Centre No.						Paper Reference	Surname	Initial(s)
Candidate No.						6 7 5 1 / 0 1	Signature	

Paper Reference(s)

6751/01

Edexcel GCE

Salters Horners Physics

Advanced Subsidiary

Unit Test PSA1

Wednesday 16 January 2008 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname and initial(s) and your signature.
Answer **ALL** of the questions, writing your answers in this question booklet.
In calculations you should show all the steps in your working, giving your answer at each stage.
Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The mark for individual questions and the parts of questions are shown in round brackets.
There are six questions in this paper. The total mark for this paper is 60.
The list of data, formulae and relationships is printed at the end of this booklet.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.

Printer's Log. No.
N28032A
W850/R6751/57570 6/6/4/3

N 2 8 0 3 2 A 0 1 1 6

Turn over

edexcel
advancing learning, changing lives

Leave blank

1. A gardener installs a solar powered fountain in a sunny part of his garden. He has the following data about the solar panel from the manufacturer.

Under best conditions:

voltage across terminals	12.0 V
power available	5.9 W

The solar panel provides power to a water pump.

(a) (i) Calculate the maximum current in the pump. Assume that the resistance of the connecting cable is negligible.

....

....

Current = ...

(2)

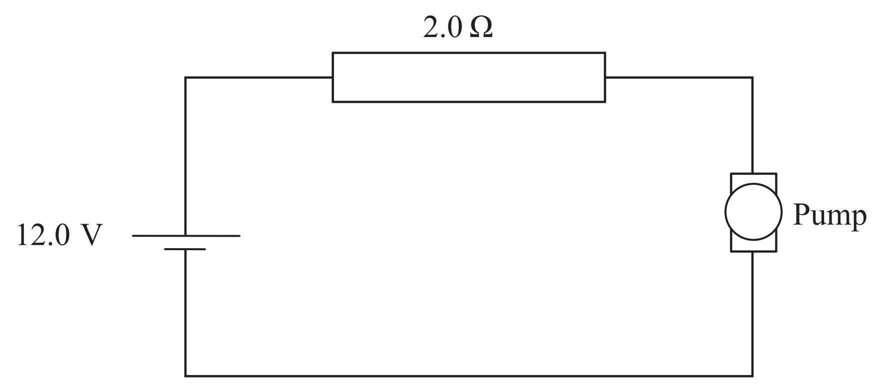
(ii) Show that the electrical resistance of the pump is about 24 Ω.

....

....

(2)

(b) He decides to install another identical fountain in a shady area of the garden. He has to place the solar panel some distance away from the pump so that it is in the sunlight. He then uses a much longer connecting cable. The connecting cable to this pump has a total resistance of 2.0 Ω. The circuit is equivalent to that shown below.



N28032A0216

Leave blank

Calculate

(i) the current in this circuit

....

....

Current = ...
(2)

(ii) the power available to the pump.

....

....

Power = ...
(2)

(c) State **one** way in which the power available to the pump in the shady area could be improved. The positions of solar panel and fountain cannot be changed.

....

....

....

....
(1)

Q1

(Total 9 marks)

Leave blank

2. A helium-filled balloon on a string is attached to an electric balance. The reading is:

-0.0094 kg

(a) (i) Explain how this shows that the force being exerted on the balance by the balloon is about 0.1 N upwards.

....

....

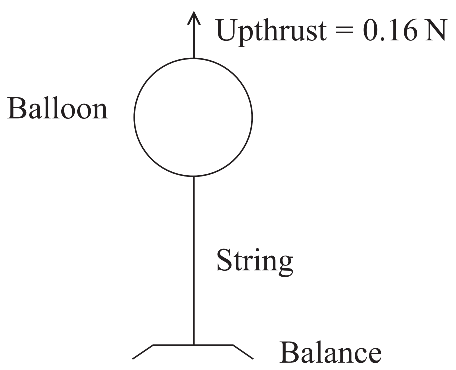
....

....

....

(2)

The force of upthrust on the balloon is 0.16 N.



(ii) Add labelled arrows to identify the other two forces acting on the balloon and show that the value of weight is about 0.07 N.

....

....

....

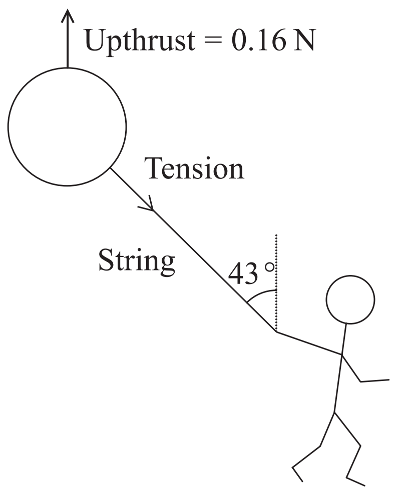
....

....

(3)

Leave blank

(b) The balloon is given to a child. The child holds the balloon by the string and walks at a constant speed. The balloon trails at an angle of 43° to the vertical as shown.



(i) Add labelled arrows to identify the other forces acting on the balloon in this situation. Values are not required.

(2)

(ii) Write an expression for the vertical component of the tension in the string.

....

(1)

(iii) By considering the vertical forces acting on the balloon, calculate the tension in the string in this situation.

....

....

....

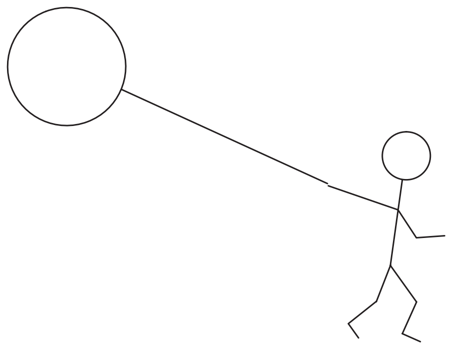
....

Tension = ...

(2)

Leave blank

(c) The child walks faster. The new angle of the balloon and string is shown below. Explain the change in angle.



....

....

....

....

....

(2)

Q2

(Total 12 marks)

Leave blank

3. Before making tea in a teapot, the pot is often warmed by pouring hot water into it.

0.25 kg of water at 93 °C is added to a stainless steel teapot. The teapot and water rapidly both reach a temperature of 79 °C.

(a) Show that the heat energy lost by the water is about 15 000 J.

Specific heat capacity of water = 4180 J kg^{-1} $°C^{-1}$

....

....

....
(2)

(b) (i) Calculate the specific heat capacity of stainless steel.

Mass of teapot = 0.41 kg, initial temperature of teapot = 24 °C

....

....

....

Specific heat capacity = ... J kg^{-1} $°C^{-1}$
(2)

(ii) State an assumption you need to make to carry out this calculation.

....

....
(1)

(iii) The accepted value for the specific heat capacity of stainless steel is about 500 J kg^{-1} $°C^{-1}$. Compare this with the value you have calculated and explain why they are different.

....

....

....

....
(2)

(Total 7 marks)

Q3

4. (a) Light changes direction when it passes from air to water.

(i) Name the process of light changing direction in this way.

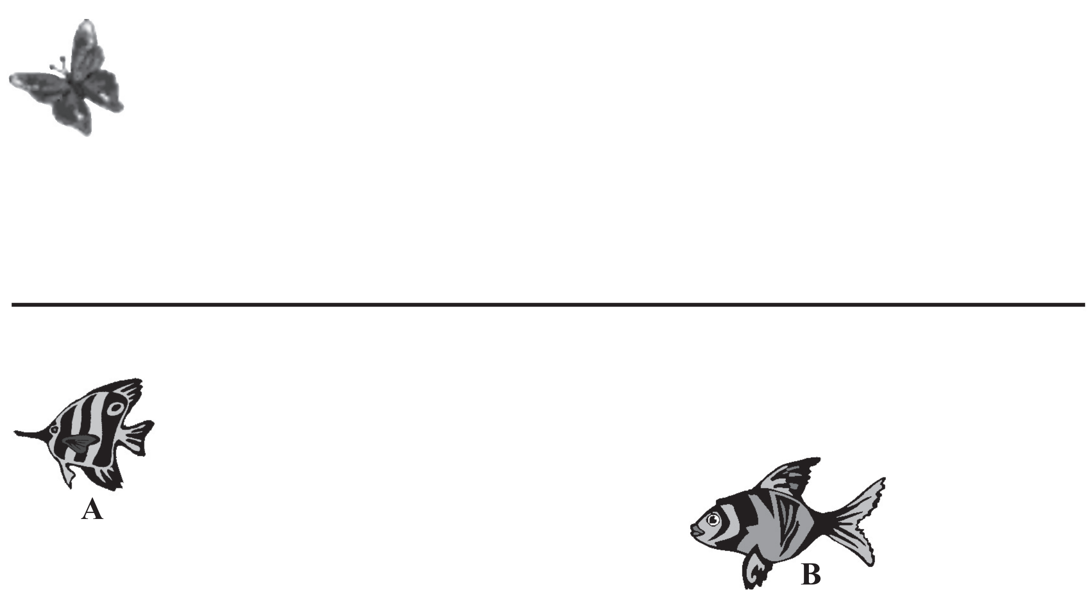
....
(1)

(ii) Explain why this process takes place.

....

....
(1)

(b) The diagram represents some fish under water and a butterfly above the water.



(i) Draw a ray to show the path of light travelling from the butterfly to the eye of fish **B**.
(2)

N 2 8 0 3 2 A 0 8 1 6

Leave blank

(ii) Explain what is meant by **critical angle**.

....

....

....

....

....
(2)

(iii) Explain how rays from fish **A** could reach the eye of fish **B** along two different paths. Add rays to the diagram to illustrate your answer.

....

....

....
(4)

Q4

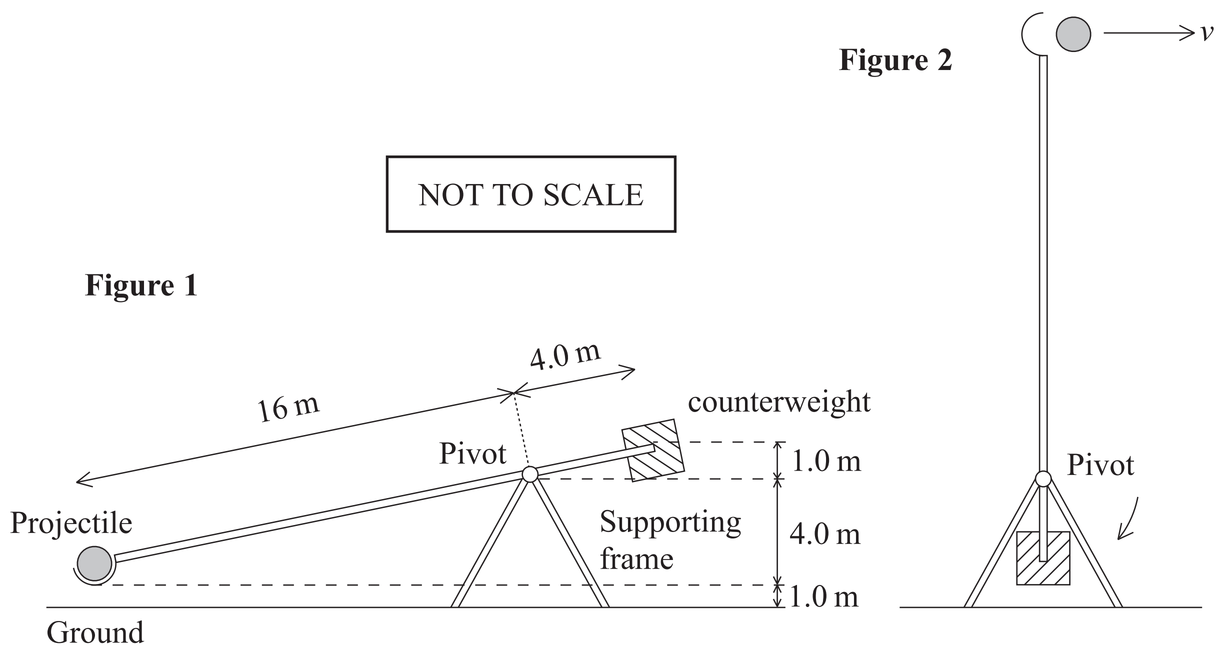
(Total 10 marks)

N 2 8 0 3 2 A 0 9 1 6

Turn over

Leave blank

5. A medieval siege engine, called a trebuchet, uses a pivoted lever arm to fire a rock projectile. Figure 1 shows a trebuchet which is ready to fire. The gravitational potential energy (E_{grav}) of the large stone counter weight is converted into E_{grav} and kinetic energy (E_k) of the small projectile and E_k of the counter weight.



(a) The mass of the counter weight is 760 kg. It falls through 5 m. Show that the E_g it loses is about 37 000 J.

....

....

....

(2)

(b) (i) The mass of the projectile is 55 kg. Its height increases by 20 m as the lever arm rotates. Show that the total E_k of the projectile and the counterweight is about 26 000 J.

....

....

....

(2)

N 2 8 0 3 2 A 0 1 0 1 6

Leave blank

(ii) State one assumption you have made in your calculation of the E_k.

....

....
(1)

(iii) The equation below can be used to find the speed v.

$$26\,000\,\text{J} = \frac{1}{2} \times 760\,\text{kg} \times \left(\frac{v}{4}\right)^2 + \frac{1}{2} \times 55\,\text{kg} \times v^2$$

Explain the term $\frac{1}{2} \times 760\,\text{kg} \times \left(\frac{v}{4}\right)^2$ in this equation.

....

....

....
(2)

(c) Solving this equation gives a speed v of 22.5 m s^{-1}.

(i) Assuming the trebuchet launches its projectile horizontally over level ground, calculate the time of flight of the projectile.

....

....

....

Time = ...
(2)

(ii) Calculate the distance the projectile travels before it hits the ground.

....

....

....

Distance = ...
(2)

Q5

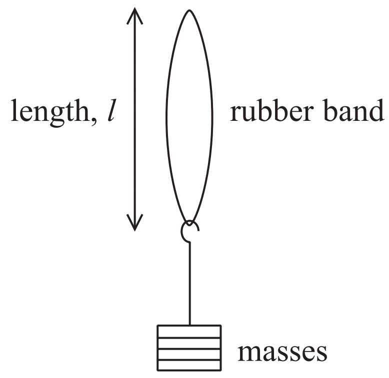
(Total 11 marks)

N 2 8 0 3 2 A 0 1 1 1 6

Leave blank

6. A student stretches a rubber band by hanging masses on it. For each mass, he measures the tension and the length of the rubber band. He records and analyses the pitch of the fundamental frequency of the sound that the rubber band makes when he plucks it.

(a) (i) The diagram shows the rubber band vibrating in its fundamental mode.



State the relationship between the wavelength, λ, of the vibration and the length, l, of the rubber band.

....

....
(1)

(ii) Explain how this standing wave is produced.

....

....

....

....

....
(3)

(b) His measurements and calculations are shown in the spreadsheet.

	A	B	C	D	E	F
1	tension/N	length/m	frequency/Hz	speed/m s^{-1}	mass per unit length/kg m^{-1}	theoretical speed/m s^{-1}
2						
3	5	0.51	45.0	45.9	0.00216	48.1
4	10	0.84	61.8	103.8	0.00131	87.4
5	15	0.94	62.9	118.3		113.2
6	20	0.99	64.0	126.7	0.00111	
7	25	1.03	79.3	163.4	0.00107	153.0
8	mass of band/kg					
9	0.0011					

Leave blank

(i) Write down a formula to show how the speeds in column D are calculated.

....

....

....

(2)

(ii) In columns E and F he makes calculations to obtain the theoretical speed of waves on the rubber band at each tension.

Calculate the missing value for cell E5.

....

....

= .... kg m^{-1}

(1)

(iii) Calculate the missing theoretical speed value for cell F6.

....

....

Speed = ... m s^{-1}

(1)

(iv) Compare and comment on the values shown in columns D and F.

....

....

....

....

....

....

....

....

(3)

Q6

(Total 11 marks)

TOTAL FOR PAPER: 60 MARKS

END

List of data, formulae and relationships

Data

Gravitational constant	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^2\,kg^{-2}}$	
Acceleration of free fall	$g = 9.81\ \mathrm{m\,s^{-2}}$	(close to Earth's surface)
Gravitational field strength	$g = 9.81\ \mathrm{N\,kg^{-1}}$	(close to Earth's surface)
Electronic charge	$e = -1.60 \times 10^{-19}\ \mathrm{C}$	
Electronic mass	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$	
Electronvolt	$1\ \mathrm{eV} = 1.60 \times 10^{-19}\ \mathrm{J}$	
Proton mass	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$	
Planck constant	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$	
Speed of light in a vacuum	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$	
Molar gas constant	$R = 8.31\ \mathrm{J\,K^{-1}\,mol^{-1}}$	
Boltzmann constant	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$	
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$	
Permeability of free space	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{N\,A^{-2}}$	

Unit 1

Physics at work, rest and play

Mechanics

Kinematic equations of motion $s = ut + \frac{1}{2}at^2$

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

Energy

% *efficiency* = [*useful energy* (or power) *output/total energy* (or power) *input*] × 100%

Heating $\Delta E = mc\Delta\theta$

Quantum Phenomena

Photon model $E = hf$

Waves and Oscillations

For waves on a wire or string $v = \sqrt{(T/\mu)}$

For a lens $P = 1/f$

BLANK PAGE

BLANK PAGE