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

Friday 8 June 2007 – Morning

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, 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 six 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. Kevlar is a very useful and **strong** material. It can withstand temperatures of up to 300 ºC and shows no loss of strength or signs of becoming **brittle** at temperatures as low as −196 ºC. It undergoes **plastic deformation** when subjected to a sudden force and is used to make a variety of objects, from bullet-proof vests to bicycle tyres and canoes.

(a) Explain what is meant by the words in bold in the above passage.

strong ....

brittle ....

plastic deformation ....

....

(3)

One type of Kevlar, Kevlar 49, is used to make cloth.

The table gives details of some properties of a single fibre of Kevlar 49.

Diameter / mm	Breaking stress / 10^9 Pa
0.254	3.80

(b) Use information from the table to show that the maximum force which can be exerted on a single fibre of Kevlar 49 without breaking it is about 200 N.

....

....

....

(3)

(c) The material has a Young modulus of 1.31×10^{11} Pa. Calculate the extension of the Kevlar 49 fibre when a stress of 2.00×10^9 Pa is applied to a 1.10 m length.

....

....

....

Extension = ...

(3)

Leave blank

(d) Kevlar is a polymer. What is meant by the term polymer?

....

....

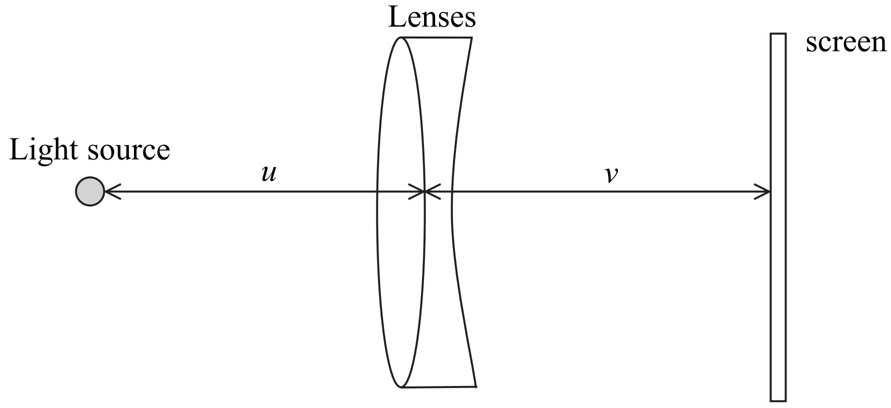
(2)

Q1

(Total 11 marks)

Leave blank

2. In an experiment, **two** lenses, one converging and one diverging, were placed together, as shown, between a light source and a screen.



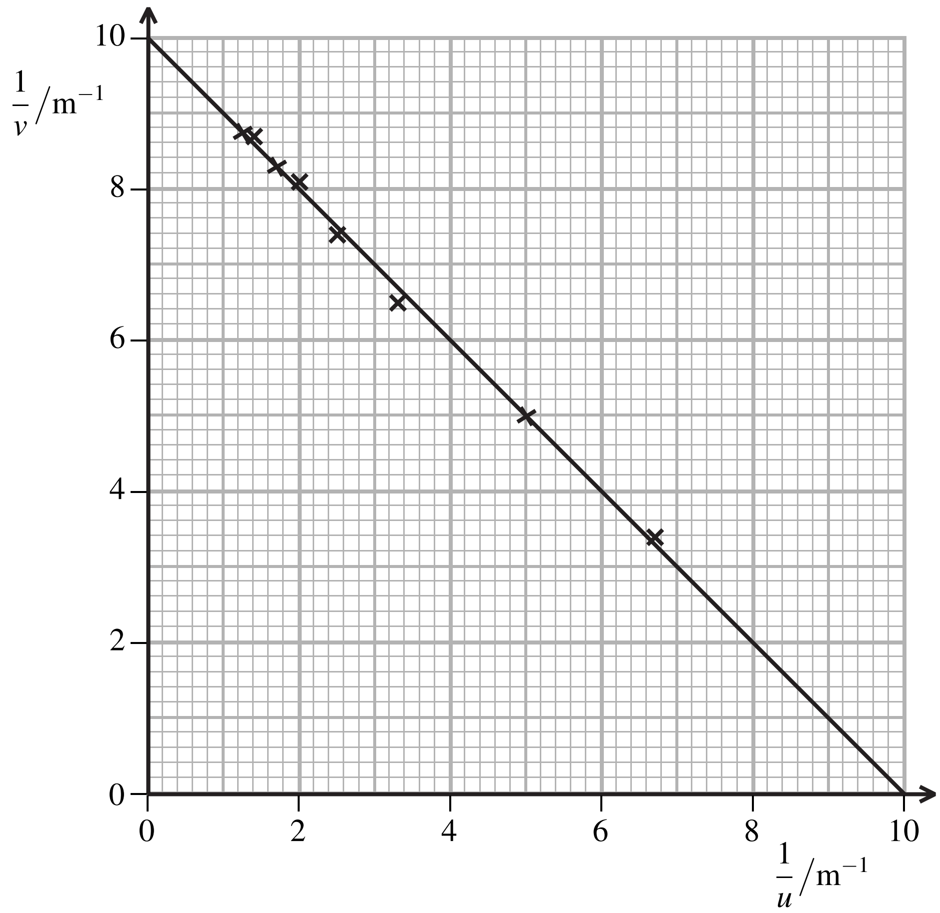
When the screen was moved back and forth, there was one point at which a clear image of the source could be seen on it.

(a) Which of the two lenses has the greater power? Explain your answer.

....

....
(2)

(b) The object distance u was set and the screen was moved until a clear image appeared a distance v from the lens. This was repeated for several values of u. The following graph shows the results obtained from this experiment.



N 2 6 1 5 6 A 0 4 1 6

Take readings from the graph and determine the equation of the line.

....

....

....

....
(3)

(c) Calculate the power of the lens combination.

....

....

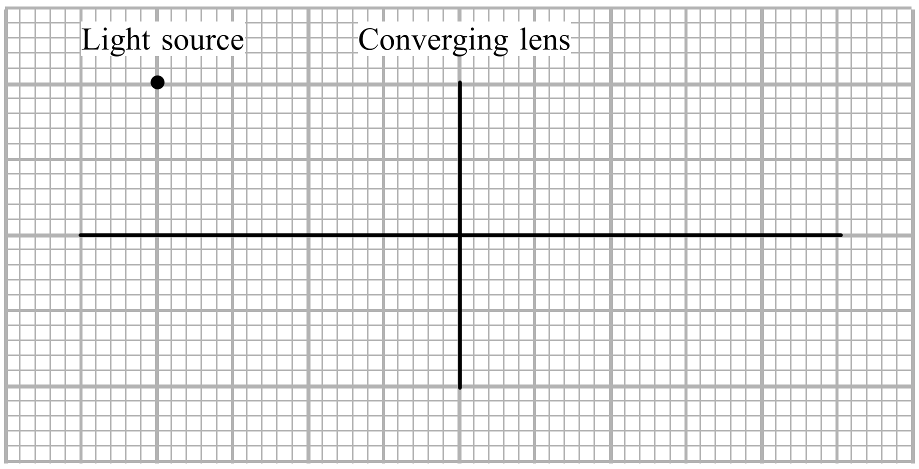
Power = ...
(2)

(d) The converging lens has a power of 20 D. What is the power of the diverging lens?

....

Power = ...
(1)

(e) The experiment is repeated using just the converging lens. This lens is placed 20 cm in front of the light source. Complete the following ray diagram and use it to determine the distance needed between the lens and the screen to produce a clear image.



Distance from lens to screen = ...
(4)

(Total 12 marks)

Leave blank

Q2

N 2 6 1 5 6 A 0 5 1 6

Turn over

Leave blank

3. Heinrich Hertz first observed the photoelectric effect in 1887. He detected a current when light fell on a metal surface. In later research scientists measured the work function ϕ of several metals.

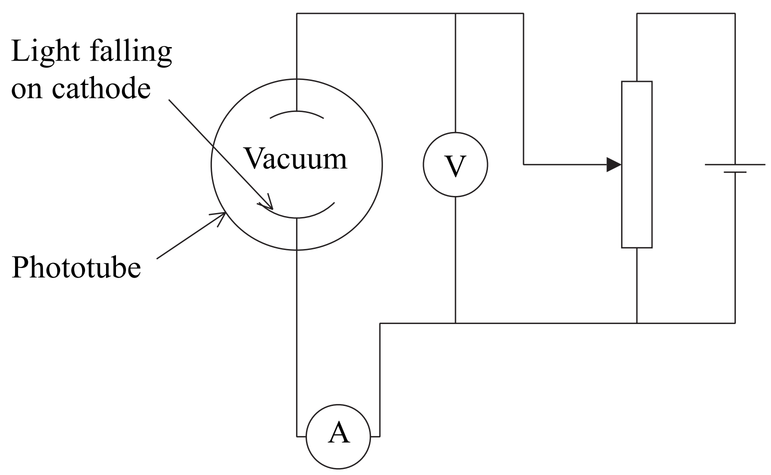
(a) What is meant by work function?

....

....

(1)

(b) To measure the work function, the scientists used a phototube, consisting of a metal cathode and anode in an evacuated tube. Light falling on the cathode produced a current in the circuit.



Explain the production of this current. Use the terms photon and photoelectron in your explanation.

....

....

....

....

....

(3)

(c) State the effect on the released photoelectrons of an increase in

(i) the intensity of the light used,

....

(ii) the frequency of the light used.

....

(2)

N 2 6 1 5 6 A 0 6 1 6

Leave blank

(d) Light of wavelength 4.2×10^{-7} m is shone onto the metal cathode. Calculate the photon energy.

....

....

Photon energy = ...

(2)

(e) The metal is sodium, with a work function of 2.7 eV. Calculate the maximum kinetic energy in eV that a photoelectron could gain from this photon.

....

....

....

Maximum kinetic energy = ... eV

(2)

(f) When the potential difference between the cathode and anode was reversed the current was reduced.

(i) Why does reversing the potential difference reduce this current?

....

....

....

(1)

(ii) State the stopping potential that would result in zero current being detected for the sodium metal.

....

....

(1)

Q3

(Total 12 marks)

N 2 6 1 5 6 A 0 7 1 6

Turn over

Leave blank

4. At night, particles in the atmosphere scatter moonlight causing it to become plane polarised.

(a) What is meant by the term plane polarised?

....

....

(2)

(b) Scientists have discovered recently that the dung beetle can navigate using polarised moonlight. The beetles hunt for fresh dung. When they find some each beetle makes a small ball. To keep this ball for itself it needs to remove it quickly. The beetle pushes the ball along with its back legs while moving with its front legs and keeping its head down. Using the plane of the polarised moonlight as a guide lets the beetle run away in a straight line.

The beetles have sensors in their eyes which act as polarising filters.

Describe and explain the effect of rotating a polarising filter in front of a source of plane polarised light.

....

....

....

....

(3)

Leave blank

(c) Scientists held a polarising filter over one of the beetles as it was retreating with a dung ball. The filter changed the polarisation plane by 90°.

Suggest how the beetle responded.

....

....
(1)

(d) Suggest what would happen to the beetles on nights when the moon is not visible.

....
(1)

Q4

(Total 7 marks)

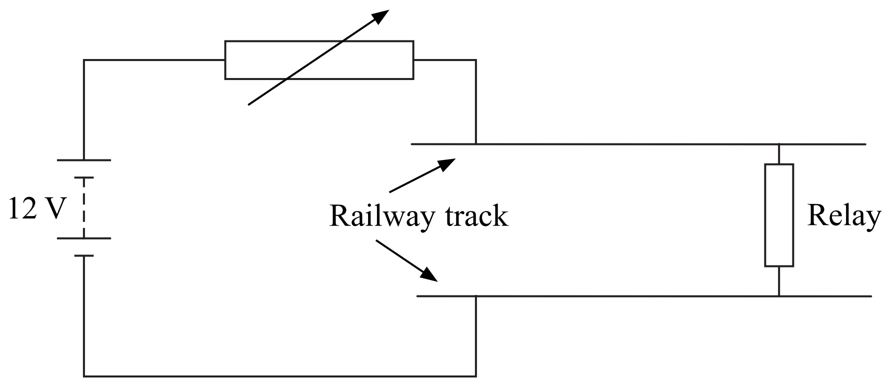
N 2 6 1 5 6 A 0 9 1 6

Turn over

Leave blank

5. Railway signals rely on a combination of resistors to trigger the correct colour of light. Figure 1 shows a simplified version of the circuit used. The relay can be considered to be equivalent to a resistor. When the potential difference across the relay is above 3 V it switches on the green signal. The signal is red when the relay potential difference is less than this value.

Figure 1



(a) The ratio of potential differences across the resistors in this circuit varies as the resistances change. What name is given to a circuit such as this which makes use of multiple resistors in this way?

....

(1)

(b) The variable resistor is set to 10 Ω. The relay resistance is 5.0 Ω. Calculate the potential difference across the relay. Assume the railway track has negligible resistance.

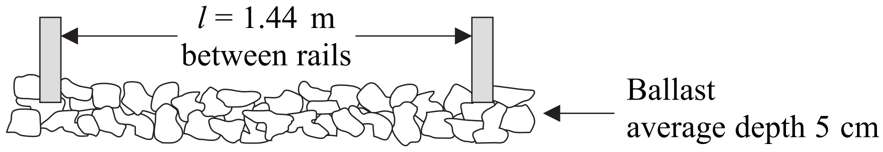
....

Potential difference = ...

(1)

(c) The track is laid in sections of 100 m, with a length l between the rails. Each section of track is insulated from the next section. Ballast, usually made of broken up rock, is used to support the track as shown in Figure 2.

Figure 2



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(i) The ballast has a depth of 5.0 cm and a resistivity of $3.4 \times 10^2\,\Omega$ m. Show that the resistance of this 100 m section of ballast between the rails is about 100 Ω.

....

....

....

(3)

(ii) The ballast resistance is in parallel with the relay. Calculate the combined resistance due to the above section of ballast and the 5.0 Ω relay.

....

....

Resistance = ...

(2)

(iii) How does the value of the potential difference across the relay and ballast compare with the potential difference across the relay alone?

....

....

(1)

(iv) When a train is on the track the current flows through the wheel axle from rail to rail causing a short-circuit in parallel with the relay. What would the effect be on the potential difference across the relay?

....

(1)

(v) When wet the ballast resistance drops considerably and may become as small as 0.5 Ω. Explain the consequence of this drop in resistance in terms of the signal lights.

....

....

....

....

(2)

Q5

(Total 11 marks)

Leave blank

6. Volcanoes vary considerably in the strength of their eruptions. A major factor in determining the severity of the eruption is the viscosity of the magma material. Magma with a high viscosity acts as a plug in the volcano allowing very high pressures to build up. When the volcano finally erupts it is very explosive. Once magma is out of the volcano it is called lava.

(a) How would the flow of high viscosity lava differ from that of lava with a low viscosity?

....

(1)

(b) What would need to be measured to make a simple comparison between the viscosities of two lava flows?

....

....

(1)

(c) When the lava is exposed to the atmosphere it cools rapidly. What effect would you expect this cooling to have on the lava's viscosity?

....

(1)

(d) When lava is fast flowing, changes to its viscosity disrupt the flow, making it no longer laminar. Use labelled diagrams to show the difference between laminar and turbulent flow.

....

....

....

(3)

Leave blank

(e) Different types of lava have different viscosities. The least viscous type has a viscosity of about 1×10^3 N s m^{-2} whereas a silica-rich lava has a viscosity of 1×10^8 N s m^{-2}. What type of scale would be used to display these values on a graph?

....

(1)

Q6

(Total 7 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	$hf = \phi + \frac{1}{2}mv_{max}^2$

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

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