Curriculum Council
Government of Western Australia

WACE
Western Australian Certificate of Education

Tertiary Entrance Examination, 2008

Question/Answer Booklet

PHYSICS

Please place your student identification label in this box

Student Number: In figures

In words

Time allowed for this paper

Reading time before commencing work: Ten minutes
Working time for paper: Three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer Booklet

Physics: Formulae, Constants and Data Sheet (inside front cover of this Question/Answer Booklet)

To be provided by the candidate

Standard items: Pens, pencils, eraser, correction fluid, ruler, highlighter

Special items: MATHOMAT and/or Mathaid, drawing compass, protractor, set square and calculators satisfying the conditions set by the Curriculum Council for this subject.

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Ref: 858

Structure of this paper

Section	Number of questions	Number of questions to be attempted	Marks available
A: Short Answers	15	15	60
B: Problem Solving	8	8	100
C: Comprehension and Interpretation	2	2	40
		Total marks	200

Instructions to candidates

1. The rules for the conduct of Western Australian external examination are detailed in the *TEE/WACE Examinations Handbook*. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in the spaces provided in this Question/Answer Booklet.

3. You may remove the enclosed *Physics: Formulae, Constants and Data Sheet* from the booklet and use as required. This sheet is not to be handed in at the end of the examination.

4. Your answers to questions involving calculations should be evaluated and given in decimal form. It is suggested that you quote all answers to three significant figures, with the exception of questions for which estimates are required. In the case of an incorrect final result, marks may be awarded for method and working, provided these are set out clearly and legibly.

5. Questions containing the specific instruction **'show working'** should be answered with a complete, logical, clear sequence of reasoning showing how you arrived at your final answer. For these questions, correct answers which do not show working will not be awarded full marks.

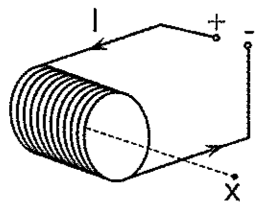
6. Questions containing the instruction **'estimate'** may give insufficient numerical data for their solution. You should provide appropriate figures to enable an approximate solution to be obtained.

7. When descriptive answers are required, you should display your understanding of the context of a question. An answer which does not display an understanding of Physics principles will not attract marks.

Section A: Short Answers **60 Marks**

Attempt **all** 15 questions in this section. Each question is worth 4 marks. Answers are to be written in the space provided.

1. A coil of copper wire carries a DC current I as shown in the diagram. The magnetic field strength is measured at the point X along the axis of the coil as drawn.



(a) On the diagram, draw a vector representing the magnetic field at X.

(b) When a rod of soft iron is placed through the centre of the coil without touching the copper wire, what happens to the **strength** of the magnetic field at X? Circle your choice:

increase / decrease / no change

2. A loudspeaker produces sound waves in air of wavelength 0.34 m and speed 340 m s^{-1}. How many cycles of vibration does the loudspeaker cone make in 50 ms?

Answer: ______________________

3. For the three properties of a sound wave; frequency, wavelength and speed complete the table below stating whether the property is **changed** or **unchanged** when undergoing reflection, refraction and diffraction. One property for diffraction has been completed for you.

Property	Reflection	Refraction	Diffraction
Frequency			**unchanged**
Wavelength			
Speed			

4. A phrase used to promote the 1979 film 'Alien' was 'In space no one can hear you scream'. Explain why you might be able to see an event in space but not hear it.

5. A pilot drops a package from an aircraft flying horizontally at a constant speed over flat ground. Neglecting air resistance, when the package hits the ground the horizontal location of the aircraft will

A. be behind the package.

B. be directly above the package.

C. be in front of the package.

D. depend on the speed of the aircraft when the package was dropped.

E. depend on the height of the aircraft when the package was released.

Answer ____________

Explain your answer.

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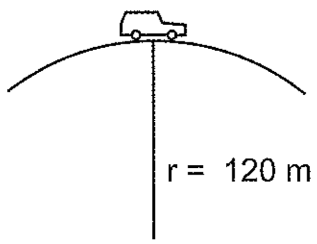
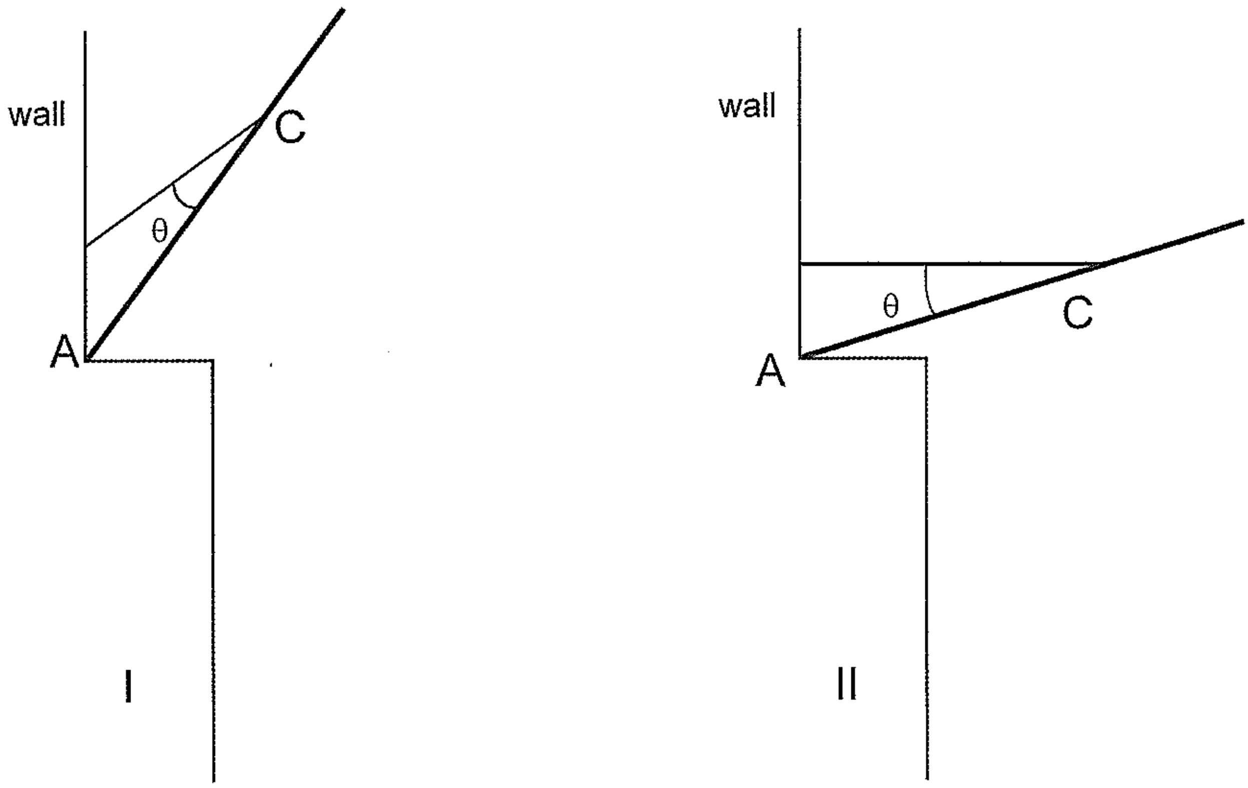
6. A car with mass 1200 kg travels over the rounded top of a hill of radius 120 m. At what minimum speed must it travel at the top of the hill so that the tyres lose contact with the ground?



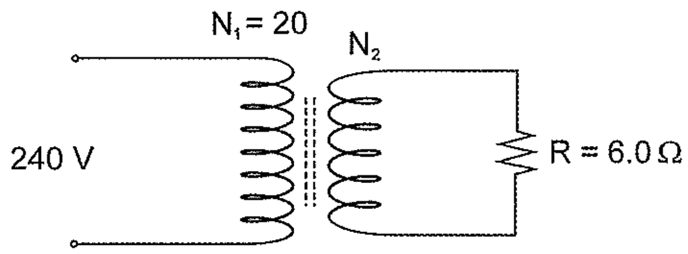
Answer: ______________________

7. A flagpole can be attached to the wall of a building in two different ways. In each case, the bottom end of the flagpole, A, rests at the back of a ledge. The flagpole is held in place by a wire attached to the centre of mass of the flagpole, and making the same angle θ with the flagpole.

In which case, I or II, is the tension in the wire greater? Explain your reasoning, using the diagram to assist your explanation.

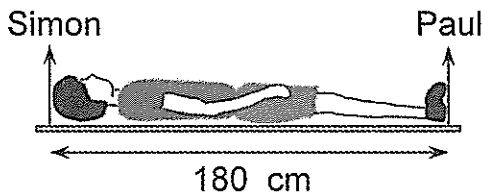


8. An alternating voltage of 240 V is applied across the primary coil of a transformer. The secondary coil is connected to a resistance of 6.0 Ω. If the primary coil contains 20 turns, what is the maximum number of turns that the secondary coil may have so that the current through the resistor does not exceed 10 A? You may assume the transformer is 100% efficient and that there is no other resistance in the circuit.



Answer: ______________________

9. After sustaining an injury in a football match, a 180 cm tall player is carried on a stretcher by two attendants, Simon and Paul. The mass of the player is 80 kg and the mass of the stretcher is 5.0 kg. The centre of mass of the player is 108 cm from the player's feet. The center of mass of the stretcher is 90 cm from the player's feet. Calculate the force that Simon exerts as they carry the injured player.



Answer: ______________________

10. Consider a 100 W red light globe and a 100 W blue light globe. The power radiated by each light globe is the same. Assume the wavelength of the red light is 670 nm and blue light 460 nm.

(a) Calculate the ratio of the photon energy emitted by the red light globe to the blue light globe. Show sufficient working to justify your answer.

Answer: ______________________

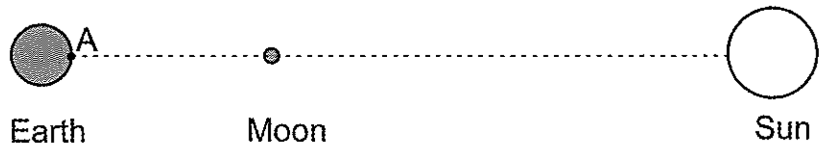
(b) Calculate the ratio of the number of photons emitted by the red light globe to the blue light globe in one second. Show sufficient working to justify your answer.

Answer: ______________________

11. In an atom, a photon is emitted when an electron drops from a higher energy level to a lower energy level. In the emission spectrum of this atom, a visible line is observed at a wavelength of 652 nm. If the lower level has an energy of - 11.6 eV, calculate the energy in electron volts of the higher level involved in the emission of this photon.

Answer: ______________________

12. The Earth's tides vary in height with the relative positions of the Earth, Moon and Sun. These positions change as the Earth and Moon move in their orbits. Two possible configurations of the Earth, Moon and Sun are shown below.



Imagine a 1 kg mass of seawater at position *A* on the Earth's surface. This mass experiences three forces:

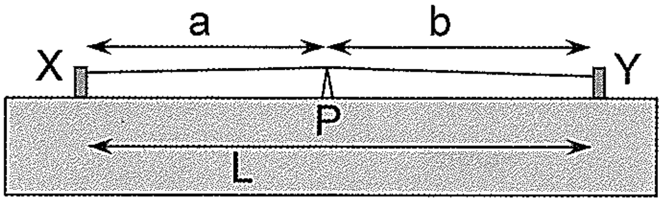
F_E – due to its position in the gravitational field of the Earth
F_S – due to its position in the gravitational field of the Sun
F_M – due to its position in the gravitational field of the Moon

On each diagram, draw labelled arrows to indicate the directions of the three forces experienced by the seawater at *A*.

13. The spacecraft *Dawn* was launched on 27 September 2007 and will reach the dwarf planet (asteroid) Ceres in 2015. Ceres has a mass of 9.40×10^{20} kg, radius of 480 km and rotates with a period of 9.07 hours. At what altitude above the surface would the spacecraft need to orbit in order to remain fixed in position relative to the planet's surface?

Answer: ______________________

14. A uniform metal wire is stretched between two posts, X and Y, and kept under constant tension as part of a musical instrument. A movable post, P, separates the wire into two parts.



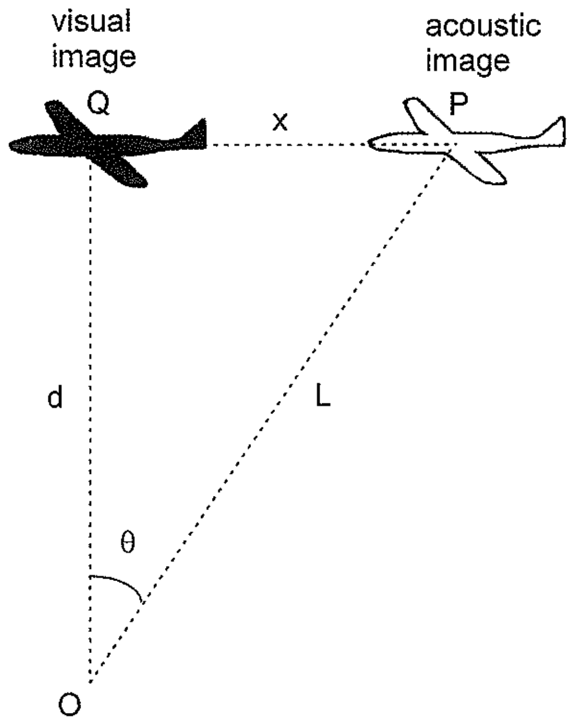
The fundamental frequency f of a stretched wire is inversely proportional to the length.

If the total length L is 72 cm, where should the post P be placed so as to split the string into two parts where one part has twice the fundamental frequency of the other?

Answer: ____________________

15. To an observer on the ground, the sound an aircraft makes seems to lag behind it. In the following diagram Q represents the visual image at a particular time when the aircraft is directly overhead at a height *d* above the observer.

P is the aircraft's position when the sound was generated as heard by the observer when the aircraft was seen at position *Q*. The aircraft has flown between *P* and *Q*, a distance *x*, in the same time the sound travels a distance *L* to the observer.



Calculate the angle θ between the visual and acoustic images when the aircraft is travelling at half the speed of sound. You may neglect the time it takes for light to travel the distance *d*.

Answer: ______________________

Section B: Problem Solving **100 Marks**

Attempt **all** 8 questions in this section.

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1. **(9 marks)**

Measurements of magnetic force are performed using two similar bar magnets labelled *A* and *B*. Magnet *A* is fixed in position with the north end pointing up, while Magnet *B* is held in various positions with the north end always pointing down. The magnetic force on Magnet *B* is measured in three positions: above (Figure 1); below (Figure 2); and to the left (Figure 3). The separation in each case is the same (distance *d* in the figures).

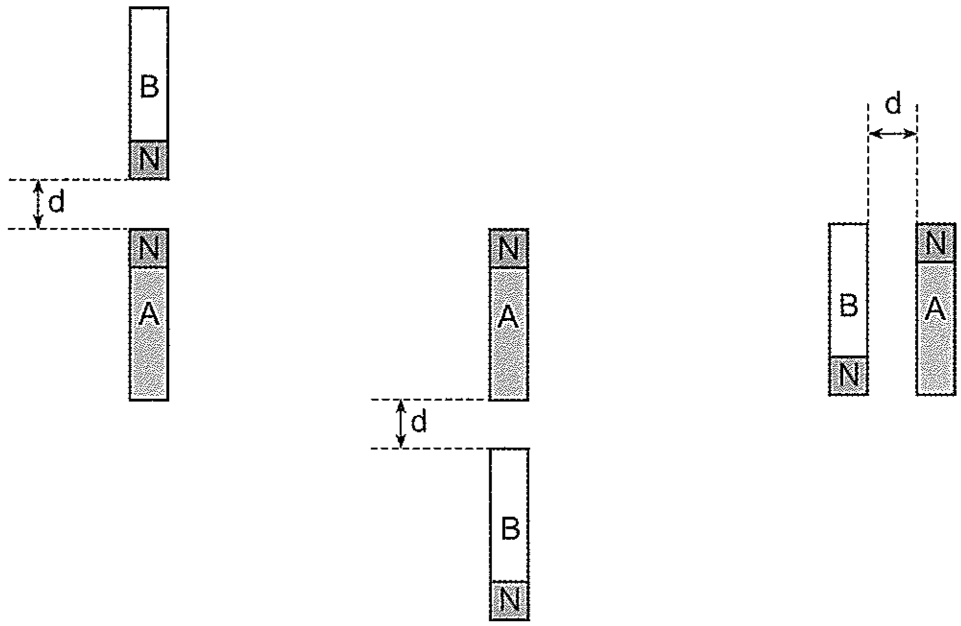

Figure 1 Figure 2 Figure 3

When Magnet *B* is above Magnet *A*, as in Figure 1, there is a repulsive magnetic force of 5 N.

(a) Determine the magnitude and direction of the magnetic force on Magnet *B* when it is below *A* as in Figure 2. (2 marks)

Answer: ____________________

(b) When Magnet *B* is to the left of *A*, as in Figure 3, will the magnetic force be attractive, repulsive or zero? If non-zero, do you expect it to be greater than or less than 5 N? Give your reasoning. (3 marks)

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(c) When a single bar magnet is floated on a cork in a bowl of water as in Figure 4 below, it is seen to always point in one direction. Explain. (4 marks)

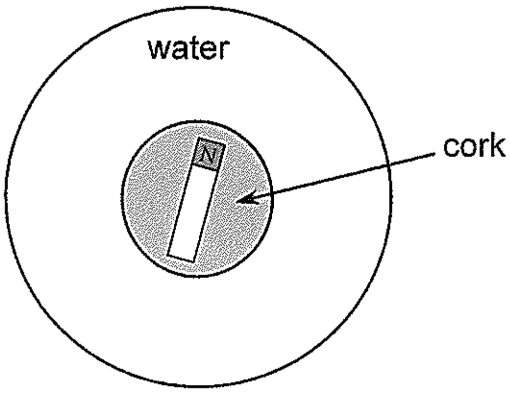

Figure 4

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2. **(15 marks)**

Two pipes open at both ends are 0.84 m and 0.85 m long. They are sounded together at their fundamental frequencies and produce beats at the rate of 46 every 20 s.

(a) Calculate the beat frequency produced by the pipes. (2 marks)

Answer: ____________________

(b) (i) Show that for two such pipes the beat frequency is equal to

$$f_{beat} = \frac{v}{2}\left|\frac{1}{L_2} - \frac{1}{L_1}\right|$$

(4 marks)

where:

$v =$ speed of sound
$L_1 =$ length of pipe 1
$L_2 =$ length of pipe 2

(ii) Calculate the speed of sound for the situation described above. (4 marks)

Answer: ____________________

(c) Calculate the fundamental frequency of the 0.84 m long pipe. (2 marks)

Answer: ______________________

(d) If the gas in the 0.84 m pipe was replaced with carbon dioxide at 25°C and 101.3 kPa, would the fundamental frequency increase, decrease or remain the same? Explain your answer. (3 marks)

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3. **(10 marks)**

A cork can leave a champagne bottle with a speed greater than 15 m s^{-1}. In 1988, a world record was set when a cork travelled 54.1 m. In competition champagne corks are fired at 40° to the horizontal. In this question you should ignore the effects of air resistance.

The range *s* of a projectile is given by the equation $s = v_o t \cos\theta$, where v_o is the initial speed, *t* is time and θ the angle from the horizontal.

The time of flight of a projectile is given by the equation

$$t = \frac{2v_o \sin\theta}{g}$$

where *g* is the acceleration due to gravity.

(a) Use the two equations above to show that the initial speed for a projectile is

$$v_o = \sqrt{\frac{gs}{2\cos\theta\sin\theta}}.$$

(4 marks)

(b) Calculate the initial speed of the record-breaking champagne cork. (2 marks)

Answer: ____________________

(c) Calculate the maximum height reached by the cork. (4 marks)

Answer: ____________________

4. **(13 marks)**

The planet Jupiter orbits the Sun with a period of 4333 days. It has a mass 318 times larger than the mass of the Earth and a diameter 11.2 times larger than the diameter of the Earth.

(a) Calculate the period of Jupiter's orbit in seconds. (2 marks)

Answer: ____________________

(b) Assuming that Jupiter has a circular orbit with a radius of 5.2 AU (astronomical unit), where 1 AU is the distance from the Earth to the Sun, calculate the speed of Jupiter in orbit around the Sun. (3 marks)

Answer: ____________________

The orbit of Jupiter is known to be elliptical rather than circular. At Jupiter's closest point, it is 4.95 AU from the Sun and at its most distant point it is 5.46 AU from the Sun.

(c) Calculate the force of gravitational attraction between Jupiter and the Sun when Jupiter is most distant from the Sun. (3 marks)

Answer: ____________________

(d) Calculate the speed of Jupiter in its orbit when it is most distant from the Sun.

(3 marks)

Answer: ______________________

When it is closest to the Sun, the force of attraction between Jupiter and the Sun is 4.60×10^{23} N and its orbital speed is 1.25×10^{4} m s^{-1}.

(e) Which one of the following statements **best** describes the motion and energy of Jupiter as it orbits the Sun? (2 marks)

A. The kinetic energy of Jupiter does not change as it orbits the Sun.

B. The kinetic energy of Jupiter keeps increasing as it orbits the Sun.

C. The total energy of Jupiter stays the same as it orbits the Sun; the kinetic energy increases as the gravitational potential energy decreases.

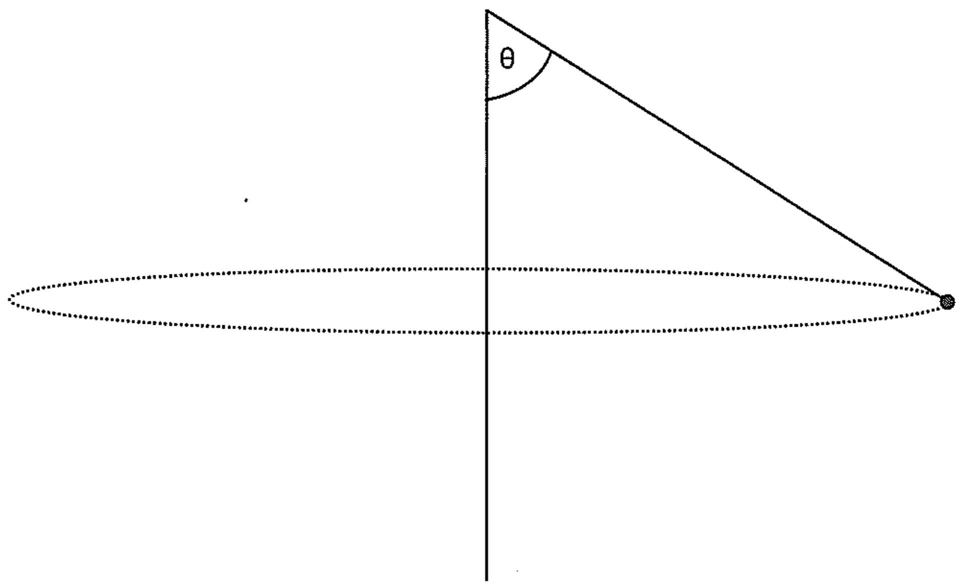
D. At its nearest point to the Sun, Jupiter has the most energy; its kinetic energy is very big and it also has a large gravitational potential energy.

E. Gravitational potential and kinetic energy change depending on where Jupiter is in its orbit; its potential and kinetic energy both increase as Jupiter gets closer to the Sun.

Answer ____________

5. **(12 marks)**

A student ties a string to a rubber ball and then whirls it so that it moves in a horizontal circle at constant speed. You should assume that air resistance is negligible.



(a) On the diagram, draw and label arrows representing the forces acting on the ball. Explain why the string is not horizontal (in other words why θ is not 90°). (4 marks)

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(b) On the diagram, draw and label an arrow representing the direction of the acceleration of the ball. (1 mark)

The mass of the ball is 0.050 kg, the length of the string from the student's hand to the ball is 0.50 m and $\theta = 75^{\circ}$.

(c) Show that the tension in the string is 1.9 N. (3 marks)

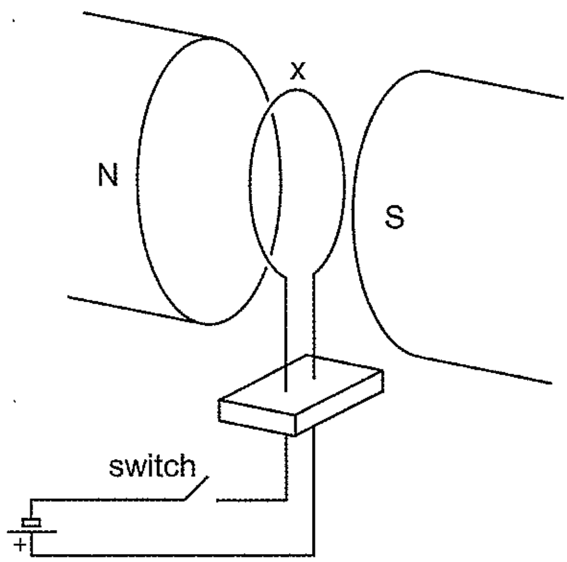
(d) Calculate the speed of the ball. (4 marks)

Answer: ____________________

6. **(10 marks)**

A circular loop of thin flexible non-magnetic wire is placed between the poles of a permanent magnet parallel to the faces, as shown in the diagram below.

When the switch is closed, a current flows from the positive terminal of the battery through the loop to the negative terminal.



(a) Consider a small section x at the top of the loop. Show clearly on the diagram the direction of the magnetic force on this section when the current is flowing. (2 marks)

(b) Given your answer to Part (a), which one of the following might be expected to occur when the current is turned on? (2 marks)

A. There will be no change in the loop dimensions or alignment.

B. The loop will twist clockwise as seen from above.

C. The loop will twist anticlockwise as seen from above.

D. The loop will increase its diameter without twisting.

E. The loop will decrease its diameter without twisting.

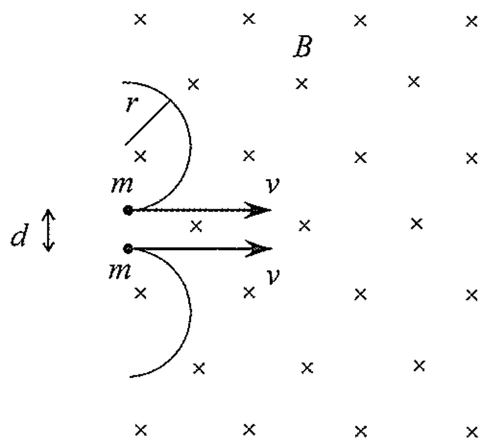
F. None of the above.

Answer ____________

(c) Describe briefly the operating principle of a DC electric motor. Include a diagram with the essential features labelled clearly. (6 marks)

7. **(11 marks)**

Two particles are injected with the same initial velocity v towards the right and separated by a distance d into a region of uniform constant magnetic field B directed into the page as in the diagram below. The particles have the same mass m and opposite charges $+q$ and $-q$. Both particles follow circular paths of radius r. You may ignore gravity in the following.



(a) Show that: $v = \frac{q}{m}Br$ (3 marks)

Consider now the particular case where one particle is an electron with mass m_e and charge $-e$, while the other is a positron with the same mass and charge $+e$. The distance d = 1.7 mm. The magnetic field strength is 0.0040 T. The radius of each orbit is 2.8 mm.

(b) Cross out the incorrect option: (2 marks)

The upper particle is the electron/positron.

Two charges q_1 and q_2, separated by a distance d will experience an electric force of

$$F_e = 9.0\times10^9 \frac{q_1 q_2}{d^2}$$

where F_e is the force in newtons if q_1 and q_2 are in coulombs and d is in metres.

(c) Calculate the magnitude of the **electric** force between the particles at injection. (2 marks)

Answer: ______________________

(d) Calculate the magnitude of the **magnetic** force on either particle. (3 marks)

Answer: ______________________

(e) Explain briefly why the formula derived in Part (a) ignored the existence of the electric force. (1 mark)

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8. **(20 marks)**

A weight-lifter carries a weight of 1800 N. The length of his tibia (the lower leg bone) is 0.45 m and its average cross-sectional area is 2.5×10^{-4} m^2.

(a) Calculate how much each tibia would be compressed under this weight. Ignore the weight of the weight-lifter. (4 marks)

Answer: ______________________

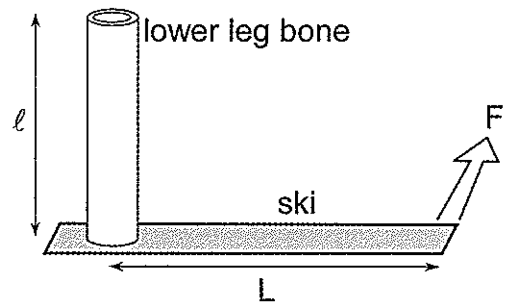
(b) Calculate how much compressive force the tibia can withstand before breaking. (3 marks)

Answer: ______________________

Most fractures occur under shear stresses. In shear stress, one end of the bone is twisted. The angle ϑ (in degrees) through which the bone is twisted under the torque acting at one end of the bone is given by the following equation:

$$\vartheta = \frac{180\tau\ell}{2\pi^2 r^3 t S}$$

Where
τ = torque in newton metres acting on the circular end of the bone
ℓ = the length of the bone in metres
S = shear modulus of the bone in pascals
r = average radius of the bone in metres
t = thickness of bone material in metres (assuming bone is a hollow cylinder)



The weight-lifter goes skiing, but has an accident. One end of the weight-lifter's lower leg bone is twisted by 7.0° relative to the other end. Assume the leg bone to be a hollow cylinder of average radius 1.5 cm and thickness 0.30 cm. The distance L from the tip of the ski to where the foot is attached is 1.3 m. The shear modulus of bone is $S = 8.0 \times 10^{10}$ N m^{-2}.

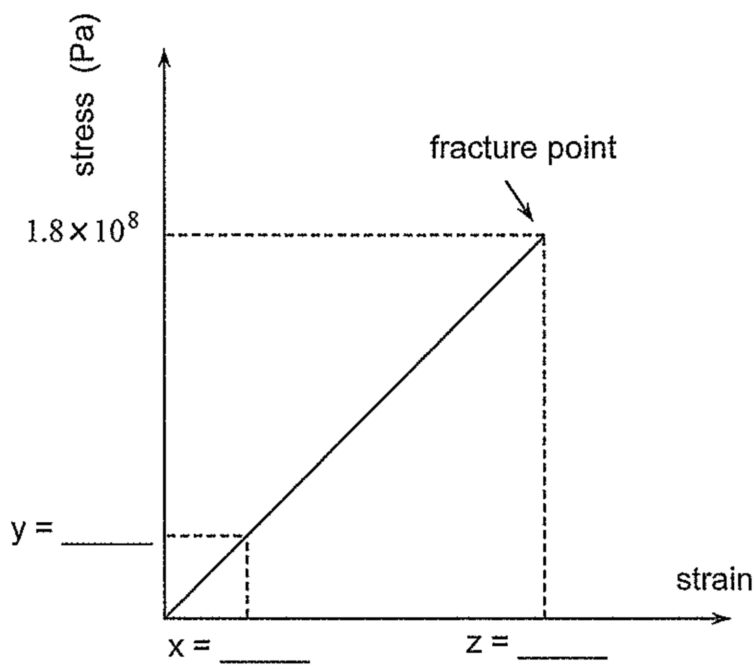
(c) Determine the torque acting on the bone that would cause this twist. (4 marks)

Answer: ______________________

(d) Determine the force *F*, acting horizontally at right angles to the tip of the ski, that would cause this twist. (3 marks)

Answer: ____________________

(e) Complete the following graph by supplying the missing values *x*, *y* and *z* where *x* and *y* refer to the situation described in Part (a) above, while *z* refers to the situation described in Part (b). (6 marks)



Section C: Comprehension and Interpretation **40 Marks**

Both questions should be attempted.

Read the following passages and answer the questions at the end of each of them. Candidates are reminded of the need for the clear and concise presentation of answers. Diagrams (sketches), equations and/or numerical results should be included as appropriate.

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1. Bicycle Tachometer (16 marks)

A common method of monitoring the speed of a bicycle is to attach a permanent magnet to the spokes of the wheel and mount a sensing coil on the frame, so that the magnet passes close by without touching on each revolution of the wheel when it is rotating.

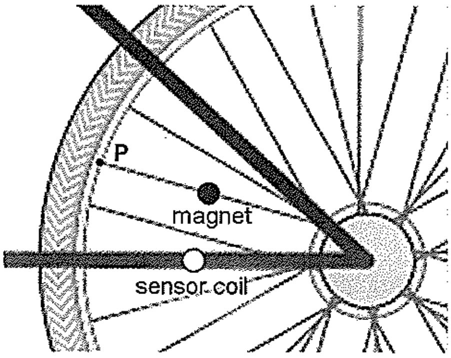

Figure 1: magnet and sensing coil mounted on bicycle.

A cylindrical magnet is used where one circular face is a north magnetic pole and the other south. The sensor is a circular coil of N turns with the same diameter as the magnet.

Consider now the view from a point P fixed on the wheel looking toward the magnet as the wheel rotates. The sensing coil will appear to follow a path as in Figure 2. The magnetic field lines due to the magnet have been shown.

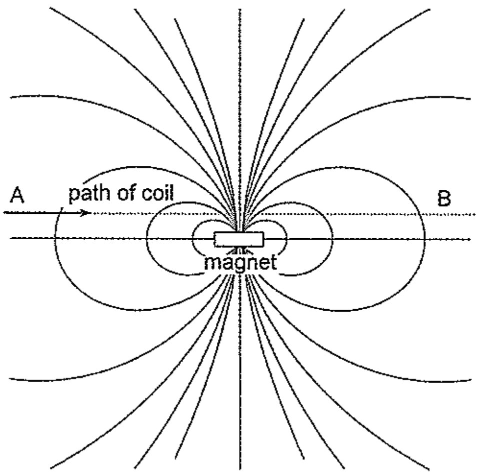

Figure 2: side-on view of magnet showing field lines and sensor path (A to B).

As the sensing coil passes by the cylindrical magnet from A to B in Figure 2, the magnetic flux through the coil induces a voltage (emf) across the coil as shown in Figure 3.

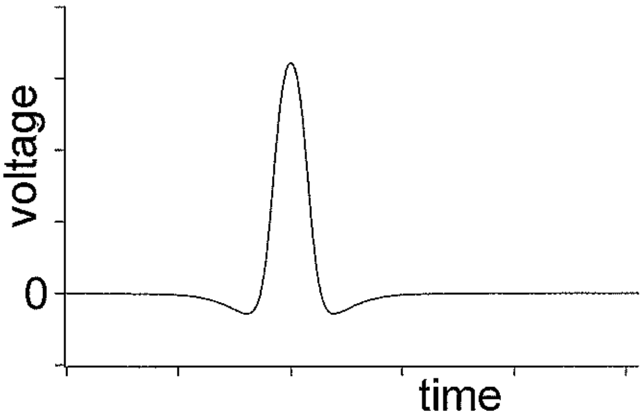

Figure 3: typical sensing coil output

To estimate the size of the voltage pulse we can approximate the change of magnetic flux through the coil as that due to an average magnetic field of strength B_o acting over a time Δt such that:

$$emf = -\frac{\Delta\Phi}{\Delta t} = -\frac{N B_o \pi D^2}{4\Delta t}$$

where D is the diameter of the magnet and coil and N the number of turns in the coil.

If the wheel has an axle to ground radius of R and the magnet and coil are at a distance R_m from the axle, then during one complete revolution of the wheel the magnet and coil will be aligned for approximately Δt, where:

$$\Delta t \approx \frac{D}{2\pi R_m} T$$

where T is the time it takes the wheel to do a single revolution.

For a bicycle travelling at a constant speed v the period of one revolution is given by:

$$T = \frac{2\pi R}{v}$$

Combining these equations yields the following approximation for the magnitude of the output voltage:

$$emf \approx \frac{\pi}{4} N D \left(\frac{R_m}{R}\right) B_o\, v$$

(a) If the bicycle is pushed backward, how would this affect the coil output? You may sketch the coil output if you wish. (3 marks)

(b) If the magnet was reversed so that **North** became **South**, how would this affect the coil output when the bicycle was moving forward? You may sketch the coil output if you wish.

(3 marks)

Consider a particular example for a bicycle with the following values:

wheel radius:	$R = 0.27$ m
magnet position:	$R_m = 0.20$ m
strength:	$B_o = 0.10$ T
magnet diameter:	$D = 0.010$ m

(c) How many voltage pulses would occur if the bicycle travelled 1.0 km? (4 marks)

Answer: ______________________

(d) How many turns should the coil have in order to generate 1.0 V at a speed of 10 m s^{-1}? (2 marks)

Answer: ______________________

(e) Why is there a slight dip before and after the main peak in the coil response? (4 marks)

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2. The Photoelectric Effect (24 marks)

The photoelectric effect is the ejection of electrons from the polished surface of a metal caused by light hitting the surface. The emitted electrons are usually referred to as *photoelectrons*. The experimental arrangement used to demonstrate the photoelectric effect can be seen in Figure 1 below.

Light shines onto the metal surface, the cathode. If the light causes photoelectrons to be emitted, they travel through the vacuum and can be detected at the anode. A *photoelectric current* will be measured by the ammeter. A variable voltage supply can be used to make the cathode negative and therefore the anode positive. The resulting electric field accelerates the photoelectrons toward the anode and a maximum possible current is measured. A reverse potential can be applied so that the cathode becomes positive and the anode negative. This arrangement can be used to investigate the kinetic energy of the photoelectrons.

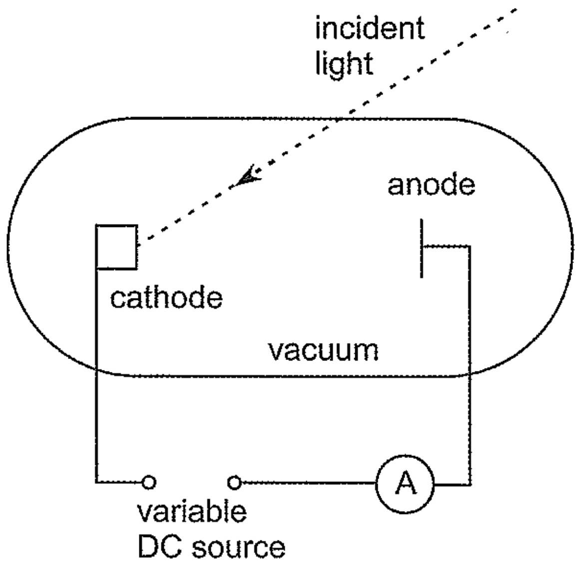

Figure 1: Photoelectric effect – light shining on the cathode produces electrons that are accelerated towards the anode.

The photoelectric effect for any particular metal is only observed when light above a given frequency (the *threshold frequency*) is illuminating the metal. If the frequency of the incident light is less than the threshold frequency, no photoelectrons are emitted. At the threshold frequency, the kinetic energy of the emitted photoelectrons is equal to zero. If the frequency is greater than the threshold frequency of the metal, the absorption of light can free some photoelectrons. The minimum energy required to release a photoelectron from the metal is called the *work function* and is a particular property of a material. The photoelectric effect is an example of experimental evidence that supports the particle, or photon, model of light.

Two equations are used in photoelectric effect calculations:

$$K_{max} = e\,V_{stop}$$

$$h\,f = K_{max} + \Phi$$

where:
e = electron charge
V_{stop} = the potential difference at which the ammeter reading just drops to zero
K_{max} = the kinetic energy of the most energetic photoelectrons
h = Planck's constant
f = the frequency of incident light
Φ = the work function of the target metal.

These equations can be combined to give

$$h\,f = e\,V_{stop} + \Phi$$

The work functions for a number of metals are recorded in the table below.

Metal	Work function (eV)
Copper	4.70
Gold	5.10
Potassium	2.30
Platinum	6.35

In a photoelectric experiment the following values were measured:

Frequency of incident light ($\times 10^{15}$ Hz)	V_{stop} (V)	K_{max}
1.20	- 0.40	
1.30	- 0.70	
1.50	- 1.60	
1.67	- 2.20	
2.00	- 3.05	
2.14	- 4.20	
2.50	- 5.65	

(a) The text on page 33 mentions the photon model of light. What other model of light have you studied? Describe one phenomenon or experiment that supports this other model. (5 marks)

(b) Make the necessary calculations and enter the results into the table on page 34. Use the table to draw a graph of K_{max} in joules against frequency in hertz. Draw a line of best fit. (4 marks)

(c) Using either the graph a graphics calculator, determine the intercept on the frequency axis of the graph and use it to determine the work function of the metal.

(4 marks)

Answer: ______________________

(d) Use the table of work function values and your answer to Part (c) to determine the metal used to collect the data you have just analysed. If you were unable to determine a value in Part (c) use 1.02×10^{-18} J. (4 marks)

Answer: ______________________

(e) Calculate the wavelength of light that corresponds to the threshold frequency for the metal in Part (d) and state to which part of the electromagnetic spectrum it belongs. (Hint: visible light has a wavelength between 400 nm and 700 nm) (3 marks)

Answer: ______________________

(f) The variable DC source is removed and replaced by a conducting wire. Will the ammeter still be able to detect a current when the light shines on the cathode? Justify your answer. (4 marks)

End of questions

Check that you have written your Student Number on the front cover of this booklet.

Extra working space

ACKNOWLEDGEMENTS

Section A

Question 12: Adapted from Johnson, K., Hewett S., Holt S. and Miller J. (2000). *Advanced Physics for You.* Cheltenham: Nelson Thornes, p. 109.

Section B

Question 5: Adapted from Johnson, K., Hewett S., Holt S. and Miller J. (2000). *Advanced Physics for You.* Cheltenham: Nelson Thornes, p. 109.

Section C

Question 1: Figure 1 adapted from the Cyclometer Website. Retrieved 15 May 2008 from: http://kellogg.co.uk/cyclometer/pdf/Cyclometer_Instructions.pdf

Question 2: Passage on photoelectric effect developed from:
Halliday, D., Resnick, R., and Walker, J. (1997). *Fundamentals of Physics* (5th ed.). New York: John Wiley and Sons, Ch 39.
Cahill, J. (2003). *Physics for Western Australia 12.* (2nd ed.). Melbourne: Heinemann, pp 265–271.

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