Government of South Australia

SACE Board of SA

External Examination 2008

2008 PHYSICS

ATTACH SACE REGISTRATION NUMBER LABEL TO THIS BOX

QUESTION BOOKLET
1
16 pages, 10 questions

Tuesday 4 November: 9 a.m.

Time: 3 hours

Part 1 of Section A

Examination material: Question Booklet 1 (16 pages)
Question Booklet 2 (20 pages)
Question Booklet 3 (8 pages)
one SACE registration number label

Approved dictionaries and calculators may be used.

Instructions to Students

1. You will have 10 minutes to read the paper. You must not write in your question booklets or use a calculator during this reading time but you may make notes on the scribbling paper provided.

2. This paper is in two sections: Section A is divided between Question Booklet 1 and Question Booklet 2; Section B is divided between Question Booklet 2 and Question Booklet 3.

   Section A (Questions 1 to 22)
   This section consists of short-answer and extended questions.
   Answer Part 1 of Section A (Questions 1 to 10) in the spaces provided in Question Booklet 1.
   Write on page 16 of Question Booklet 1 if you need more space to finish your answers.
   Answer Part 2 of Section A (Questions 11 to 22) in the spaces provided in Question Booklet 2.
   Write on page 20 of Question Booklet 2 if you need more space to finish your answers.

   Section B (Questions 23 to 25)
   This section consists of one experimental skills question and two extended-response questions.
   Answer Part 1 of Section B (Question 23) in the spaces provided in Question Booklet 2.
   Write on page 20 of Question Booklet 2 if you need more space to finish your answers.
   Answer Part 2 of Section B (Questions 24 and 25) in the spaces provided in Question Booklet 3.
   Write on page 8 of Question Booklet 3 if you need more space to finish your answers.

3. The allocation of marks and the suggested allotment of time are:

Section A		
Part 1	64 marks	64 minutes
Part 2	66 marks	66 minutes
Section B		
Part 1	20 marks	20 minutes
Part 2	30 marks	30 minutes
Total	180 marks	180 minutes

4. The equation sheet is on pages 3 and 4, which you may remove from this booklet.

5. Vector quantities in this paper are indicated by arrows over the symbols.

6. Marks may be deducted if you do not clearly show all steps in the solution of problems or if you do not define additional symbols. You should use diagrams where appropriate in your answers.

7. Use only black or blue pens for all work other than graphs and diagrams, for which you may use a sharp dark pencil.

8. Attach your SACE registration number label to the box at the top of this page. Copy the information from your SACE registration number label into the boxes on the front covers of Question Booklet 2 and Question Booklet 3.

9. At the end of the examination, place Question Booklet 2 and Question Booklet 3 inside the back cover of this question booklet.

STUDENT'S DECLARATION ON THE USE OF CALCULATORS

By signing the examination attendance roll I declare that:

- my calculators have been cleared of all memory;
- no external storage media are in use on these calculators.

I understand that if I do not comply with the above conditions for the use of calculators I will:

- be in breach of the rules;
- have my marks for the examination cancelled or amended;
- be liable to such further penalty, whether by exclusion from future examinations or otherwise, as the SACE Board of South Australia determines.

Remove this page from the booklet by tearing along the perforations and keep the information in front of you for reference.

EQUATION SHEET

The following tables show the symbols of common quantities and the magnitude of physical constants used in the equations. Other symbols used are shown next to the equations. Vectors are indicated by arrows. If only the magnitude of a vector quantity is used, the arrow is not used.

Symbols of Common Quantities

acceleration	$\vec{a}$	wavelength	λ	momentum	$\vec{p}$
time	t	force	$\vec{F}$	electric field	$\vec{E}$
displacement	$\vec{s}$	charge	q	kinetic energy	K
velocity	$\vec{v}$	mass	m	magnetic field	$\vec{B}$
period	T	potential difference	ΔV	electric current	I
frequency	f	work done	W		

Magnitude of Physical Constants

Acceleration due to gravity at the Earth's surface	$g = 9.8$ m s^{-2}	Charge of the electron	$e = 1.60 \times 10^{-19}$ C
Constant of universal gravitation	$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}	Mass of the electron	$m_e = 9.11 \times 10^{-31}$ kg
Speed of light in a vacuum	$c = 3.00 \times 10^8$ m s^{-1}	Mass of the proton	$m_p = 1.673 \times 10^{-27}$ kg
Coulomb's law constant	$\dfrac{1}{4\pi\varepsilon_0} = 9.00 \times 10^9$ N m^2 C^{-2}	Mass of the neutron	$m_n = 1.675 \times 10^{-27}$ kg
Planck's constant	$h = 6.63 \times 10^{-34}$ J s	Mass of the α particle	$m_\alpha = 6.645 \times 10^{-27}$ kg

Section 1: Motion in Two Dimensions

$\vec{v} = \vec{v}_0 + \vec{a}t$ — $\vec{v}$ = velocity at time t; $\vec{v}_0$ = velocity at $t = 0$

$v^2 = v_0^2 + 2as$

$\vec{s} = \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$

$v_H = v \cos\theta$ — θ = angle to horizontal

$v_v = v \sin\theta$

$v = \dfrac{2\pi r}{T}$ — r = radius of circle

$\Delta\vec{v} = \vec{v}_f - \vec{v}_i$ — $\vec{v}_f$ = final velocity; $\vec{v}_i$ = initial velocity

$\vec{a}_{\text{ave}} = \dfrac{\Delta\vec{v}}{\Delta t}$ — $\vec{a}_{\text{ave}}$ = average acceleration

$a = \dfrac{v^2}{r}$

$\tan\theta = \dfrac{v^2}{rg}$ — θ = banking angle

$F = G\dfrac{m_1 m_2}{r^2}$ — r = distance between masses m_1 and m_2

$v = \sqrt{\dfrac{GM}{r}}$ — M = mass of object orbited by satellite; r = radius of orbit

$\vec{F} = m\vec{a}$

$\vec{p} = m\vec{v}$

$\vec{F} = \dfrac{\Delta\vec{p}}{\Delta t}$

$K = \frac{1}{2}mv^2$

$W = Fs\cos\theta$ — θ = angle between force $\vec{F}$ and displacement $\vec{s}$

Section 2: Electricity and Magnetism

$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$ — r = distance between charges q_1 and q_2

$\vec{E} = \frac{\vec{F}}{q}$

$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

$W = q\Delta V$

$E = \frac{\Delta V}{d}$ — d = distance between parallel plates

$F = I\Delta lB \sin\theta$ — θ = angle between field $\vec{B}$ and current element $I\Delta\vec{l}$

$F = qvB \sin\theta$ — θ = angle between field $\vec{B}$ and velocity $\vec{v}$

$r = \frac{mv}{qB}$ — r = radius of circle

$T = \frac{2\pi m}{qB}$

$K = \frac{q^2 B^2 r^2}{2m}$

Section 3: Light and Matter

$v = f\lambda$ — v = speed of light

$d \sin\theta = m\lambda$ — d = distance between slits
θ = angular position of mth maximum
m = integer (0, 1, 2, . . .)

$\Delta y = \frac{\lambda L}{d}$ — Δy = distance between adjacent minima or maxima
L = slit-to-screen distance

$d = \frac{1}{N}$ — N = number of slits per metre of grating

$E = hf$ — E = energy of photon

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

$K_{max} = hf - W$ — W = work function of the metal

$W = hf_0$ — f_0 = threshold frequency

$f_{max} = \frac{e\Delta V}{h}$ — ΔV = potential difference across the tube

Section 4: Atoms and Nuclei

$E_n - E_m = hf$ — $E_n - E_m$ = energy difference

$A = Z + N$ — A = mass number
Z = atomic number
N = number of neutrons

$E = mc^2$ — E = energy

TABLE OF PREFIXES

Refer to the following table when answering questions that involve the conversion of units:

Prefix	**Symbol**	**Value**
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
centi	c	10^{-2}
milli	m	10^{-3}
micro	µ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}

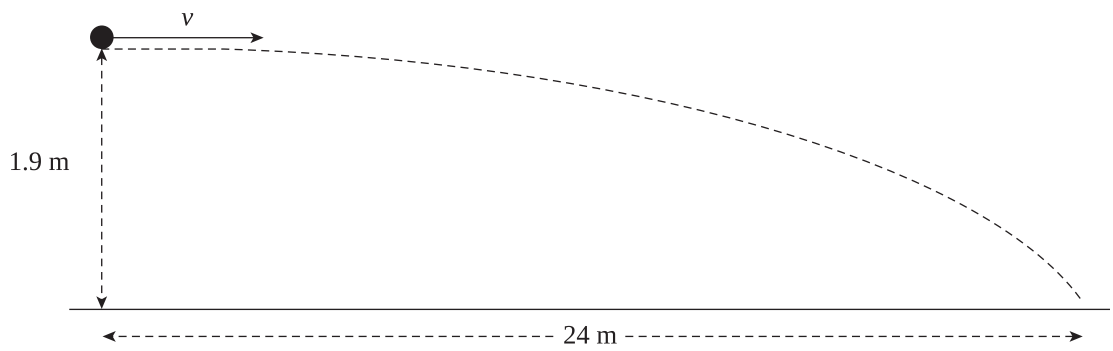
SECTION A

Part 1 (Questions 1 to 10)

(64 marks)

*Answer **all** questions in this part in the spaces provided.*

1. A ball is thrown horizontally with speed v from a height of 1.9 m above the ground, as shown in the diagram below. The ball hits the ground a horizontal distance of 24 m from the initial launch position. *Ignore the effects of air resistance*.



[*This diagram is not drawn to scale.*]

(a) Show that the time the ball takes to reach the ground is 0.62 s.

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____ (2 marks)

(b) Calculate the initial speed v of the ball.

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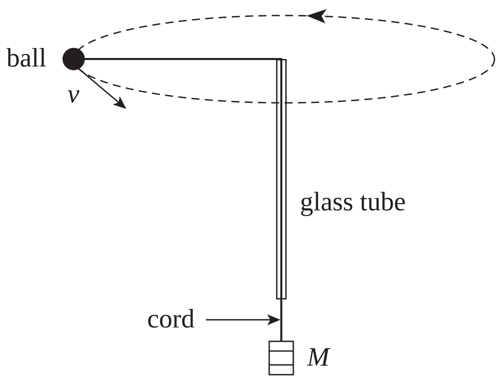
____ (2 marks)

(c) State the effect that air resistance would have on the range of the ball.

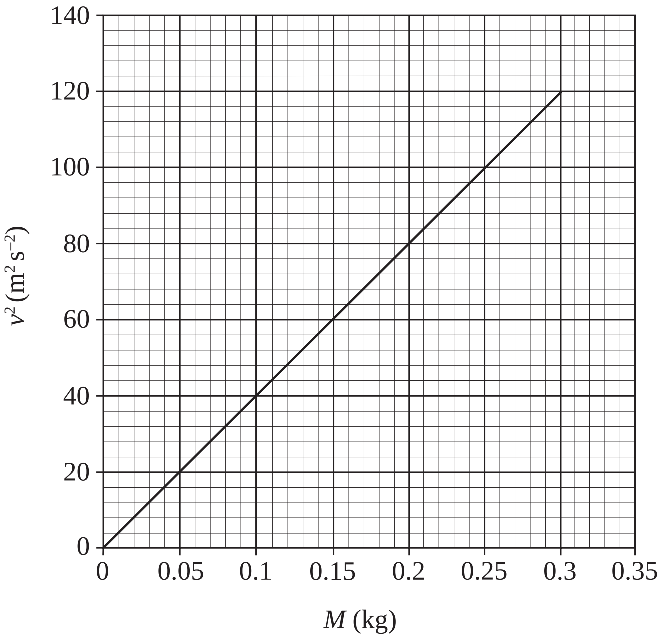
____ (1 mark)

2. In an experiment a small ball is attached to a cord of negligible mass that passes through a glass tube, as shown in the diagram below. Also attached to the cord is a mass M, which hangs vertically below the glass tube.

The ball is moving in a horizontal circle at a constant radius with a tangential speed of v m s^{-1}. During the experiment the mass M is varied and the corresponding value of the tangential speed v of the ball is measured.



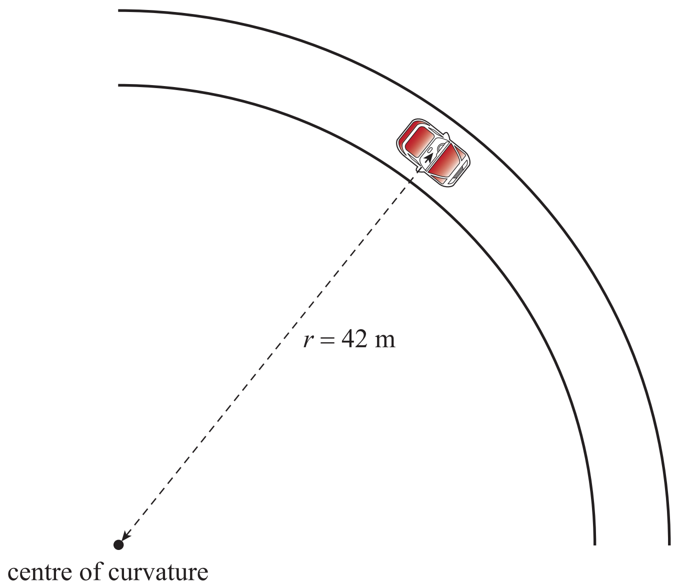
The graph below shows the square of the tangential speed v^2 versus the mass M:



Calculate the gradient of the line of best fit shown on the graph above. Include the unit of the gradient. Clearly label on the graph the points you have used in your calculation.

____ (3 marks)

3. A car travels round a circular curve on a flat, horizontal road at a radius of 42 m, as shown in the diagram below:



(a) Draw an arrow on the diagram above to show the direction of the frictional force needed for the car to travel round the curve at a radius of 42 m. (1 mark)

(b) The maximum frictional force between the tyres and the road is equal to 20% of the weight of the car.

Calculate the maximum speed at which the car can travel round the curve at a constant radius of 42 m.

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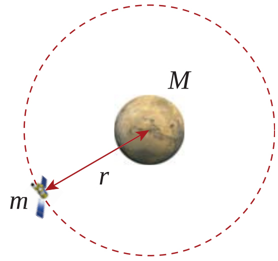
____ (4 marks)

4. (a) A satellite of mass m moves in a circular orbit of radius r about a planet of mass M, as shown in the diagram below.

Using Newton's law of universal gravitation and Newton's second law of motion, show that the period T of the satellite is given by $T = \sqrt{\frac{4\pi^2 r^3}{GM}}$, where G is the constant of universal gravitation.



[*This diagram is not drawn to scale.*]

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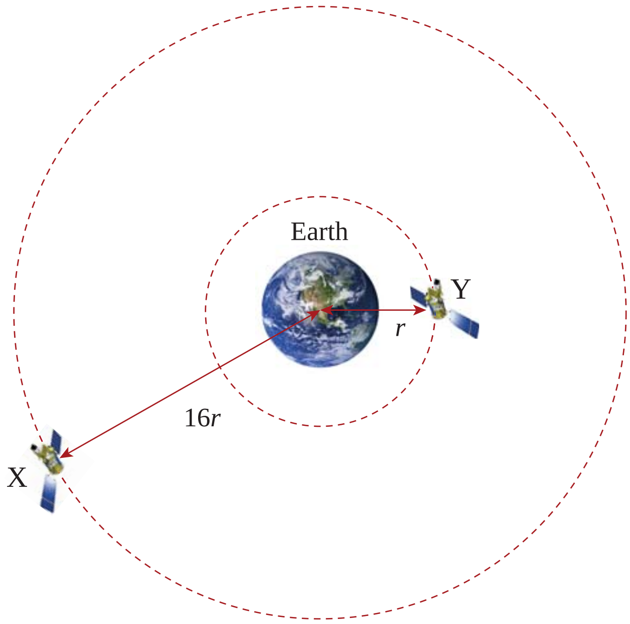
_____________________________________ (5 marks)

(b) Two identical satellites X and Y, with orbital radii 16r and r respectively, move in circular orbits about the Earth, as shown in the diagram below.

(i) Using proportionality, calculate the ratio $T_X : T_Y$ of the satellites' orbital periods.



[*This diagram is not drawn to scale.*]

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(ii) Satellite X is a geostationary satellite moving in the Earth's equatorial plane. Explain why this satellite must move in a particular orbit of relatively large radius.

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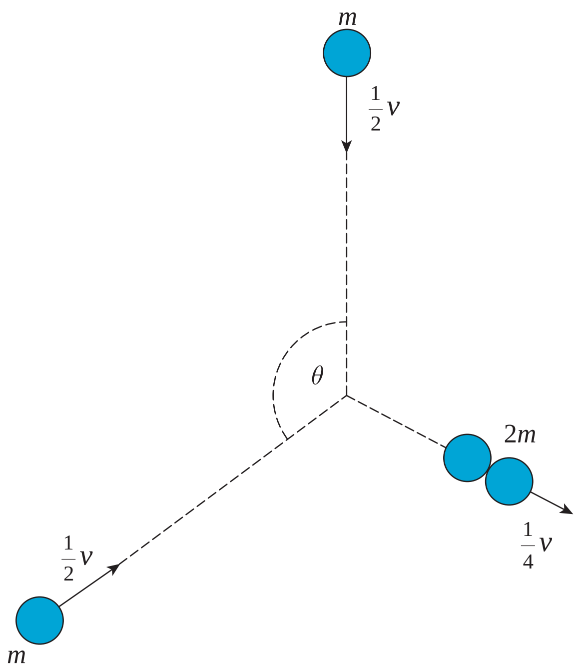
____ (3 marks)

5. Two identical objects of equal mass m, moving with the same initial speed $\frac{1}{2}v$, collide. After the collision the two objects join together and move off as one object of mass $2m$, with speed $\frac{1}{4}v$, as shown in the diagram below. The angle θ between the directions of the initial velocities is also shown in the diagram.



[*This diagram is not drawn to scale.*]

Space for vector diagram

Determine the value of θ, drawing a labelled vector diagram in the space above. *Assume an isolated system*.

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____ (5 marks)

6. (a) The force exerted on a solar sail by a photon of momentum p is greater when the photon is reflected than when the photon is absorbed.

Justify this statement. Assume that the time of interaction for the reflection of the photon is the same as for the absorption of the photon *and* that the reflected photon moves in the opposite direction to the incident photon.

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____ (4 marks)

(b) A photon of wavelength λ collides with a solar sail. The time of interaction is Δt.

Using Newton's second law of motion, show that when the photon is reflected the force on the solar sail is given by $F = \dfrac{2h}{\lambda \Delta t}$.

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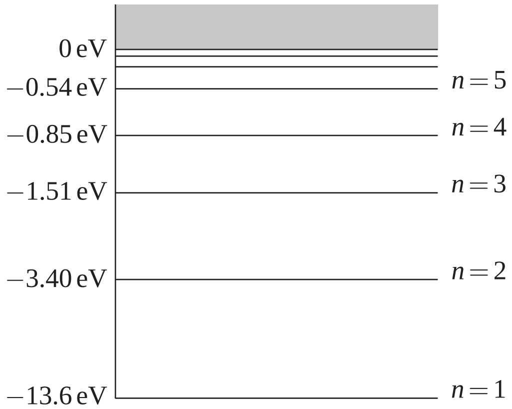
____ (2 marks)

7. Hydrogen can be identified by its unique emission spectrum. Some of the energy levels of hydrogen are shown in the diagram below:



[*This diagram is not drawn to scale.*]

(a) One emission line in the spectrum of hydrogen corresponds to the transition between the $n = 4$ and the $n = 2$ energy levels.

(i) On the diagram above, draw an arrow between the energy levels to represent this transition. (1 mark)

(ii) Show that the wavelength of this emission line is 4.88×10^{-7} m.

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____ (3 marks)

(iii) State the region in the electromagnetic spectrum that corresponds to this wavelength.

____ (1 mark)

(b) The emission spectrum of hydrogen is viewed through a diffraction grating that has 300 lines per millimetre.

Calculate the angular position for the second-order maximum ($m = 2$) of the interference pattern for an emission line of wavelength 4.88×10^{-7} m.

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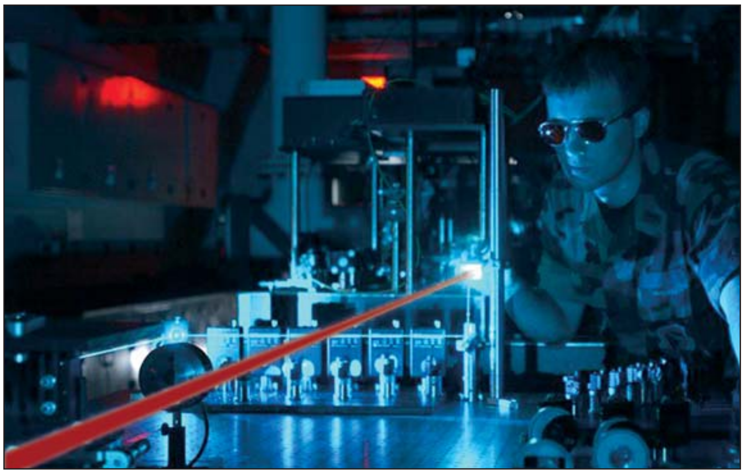
____ (3 marks)

8.



Source: US Air Force photograph, adapted from http://en.wikipedia.org/wiki/Laser

(a) A metastable state is necessary for a population inversion to occur in a gas.

(i) Explain why a metastable state is necessary for a population inversion to occur.

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____ (2 marks)

(ii) Explain why a population inversion is necessary to produce a laser beam.

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____ (2 marks)

(b) Describe the purpose of the following components of a helium–neon gas laser:

(i) Pump.____

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____ (2 marks)

(ii) Gain medium.____

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____ (2 marks)

9. (a) Explain how it is possible to have stable nuclei despite the strong electrostatic force between the protons.

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____ (2 marks)

(b) Explain why no stable isotopes exist when $Z > 83$.

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____ (2 marks)

(c) Rubidium-88 ($^{88}_{37}\text{Rb}$) can be produced in a nuclear reactor but is unstable, with a short half-life. The stable isotope of rubidium is $^{85}_{37}\text{Rb}$.

(i) Explain, by comparing these isotopes, why rubidium-88 is unstable.

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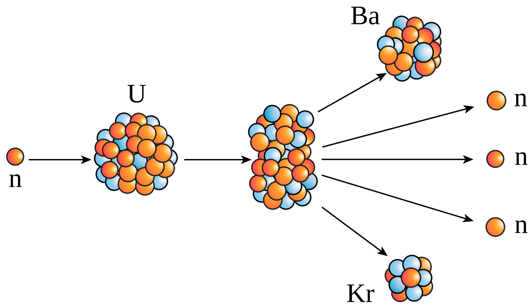
____ (2 marks)

(ii) Predict the likely type of decay for rubidium-88.

____ (1 mark)

10. Nuclear fission for large nuclei and nuclear fusion for smaller nuclei both result in an energy release due to an associated mass defect. The diagram below shows one example of an induced fission reaction:



(a) The following equation shows this fission reaction:

$$ {}^{1}_{0}\text{n} + {}^{235}_{92}\text{U} \longrightarrow {}^{141}_{56}\text{Ba} + {}^{92}_{36}\text{Kr} + 3\,{}^{1}_{0}\text{n} $$

The atomic masses of the particles are:

$$ {}^{1}_{0}\text{n} = 1.6749 \times 10^{-27} \text{ kg} $$
$$ {}^{235}_{92}\text{U} = 3.9030 \times 10^{-25} \text{ kg} $$
$$ {}^{141}_{56}\text{Ba} = 2.3399 \times 10^{-25} \text{ kg} $$
$$ {}^{92}_{36}\text{Kr} = 1.5265 \times 10^{-25} \text{ kg.} $$

Calculate the energy released in this fission reaction.

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____ (4 marks)

(b) (i) State *one advantage* of nuclear fusion in comparison with nuclear fission as a future source of power.

____ (1 mark)

(ii) State *one scientific disadvantage* of nuclear fusion in comparison with nuclear fission as a future source of power.

____ (1 mark)

You may write on this page if you need more space to finish your answers to Part 1 of Section A. Make sure to label each answer carefully (e.g. 7(a)(ii) continued).

Government of South Australia

SACE Board of SA

External Examination 2008

2008 PHYSICS

SACE REGISTRATION NUMBER			
SEQ	FIGURES	CHECK LETTER	BIN
PHYSICS			

QUESTION BOOKLET

2

20 pages, 13 questions

Tuesday 4 November: 9 a.m.

Part 2 of Section A and Part 1 of Section B

Write your answers to Part 2 of Section A and Part 1 of Section B in this question booklet.

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AUSTRALIA

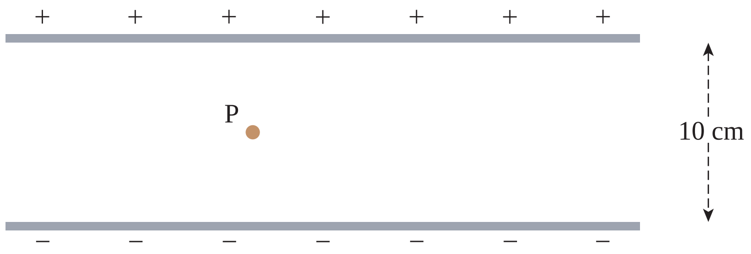
SECTION A

Part 2 (Questions 11 to 22)

(66 marks)

*Answer **all** questions in this part in the spaces provided.*

11. In an experiment a uniform electric field of magnitude 6.00×10^{4} V m^{-1} is produced between two equally and oppositely charged parallel conducting plates in a vacuum. The upper plate is positively charged and the lower plate is negatively charged. The plates are 10 cm apart, as shown in the diagram below:



[*This diagram is not drawn to scale.*]

In the experiment a negatively charged drop of oil of mass 1.96×10^{-15} kg is observed to be stationary in the electric field at position P, as shown in the diagram above. The experiment is conducted in a laboratory on Earth.

(a) Draw and label arrows to show the forces acting on the drop of oil. (2 marks)

(b) Calculate the magnitude of the charge on the drop of oil.

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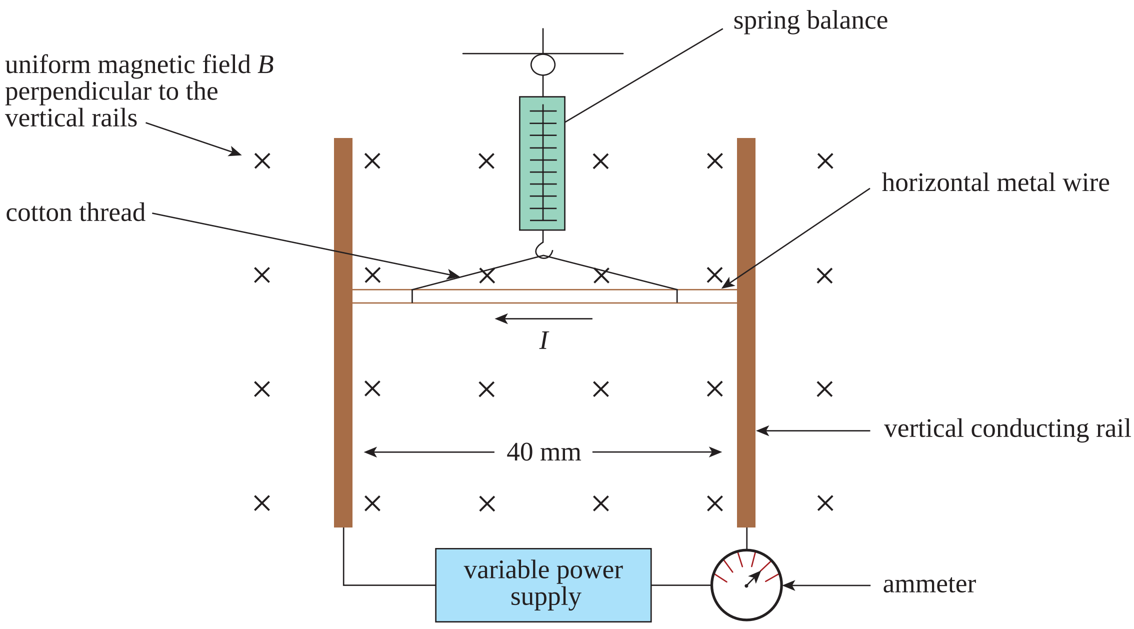
____ (3 marks)

12. A student conducts an experiment to investigate the relationship between the current flowing in a horizontal metal wire and the magnetic force acting on the wire when it is placed in a uniform magnetic field *B*. The experimental arrangement is shown in the diagram below.

The horizontal metal wire has a good electrical contact with two vertical conducting rails, which are connected to a variable power supply that can provide current *I* in either direction.

The horizontal metal wire is attached to a spring balance by a cotton thread of negligible mass. The horizontal metal wire is free to move up and down in a vertical direction and remains in contact with the vertical conducting rails. The spring balance is calibrated in millinewtons and is set to read zero when supporting no load.

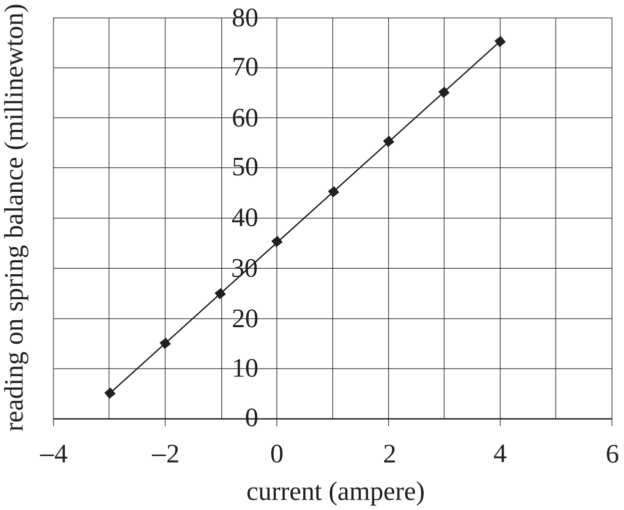


(a) State the direction of the magnetic force that is acting on the horizontal metal wire when the current *I* is flowing in an anticlockwise direction in the wire, as shown.

____ (1 mark)

The student changes the current flowing in the horizontal metal wire by varying the power supply, and records the new readings on the spring balance. The results are shown in the following graph:

Reading on Spring Balance versus Current



(b) State the dependent variable in this experiment.

____ (1 mark)

(c) Using the graph above, state the value of the current flowing in the horizontal metal wire when the reading on the spring balance is zero.

____ (1 mark)

(d) Using the graph above, determine the mass of the horizontal metal wire.

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____ (3 marks)

(e) On the graph above, draw the line that would be produced if the uniform magnetic field *B* were doubled. (2 marks)

13.

This photograph cannot be reproduced here for copyright reasons.

Source: www.pennhealth.com/perelman/images/proton/cyclotron.jpg

A cyclotron accelerates protons, using an alternating potential difference of 350 V applied between its 'dees'. A proton accelerated in the cyclotron completes 50 revolutions before emerging from the cyclotron.

(a) State the number of times the proton, in completing the 50 revolutions, experiences a force due to the electric field.

______________________________ (1 mark)

(b) Calculate the kinetic energy of the proton when it emerges from the cyclotron.

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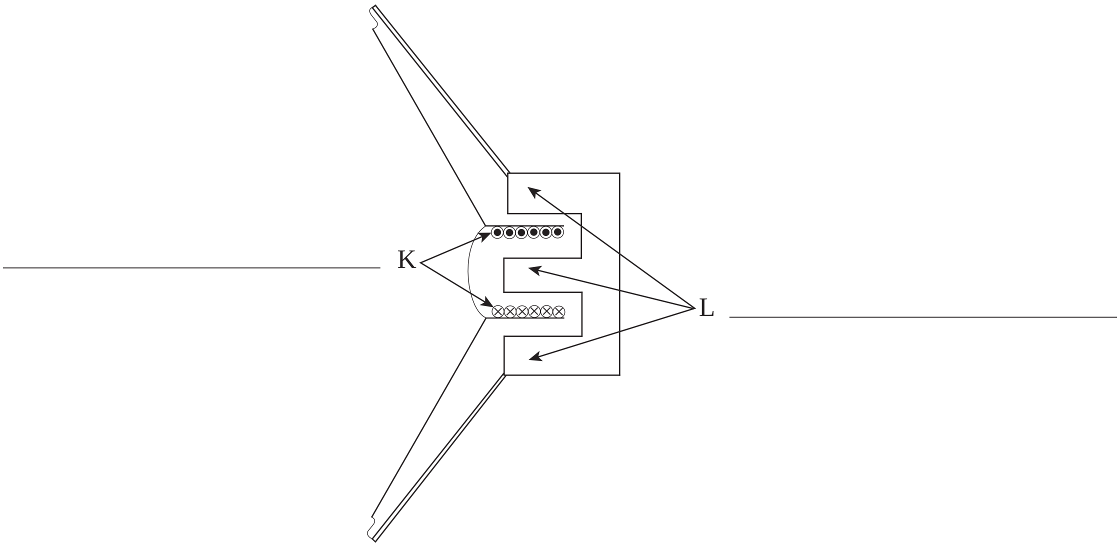
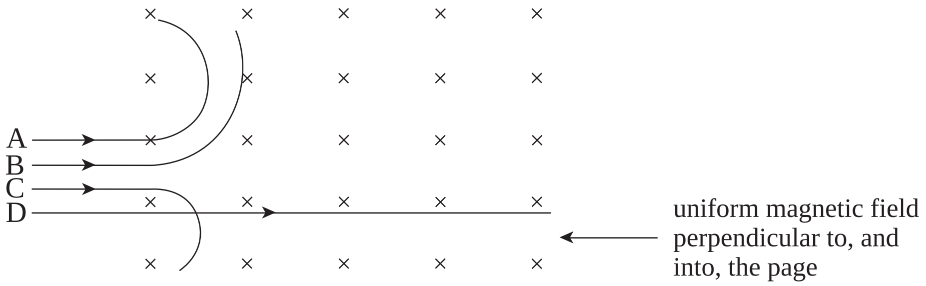
______________________________ (2 marks)

14. The diagram below shows a cross-section of a moving-coil loudspeaker:



On the diagram above, label the two components of the moving-coil loudspeaker indicated by the letters K and L. (2 marks)

15. Particles labelled A, B, C, and D enter an evacuated region in which a uniform magnetic field is directed into the page, as represented in the diagram below:



(a) Identify a particle (A, B, C, or D) that has a positive charge.

____ (1 mark)

(b) Particles A and B have equal charges and enter the uniform magnetic field with the same initial velocity.

Explain which of the two particles has the larger mass.

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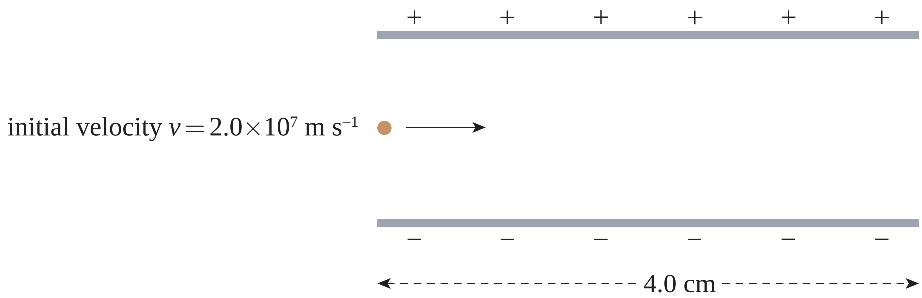
____ (3 marks)

16. An electron moving with a constant velocity of $v = 2.0 \times 10^7$ m s^{-1} enters midway between two oppositely charged parallel conducting plates, as shown in the diagram below. The uniform electric field between the plates has a magnitude of 2.0×10^4 V m^{-1} and is directed downwards. The electron moves a horizontal distance of 4.0 cm in the uniform electric field. *Assume the electron moves in a vacuum*.



[*This diagram is not drawn to scale.*]

(a) Show that the time the electron takes to move horizontally the 4.0 cm in the uniform electric field is 2.0×10^{-9} s.

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____ (1 mark)

(b) Show that the magnitude of the acceleration of the electron while moving in the uniform electric field is 3.5×10^{15} m s^{-2}.

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____ (2 marks)

(c) Calculate the magnitude of the speed of the electron after it has moved 4.0 cm in the uniform electric field.

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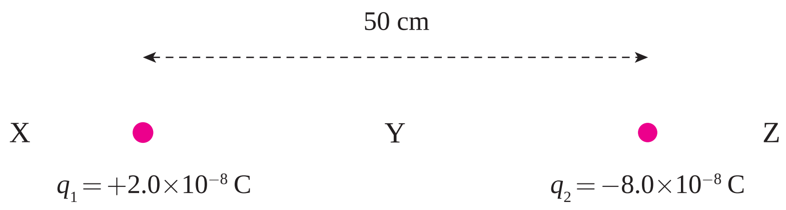
____ (4 marks)

17. Two point charges, $q_1 = +2.0\times10^{-8}\,\text{C}$ and $q_2 = -8.0\times10^{-8}\,\text{C}$, are 50 cm apart in a vacuum, as shown in the diagram below. X, Y, and Z indicate positions in the electric field surrounding the charges.



[*This diagram is not drawn to scale.*]

(a) State the position (X, Y, or Z) at which the electric field can be zero.

____ (1 mark)

(b) Calculate the position at which the electric field, measured from the position of charge q_1, is zero.

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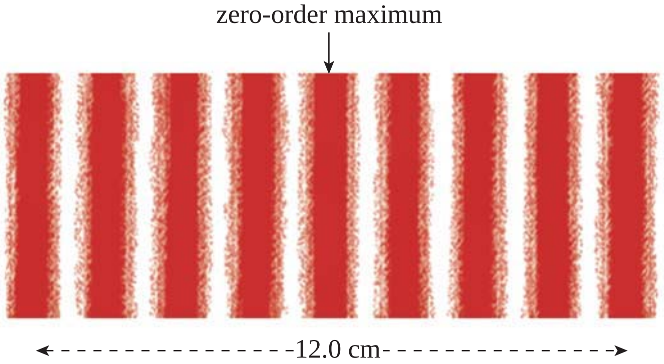
____ (4 marks)

18. A red laser beam of wavelength 628 nm illuminates two narrow vertical slits. The interference pattern produced is observed on a screen parallel to, and 3.00 m from, the slits. The distance between the centres of the fourth-order maxima on either side of the zero-order maximum is 12.0 cm, as shown in the diagram below:



[*This diagram is not drawn to scale.*]

(a) Calculate the average distance Δy between the adjacent maxima on the screen.

(2 marks)

(b) Calculate, using the value of Δy that you obtained in part (a), the separation of the slits.

(2 marks)

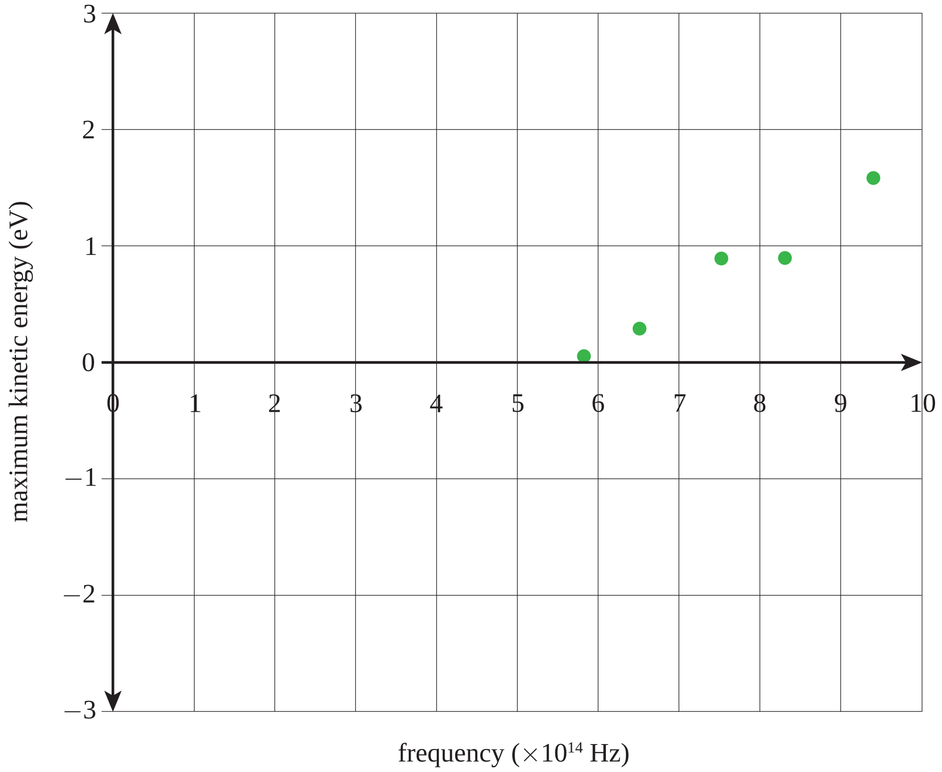
(c) Explain the change in the separation of the interference fringes that would occur if a green laser beam were used instead of the red laser beam, with the same experimental arrangement.

(3 marks)

19. Explain the speckle effect in terms of interference.

____ (3 marks)

20. The points plotted on the grid below represent the data collected by a student in a photoelectric experiment. The maximum kinetic energy of the emitted electrons (measured in eV) is plotted against the frequency of the incident light.



(a) On the grid above, draw a line of best fit for the points plotted. (2 marks)

(b) The student then used light of wavelength 435 nm to illuminate the metal surface in the photoelectric experiment.

Determine whether or not electrons would then have been emitted from the metal surface.

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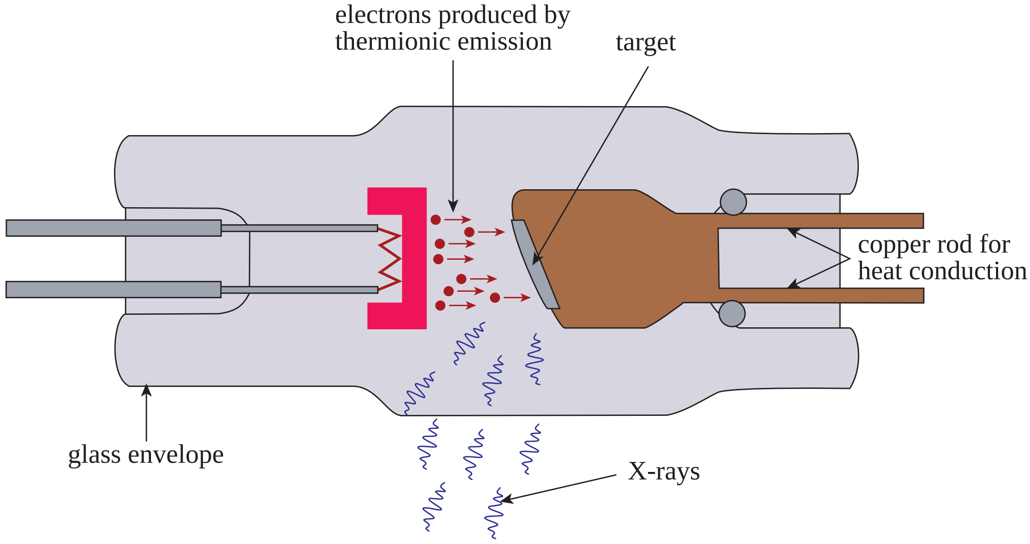
____ (4 marks)

21. A simple X-ray tube is shown in the diagram below:



(a) Show that the maximum frequency produced by an X-ray tube is given by $f_{max} = \dfrac{e\Delta V}{h}$, where ΔV is the potential difference across the X-ray tube.

(3 marks)

(b) Electrons are accelerated through a potential difference of 100 kV in an X-ray tube.

Calculate the minimum wavelength of the X-ray photons produced in this tube.

(3 marks)

22. An electron microscope accelerates electrons through a potential difference of 5.00 kV.

(a) Show that the speed of the electrons accelerated from rest through this potential difference is 4.19×10^{7} m s^{-1}.

(3 marks)

This photograph cannot be reproduced here for copyright reasons

Source: http://techluver.com/category/microscopes/

(b) Calculate the de Broglie wavelength of the electrons.

(2 marks)

(c) At one point in the electron microscope an electron moves through a magnetic field of magnitude 0.55 T. The electron is moving at an angle of 45° to the magnetic field at this point with a speed of 4.19×10^{7} m s^{-1}.

Calculate the magnitude of the magnetic force acting on the electron.

(2 marks)

(d) Explain how the high speed of the accelerated electrons allows electron microscopes to achieve very high resolution.

(3 marks)

SECTION B

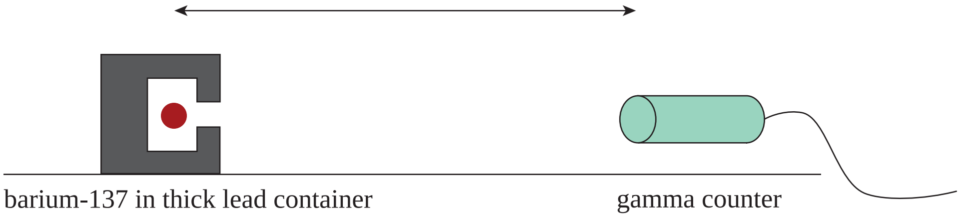
Part 1 (Question 23)

(20 marks)

*Answer **all** questions in this part in the spaces provided.*

23. An excited form of barium (barium-137) releases gamma radiation as its nucleus undergoes a transition to its ground state.

The activity of a sample of excited barium-137 was investigated by using a gamma counter to measure the number of gamma rays detected at various distances from the sample. The sample of barium-137 was placed in a thick lead container with a small opening. The gamma counter was aligned with the small opening, as shown in the diagram below:



The distance *d* from the sample to the gamma counter was varied and the number *N* of gamma rays detected at each distance during equal time intervals was recorded, as shown in the table below:

Distance *d* from sample to gamma counter (cm)	Number *N* of gamma rays detected during equal time intervals	Inverse square of distance $\frac{1}{d^2}$ (cm^{-2})
10.4	133	
14.4	80	
20.0	35	
25.0	24	

(a) Complete the table above by calculating each of the values of $\frac{1}{d^2}$ to the correct number of significant figures. (3 marks)

(b) On the page opposite, plot the number *N* of gamma rays detected against $\frac{1}{d^2}$ and draw a line of best fit. (5 marks)

(c) State and explain the relationship between the variables you have plotted.

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____ (3 marks)

(d) Explain how the effect of random errors may be minimised.

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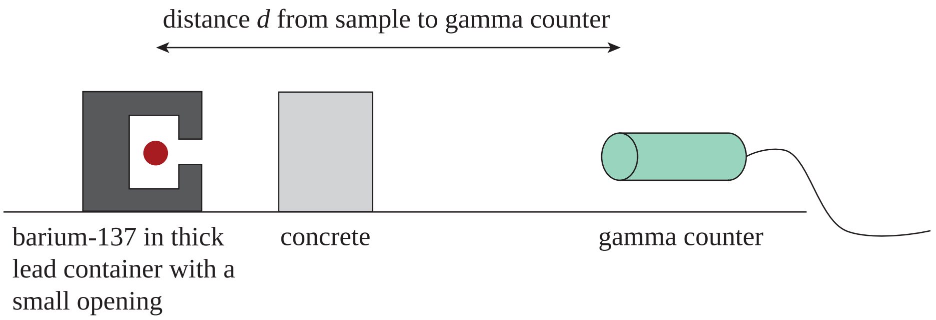
____ (2 marks)

(e) Another experiment was carried out to investigate the effect of shielding on the penetration of gamma rays. A thick piece of concrete was placed between the sample and the gamma counter, as shown in the diagram below:



(i) On page 17, draw a line to show the expected values for the number of gamma rays detected after the concrete was placed between the sample and the gamma counter. (1 mark)

(ii) Give the reason for the line you have drawn.

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____ (2 marks)

(f) One purpose of the thick lead container was to shield the experimenter from the sample, reducing the danger posed by the gamma radiation from the barium-137.

(i) Explain how gamma radiation may damage living matter.

(2 marks)

(ii) Explain one way *other than shielding* in which the experimenter could limit his or her exposure to the gamma radiation.

(2 marks)

You may write on this page if you need more space to finish your answers to Part 2 of Section A or to Part 1 of Section B. Make sure to label each answer carefully (e.g. 12(d) continued).

Government of South Australia

SACE Board of SA

External Examination 2008

2008 PHYSICS

SACE REGISTRATION NUMBER

SEQ | FIGURES | CHECK LETTER | BIN

PHYSICS

QUESTION BOOKLET

3

8 pages, 2 questions

Tuesday 4 November: 9 a.m.

Part 2 of Section B

Write your answers to Part 2 of Section B in this question booklet.

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SECTION B

Part 2 (Questions 24 and 25)

(30 marks)

*Questions 24 and 25 are extended-response questions. Answer **both** questions.*

Write your answers in this question booklet:

- Question 24, on pages 4 and 5, is worth 14 marks.
- Question 25, on pages 6 and 7, is worth 16 marks.

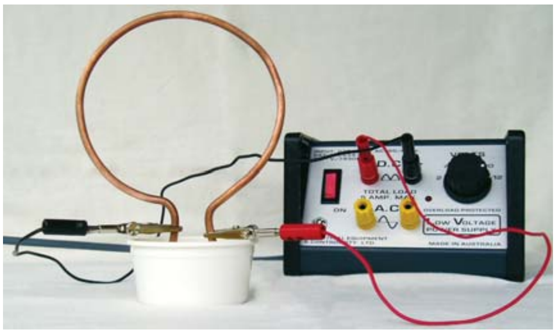
In answering these questions, you should:

- communicate your knowledge clearly and concisely;
- use physics terms correctly;
- present information in an organised and logical sequence;
- include only information that is related to the question.

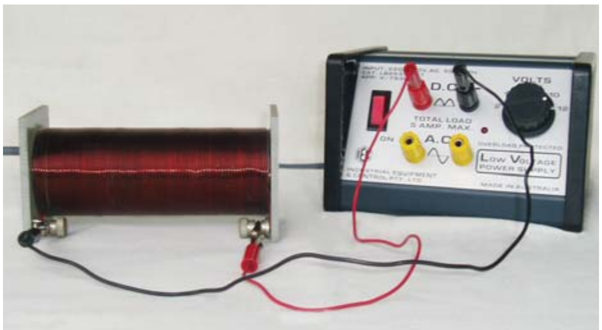
You may use clearly labelled diagrams that are related to your answer.

24. Magnetic fields are produced by electric currents flowing in a wire. Magnetic fields can be represented by magnetic field lines.

- Describe how the direction of magnetic field lines is determined from the direction of the current flow in a wire loop.
- Explain how the magnitude of the magnetic field is represented by magnetic field lines, using the example of a tightly wound solenoid in which a current flows. (14 marks)

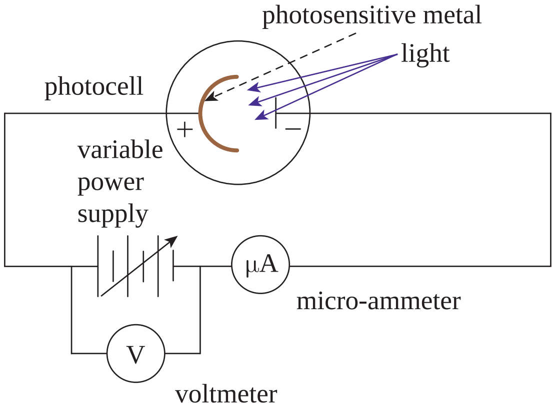


wire loop



solenoid

25. The diagram below represents a circuit used to investigate the photoelectric effect:



Light is incident on a photosensitive metal in the photocell.

When ultraviolet light illuminates the photocell the micro-ammeter indicates that electrons are emitted from the photocell, but when red light illuminates the photocell the micro-ammeter indicates that no electrons are emitted.

- Explain, using the concept of a photon, why electrons are emitted when ultraviolet light illuminates the photocell.
- Explain why no electrons are emitted when red light illuminates the photocell. (16 marks)

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You may write on this page if you need more space to finish your answers to Questions 24 and 25. Make sure to label each answer carefully (e.g. 24 continued).