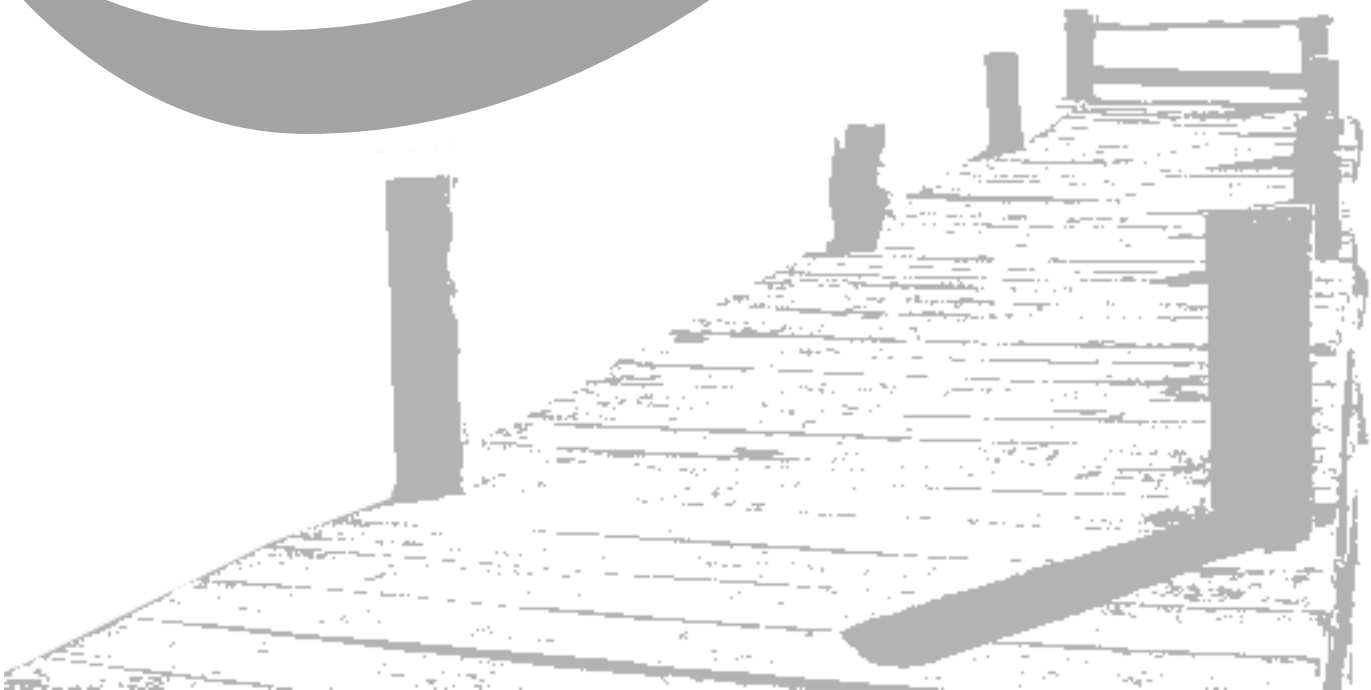
GCE
AS and A Level

Physics A

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 4B: Approved specimen question paper

Version 1.1



Surname		Other Names	
Centre Number						Candidate Number				
Candidate Signature										

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General Certificate of Education
2010
Advanced Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

version 1.1

PHYSICS A PHYA4/2
Unit 4 Fields and Further Mechanics

Section B

SPECIMEN PAPER

Time allowed: 1 hour

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- A *Data and Formula Booklet* is provided as a loose insert.

Information
- The maximum mark for this paper is 50.
- The marks for the questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers. You will be assessed on your quality of written communication where indicated in the question.

For Examiner's Use			
Number	Mark	Number	Mark
1		**5**	
2		**6**	
3			
4			
Total (Column 1)			
Total (Column 2)			
TOTAL			
Examiner's Initials			

1 A golf club undergoes an *inelastic* collision with a stationary golf ball and gives it an initial velocity of 60 m s^{-1}. The ball is in contact with the club for 15 ms and the mass of the ball is 4.5×10^{-2} kg.

(a) Explain what is meant by an inelastic collision.

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(1 mark)

(b) Calculate

(i) the change in momentum of the ball,

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(ii) the average force the club exerts on the ball.

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(4 marks)

Total 5 marks

2 (a) A spring, which hangs from a fixed support, extends by 40 mm when a mass of 0.25 kg is suspended from it.

(i) Calculate the spring constant of the spring.

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(ii) An additional mass of 0.44 kg is then placed on the spring and the system is set into vertical oscillation. Show that the oscillation frequency is 1.5 Hz.

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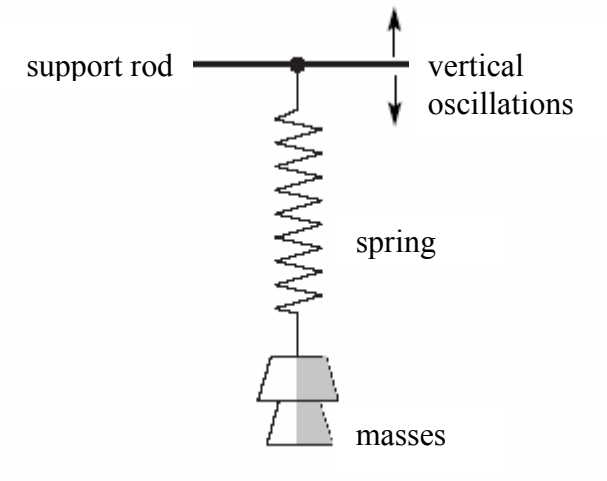
(4 marks)

(b) With both masses still in place, the spring is now suspended from a horizontal support rod that can be made to oscillate vertically, as shown in **Figure 1**, with amplitude 30 mm at several different frequencies.

Figure 1



The response of the masses suspended from the spring to the vertical oscillations of the support rod varies with frequency. Describe and explain, as fully as you can, the motion of the masses when the support rod oscillates at a frequency of (i) 0.2 Hz, (ii) 1.5 Hz and (iii) 10 Hz.
The quality of your written answer will be assessed in this question.

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(6 marks)

Total 10 marks

3 Communications satellites are usually placed in a *geo-synchronous* orbit.

(a) State **two** features of a geo-synchronous orbit.

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(2 marks)

(b) The mass of the Earth 6.00×10^{24} kg and its mean radius is 6.40×10^{6} m.

(i) Show that the radius of a geo-synchronous orbit must be 4.23×10^{7} m,

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(ii) Calculate the increase in potential energy of a satellite of 750 kg when it is raised from the Earth's surface into a geo-synchronous orbit.

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(6 marks)

(c) Satellites in orbits nearer the Earth than geo-synchronous satellites may be used in the future to track road vehicles.

(i) State and explain **one** reason why geo-synchronous satellites would not be suitable for such a purpose.

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(ii) Give **two** points you would make in arguing for or against tracking road vehicles. Explain your answers.

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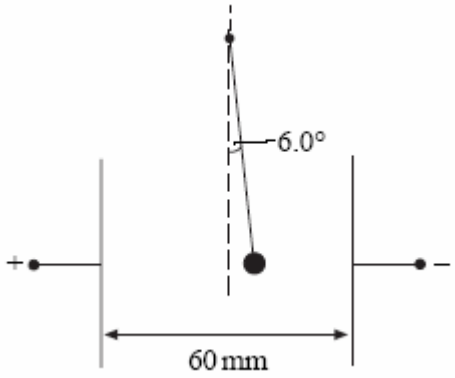
(4 marks)

Total 12 marks

4 A small charged sphere of mass 2.1×10^{-4} kg, suspended from a thread of insulating material, was placed between two vertical parallel plates 60 mm apart. When a potential difference of 4200 V was applied to the plates, the sphere moved until the thread made an angle of 6.0º to the vertical, as shown in **Figure 2**.

Figure 2



(a) Show that the electrostatic force F on the sphere is given by $F = mg \tan 6.0º$, where m is the mass of the sphere.

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(3 marks)

(b) Calculate the charge on the sphere.

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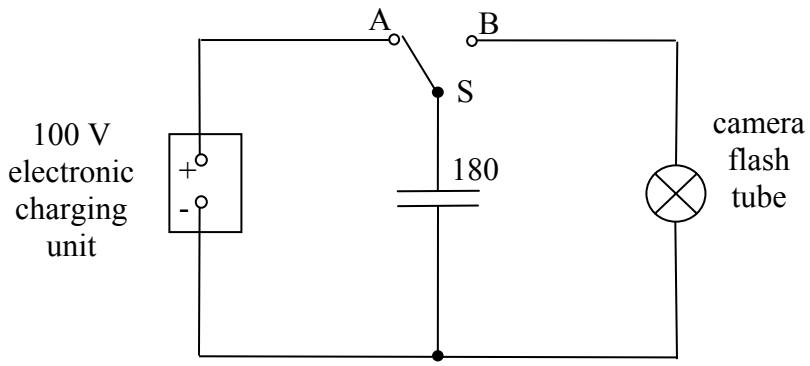
(3 marks)

Total 6 marks

5 The flash tube in a camera produces a flash of light when a 180 μF capacitor is discharged across the tube.

Figure 3



(a) The capacitor is charged to a pd of 100 V from an electronic charging unit in the camera, as shown in **Figure 3**.
Calculate,

(i) the energy stored in the capacitor,

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(ii) the work done by the battery.

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(2 marks)

(b) When a photograph is taken, switch S in **Figure 3** is automatically moved from A to B and the capacitor is discharged across the flash tube. The discharge circuit has a resistance of 1.5 Ω. Emission of light from the flash tube ceases when the pd falls below 30 V.

(i) Calculate the duration of the light flash.

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(ii) The capacitor in the circuit in **Figure 3** is replaced by a capacitor of greater capacitance. Discuss the effect of this change on the photograph image of a moving object.

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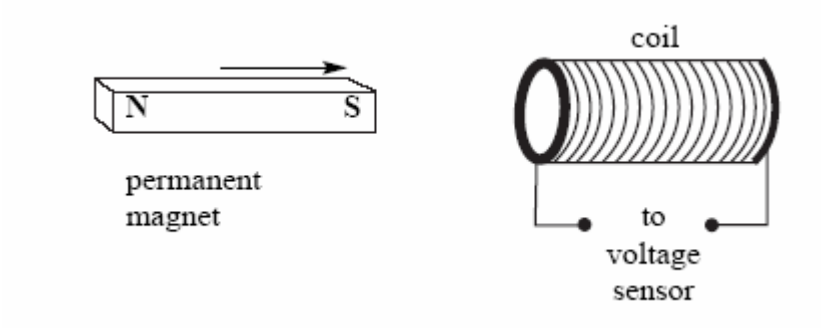
(4 marks)

Total 6 marks

6 (a) In an experiment to illustrate electromagnetic induction, a permanent magnet is moved towards a coil, as shown in **Figure 4**, causing an emf to be induced across the coil.

Figure 4



Using Faraday's law, explain why a larger emf would be induced in this experiment if a stronger magnet were moved at the same speed.

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(3 marks)

(b) A conductor of length l is moved at constant speed v so that is passes perpendicularly through a uniform magnetic field of flux density B, as shown in **Figure 5**.

Figure 5

Show that the induced emf, ϵ, across the ends of the conductor is given by

$$\epsilon = Blv.$$

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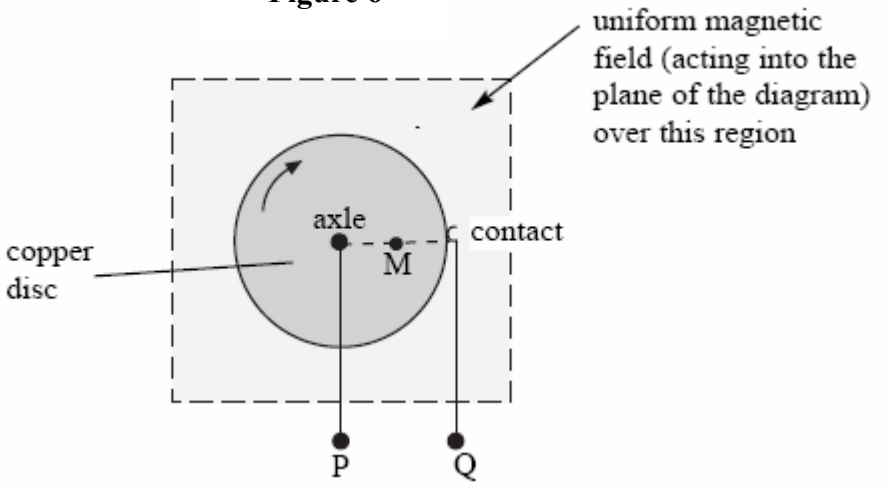
(3 marks)

(c) A simple electrical generator can be made from a copper disc, which is rotated at right angles to a magnetic field, directed into the plane of the diagram (**Figure 6**). An emf is developed across the terminals P (connected to the axle) and Q (connected to a contact on the edge of the disc).

Figure 6



The radius of the disc is 64 mm and it is rotated at 16 revolutions per second in a uniform magnetic field of flux density 28 mT.

(i) Calculate the angular speed of the disc.

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(ii) Calculate the linear speed of mid-point M of a radius of the disc.

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(iii) Hence, or otherwise, calculate the emf induced across the terminals P and Q.

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(5 marks)

Total 11 marks