Centre No.						Paper Reference	Surname	Initial(s)
Candidate No.						6 7 5 2 / 0 1	Signature	

Paper Reference(s)

6752/01

Edexcel GCE

Salters Horners Physics

Advanced Subsidiary

Unit Test PSA2

Wednesday 16 January 2008 – Afternoon

Time: 1 hour 30 minutes

Materials required for examination	Items included with question papers
Protractor	Nil

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and 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 marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 6 questions in this question 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. Many species of bat detect their prey using ultrasound.

(a) What is meant by ultrasound?

....

(1)

(b) A bat emits short pulses of ultrasound up to 200 times each second. These pulses reflect off the prey and are detected by the bat.

(i) Explain why the bat uses pulses rather than a continuous beam of ultrasound.

....

....

....

(ii) Suggest why a high rate of pulses is important for the bat's success in hunting.

....

....

....

(2)

(c) The bat can detect any object whose size is at least as large as the wavelength of the emitted ultrasound. Calculate the size of the smallest object which can be detected for emitted ultrasound of maximum frequency 70 kHz.

Speed of ultrasound in air = 340 m s^{-1}.

....

....

....

....

Size =..

(2)

Leave blank

(d) A bat detects a moth 0.5 m away. Calculate the time between the bat emitting a pulse and detecting the reflected pulse from the moth.

....

....

....

Time = ...

(2)

(e) As the moth moves away from the bat the ultrasound is reflected with a different frequency from that emitted.

Describe how the frequency of the reflected pulse changes as the moth moves away from the bat and how this relates to the movement of the moth.

....

....

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....

(2) **Q1**

(Total 9 marks)

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2. (a) Use a diagram to show what is meant by diffraction.

(2)

(b) X-ray diffraction images such as the one shown below led scientists to the first understanding of the structure of DNA. The image shown is a negative on photographic film. The dark bands correspond to maximum X-ray detection.

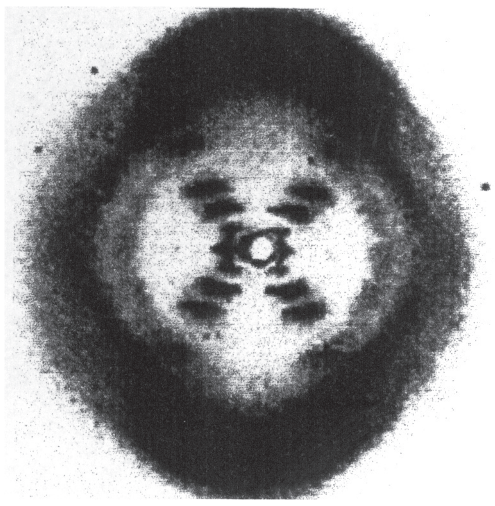


Figure 1

Use diagrams to explain how two X-ray waves overlap to produce maximum intensity.

(2)

Leave blank

(c) State two pieces of information about the structure of DNA that can be deduced from Figure 1.

1 ....

2 ....

(2)

(d) Electrons can also be used to produce diffraction patterns and hence to study materials in this way.

What does this tell you about the behaviour of electrons when passing through such materials?

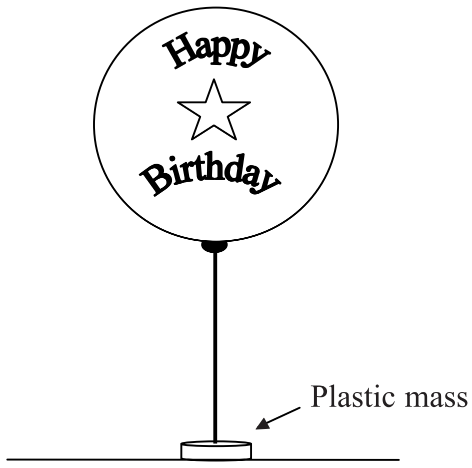
....

(1)

Q2

(Total 7 marks)

3. A child's birthday balloon is filled with helium to make it rise. A ribbon is tied to it, holding a small plastic mass designed to prevent the balloon from floating away.



(a) Add labelled arrows to the diagram of the balloon to show the forces acting on the balloon.

(2)

(b) The balloon is approximately a sphere, of diameter 30 cm. Show that the upthrust on the balloon is about 0.2 N.

The density of the surrounding air $\rho = 1.30 \text{ kg m}^{-3}$

....

....

....

....

(3)

(c) The ribbon is cut and the balloon begins to rise slowly.

(i) Sketch a diagram to show the airflow around the balloon as it rises.

(1)

Leave blank

Leave blank

(ii) What is the name of this type of airflow?

....

(1)

(d) A student suggests that if the balloon reaches terminal velocity, its motion could be described by the relationship

$$mg + 6\pi r\eta v = \frac{4}{3}\pi r^3 \rho g$$

where η = viscosity of air, m = mass of the balloon, r = radius of the balloon and v = the terminal velocity reached.

(i) Write the above relationship as a word equation.

....

(1)

(ii) The balloon has a total weight of 0.17 N. Use the equation given above to calculate the corresponding value for the terminal velocity of the balloon.

Viscosity of air = 1.8×10^{-5} N s m^{-2}

....

....

....

....

Terminal velocity = ...

(3)

(iii) Suggest a reason why the balloon is not likely to reach this calculated velocity.

....

....

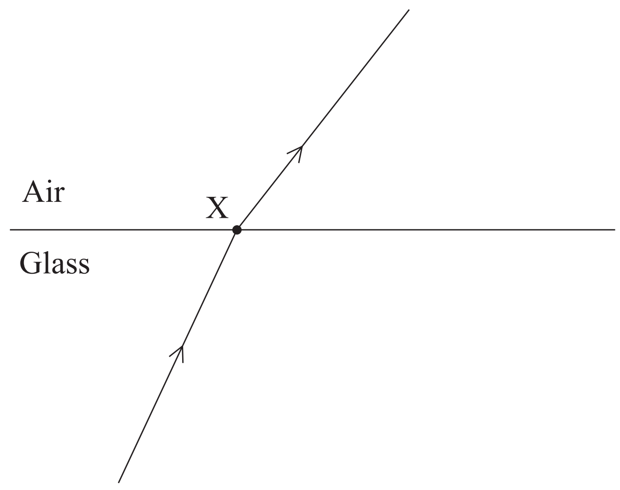
(1)

Q3

(Total 12 marks)

Leave blank

4. A student carries out an experiment to investigate the refraction of light as it passes from glass into air. He shines a ray of light through a glass block and into the air as shown.



(a) (i) Add to the diagram to show *i* the angle of incidence and *r* the angle of refraction. Measure these two angles.

i = ...

r = ...

(3)

(ii) Hence, calculate the refractive index from air to glass $_a\mu_g$.

....

....

....

$_a\mu_g$ = ...

(2)

(b) At X, some of the light takes a path different from that shown on the diagram. Add another ray to the diagram showing the path of this light.

(1)

N 2 6 4 1 4 A 0 8 1 6

Leave blank

(c) The student increases the angle of incidence and notices that, above a certain angle, the light no longer passes into the air. Explain this observation.

....

....

....

....

....

(2)

(d) Determine the largest angle of incidence which allows the light to pass into the air from this block.

....

....

....

Angle = ...

(2)

Q4

(Total 10 marks)

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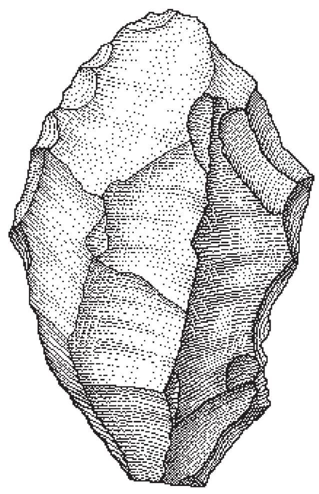
5. Thermoluminescence measurements are commonly used in the dating of flint tools, believed to have been used in the Iron Age. Such tools were constructed by heating up the flints in a fire to make it easier to chip.



(a) During testing, the outer 2-3 mm of the flint is removed leaving the central core to be tested. This core has been naturally exposed to just the gamma ray component of the background radiation.

(i) Explain why the flint core has been exposed to gamma radiation only.

....

....
(1)

(ii) What is meant by background radiation?

....
(1)

(iii) Assuming the flint has been buried in the ground since the Iron Age, suggest a possible source of the background radiation that it has been exposed to.

....
(1)

(iv) What assumption is made about background radiation for the time the flint is in the ground?

....
(1)

Leave blank

(b) The remaining core of flint is now crushed to a powder. What must be done to this powder if thermoluminescence is to be observed?

....

(1)

(c) As thermoluminescence occurs what must be measured to determine the age of the flint tool?

....

(1)

(d) Draw a labelled energy level diagram below and use it to explain how thermoluminescence occurs.

....

....

....

....

....

(4)

Q5

(Total 10 marks)

6. It is common for pens to have retractable ink refills. When a force F is applied to the button at the end of the pen, the tip of the refill is pushed out of the body of the pen. This compresses a spring in the end of the pen so that if the button is pressed again the refill is pushed back inside the pen.

(a) What sort of deformation must the spring undergo when compressed? Justify your answer.

....

....

....
(2)

In an experiment, an increasing force was used to compress this spring. The table shows the compression for each value of force.

Force / N	Compression / mm
0.0	0.0
1.0	1.9
2.0	3.8
3.0	5.6
4.0	7.5
5.0	9.4
6.0	11.3
7.0	13.1
8.0	15.0

(b) On the grid opposite, plot a graph of compression against force for this spring. Add a line of best fit to your points.
(3)

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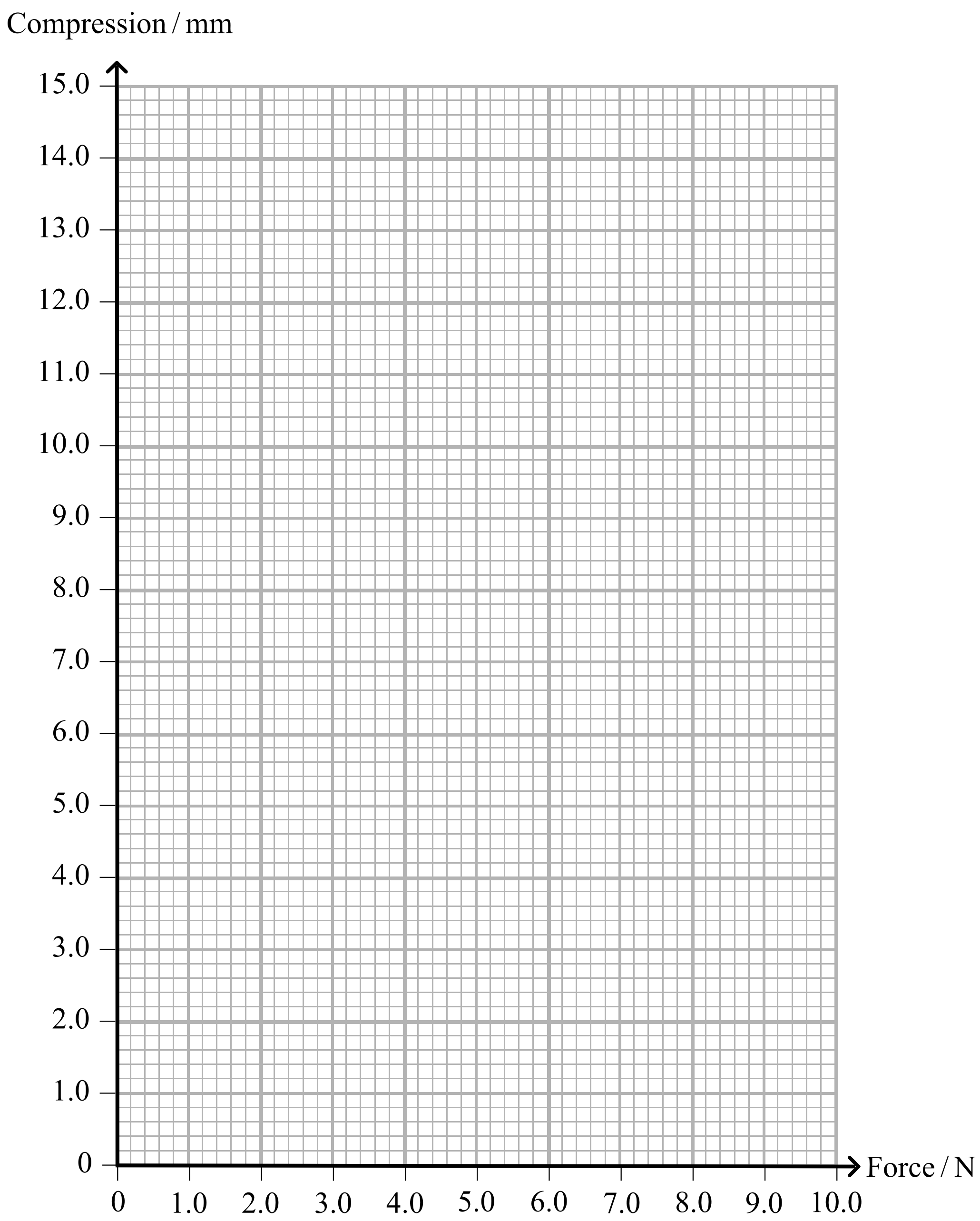
Leave blank



(c) Calculate the stiffness of this spring.

....

....

Stiffness = ...

(2)

N 2 6 4 1 4 A 0 1 3 1 6

Turn over

Leave blank

(d) In the pen, the spring is compressed by 6.0 mm. What force is needed for this compression?

....

Force = ...
(1)

(e) Calculate the elastic energy stored in the spring when its compression is 6.0 mm.

....

....

....

Elastic energy = ...
(3)

(f) The spring is replaced by another with double the length but identical in all other ways. How would the force needed to compress this new spring by 6.0 mm compare with the force needed for the original spring?

....

....
(1)

Q6

(Total 12 marks)

TOTAL FOR PAPER: 60 MARKS

END

List of data, formulae and relationships

Data

Gravitational constant	$G = 6.67 \times 10^{-11}\,\mathrm{N\,m^2\,kg^{-2}}$	
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 $s = ut + \frac{1}{2}at^2$

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

Momentum and 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 $P = 1/f$

Unit 2

Physics for life

Quantum Phenomena

Photoelectric effect $hf = \phi + \frac{1}{2}mv^2_{max}$

Materials

Elastic strain energy $E_{el} = F\Delta x / 2$

Stress $\sigma = F/A$

Strain $\varepsilon = \Delta x / x$

Young modulus $E = \sigma / \varepsilon$

Stokes' law $F = 6\pi\eta rv$

Waves and Oscillations

Refraction $\mu = \sin i / \sin r = v_1/v_2$

For lenses $1/v + 1/u = 1/f$

$P = P_1 + P_2$

Mathematics

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