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

Paper Reference(s)

6755/02

Edexcel GCE

Salters Horners Physics

Advanced Level

Unit Test PSA5(ii)

Thursday 14 June 2007 – Morning

Time: 1 hour

Materials required for examination	**Items included with question papers**
Nil	Nil

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
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.
There are five questions in this paper.
The total mark for this paper is 40.
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.
N20967A
W850/R6755/57570 6/6/6/6/3,200

N 2 0 9 6 7 A 0 1 1 2

Turn over

edexcel advancing learning, changing lives

Leave blank

1. Before a train can be seen approaching a station, it can be heard through a whistling sound in the rails.

(a) Calculate how much faster the sound travels through steel rails than through air.

Speed of sound in air = 330 $m\,s^{-1}$
Density of steel = $7.9 \times 10^3\,kg\,m^{-3}$
Young modulus of steel = $2.1 \times 10^{11}\,N\,m^{-2}$

....

....

....

....

....

$$\frac{\text{Speed of sound in steel}}{\text{Speed of sound in air}} = \text{.......................................}$$

(3)

(b) Suggest why sound travels much faster through steel rails than through air.

....

....

....

....

(2)

(c) Also, sound through the air is reduced in intensity according to the relationship $F = \frac{L}{4\pi d^2}$. Suggest why this is not an appropriate relationship for the attenuation of the sound through the rails.

....

....

....

....

(2)

Q1

(Total 7 marks)

Leave blank

2. Buildings situated close to railway lines should be constructed in a manner which minimises noise and vibrations from passing trains.

(a) Discuss how a suitable choice of construction materials could reduce the noise which enters the building.

....

....

....

....

....

....

(3)

(b) Vibrations could cause parts of the building to resonate. Describe the meaning of the word **resonate** in this context.

....

....

....

....

(2)

(c) Some buildings, which are subject to vibrations, are constructed on springs.

(i) Suggest how springs could prevent these buildings from vibrating.

....

....

....

....

(2)

(ii) It is said that such buildings would also suffer less damage in the event of an earthquake. Comment on this statement.

....

....

(1)

Q2

(Total 8 marks)

Leave blank

3. Meteosat is a weather satellite which is in a geostationary orbit around the Earth, i.e. it stays above the same point on the Earth's surface all the time.

(a) Write down an expression for the gravitational force on this satellite, mass m, in an orbit of radius r around the Earth, mass M.

....

....
(1)

(b) Hence derive an expression for the gravitational field strength at a distance r from the centre of the Earth.

....

....
(1)

(c) Use this, together with an expression for the centripetal acceleration, to show that the radius r of the geostationary orbit is given by

$$r^3 = \frac{GMT^2}{4\pi^2}$$

where T is the time for one orbit of the satellite.

....

....

....

....

....
(3)

(d) Calculate this radius.

Mass M of the Earth = 6.0×10^{24} kg.

....

....

....

Radius = ...
(2)

Leave blank

(e) The mass and speed of the satellite do not appear in the above equation. Explain whether a satellite could remain in geostationary orbit with

(i) a greater mass.

....

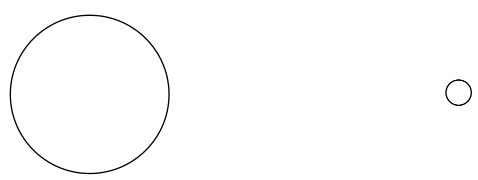
....

(ii) a greater speed.

....

....
(2)

(f) Explain why a satellite has to be over the equator to remain in a geostationary orbit. You may use the diagram to help your explanation.



....

....

....

....
(2)

Q3

(Total 11 marks)

Leave blank

4. The Joint European Torus (JET) was a nuclear fusion experiment near Oxford in England. JET was the first experiment to produce a controlled nuclear fusion reaction.

(a) Describe the process of nuclear fusion.

....

....

....

....
(2)

(b) Explain why it is difficult to maintain the conditions for nuclear fusion in a reactor.

....

....

....

....
(2)

(c) The nuclei which fused were two isotopes of hydrogen. Why should the fusing of hydrogen nuclei release energy?

....

....

....

....
(2)

Q4

(Total 6 marks)

BLANK PAGE

Turn over

Leave blank

5. In July 2003 there was an attempt to fly a manned, spherical balloon to a height of about forty kilometres. At this height the atmospheric pressure is only one thousandth of its value at sea level and the balloon would have expanded to a diameter of 210 m. The temperature at this height is –60 °C. The attempt failed because the thin skin of the balloon split while it was being filled with helium at sea level.

(a) Make an estimate of the temperature at sea level, and hence obtain the volume of helium the balloon would have contained at sea level if it had been filled successfully.

....

....

....

....

....

....

....

....

....

....

....

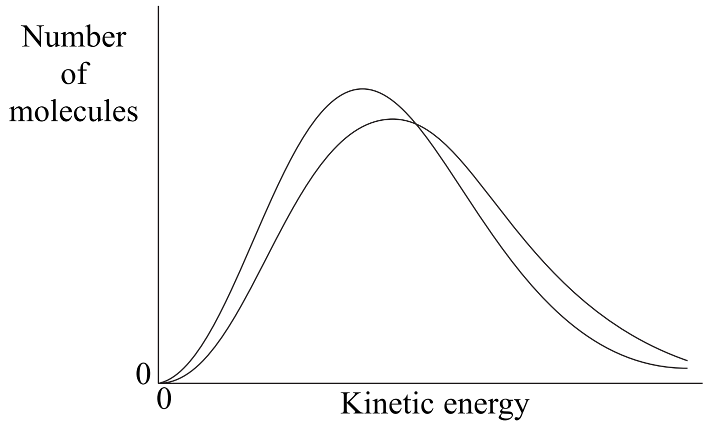
....

....

....

(6)

(b) The graphs below show the distributions of kinetic energy of the molecules in the atmosphere at sea level and at 40 km.



Label the sea level graph and give a reason for your answer.

....

....

....

(2)

Q5

(Total 8 marks)

TOTAL FOR PAPER: 40 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 $P = 1/f$

N 2 0 9 6 7 A 0 1 0 1 2

Unit 2

Physics for life

Quantum Phenomena

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

Materials

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

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 $P = P_1 + P_2$

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

Mathematics

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

Unit 4

Moving with physics

Mechanics

Motion in a circle $v = \omega r$

$T = 2\pi/\omega$

Energy

Attenuation $I = I_0 e^{-\mu x}$

Nuclear Physics

Mass-energy $\Delta E = c^2\Delta m$

Quantum Phenomena

de Broglie wavelength $\lambda = h/p$

Fields

Electric field $E = F/Q$

$E = V/d$

In a magnetic field $F = BIl\sin\theta$

$F = Bqv\sin\theta$

$r = p/BQ$

Energy stored in capacitor $W = \frac{1}{2}QV$

Capacitor discharge $Q = Q_0 e^{-t/RC}$

Magnetic Effects of Currents

Faraday's and Lenz's Laws $E = -d(N\Phi)/dt$

Unit 5

Physics from creation to collapse

Mechanics

Two masses in mutual orbit $1/T^2 = G(m_1 + m_2)/4\pi^2 r^3$

Energy

Radiant energy flux $F = L/4\pi d^2$

Molecular kinetic theory $\frac{1}{2}m\langle c^2\rangle = \frac{3}{2}kT$

Nuclear Physics

Radioactive decay $\mathrm{d}N/\mathrm{d}t = -\lambda N$

$\lambda = \ln 2/t_{1/2}$

$N = N_0 \mathrm{e}^{-\lambda t}$

Waves and Oscillations

Waves in a solid $v = \sqrt{(E/\rho)}$

Redshift of electromagnetic radiation $z = \Delta\lambda/\lambda \approx \Delta f/f \approx v/c$

Cosmological redshift $z = \Delta\lambda/\lambda = H_0 d/c$

Simple harmonic motion $a = -\omega^2 x$

$a = -A\omega^2 \cos\omega t$

$x = A\cos\omega t$

$$E = E_\mathrm{k} + E_\mathrm{p} = \tfrac{1}{2}mv^2 + \tfrac{1}{2}kx^2$$

$$= \tfrac{1}{2}m\omega^2(A^2 - x^2) + \tfrac{1}{2}m\omega^2 x^2$$

$$= \tfrac{1}{2}m\omega^2 A^2$$