ERRATUM NOTICE

General Certificate of Education
June 2007
Advanced Subsidiary Examination

Physics (Specification B) **PHB1**
Unit 1
Foundation Physics

Friday 8 June 9.00 a.m. – 10.30 a.m.

Instructions to Invigilators

Before the start of the examination please hand to candidates a replacement sheet.

Replacement Figure 9, for Question 9(e), page 18.

Before the start of the examination, please read out the following notice to candidates. (Please read out this message twice to ensure understanding.)

Please ignore the original Figure 9 and use the replacement provided on the loose sheet. Please make sure that you write your answer in the question paper answer booklet, not on the loose sheet.

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ASSESSMENT and QUALIFICATIONS ALLIANCE

Replacement Sheet

Figure 9, for Question 9(e), page 18.

Please ignore the original Figure 9 and use the replacement provided on this loose sheet.

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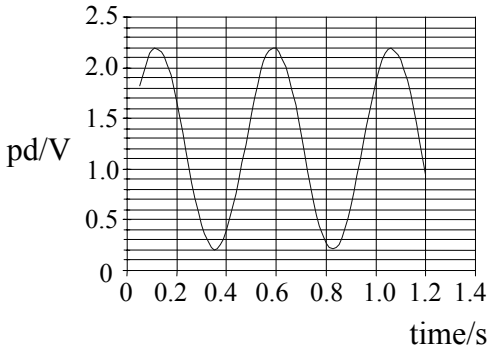
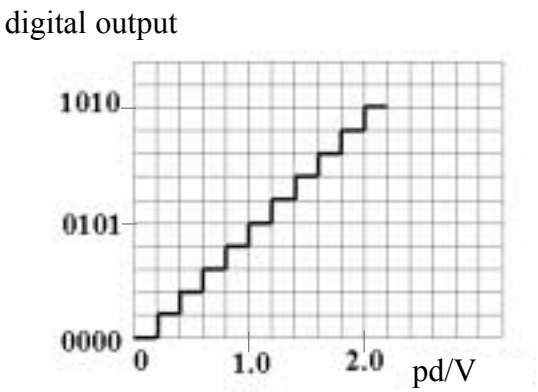
Figure 9





Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
June 2007
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

PHYSICS (SPECIFICATION B) **PHB1**
Unit 1 Foundation Physics

Friday 8 June 2007 9.00 am to 10.30 am

For this paper you must have:
- a calculator
- a pencil and a ruler.

Time allowed: 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 **Section A** and **Section B**.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show all your working.
- A *Formulae Sheet* is provided on page 3. Detach this perforated page at the start of the examination.

Information
- The maximum mark for this paper is 75.
- Four of these marks will be awarded for using good English, organising information clearly and using specialist vocabulary where appropriate.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- Questions 7 and 9(f) should be answered in continuous prose. In these questions you may be marked on your ability to use good English, to organise information clearly and to use specialist vocabulary where appropriate.

Advice
- You are advised to spend about 30 minutes on **Section A** and about 1 hour on **Section B**.

For Examiner's Use			
Question	Mark	Question	Mark
A		6	
		7	
		8	
		9	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

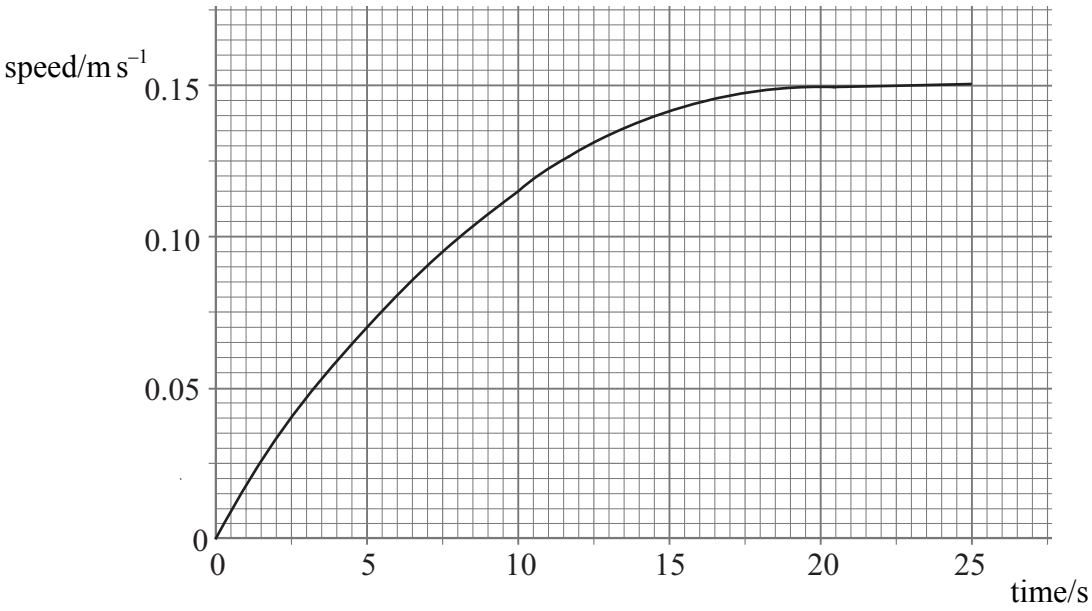
SECTION A

Answer **all** questions in this section.

There are 26 marks in this section.

1 A small metal cylinder falls vertically from rest through a tube of oil. **Figure 1** shows its speed–time graph.

Figure 1



(a) State the name given to the maximum speed.

.....

(1 mark)

(b) Show that the distance through which the cylinder falls in 25 s is about 3 m.

(3 marks)

(c) The cylinder has a mass of 0.075 kg.
Calculate the gravitational potential energy lost by the cylinder as it falls for 25 s.

acceleration due to gravity $g = 9.8\,\text{m s}^{-2}$

gravitational potential energy.....

(2 marks)

Detach this perforated page at the start of the examination.

Foundation Physics Mechanics Formulae

moment of force $= Fd$

$v = u + at$

$s = ut + \frac{1}{2}at^2$

$v^2 = u^2 + 2as$

$s = \frac{1}{2}(u + v)t$

for a spring, $F = k\Delta l$

energy stored in a spring $= \frac{1}{2}F\Delta l = \frac{1}{2}k(\Delta l)^2$

$T = \frac{1}{f}$

Foundation Physics Electricity Formulae

$I = nAvq$

terminal p.d. $= E - Ir$

in series circuit, $R = R_1 + R_2 + R_3 + ...$

in parallel circuit, $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$

output voltage across $R_1 = \left(\frac{R_1}{R_1 + R_2}\right) \times$ input voltage

Waves and Nuclear Physics Formulae

fringe spacing $= \frac{\lambda D}{d}$

single slit diffraction minimum $\sin\theta = \frac{\lambda}{b}$

diffraction grating $n\lambda = d\sin\theta$

Doppler shift $\frac{\Delta f}{f} = \frac{v}{c}$ for $v << c$

Hubble law $v = Hd$

radioactive decay $A = \lambda N$

Properties of Quarks

Type of quark	Charge	Baryon number
up u	$+\frac{2}{3}e$	$+\frac{1}{3}$
down d	$-\frac{1}{3}e$	$+\frac{1}{3}$
$\overline{\text{u}}$	$-\frac{2}{3}e$	$-\frac{1}{3}$
$\overline{\text{d}}$	$+\frac{1}{3}e$	$-\frac{1}{3}$

Lepton Numbers

Particle	Lepton number L		
	L_e	L_μ	L_τ
e^-	1		
e^+	−1		
υ_e	1		
$\overline{\upsilon}_e$	−1		
μ^-		1	
μ^+		−1	
υ_μ		1	
$\overline{\upsilon}_\mu$		−1	
τ^-			1
τ^+			−1
υ_τ			1
$\overline{\upsilon}_\tau$			−1

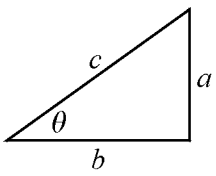
Geometrical and Trigonometrical Relationships

circumference of circle $= 2\pi r$

area of a circle $= \pi r^2$

surface area of sphere $= 4\pi r^2$

volume of sphere $= \frac{4}{3}\pi r^3$



$\sin\theta = \frac{a}{c}$

$\cos\theta = \frac{b}{c}$

$\tan\theta = \frac{a}{b}$

$c^2 = a^2 + b^2$

There are no questions printed on this page

2 The powerful magnets used in hospital body scanners have superconducting materials to carry the large electrical currents used in the devices.

(a) Explain what is meant by *superconductivity*.

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(2 marks)

(b) Explain the advantage of using a superconductor in a large current application such as this.

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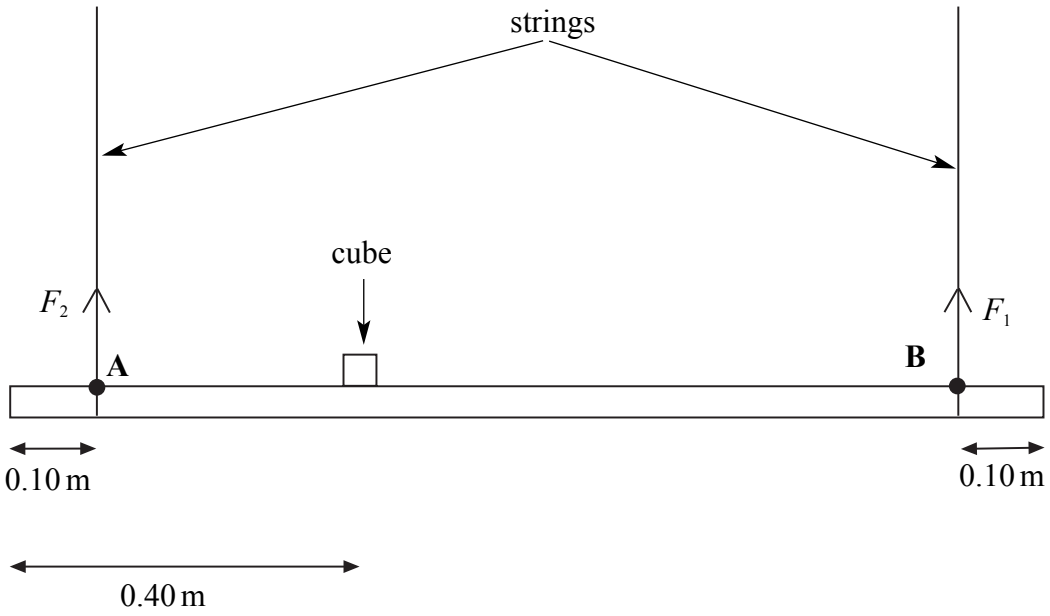
(2 marks)

Turn over for the next question

3 **Figure 2** shows a uniform metre ruler of weight 0.75 N. It is suspended horizontally by two strings located 0.10 m from each end of the ruler. A small cube of weight 0.50 N is placed on the ruler 0.40 m from the left-hand end.

Figure 2

not to scale



(a) By taking moments about point **A**, calculate the tension, F_1, in the right-hand string.

F_1.....

(3 marks)

(b) Calculate the tension, F_2, in the left-hand string.

F_2.....

(2 marks)

4 A car of mass 1500 kg accelerates uniformly from rest to 23 m s^{-1} in a time of 9.4 s.

(a) Calculate the average resultant force that acts on the car during the acceleration.

average resultant force.....
(3 marks)

(b) Calculate the distance covered during the acceleration.

distance.....
(2 marks)

Turn over for the next question

5 A student is provided with two 1.0 kΩ metal resistors and a negative temperature coefficient thermistor of initial resistance 1.5 kΩ at 20°C.

(a) Calculate the **minimum** value of resistance that can be produced when using all three components at 20°C. Draw a diagram to make it clear how the components are connected together to achieve this minimum resistance.

minimum value of resistance.....

(3 marks)

(b) When charge flows through the resistor network, the temperature of each component rises.
State and explain the changes in resistance that occur in each of the components as a result of the changes in temperature.

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(3 marks)

26

Turn over for the next question

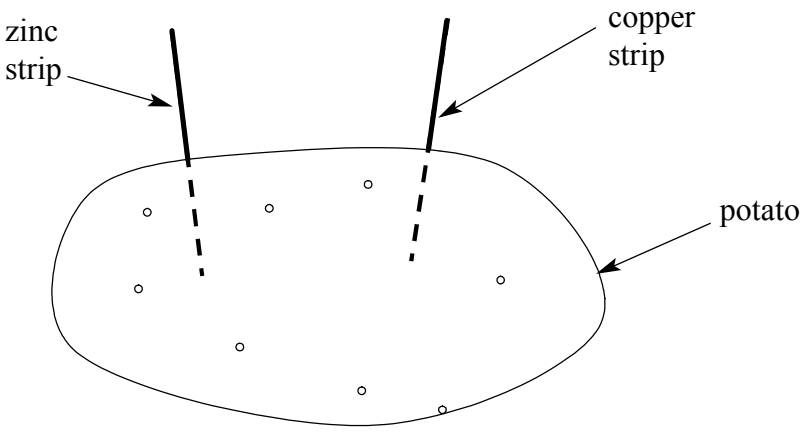
SECTION B

Answer **all** questions in this section.

There are **49** marks in this section.

6 **Figure 3** shows an electrical cell that consists of two strips of metal inserted into a potato. One strip is copper, the other is zinc.

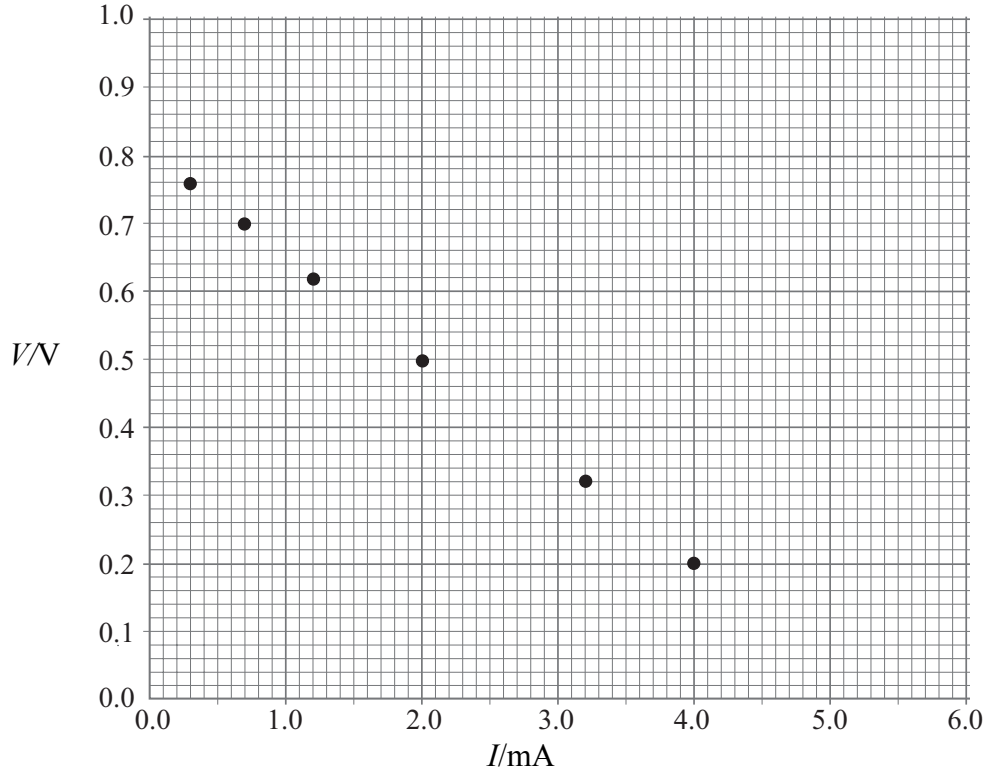
Figure 3



A student constructs a potato cell and connects it into an electrical circuit. He measures the terminal potential difference, V, and the current, I, in the circuit for various values of a load resistor.

Figure 4 shows the results of the experiment.

Figure 4



(a) Draw a circuit diagram of the apparatus that could have been used to take these readings.

(3 marks)

(b) (i) Use the graph in **Figure 4** to estimate the emf of the potato cell.

emf of potato cell.....

(ii) Show that the internal resistance of the potato cell is about 0.15 kΩ.

(4 marks)

(c) The potato cell is used to energise a digital clock that requires a current of 5.0 μA.
The clock runs for 72 hours.
Calculate the charge that flows through the clock in this time.

charge .....
(2 marks)

Question 6 continues on the next page

(d) State the charge carriers responsible for conduction

(i) in the zinc strip,

.....

(ii) in the potato.

.....

(2 marks)

(e) The student suggests that 200 potato cells could be used to make a high voltage battery.

(i) State how the cells would be connected together to achieve this.

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(ii) The high-voltage potato battery is likely to be very ineffective as a power supply, but nevertheless completely safe to use.
Explain why this power supply is electrically safe.

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(2 marks)

13

7 Nuclear power stations and wind farms are sources of energy for the National Grid. Some residents in rural areas wish to remove the wind farms in favour of more nuclear power stations.

Outline the arguments that these opponents of wind farms might use. Include in your answer a discussion of the processes involved in generating electrical energy using a wind farm.

Two of the 7 marks are available for the quality of your written communication.

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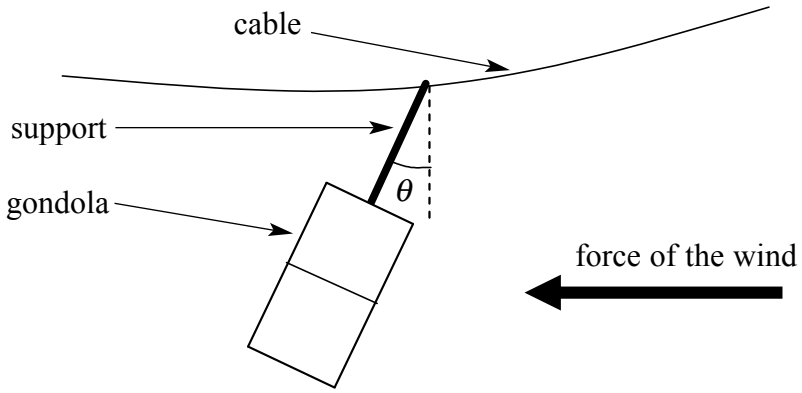
(7 marks)

7

8 **Figure 5** represents the gondola of a cable-car system that lifts skiers to the top of a mountain. Normally, the gondola hangs vertically, but **Figure 5** shows the gondola blown through an angle θ by the force of the wind.

Figure 5



(a) The weight of the gondola is 1900 N and the tension in the support is 2100 N when the gondola is in equilibrium.

(i) Show that the angle θ is about 25°.

(ii) Calculate the magnitude of the horizontal force acting on the gondola.

horizontal force .....

(4 marks)

(b) When hanging vertically, the gondola and its cable suspension behave as a mass on a spring so that the gondola oscillates up and down. When the gondola is empty, the oscillations will typically have a period of a few seconds and a vertical amplitude of a few centimetres.

(i) Explain what is meant by the period of an oscillation.

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(ii) Explain what is meant by the amplitude of an oscillation.

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(iii) State and explain the likely effect on the period of the oscillation when there are two people in the gondola.

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(4 marks)

(c) A paraglider pilot rides the gondola to the top of the mountain and launches herself and her glider into the air. The glider moves horizontally.
Discuss the vertical forces that act on the pilot and glider and their comparative size and direction when flying horizontally.

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(3 marks)

11

9 (a) Define the *ohm*.

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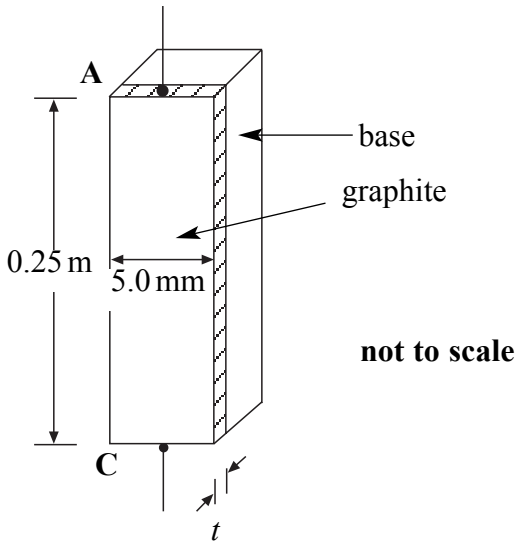
(1 mark)

(b) An engineer designs a resistor made from a thin layer of graphite mounted on an insulating base. **Figure 6** shows the arrangement.

Figure 6



The graphite layer has a length of 0.25 m, a width of 5.0 mm, and a resistance of 1.2 kΩ.
Calculate the thickness, *t*, of the graphite layer.

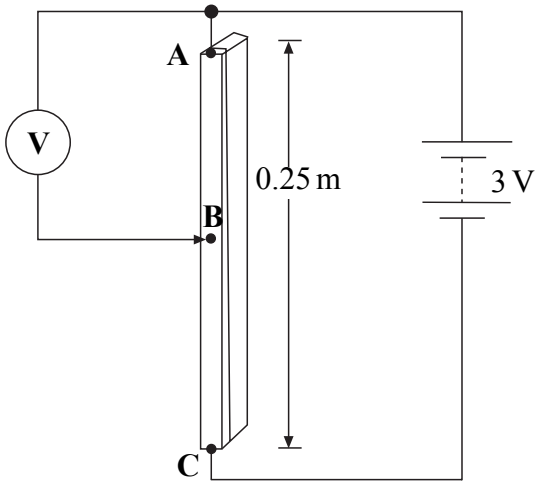
resistivity of graphite = $3.0 \times 10^{-5}\ \Omega\,\text{m}$

t.....

(3 marks)

(c) **Figure 7** shows the circuit in which the resistor will be used. A slider **B** presses onto the graphite to make an electrical connection. The battery has a negligible internal resistance.

Figure 7



Calculate the power dissipated in the graphite layer.

power .....
(2 marks)

(d) (i) The slider is placed 0.040m from end **A**.

Calculate the voltmeter reading.

voltmeter reading.....

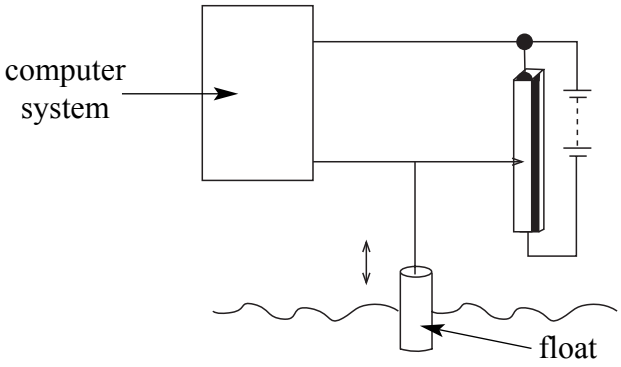
(ii) The slider is now moved to 0.040 m from end **C**.
Calculate the **change** in the voltmeter reading.

change in voltmeter reading.....
(4 marks)

Question 9 continues on the next page

(e) The slider is part of a system that measures the wave height in a tank used to test model boats. **Figure 8** shows the arrangement in which the slider is connected to a float that rests in the water.

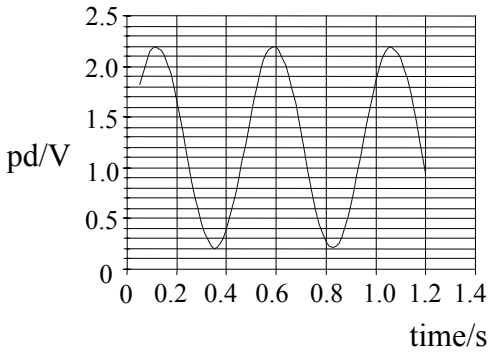
Figure 8

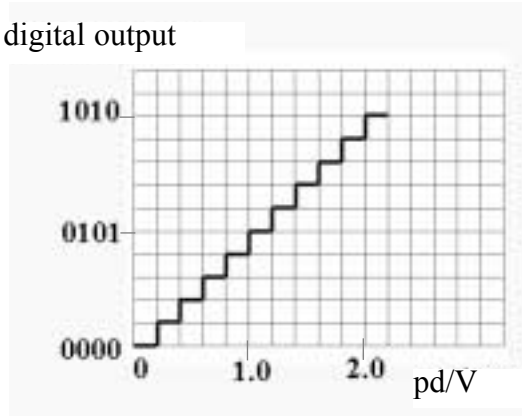


The voltmeter is replaced by a computer system that converts the analogue potential difference (pd) into a digital form. The digital output ranges from 0000 (corresponding to 0 V) to 1010 (corresponding to 2.0 V). **Figure 9** shows both the analogue variation of pd with time and the analogue to digital conversion.

Calculate the digital output when the time is 1.0 s.

Figure 9





digital output.....

(2 marks)

(f) Other sensors can be connected to the computer to make additional measurements such as the speed of the water and details of the motion of the boat.

Explain the merits of computer-based data collection over a system based on collection from analogue instruments by a human observer.

Two of the 6 marks are available for the quality of your written communication.

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(6 marks)

18

END OF QUESTIONS

There are no questions printed on this page