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

Thursday 22 May 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.

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1. A student reads the following statement in a novel.

"A man weighing 70 kilograms will fall 100 metres in less than 5 seconds."

(a) Comment on the use of the word **weighing**.

.....

.....

(1)

(b) Make an appropriate calculation to check whether the statement is correct. Assume the man falls from rest.

.....

.....

.....

.....

(2)

(c) Calculate the kinetic energy of the man after falling 100 m from rest.

.....

.....

.....

.....

.....

Kinetic energy = ...

(3)

Q1

(Total 6 marks)

Leave blank

2. (a) The diagram shows a convex lens.

Explain what is meant by focal length.
You may add to the diagram above to illustrate your explanation.

.....

.....

.....

(2)

(b) It is important to ensure that as little light as possible is wasted from lighthouses. In 1822 the French physicist Augustin Fresnel developed an efficient combination of lenses and prisms.

The light source is placed at the centre of this combination. This ensures that most of the light emerges as parallel rays. Figure 1 shows the whole arrangement. Figure 2 shows a cross-section of part of the arrangement with incident rays and some of the emergent rays.

Figure 1

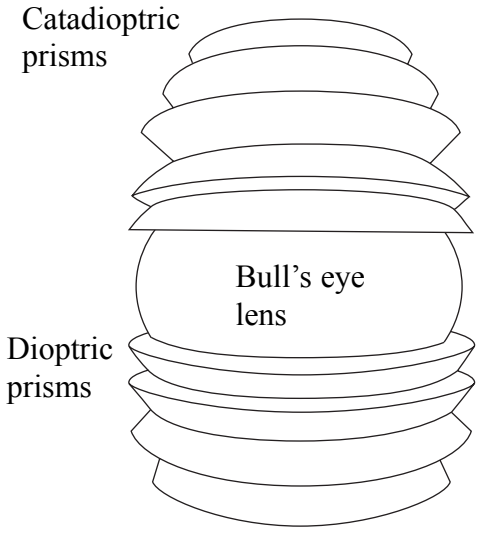

Figure 2

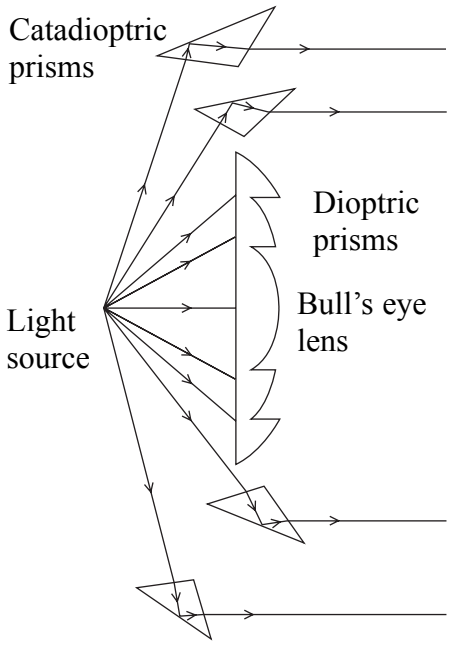

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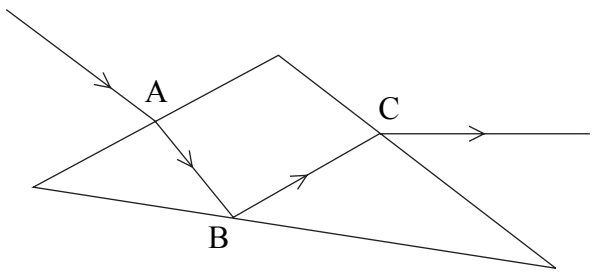
Figure 3 shows an enlarged representation of the path of a light ray through one of the catadioptric prisms. Both reflection and refraction take place.

Figure 3



(i) State the necessary condition for the reflection at B.

.....

(1)

(ii) Describe the path of the ray shown in Figure 3 as fully as possible.

.....

.....

.....

.....

.....

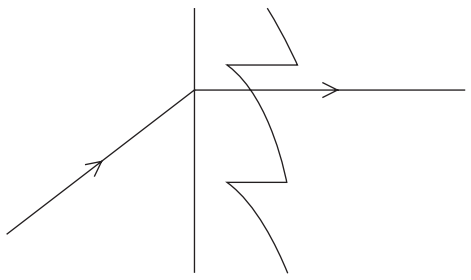
.....

(2)

Leave blank

(c) (i) Figure 4 shows part of a diagram from an internet site showing the path of a light ray through a dioptric prism.

Figure 4



State two things that are wrong with the diagram.

1. .....

.....

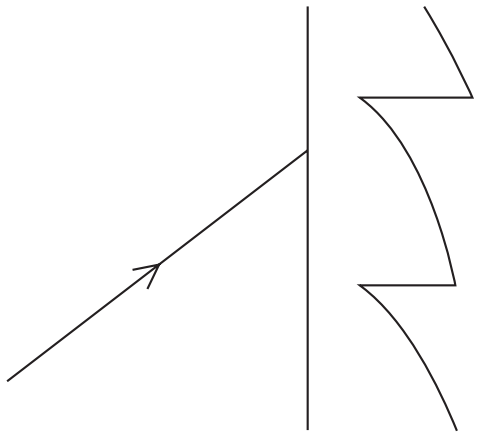
2. .....

.....

(2)

(ii) Add to Figure 5 to show the correct path of the light ray.

Figure 5



(3)

(d) The light source of the arrangement shown in Figure 2 is 0.19 m from the bull's-eye lens. Calculate the power of the lens.

.....

.....

Power = ...

(1)

Q2

(Total 11 marks)

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3. A student is surprised to read that the optimum angle for a long football throw-in is below 35°, having been taught to assume an angle of 45° for maximum range.

She investigates projectile motion with the following spreadsheet showing the variation of horizontal and vertical components of velocity with time. She has assumed there is no air resistance.

	A	B	C
1	launch speed / m s^{-1}	15.2	
2	launch angle / °	45	
3			
4	time / s	horizontal component of velocity v_h / m s^{-1}	vertical component of velocity v_v / m s^{-1}
5	0.0	10.7	10.7
6	0.2	10.7	8.8
7	0.4	10.7	6.8
8	0.6	10.7	4.9
9	0.8	10.7	2.9
10	1.0	10.7	0.9
11	1.2	10.7	–1.0
12	1.4	10.7	–3.0
13	1.6	10.7	–4.9
14	1.8	10.7	–6.9
15	2.0	10.7	–8.9
16	2.2	10.7	–10.8

(a) Write the formula which is used to calculate cell C6, the vertical component of velocity after 0.2 s.

.....

(1)

(b) The vertical component changes with time but the horizontal component is constant. Explain why the values in cells B5 to B16 are all the same.

.....

.....

(1)

Leave blank

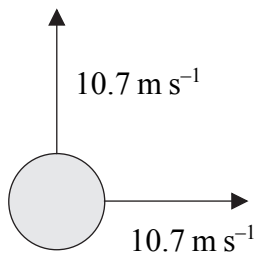
(c) What is the significance of the negative values in column C?

.....

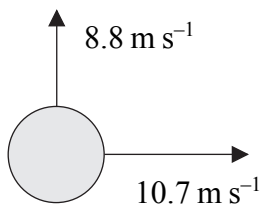
.....

(1)

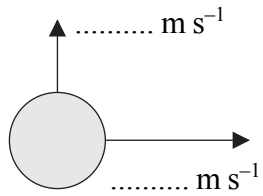
(d) The student sketches the components of the ball's velocity for three different times.



$t = 0.0$ s



$t = 0.2$ s



$t = 0.4$ s

(i) Complete the diagram for time $t = 0.4$ s.

(1)

(ii) Calculate the ball's velocity at time $t = 0.4$ s.
(Give its direction as the angle to the horizontal.)

.....

.....

.....

.....

.....

Magnitude = ...

Direction = ...

(4)

Leave blank

(e) (i) The launch angle is changed to 35°. Calculate the initial vertical and horizontal velocity components. The launch speed remains at 15.2 m s^{-1}.

.....

.....

.....

.....

.....

Vertical component of velocity = ...

Horizontal component of velocity = ...

(2)

(ii) Suggest a reason why a football thrown at 35° to the horizontal travels a greater distance than one thrown at 45°.

.....

.....

(1)

Q3

(Total 11 marks)

Leave blank

4. A problem with warming milk in a saucepan is that it can suddenly boil over if it is not watched carefully. A student decides to take some measurements to find the time it takes for the milk to reach a temperature of 96 °C so he can be ready for it without having to keep a constant watch.

(a) The student first uses an electric hotplate to warm a saucepan of water from room temperature to 96 °C. He measures the time taken to be 347 s.

He calculates the heat energy gained by the water to be 1.63×10^5 J.

Show that the rate at which heat energy is supplied to the water by the electric hotplate is about 500 W.

.....

.....

.....

(2)

(b) The student then uses the following data to calculate the time taken for milk taken from a refrigerator to reach the temperature of 96 °C.

mass of milk = 0.44 kg
initial temperature of milk = 12 °C
desired final temperature of milk = 96 °C
specific heat capacity of milk = 3800 J kg^{-1} $°C^{-1}$

(i) Show that the heat energy the milk needs to gain is about 1×10^5 J.

.....

.....

.....

(2)

(ii) Calculate the time it would take for the milk to reach the temperature of 96 °C. Assume that the student uses the same hotplate as in (a).

.....

.....

.....

Time = ...

(2)

Leave blank

(c) The student warms up the milk and is surprised when the time taken is exactly the time calculated. He had expected it to take longer because of heat losses.

(i) Explain why he might expect it to take longer.

.....

.....

.....

.....

(1)

(ii) Suggest why the calculated time was the same as the actual time.

.....

.....

.....

.....

(1)

Q4

(Total 8 marks)

Leave blank

5. A portable games console has the option of using a rechargeable battery unit which is recharged by connecting it to a mains adaptor. The adaptor has an input power of 2.5 W at a voltage of 230 V.

(a) Calculate the adaptor's input current when it is in use.

.....

.....

Current = ...

(2)

(b) The adaptor's output is marked as: 3 V 0.2 A 0.6 V A

(i) Explain why V A is a unit of power.

.....

.....

(1)

(ii) Calculate the efficiency of the adaptor.

.....

.....

Efficiency = ...

(2)

(iii) Suggest and explain a reason for the efficiency being less than 100%.

.....

.....

.....

(2)

Leave blank

(c) (i) The battery unit takes a time of 6 hours to charge fully. Assuming the adaptor's output current remains constant, calculate the amount of charge which flows from the adaptor.

.....

.....

.....

Charge = ...

(2)

(ii) Calculate the work done by the adaptor.

.....

.....

.....

Work done = ...

(3)

Q5

(Total 12 marks)

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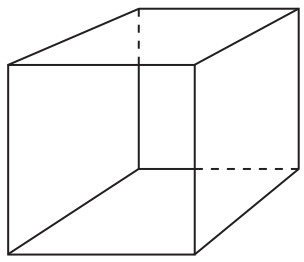
6. A student is thinking about how the physics of standing waves might affect music within a room.

She models a room as a completely empty cubic box with reflecting walls, as shown in Figure 1.

Figure 1



Suppose that sound waves travel across the room from side to side.

(a) The diagrams in Figure 2 are to represent three possible standing wave patterns that might form across the room. One has been drawn in.

(i) Add to Diagrams B and C two other possible patterns.

Figure 2

Diagram A Diagram B Diagram C

(2)

(ii) Mark with an X on Diagram A a place where the air particles are oscillating with the largest amplitude.

(1)

(iii) What is the name given to the place you have marked?

.....

(1)

Leave blank

(b) Assume the room is a cube of side 2.8 m. The speed of sound is 330 m s^{-1}.

For the standing wave pattern shown in Diagram A, calculate

(i) the wavelength of the waves,

.....

Wavelength = ...

(1)

(ii) the frequency of the waves.

.....

.....

.....

Frequency = ...

(2)

(c) Suppose music containing the full range of audible frequencies is being played in the room.

(i) Explain why the frequency calculated in (b)(ii) might sound louder than other frequencies.

.....

.....

.....

(1)

(ii) Suggest one other frequency that might also sound louder in this room.

Explain your answer.

.....

.....

.....

(2)

Leave blank

(d) Now suppose music was being played in a similar but much bigger room. Explain how the frequencies of the standing waves would be different in this bigger room.

.....

.....

.....

.....

(2)

Q6

(Total 12 marks)

TOTAL FOR PAPER: 60 MARKS

END

List of data, formulae and relationships

Data

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

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 $P = 1/f$

N 2 9 1 5 6 A 0 1 8 2 0

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