by

- A. any moving charge
- B. any accelerating charge
- C. only a charge with changing acceleration
- D. only a charge moving in a circle

**Question 13**

The index of refraction of benzene is 1.80. The critical angle for total internal reflection, at a benzene-air interface, is about:

- A.  $56^\circ$
- B.  $47^\circ$
- C.  $34^\circ$
- D.  $22^\circ$

**SECTION A – continued**

**Question 14**

The frequency of an electromagnetic wave with a wavelength of  $2.75 \times 10^{-8}\text{m}$  is

- A. 1.10 Hz
- B.  $1.09 \times 10^{16}\text{Hz}$
- C.  $9.17 \times 10^{15}\text{Hz}$
- D.  $9.17 \times 10^{16}\text{Hz}$

**Question 15**

An electron can circle a nucleus only in orbits that contain a whole number of wavelengths. This statement

- A. Has a few exceptions, but they are not important at a quantum level.
- B. Implies that the quantum number,  $n$ , is the sum of all the orbits minus the length of the de Broglie wavelength
- C. Combines both the particle and wave characteristics of the electron into a single statement
- D. Suggests the uncertainty principle is not correct after all.

**Question 16**

An important implication of the uncertainty principle discovered by Werner Heisenberg is:

- A. Very small particles moving a slow speeds contains vast quantities of energy.
- B. If we can gather enough data, then it may be possible to predict the future based on present conditions
- C. Above a certain particle size the de Broglie waves are so insignificant that they drop to zero.
- D. We can never predict the future with absolute certainty because it is impossible to know the present with certainty.

**Question 17**

Which of the following properties is a characteristic of the light from a laser?

- A. The waves all have the same frequency
- B. The waves are all in phase with each other
- C. The waves form a narrow beam
- D. All of the above

**Question 18**

Which of the following effects could not be observed for sound waves in air?

- A. Interference
- B. Refraction
- C. Polarisation
- D. Diffraction

**SECTION A – continued**  
**TURN OVER**

**Question 19**

Systematic errors are:

- A. Instrumental errors
- B. Environmental errors
- C. Random errors
- D. Both A and B

**Question 20**

In an experiment, the one variable that is changed is called the

- A. Dependent
- B. Independent
- C. Controlled
- D. Experimental

**END OF SECTION A  
TURN OVER**

**SECTION B – Short answer****Instructions for Section B**

Answer **all** questions in the spaces provided. Write using blue or black pen

Where an answer box is provided, write your full answer in the box.

If an answer box has a unit provided in it, give your answer in that unit.

In questions where more than one mark is available, appropriate working **must** be shown.

Unless indicated the diagrams in this book are **not** drawn to scale

Take the value of  $g$  to be  $9.8 \text{ ms}^{-2}$

**Question 1** (3 marks)

Two point charges  $Q_1 = 5 \text{ nC}$  and  $Q_2 = -8 \text{ nC}$  are placed in a vacuum. Point P is 0.5 m from the first charge and 120 cm from the second one as shown in Figure 1

**Figure 1**

State the field strength at Point P.

3 marks

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$\text{N C}^{-1}$

**Question 2** (6 marks)

A uniform electric field between two parallel plates 20 cm apart has the value of  $400 \text{ N C}^{-1}$ .

a. Find the voltage between the plates

2 marks

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V

**SECTION B – Question 1 - continued**  
**TURN OVER**

- b.** What force would be acting on a charge of  $-2 \text{ nC}$  placed in the field 2 marks

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N

- c.** What would be the electric field strength when the distance between the plates changes to  $30 \text{ cm}$ ? 2 marks

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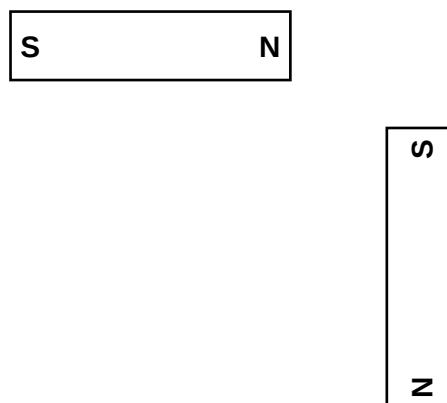


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$\text{N C}^{-1}$

**Question 3** (4 marks)

- a.** Sketch field lines around the two bar magnets shown in Figure 2a



**Figure 2a**

**SECTION B – Question 3 - continued**

- b. Which of the following best describes the direction of the magnetic field at **A** due to the current carrying wire shown in Figure 2b? 2 marks

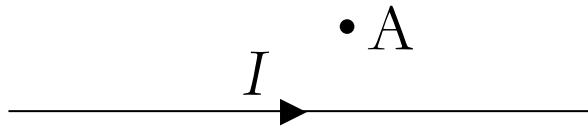


Figure 2b

| A | B | C         | D           | E  |
|---|---|-----------|-------------|----|
| → | ← | Into page | Out of page | Up |

**Question 4** (9 marks)

Mars has a mass of  $6.42 \times 10^{23} \text{ kg}$  and radius of 3400 km and orbits the sun every 16500 hours at a distance of  $2.28 \times 10^8 \text{ km}$ . A day on Mars is 24 hours and 39 minutes long.

- a. Calculate the acceleration due to gravity at the surface of Mars. 2 marks

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  $\text{ms}^{-2}$ 

- b. Calculate the period of revolution of Mars about the Sun in seconds. 1 mark

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**SECTION B – Question 4 - continued**  
**TURN OVER**

c. Calculate the mass of the Sun.

3 marks

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Steve wishes to launch a geostationary satellite above the surface of Mars.

d. Calculate the distance above the surface of Mars of the satellite.

3 marks

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**SECTION B** – continued

**Question 5** (8 marks)

Gavin is at the golf driving range. He selects a club that will launch the ball at an angle of  $60^\circ$  to the horizontal. Gavin strikes the ball with a launch speed of  $50 \text{ ms}^{-1}$ . The ball lands at the same elevation that it leaves the ground

The effects of air resistance on the ball can be ignored for **a, b and c**.

- a.** Calculate the total time of flight of the ball.

3 marks

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- b.** Calculate the horizontal range of the ball.

2 marks

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- c.** Calculate the acceleration of the golf ball at the top of its flight.

2 marks

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| $\text{ms}^{-2}$ |
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**SECTION B – Question 5 - continued**  
**TURN OVER**

- d.** If the effects of air resistance are significant what would happen to the horizontal range of the ball? 1 mark

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**Question 6** (9 marks)

A red ball of mass 30 g and travelling at speed of  $3 \text{ ms}^{-1}$  East strikes a stationary blue ball of mass 80 g. After the collision the red ball rebounds off the blue ball towards the West. The velocity of the blue ball after the collision is  $1.5 \text{ ms}^{-1}$  East. The time of the collision is 0.15 s. Assume the collision can be considered isolated.

- a.** Calculate the velocity of the red ball after the collision. 3 marks

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| $\text{ms}^{-1}$ |
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- b.** Calculate the average force exerted by the red ball on the blue ball during the collision. 3 marks

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**SECTION B – Question 6 - continued**

- c. Is this an elastic or inelastic collision? Justify your answer with an appropriate calculation. 3 marks

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**Question 7 (3 marks)**

A car drives around a roundabout at a constant speed of  $20 \text{ kmh}^{-1}$ . The roundabout has a radius of 3.5 m and the car a mass of 1 200 kg.

- a. Calculate the speed of the car in  $\text{ms}^{-1}$ . 1 mark

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| $\text{ms}^{-1}$ |
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- b. Calculate the magnitude and direction of the net force acting on the car. 2 marks

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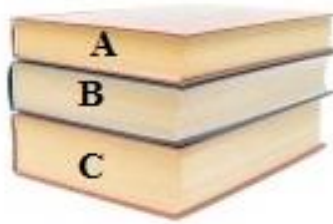
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**SECTION B – Question 7 - continued**  
**TURN OVER**

**Question 8** (4 marks)

Three books, book A (0.6 kg), book B (1.0 kg) and book C (1.2 kg), are sitting on a table as shown in Figure 3.



**Figure 3**

- a.** What is the force by book C on book B?  
Explain your answer in terms of Newton's Laws.

2 marks

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- b.** The table is now removed and the books free fall.  
Calculate the force by book B on book C. Ignore air resistance and explain your answer.

2 marks

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**SECTION B – continued**

**Question 9** (7 marks)

Donald has built a super fast space ship that can travel at 30% of the speed of light.

He sets out from Earth for the planet Pluto which is  $5.9 \times 10^9 \text{ km}$  away from the Earth. Daisy is on Earth and is observing Donald's journey. Daisy and Donald synchronise their watches so that both watches read 12:00 noon when Donald takes off.

- a.** What time does Daisy's watch read at the instant Donald arrives at Pluto? 2 marks

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- b.** What time does Donald's watch read at the instant Donald arrives at Pluto? 3 marks

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Donald's spacecraft is 7 m in length. Calculate the length of Donald's spacecraft as measured by Daisy. 2 marks

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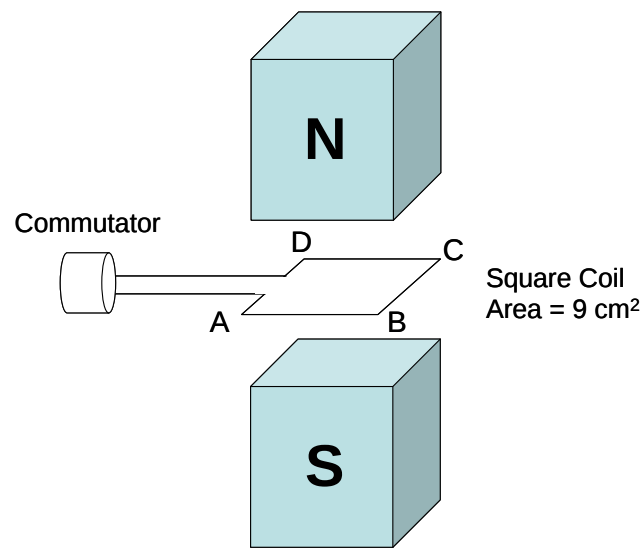
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**SECTION B – continued**  
**TURN OVER**

**Question 10** (5 marks)

Figure 4 shows a basic DC motor.



**Figure 4**

In the position shown, a force of  $8.1 \times 10^{-2} \text{ N}$  acts on side **AB**. The field strength due to the uniform field created by the magnets is 0.3 T and the current is 100 mA.

- a. Determine the number of loops that must be in the coil of the DC motor shown in **Figure 4**. 2 marks

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**SECTION B – Question 10** - continued

- b. Complete **Table 1** by inserting the option which correctly describes the **changes in magnitude** of the forces and current that act on the coil when it is rotated  $90^\circ$  from horizontal (as in **Figure 12**) to a vertical position. 3 marks  
(Use terminology: INCREASED / DECREASED / NO CHANGE)

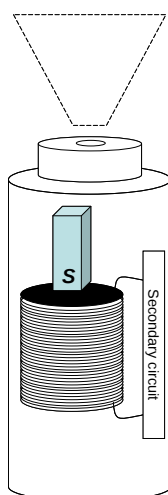
**Changes to the coil as it rotates from horizontal to vertical**

| FORCE on SIDE AB | FORCE on SIDE BC | CURRENT in SIDE AB |
|------------------|------------------|--------------------|
|                  |                  |                    |

**Table 1**

**Question 11** (6 marks)

Brian has been given a rechargeable torch, which uses electromagnetic induction to charge a small capacitor and power an LED. A simplified sketch of the casing, coil and magnet is shown in Figure 5

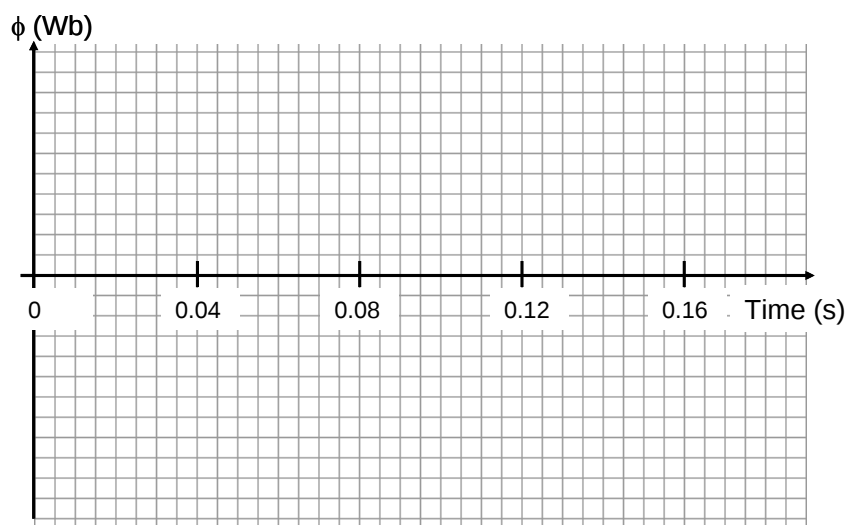


**Figure 5**

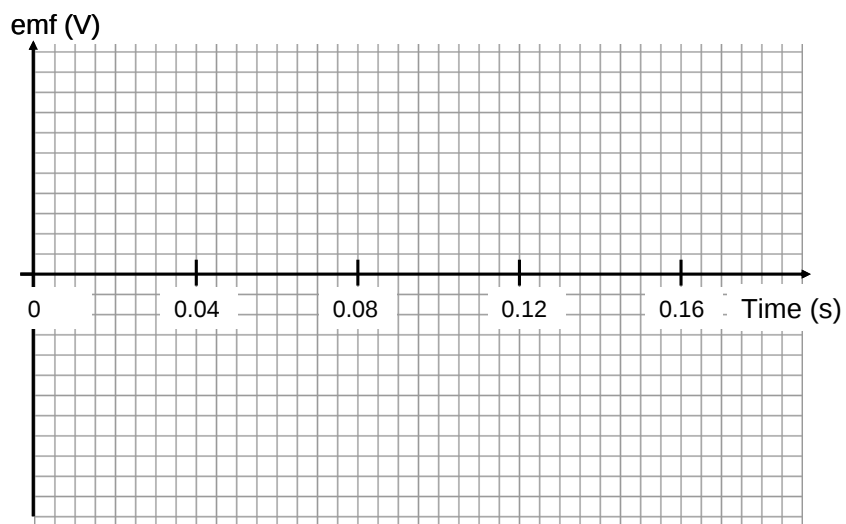
- A small, but strong magnet ( $B = 0.4 \text{ T}$ ) is shaken up and down within a circular coil (diameter = 3 cm) which is connected to a secondary circuit.
- You may assume the magnet takes 0.04 s to enter the coil and moves at a constant speed.
- After 0.16 sec, the magnet has fully exited the coil.
- Flux is zero at either end (i.e. magnet clear of the coil)

**SECTION B – Question 11 - continued**  
**TURN OVER**

- a. Using the axes provided below, sketch a graph of flux over time as the magnet moves from the **top to the bottom** of the torch. Specify a vertical scale. 2 marks



- b. For the same movement from top to bottom of the coil, sketch a graph of induced voltage (emf) over time. No vertical scale is required. 2 marks



**SECTION B** – continued

PHYS EXAM

As the magnet first enters the coil, the average emf over the 0.04 sec interval is 0.353 V.

- c. Which of the following options best approximates the number of loops in the coil?

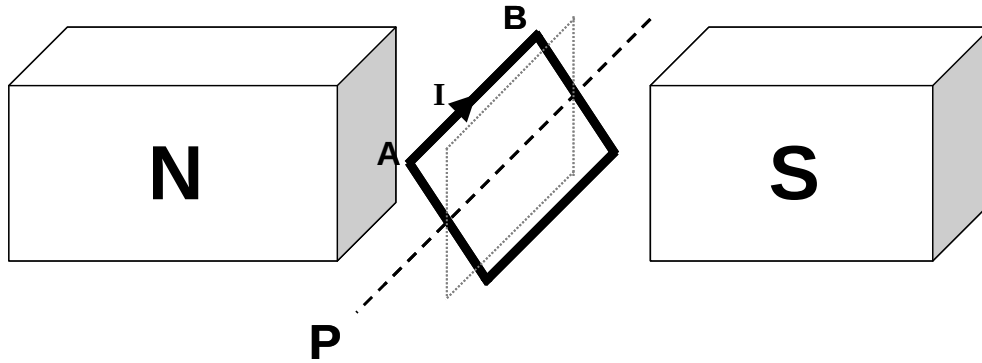
2 marks

- A. 2
- B. 20
- C. 50
- D. 250

**SECTION B – continued**  
**TURN OVER**

**Question 12** (10 marks)

A wind turbine is modelled as a coil rotating within a magnetic field, as shown in Figure 6. Assume an observer is positioned at **P** and current is flowing from **A** to **B** as shown. (NOTE: For reference purposes, a faint line indicates what the coil would look like in a vertical position)



**Figure 6**

- a.** Is the turbine spinning **clockwise** or **anticlockwise**? Justify your answer with reference to the principle of electromagnetic induction. 3 marks

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**SECTION B – Question 12 - continued**

The turbine's coil is connected to an output circuit via **slip rings**.

**b.** Explain the purpose of **slip rings** in such a circuit.

2 marks

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**c.** Is this setup an **alternator** or **generator**? Explain your answer and be sure to distinguish between these two terms.

3 marks

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**SECTION B – Question 12 - continued**  
**TURN OVER**

- d. The output circuit from the turbine leads to a step down transformer. Explain, in terms of induction, why **alternating current** is preferable to **direct current** in this situation. 2 marks

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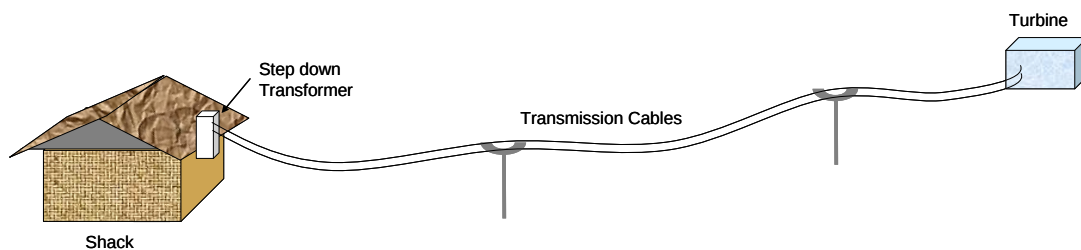
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**Question 13** (9 marks)

At one point, the turbine produces 2.5 kW at 400 V AC RMS. It is connected, via transmission cables ( $R = 4 \Omega$ ) and a step down transformer, to a small shack located 5 km away. Figure 7 shows a basic outline of the setup.



**Figure 7**

- a. Determine the value of  $V_{\text{peak}}$  at the turbine. 2 marks

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**SECTION B – Question 13 - continued**

**b.** Determine the value of  $I_{\text{peak-peak}}$  at the turbine.

2 marks

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**c.** Determine the voltage drop in the cables.

2 marks

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The owner of the shack is disappointed to find that, when several large appliances are operating and the current in the shack is increased, the voltage falls below 110 V. Assume an ideal transformer is being used.

**d.** Explain why the voltage drops below 110 V, despite the use of an ideal transformer.

3 marks

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**SECTION B – continued**  
**TURN OVER**

**Question 14** (4 marks)

Choose the correct descriptors to complete Table 2.

4 marks

| Source of Light    | Spectrum<br>(Continuous/Discrete) | Nature of Phase<br>(Coherent/Incoherent) | Electron behaviour<br>(Thermal motion /<br>Quantised energy level) |
|--------------------|-----------------------------------|------------------------------------------|--------------------------------------------------------------------|
| LASER              |                                   |                                          |                                                                    |
| Candle             |                                   |                                          |                                                                    |
| Metal Vapour Lamp  |                                   |                                          |                                                                    |
| Incandescent Globe |                                   |                                          |                                                                    |

**Table 2****Question 15** (13 marks)

Students as part of their extended practical investigation are investigating the interference of light via Young's Double Slit experiment.

They start using a laser with red light of frequency  $4.14 \times 10^{14} \text{ Hz}$

**a.** Calculate the wavelength of the laser.

2 marks

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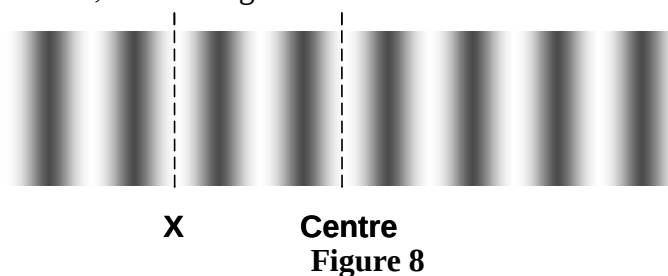
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The students use the laser to obtain the interference pattern shown in Figure 8 and find the path difference to Point X, the 2<sup>nd</sup> bright band from the centre.

**SECTION B – Question 15 - continued**

- b.** Identify the independent and dependent variables within this experiment. 2 marks

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- c.** Outline a suitable method they may use to achieve the interference pattern. 2 marks

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- d.** Calculate the path difference in nanometres 2 marks

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- e.** List two possible errors within the experiment and identify them as systematic or random errors. 2 marks

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- f.** The students replace the red laser with another laser of unknown frequency. The point that was the 2<sup>nd</sup> bright band in the original experiment is now the first dark band. Find the frequency of this new laser. 3 marks

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**SECTION B – continued**  
**TURN OVER**

**Question 16** (6 marks)

Brian supervises a basic experiment to investigate the photoelectric effect. A violet light source ( $\lambda = 380 \text{ nm}$ ) illuminates a metal surface and photocurrent is generated. Brian records a stopping voltage of  $1.3 \text{ V}$ .

- a.** Determine the momentum of a photon of the violet light

2 marks

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$\text{kg ms}^{-1}$

- b.** Determine the momentum of the most energetic electron ejected from the metal.

2 marks

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$\text{kgms}^{-1}$

- c.** Determine the threshold frequency for the metal surface in hertz.

2 marks

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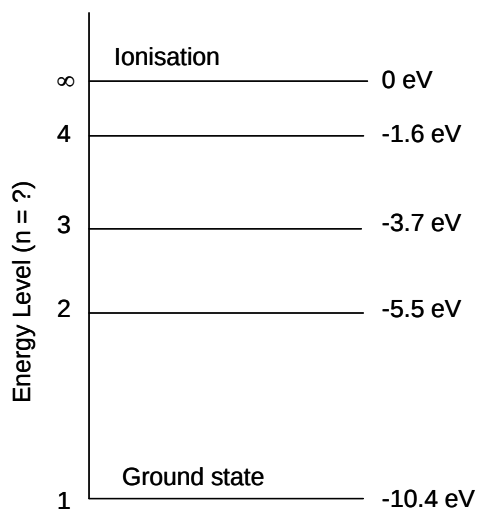
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$\text{Hz}$

**SECTION B – continued**

**Question 17** (4 marks)

Figure 9 is a simplified depiction of the energy levels for mercury. High voltage is applied across mercury vapour, causing its electrons to become excited.



**Figure 9**

- a. Which **one or more of** the following wavelengths may be observed within the emission spectrum for the mercury? 2 marks

- A. 776 nm
- B. 591 nm
- C. 185 nm
- D. 226 nm

- b. Explain, with reference to **standing waves**, why there is no energy level at -4.5 eV. 2 marks

**END OF QUESTION AND ANSWER BOOK**

**Data Sheet**

|    |                                                              |                                                                                                                 |
|----|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| 1  | Velocity, acceleration                                       | $v = \frac{\Delta x}{\Delta t} \quad a = \frac{\Delta v}{\Delta t}$                                             |
| 2  | Equations for constant acceleration                          | $v = u + at$ $x = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$ $x = \frac{1}{2}(u + v)t$                             |
| 3  | Newton's second law                                          | $F = ma$                                                                                                        |
| 4  | Circular motion                                              | $a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$                                                                      |
| 5  | Hooke's law                                                  | $F = -kx$                                                                                                       |
| 6  | Elastic potential energy                                     | $\frac{1}{2}kx^2$                                                                                               |
| 7  | Gravitational potential energy near the surface of the earth | $mgh$                                                                                                           |
| 8  | Kinetic energy                                               | $\frac{1}{2}mv^2$                                                                                               |
| 9  | Lorentz factor                                               | $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$                                                                 |
| 10 | Time dilation                                                | $t = t_0 \gamma$                                                                                                |
| 11 | Length contraction                                           | $L = L_0 / \gamma$                                                                                              |
| 12 | Relativistic mass                                            | $m = m_0 \gamma$                                                                                                |
| 13 | Newton's law of universal gravitation                        | $F = \frac{GM_1 M_2}{r^2}$                                                                                      |
| 14 | Gravitational field                                          | $g = \frac{GM}{r^2}$                                                                                            |
| 15 | Transformer action                                           | $\frac{V_1}{V_2} = \frac{N_1}{N_2}$                                                                             |
| 16 | AC voltage and current                                       | $V_{\text{RMS}} = \frac{1}{\sqrt{2}} V_{\text{peak}} \quad I_{\text{RMS}} = \frac{1}{\sqrt{2}} I_{\text{peak}}$ |
| 17 | Voltage, power                                               | $V = IR, \quad P = VI$                                                                                          |
| 18 | magnetic force                                               | $F = IlB$                                                                                                       |

|    |                                                                    |                                                                                                           |
|----|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| 19 | electromagnetic induction                                          | emf : $\varepsilon = -N \frac{\Delta\phi}{\Delta t}$ flux : $\phi = BA$                                   |
| 20 | transmission losses                                                | $V_{\text{drop}} = I_{\text{line}} R_{\text{line}}$ $P_{\text{loss}} = I_{\text{line}}^2 R_{\text{line}}$ |
| 21 | Snell's Law                                                        | $n_1 \sin i = n_2 \sin r$                                                                                 |
| 22 | photoelectric effect                                               | $E_{k \text{ max}} = hf - W$                                                                              |
| 23 | photon energy                                                      | $E = hf$                                                                                                  |
| 24 | photon momentum                                                    | $p = \frac{h}{\lambda}$                                                                                   |
| 25 | de Broglie wavelength                                              | $\lambda = \frac{h}{p}$                                                                                   |
| 26 | Planck's constant                                                  | $h = 6.63 \times 10^{-34} \text{ J s}$<br>$h = 4.14 \times 10^{-15} \text{ eV s}$                         |
| 27 | Universal gravitational constant                                   | $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$                                                  |
| 28 | Mass of Earth                                                      | $M_E = 5.98 \times 10^{24} \text{ kg}$                                                                    |
| 29 | Radius of Earth                                                    | $R_E = 6.37 \times 10^6 \text{ m}$                                                                        |
| 30 | Mass of the electron                                               | $m_e = 9.1 \times 10^{-31} \text{ kg}$                                                                    |
| 31 | Charge on the electron                                             | $q = -1.6 \times 10^{-19} \text{ C}$                                                                      |
| 32 | Speed of light                                                     | $c = 3.0 \times 10^8 \text{ ms}^{-1}$                                                                     |
| 33 | energy transformations for electrons in an electron gun (<100 keV) | $\frac{1}{2} m v^2 = eV$                                                                                  |
| 34 | radius of electron beam                                            | $r = \frac{p}{qB}$                                                                                        |
| 35 | force applied to an electron beam                                  | $F = qvB$                                                                                                 |
| 36 | electric field between charged plates                              | $E = \frac{V}{d}$                                                                                         |

**Prefix/Units**

$$p = \text{pico} = 10^{-12}$$

$$n = \text{nano} = 10^{-9}$$

$$\mu = \text{micro} = 10^{-6}$$

$$m = \text{milli} = 10^{-3}$$

$$k = \text{kilo} = 10^3$$

$$M = \text{mega} = 10^6$$

$$G = \text{giga} = 10^9$$

$$t = \text{tonne} = 10^3 \text{ kg}$$

**SECTION A MULTIPLE CHOICE ANSWER SHEET**

**Answers – Circle ONE of A-D for each of the 11 multiple choice questions.**

| Question | Answer |   |   |   |
|----------|--------|---|---|---|
| 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 |