Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature				

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General Certificate of Education
January 2005
Advanced Level Examination

AQA
ASSESSMENT and QUALIFICATIONS ALLIANCE

PHYSICS (SPECIFICATION A) PA04
Unit 4 Waves, Fields and Nuclear Energy

Section B

Wednesday 26 January 2005 Morning Session

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

In addition to this paper you will require:
- a calculator;
- a pencil and a ruler.

Time allowed: The total time for Section A and Section B of this paper is 1 hour 30 minutes

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this Section is 45.
- Mark allocations are shown in brackets.
- Section A and Section B of this paper together carry 15% of the total marks for Physics Advanced.
- You are expected to use a calculator where appropriate.
- A *Data Sheet* is provided on pages 3 and 4 of Section A. You may wish to detach this perforated sheet at the start of the examination.
- In questions requiring description and explanation you will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary where appropriate. The degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.

Answer **all** questions

You are advised to spend approximately **one hour** on this section.

1 (a) A body is moving with simple harmonic motion. State **two** conditions that must be satisfied concerning the *acceleration* of the body.

condition 1 .....

.....

condition 2 .....

.....

(2 marks)

(b) A mass is suspended from a vertical spring and the system is allowed to come to rest. When the mass is now pulled down a distance of 76 mm and released, the time taken for 25 oscillations is 23 s.

Calculate

(i) the frequency of the oscillations,

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(ii) the maximum acceleration of the mass,

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(iii) the displacement of the mass from its rest position 0.60 s after being released. State the direction of this displacement.

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(6 marks)

(c)

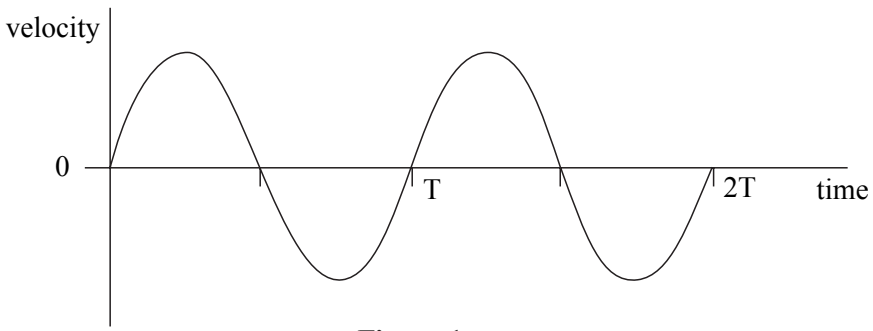


Figure 1

Figure 1 shows qualitatively how the velocity of the mass varies with time over the first two cycles after release.

(i) Using the axes in **Figure 2**, sketch a graph to show qualitatively how the displacement of the mass varies with time during the same time interval.

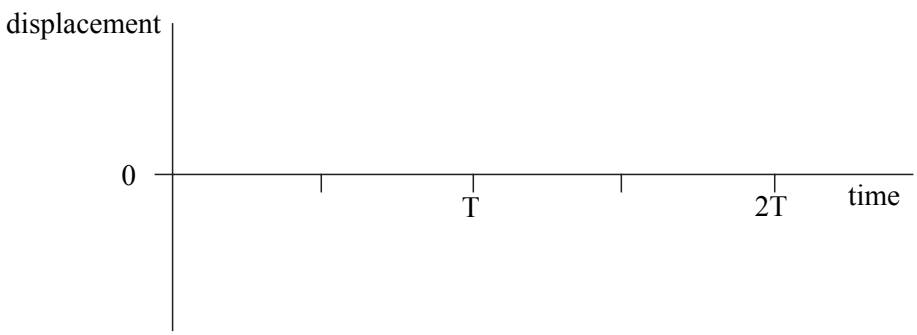
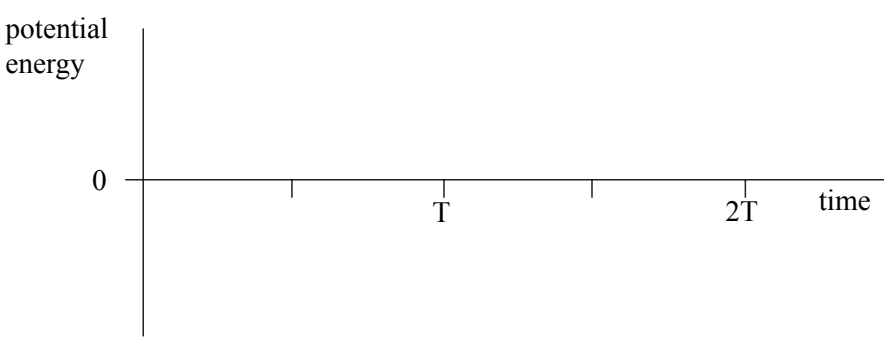


Figure 2

(ii) Using the axes in **Figure 3**, sketch a graph to show qualitatively how the potential energy of the mass-spring system varies with time during the same time interval.



(4 marks)

Figure 3

12

2 (a) State the characteristic features of

(i) longitudinal waves,

.....

.....

(ii) transverse waves.

.....

.....

(3 marks)

(b) Daylight passes horizontally through a fixed polarising filter **P**. An observer views the light emerging through a second polarising filter **Q**, which may be rotated in a vertical plane about point **X** as shown in **Figure 4**.

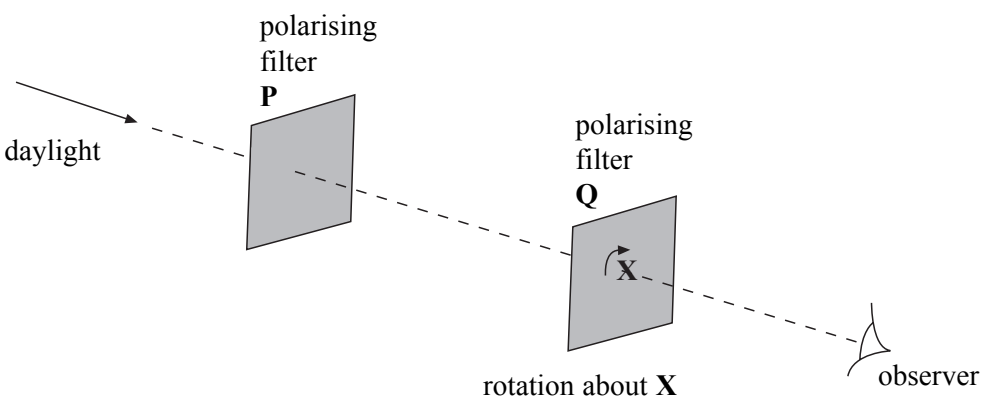


Figure 4

Describe what the observer would see as **Q** is rotated slowly through 360°.

You may be awarded marks for the quality of written communication provided in your answer.

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.....

(2 marks)

5

TURN OVER FOR THE NEXT QUESTION

3 (a) Explain what is meant by the *gravitational potential* at a point in a gravitational field.

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.....

(2 marks)

(b) Use the following data to calculate the gravitational potential at the surface of the Moon.

mass of Earth = 81 × mass of Moon
radius of Earth = 3.7 × radius of Moon
gravitational potential at surface of the Earth = –63 M Jkg^{-1}

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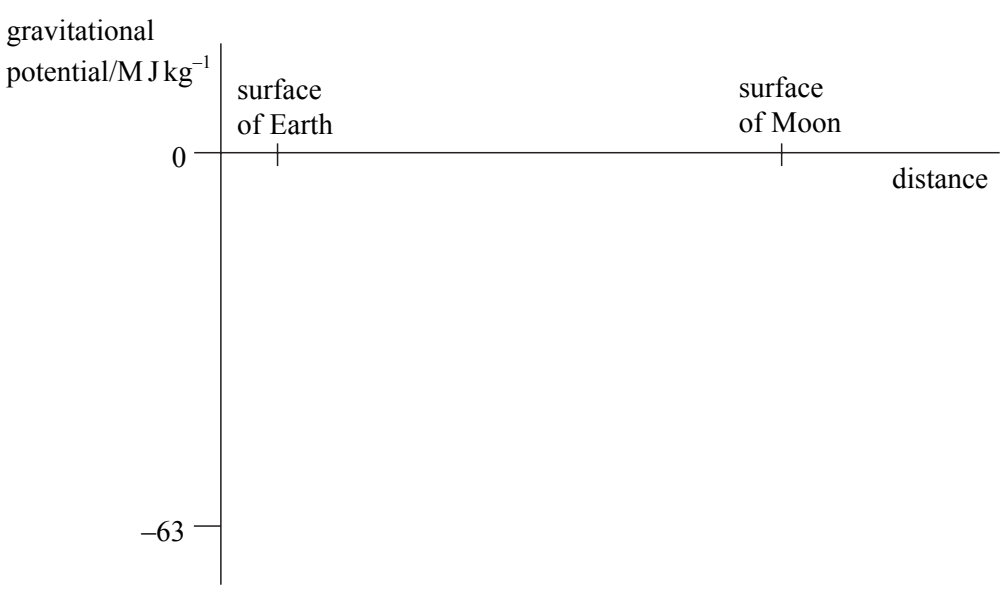
(3 marks)

(c) Sketch a graph on the axes below to indicate how the gravitational potential varies with distance along a line outwards from the surface of the Earth to the surface of the Moon.



(3 marks)

8

4

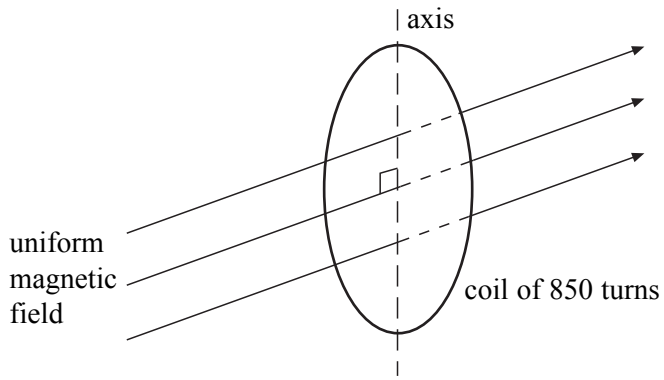


Figure 5

A circular coil of diameter 140 mm has 850 turns. It is placed so that its plane is perpendicular to a horizontal magnetic field of uniform flux density 45 mT, as shown in **Figure 5**.

(a) Calculate the magnetic flux passing through the coil when in this position.

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.....

(2 marks)

(b) The coil is rotated through 90 ° about a vertical axis in a time of 120 ms.

Calculate

(i) the change of magnetic flux linkage produced by this rotation,

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(ii) the average emf induced in the coil when it is rotated.

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(4 marks)

6

5 In a nuclear reactor, uranium nuclei undergo *induced fission* by *thermal neutrons*. The reaction is a *self-sustaining chain reaction* which requires *moderation* and has to be *controlled*.

(a) Explain the meaning of

(i) induced fission,

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(ii) thermal neutrons,

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(iii) self-sustaining chain reaction.

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(5 marks)

(b) You may be awarded marks for the quality of written communication provided in your answer to parts (b)(i) and (b)(ii).

(i) Explain what is involved in the process of moderation.

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(ii) Describe how the rate of fission is controlled in a nuclear reactor.

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(7 marks)

12

QUALITY OF WRITTEN COMMUNICATION *(2 marks)*

2

END OF QUESTIONS