Candidate Name	Centre Number	Candidate Number

GCE A level

1324/01

PHYSICS

ASSESSMENT UNIT PH4: OSCILLATIONS AND FIELDS

P.M. THURSDAY, 27 January 2011

1½ hours

For Examiner's use only.		
1.	10	
2.	10	
3.	4	
4.	11	
5.	18	
6.	6	
7.	9	
8.	12	
Total	80	

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ADDITIONAL MATERIALS

In addition to this examination paper, you will require a calculator and a **Data Booklet**.

INSTRUCTIONS TO CANDIDATES

Use black ink or ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The total number of marks available for this paper is 80.

The number of marks is given in brackets at the end of each question or part question.

You are reminded of the necessity for good English and orderly presentation in your answers.

You are reminded to show all working. Credit is given for correct working even when the final answer given is incorrect.

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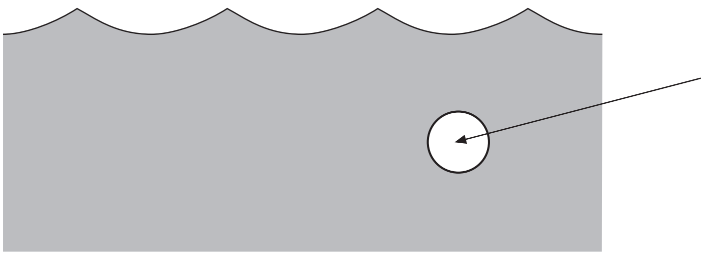
1. A bubble of krypton (Kr) gas is formed underwater. The bubble has a volume of $2.14 \times 10^{-6}\,m^3$ and contains 1.70×10^{20} krypton molecules each of mass 1.39×10^{-25} kg. The pressure of the gas inside the bubble is 300 kPa.



(a) Calculate:

(i) the rms speed of the Kr molecules in the bubble; [3]

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(ii) the relative molecular mass of Kr; [2]

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(iii) the temperature of the gas inside the bubble. [3]

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(b) The bubble is initially 20 m below the surface of the water. Explain, giving your reasoning, what happens to the size of the bubble as it rises. [2]

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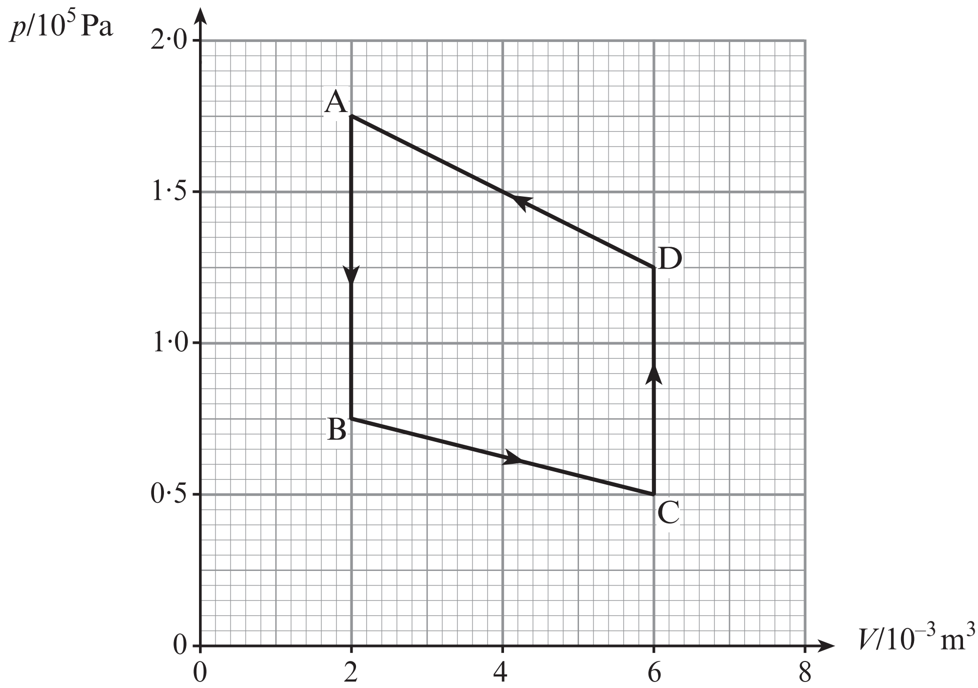
2. A gas undergoes the cycle ABCDA as shown in the p-V graph below.



(a) Explain very briefly why no work is done during AB or CD. [1]

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(b) Calculate the work done by the gas during process DA. [3]

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(c) The first law of thermodynamics is usually written

$\Delta U = Q - W$

State the meaning of each term. [3]

ΔU ....

Q ....

W ....

(d) Calculate the heat flow out of the gas during the cycle ABCDA. [3]

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3. Describe an everyday circumstance where resonance occurs. Your example of resonance may be useful or it may be an example where resonance should be avoided. You should explain what is your oscillating system, what provides the driving force and what is the result of the resonance. A diagram may (or may not) assist your answer. [4]

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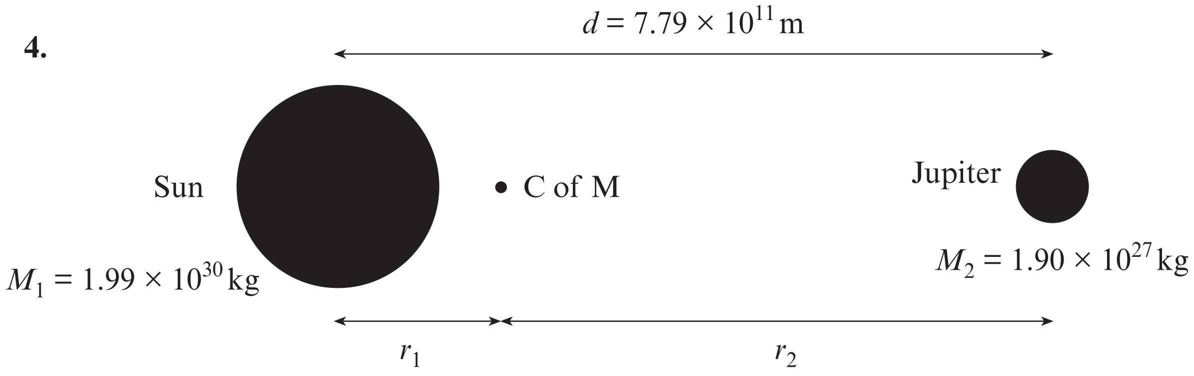

Diagram not to scale

(a) Calculate r_1, the distance from the centre of the Sun to the centre of mass (C of M) of the Sun-Jupiter system. [2]

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(b) Show that the period of orbit of Jupiter is nearly 12 years. [3]

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(c) Show that the orbital speed of the Sun is around $12.5\,\mathrm{m\,s^{-1}}$. [2]

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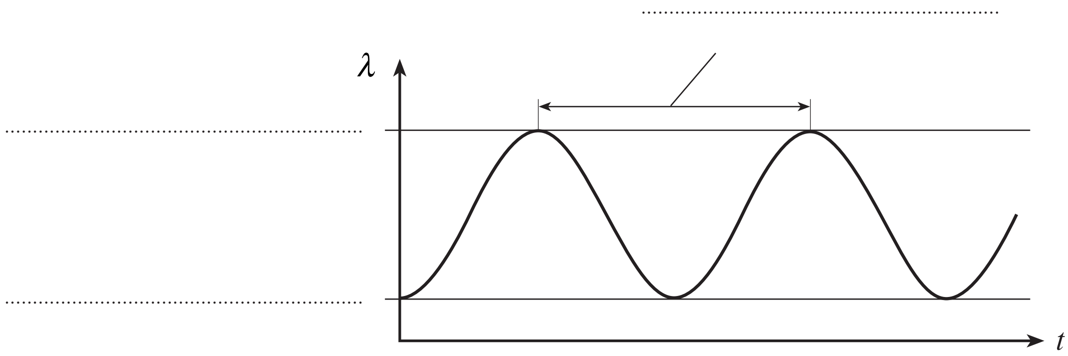
Examiner only

(d) An alien outside the Solar System analyses light from the Sun and finds that sunlight is Doppler shifted due to the Sun's orbital speed of 12.5 m s^{-1}. An absorption line of wavelength 1.28 µm is used to measure the Doppler shift. The graph shows the variation of wavelength of the 1.28 µm line as observed by the alien. Place the correct values on the dotted lines (you will need to calculate Doppler shift values for full marks). [4]



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Turn over.

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5. A child stands on a park roundabout as it rotates with a constant angular speed of $1.40\ \text{rad}\,\text{s}^{-1}$.

The child's mass is 32.5 kg and she stands a distance r from the centre of the roundabout.

(a) Show that the frictional force exerted on the child is given by $F = 63.7\,r$, where F is in newtons and r is in metres. [3]

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(b) The maximum possible value of the frictional force is 114 N. Explain briefly why the child cannot stand further than about 1.80 m from the centre of the roundabout. [2]

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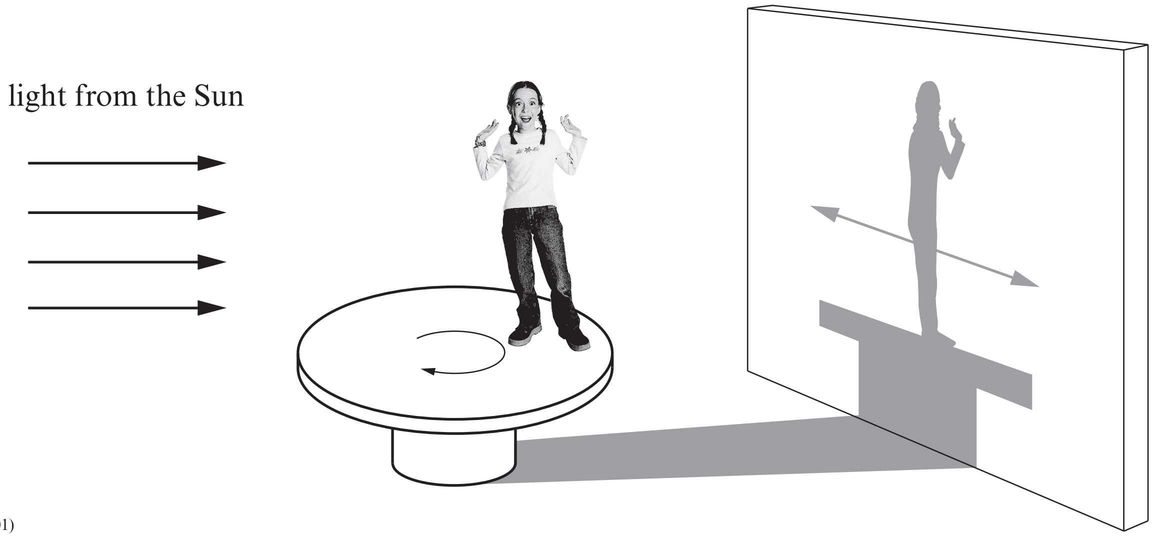
As the Sun sets, the girl's shadow is cast on a wall. The shadow now performs simple haromic motion with an amplitude of 1.80 m with $\omega = 1.40\ \text{rad}\,\text{s}^{-1}$.



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(c) Calculate the period of oscillation. [2]

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(d) Calculate the maximum speed of the shadow. [2]

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(e) Calculate the maximum acceleration of the shadow and state where this occurs. [3]

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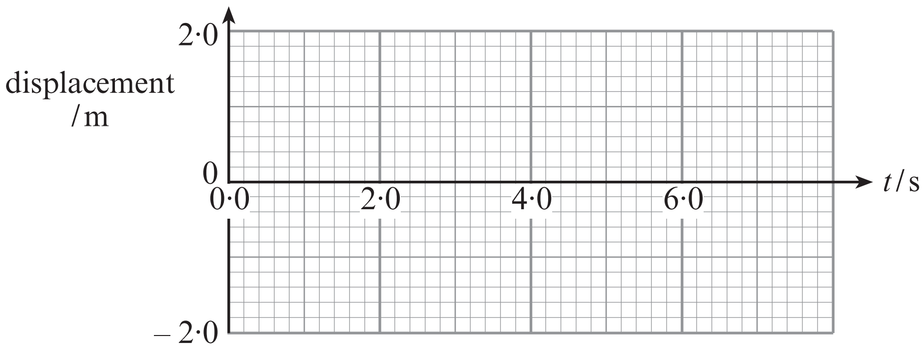
(f) At time $t = 0$, the shadow is at the centre of its motion and moving in the positive x-direction. Sketch a graph of the shadow's displacement against time on the grid below. [2]



(g) Calculate, using an appropriate equation, **two** values of t within the first six seconds when the displacement of the shadow is –1.00 m. [4]

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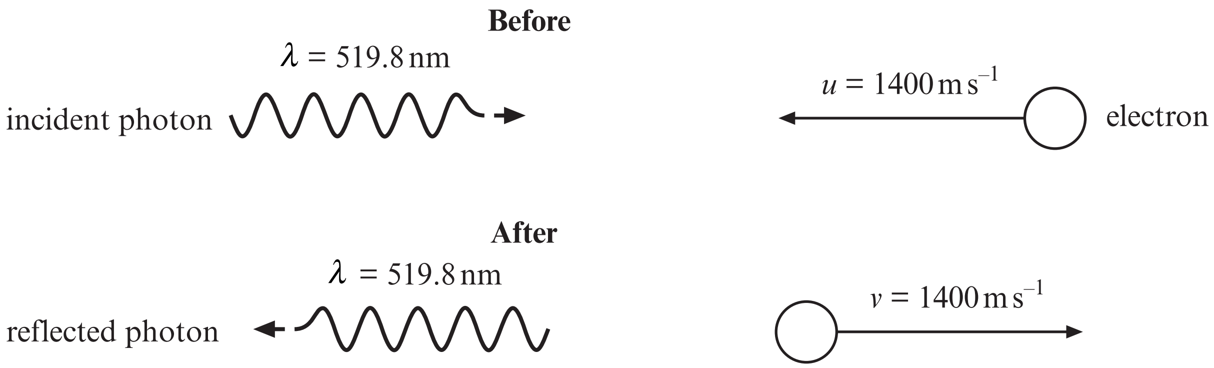
6. A photon collides with an electron and rebounds as shown below.

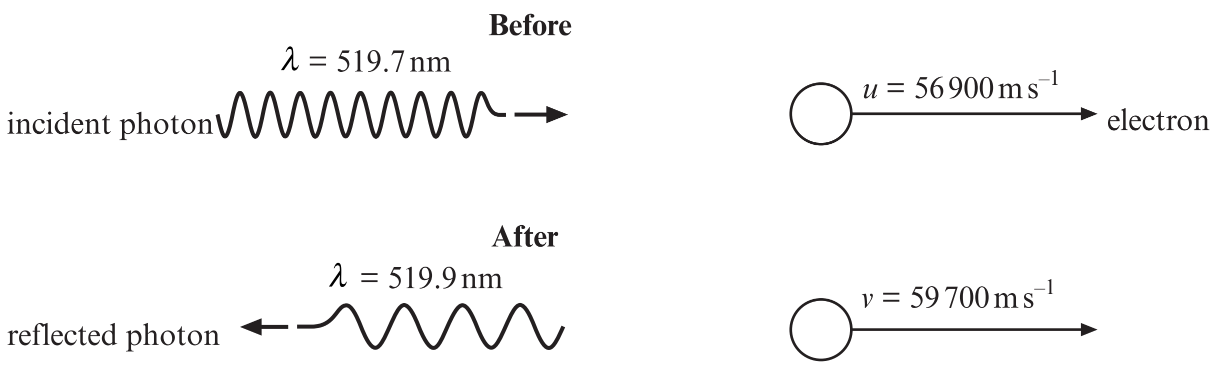


(a) Calculate the momentum of the photon. [1]

(b) Show that the combined momentum of the system before the collision is $0.00 \times 10^{-27}\,\text{kg m s}^{-1}$ (i.e. nearly zero). [2]

(c) Explain briefly whether or not momentum is conserved in the collision. [1]

(d) The same collision is witnessed by an observer moving very quickly to the left.



Without further calculations, explain how conservation of **energy** still applies to this collision. [2]

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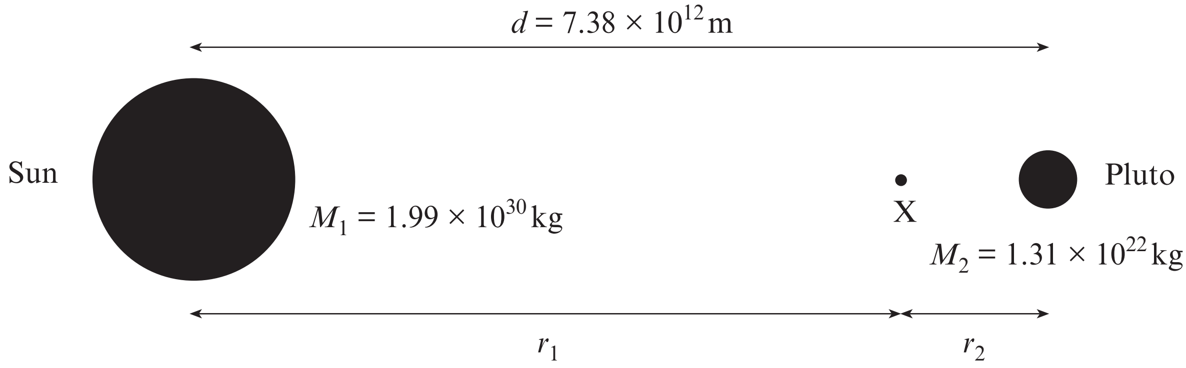

Diagram not drawn to scale.

(a) Calculate the gravitational force of attraction between the Sun and Pluto. [2]

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(b) At point X, the resultant gravitational field is zero.

By equating the gravitational fields due to the Sun and due to Pluto, calculate the ratio $\frac{r_2}{r_1}$ and hence r_2. [4]

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(c) The distance between Pluto and the Sun decreases from 7.38×10^{12} m to 4.44×10^{12} m due to its elliptical orbit.

Apply the principle of conservation of energy to calculate the corresponding increase in kinetic energy of the system. [3]

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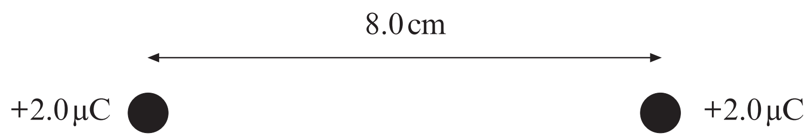
Turn over.

Examiner only

8. The diagram shows an isolated negative charge (–Q).

(a) Sketch electric field lines and equipotential surfaces for the negative charge. [3]

(b) Two point charges are placed a distance 8.0 cm apart as shown in the diagram below.



(i) Calculate the force between the two charges. [2]

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(ii) One of the two +2.0 μC charges is released from rest while the other is held stationary. Use the concept of potential or potential energy to calculate the maximum kinetic energy that the charge will eventually acquire. [3]

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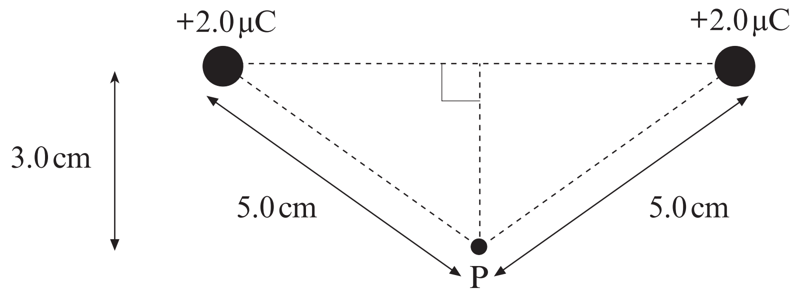
(c) Calculate the resultant electric field at P in the setup shown below. [4]



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