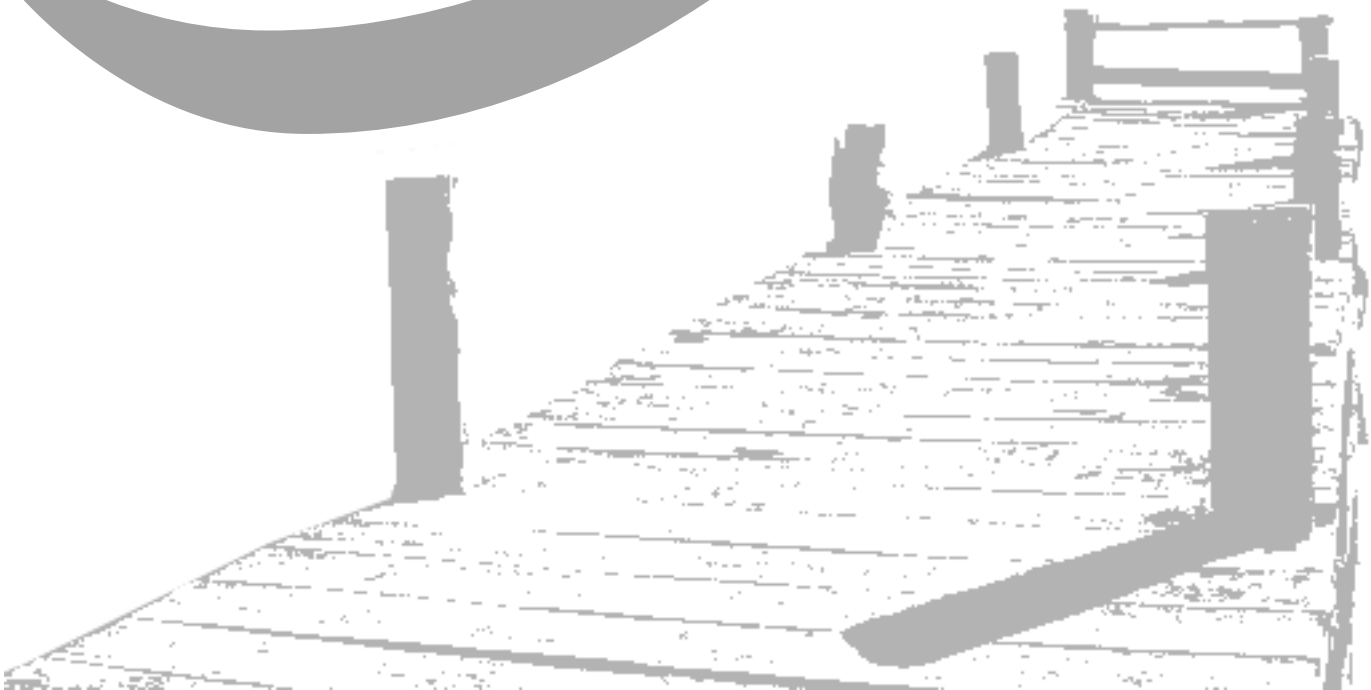
GCE
AS and A Level

Physics A

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 2: Approved specimen question paper

Version 1.1



Surname		Other Names	
Centre Number						Candidate Number				
Candidate Signature										

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General Certificate of Education
2009
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

version 1.1

PHYSICS A PHYA2
Unit 2 Mechanics, Materials and Waves

SPECIMEN PAPER

Time allowed: 1 ¼ hours

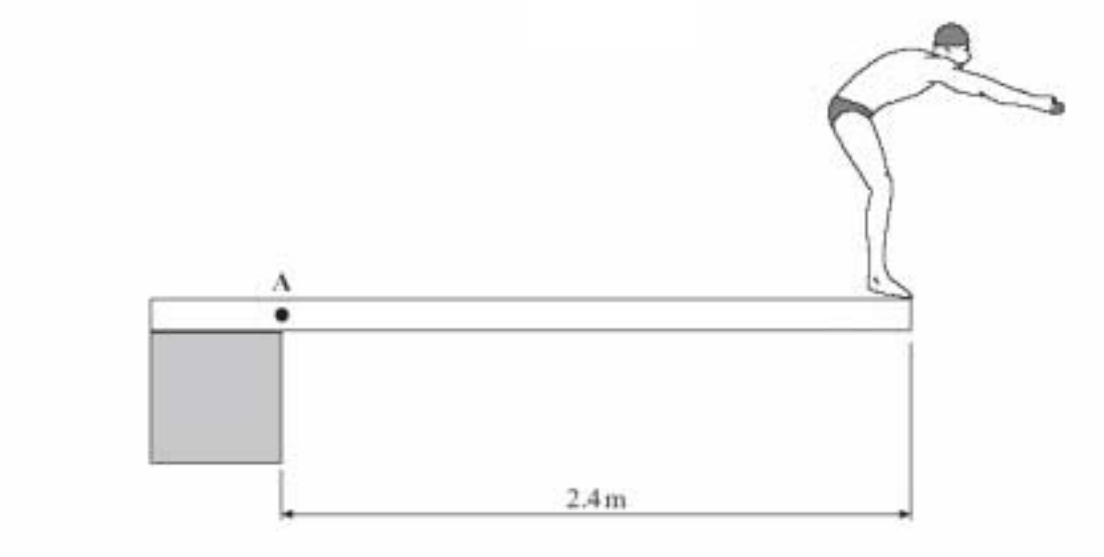
Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- A *Data and Formula Booklet* is provided as a loose insert.

Information
- The maximum mark for this paper is 70.
- The marks for the questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers. You will be assessed on your quality of written communication where indicated in the question.

For Examiner's Use			
Number	Mark	Number	Mark
1		**5**	
2		**6**	
3			
4			
Total (Column 1)			
Total (Column 2)			
TOTAL			
Examiner's Initials			

1 **Figure 1** shows a swimmer standing at the end of a diving board above a swimming pool. The mass of the swimmer is 72 kg and the horizontal distance between point A and his centre of mass is 2.4 m.

Figure 1



(a) Calculate the moment of the swimmer's weight about point A.

Gravitational field strength of the Earth, $g = 9.8$ N kg^{-1}.

Moment .....

(3 marks)

(b) The swimmer dives off the diving board and his centre of mass falls through 3.2 m before he reaches the water. Calculate the swimmer's vertical speed as he enters the water. Neglect air resistance.

Gravitational field strength of the Earth, $g = 9.8$ N kg^{-1}

Speed .....

(3 marks)

(c) The water brings the diver to rest when his centre of mass is 1.6 m below the surface of the water. Calculate the average total upward force acting on the diver which brings his vertical velocity to zero.

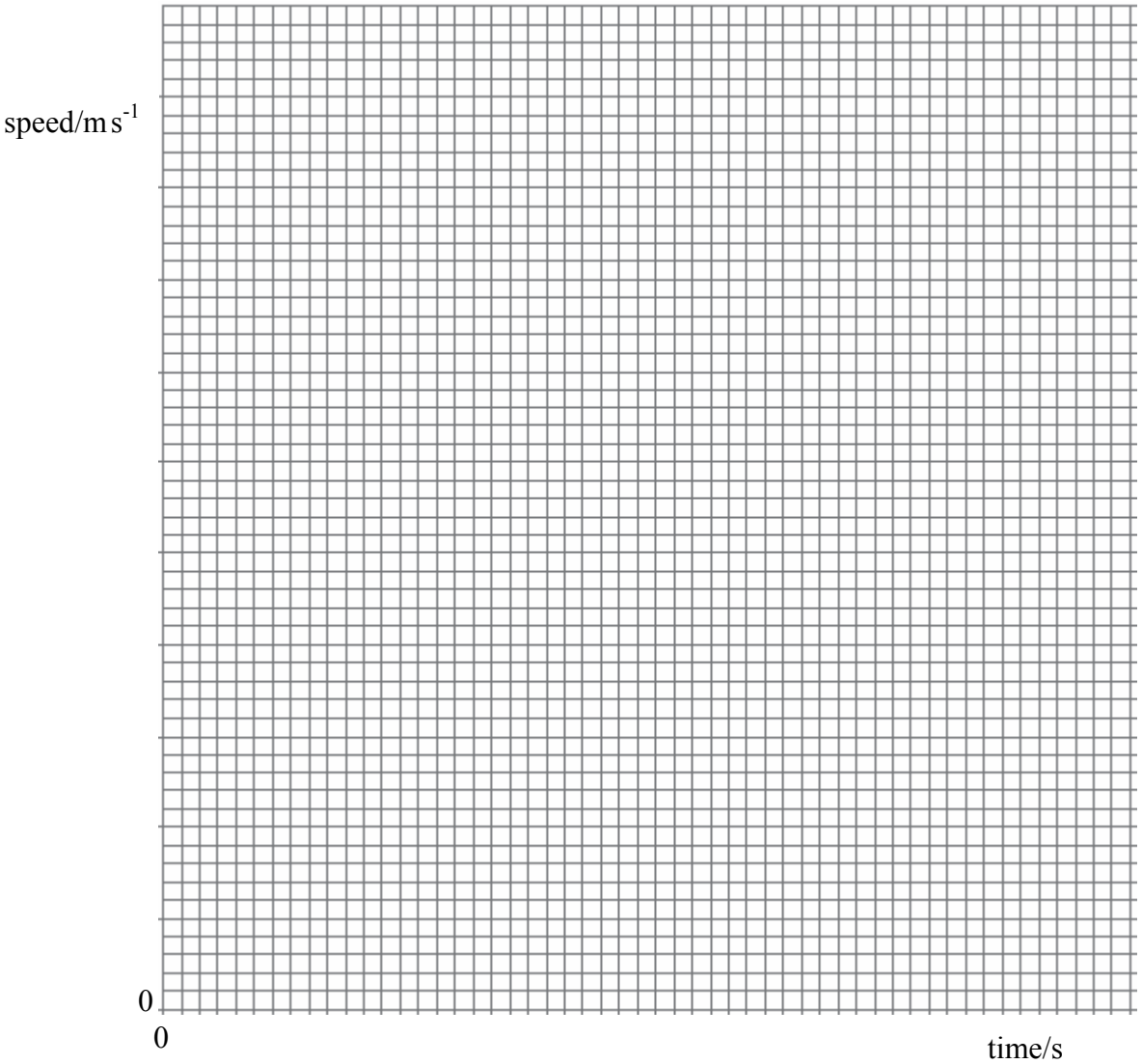
(3 marks)

Total 9 marks

2 A car accelerates from rest to a speed of 26 ms^{-1}. The table shows how the speed of the car varies over the first 30 seconds of motion.

time/s	0	5.0	10.0	15.0	20.0	25.0	30.0
speed/$m\,s^{-1}$	0	16.5	22.5	24.5	25.5	26.0	26.0

(a) Draw a graph of speed against time on the grid provided.



(5 marks)

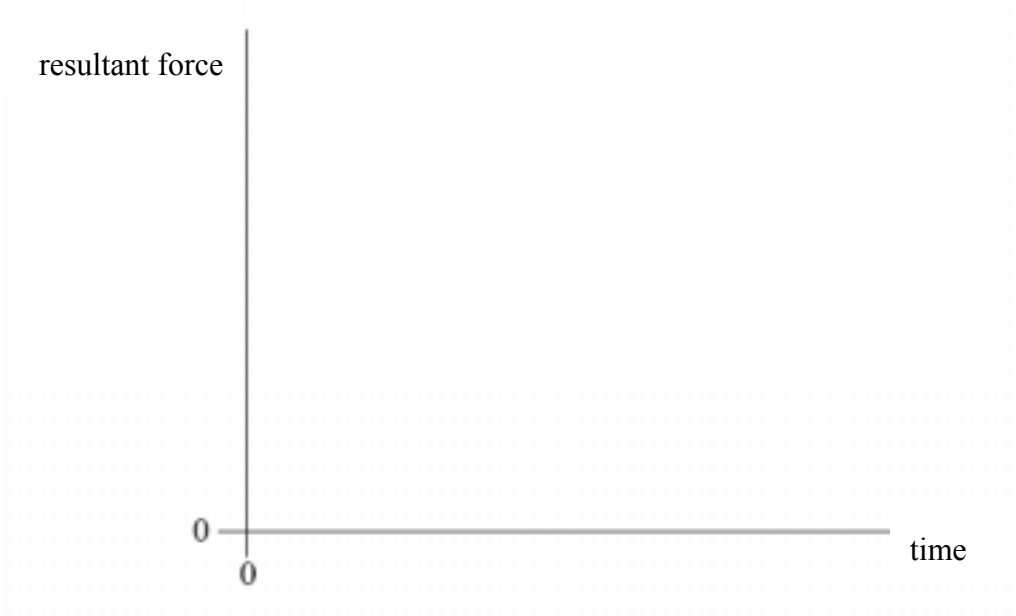
(b) Calculate the average acceleration of the car over the first 25 s.

(2 marks)

(c) Use your graph to estimate the distance travelled by the car in the first 25 s.

(2 marks)

(d) Using the axes below, sketch a graph to show how the resultant force acting on the car varies over the first 30 s of motion.



(3 marks)

(e) Explain the shape of the graph you have sketched in part (d), with reference to the graph you plotted in part (a).

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(2 marks)

Total 14 marks

3 (a) (i) Describe the behaviour of a wire that obeys Hooke's law.

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(ii) Explain what is meant by the elastic limit of the wire.

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(iii) Define the Young modulus of a material and state the unit in which it is measured.

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(5 marks)

(b) A student is required to carry out an experiment and draw a suitable graph in order to obtain a value for the Young modulus of a material in the form of a wire. A long, uniform wire is suspended vertically and a weight, sufficient to make the wire taut, is fixed to the free end. The student increases the load gradually by adding known weights. As each weight is added, the extension of the wire is measured accurately.

(i) What other quantities must be measured before the value of the Young modulus can be obtained?

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(ii) Explain how the student may obtain a value of the Young modulus.

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(iii) How would a value for the elastic energy stored in the wire be found from the results?

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(6 marks)

Total 11 marks

4 (a) State **two** requirements for two light sources to be coherent.

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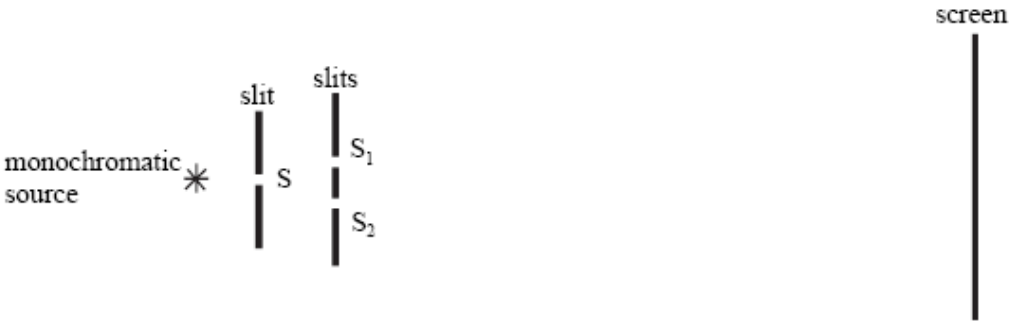
(2 marks)

(b)

Figure 2



Young's fringes are produced on the screen from the monochromatic source by the arrangement shown in **Figure 2**.
Explain how this arrangement produces interference fringes on the screen. In your answer, explain why slit S should be narrow and why slits S_1 and S_2 act as coherent sources.
The quality of your written answer will be assessed in this question.

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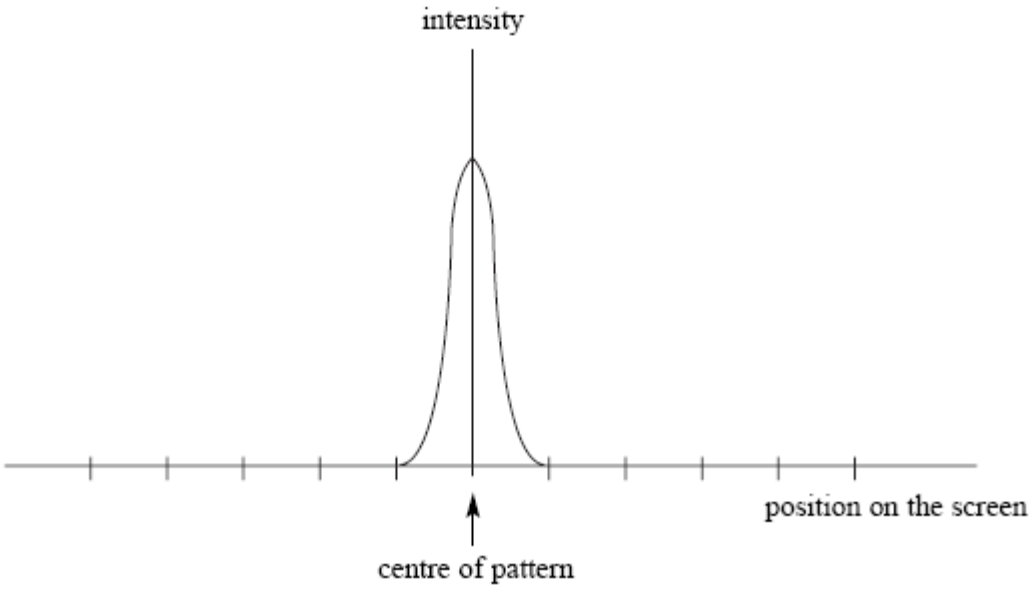
(6 marks)

(c) The pattern on the screen may be represented as a graph of intensity against position on the screen. The central fringe is shown on the graph in **Figure 3**. Complete this graph to represent the rest of the pattern by drawing on **Figure 3**.

Figure 3



(2 marks)

Total 10 marks

5 (a) State and explain **two** physical properties of the light produced by a laser which makes it different from the light produced by a filament lamp.

Property 1 .....

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Property 2 .....

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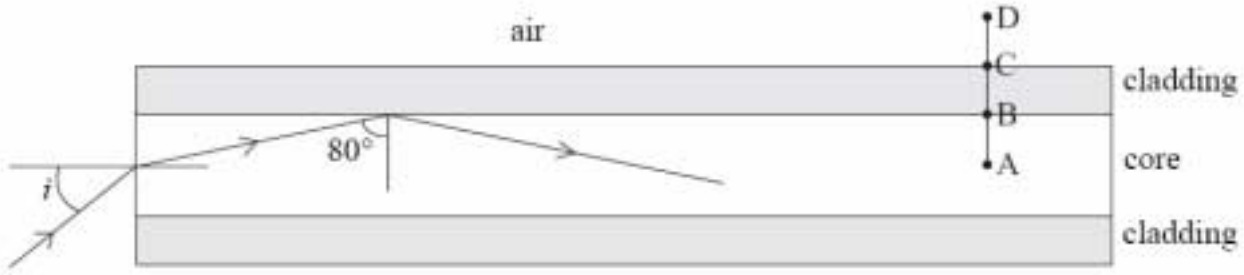
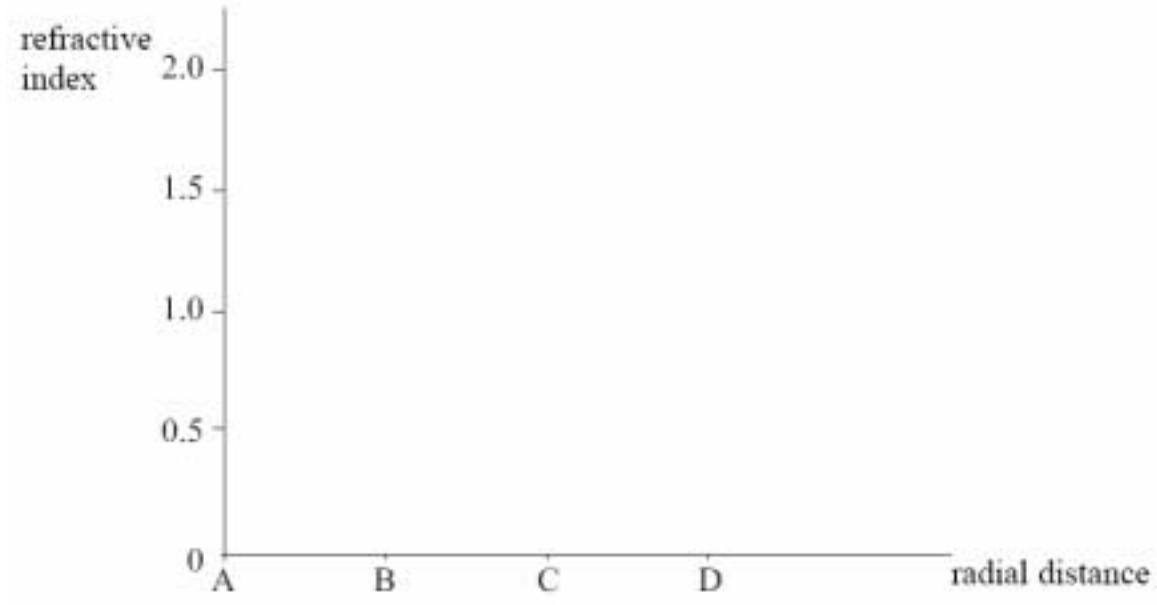
(4 marks)

(b) **Figure 4** shows a cross-section through an optical fibre used for transmitting information. A laser beam, carrying digital data, is incident on the end of the core of the fibre at an angle of incidence ***i***.
The core is made from glass of refractive index 1.5.

Figure 4



(i) Complete the graph below to show how the refractive index changes with radial distance along the line ABCD in **Figure 4**.



(ii) Calculate the value of the angle of incidence, *i*, shown in **Figure 4**.

Angle of incidence, *i* .....

(iii) Explain how the glass cladding around the optical fibre's core improves the security of data being transmitted through it and give a reason why this is important.

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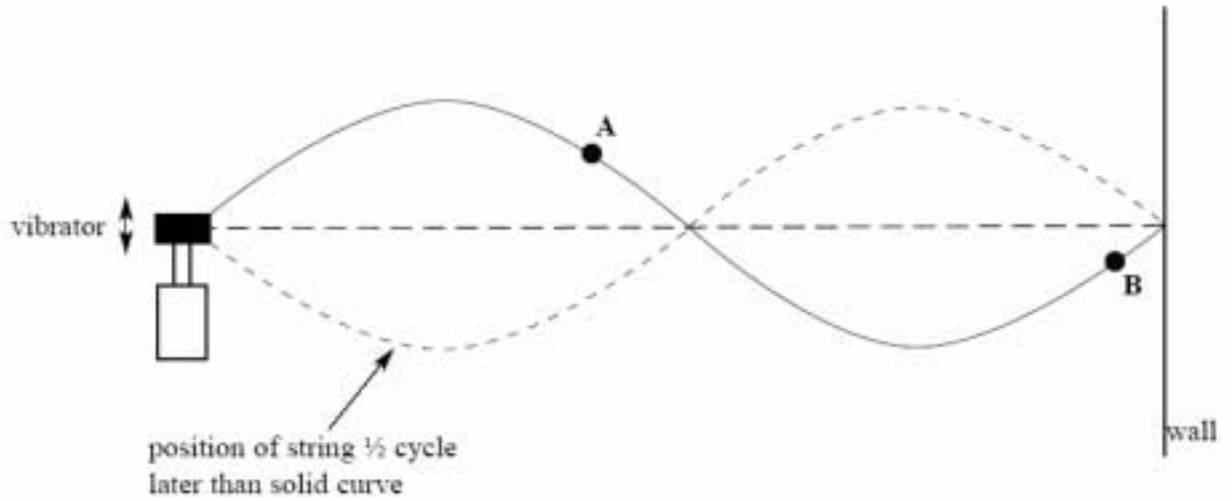
(8 marks)

Total 12 marks

6 **Figure 5** shows a stretched string driven by a vibrator. The right-hand end of a string is fixed to a wall. A stationary wave is produced on the string; the string vibrates in two loops.

Figure 5



(a) State the physical conditions that are necessary for a stationary wave to form on the string.

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(3 marks)

(b) State how you know that the wave on the string is transverse.

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(1 mark)

(c) Compare the *amplitude* and *phase* of the oscillations of points **A** and **B** on the string.

Amplitude.....

Phase .....

(2 marks)

(d) The length of the string is 1.2 m and the speed of the transverse wave on the string is 6.2 m s^{-1}. Calculate the vibration frequency of the vibrator.

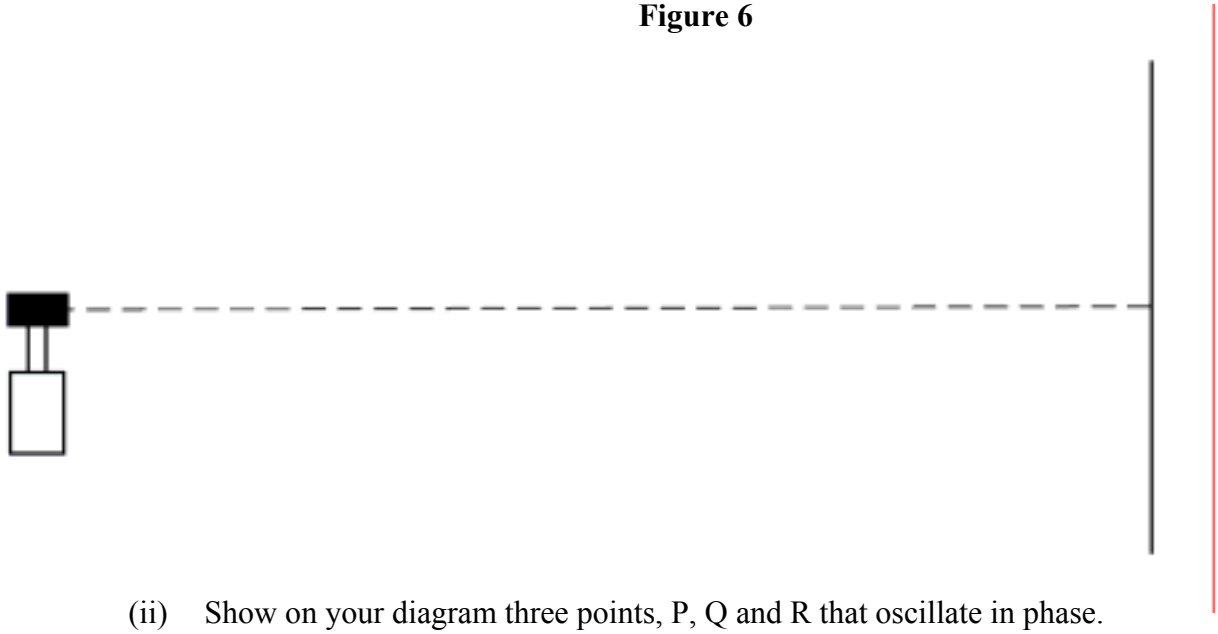
Vibration frequency .....

(4 marks)

(e) The frequency of the vibrator is tripled.

(i) Sketch the new shape of the stationary wave on **Figure 6**.

Figure 6



(ii) Show on your diagram three points, P, Q and R that oscillate in phase.

(2 marks)

Total 12 marks