Paper 2 style questions

Answer **all** the questions

1 a Figure 1a shows a 500 g mass suspended from two strings. The mass hangs vertically and is in equilibrium.

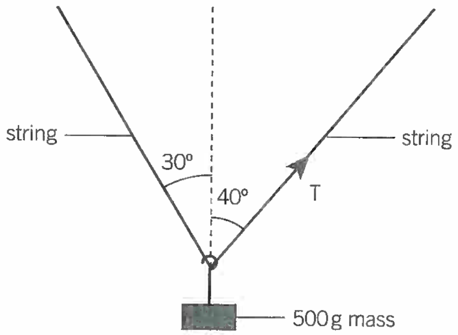


Figure 1a

(i) Determine the tension T in one of the strings. *(4 marks)*

(ii) Describe how a student could determine the value of T experimentally in the laboratory. State one possible limitation of the experiment. *(2 marks)*

b Figure 1b shows an experiment designed by a student.

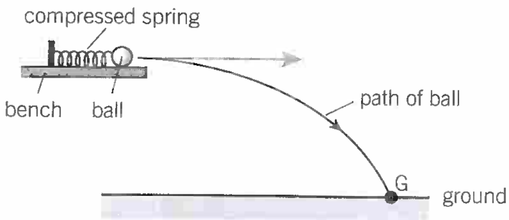


Figure 1b

A metal ball is pushed against a compressible spring and then released. The ball has a horizontal velocity of $1.5\,\mathrm{m\,s^{-1}}$. The ball leaves the horizontal bench and lands on the ground below at point **G**.

Assume friction has negligible effect on the motion of the ball.

(i) Describe the energy changes of the **ball** from the instant it is held against the compressed spring to the instant just before it lands at **G**. *(4 marks)*

(ii) The ball takes 0.42 s to travel from top of the bench to **G**.

Calculate the height of the bench from the ground. *(3 marks)*

2 Figure 2 shows a simple pendulum. It consists of a metal ball of diameter 2.00 cm and a thin string.

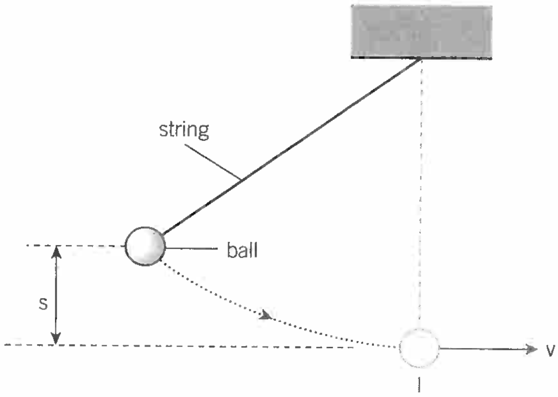


Figure 2

The ball is raised to a vertical height s and then released.

a Show that its speed v at the bottom of its swing is given by the equation $v^2 = 2gs$, where g is the acceleration of free fall. *(3 marks)*

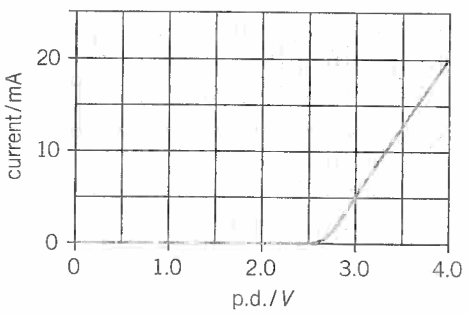
b Describe how a student could determine the speed v at the bottom of the pendulum's swing in the laboratory. State one possible limitation of your method. *(4 marks)* c The table below shows **some** of the results obtained by a student.

s/m	v/m s^{-1}	v^2/m^2 s^{-2}
0.210	2.03 ± 0.15	4.12 ± 0.61
0.330	2.54 ± 0.18	
0.410	2.83 ± 0.25	8.01 ± 1.42
0.490	3.10 ± 0.30	9.61 ± 1.86

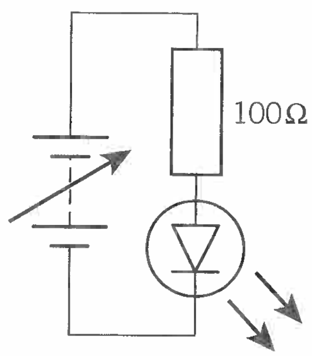
(i) Copy and complete the table by determining the missing value for v^2 and the absolute uncertainty in this value. *(3 marks)*

(ii) The student plots a graph of v^2 against s. Explain how the graph may be used to determine the acceleration of free fall g. *(2 marks)*

3 Figure 2 shows the *I-V* characteristic of a blue light-emitting diode (LED).



▲ Figure 3a



▲ Figure 3b

a (i) The data for plotting the *I-V* characteristic is collected using the components shown in Figure 3b. By drawing on a copy of Figure 3b complete the circuit showing how you would connect the two meters needed to collect these data. *(1 mark)*

(ii) When the current in the circuit of Figure 3b is 20 mA calculate the terminal potential difference across the supply.

(3 marks)

b The energy of each photon emitted by the LED comes from an electron passing through the LED. The energy of each blue photon emitted by the LED is 4.1×10^{-19} J.

(i) Calculate the energy of a blue photon in electron volts.

(1 mark)

(ii) Explain how your answer to (i) is related to the shape of the curve in Figure 3a. *(2 marks)*

c Calculate for a current of 20 mA

(i) the number n of electrons passing through the LED per second,

(2 marks)

(ii) the total energy of the light emitted per second,

(2 marks)

(iii) the efficiency of the LED in transforming electrical energy into light energy.

(2 marks)

d The energy of a photon emitted by a red LED is 2.0 eV. The current in this LED is 20 mA when the p.d. across it is 3.4 V. Draw the *I-V* characteristic of this LED on a copy of Figure 3a. *(2 marks)*

Q4 G482 June 2014 paper

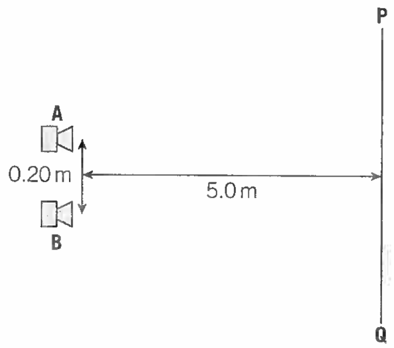
4 a Interference of waves from two sources can only be observed when the waves are coherent.

Explain the meaning of

(i) *interference,* (*2 marks*)

(ii) *coherence.* (*1 mark*)

b Figure 4 shows two microwave transmitters **A** and **B** 0.20 m apart. The transmitters emit microwaves of equal amplitude in phase and of wavelength 30 mm. A detector, moved along the line **PQ** at a distance of 5.0 m from **AB**, detects regions of high and low intensity forming an interference pattern.



▲ Figure 4

(i) Use the ideas of path difference or phase difference to explain how the interference pattern is formed. (*3 marks*)

(ii) Calculate the separation between one region of high intensity and the next along the line **PQ**. (*2 marks*)

(iii) State the effect, if any, on the position and intensity of the maxima when each of the following changes is made, separately, to the experiment.

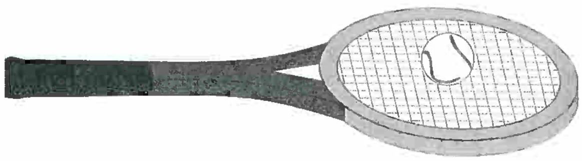
1 The amplitude of the transmitted waves is doubled. (*2 marks*)

2 The separation between the transmitters is halved. (*2 marks*)

3 The phase of transmitter **A** is reversed so that there is now a phase difference of 180° between the waves from **A** and **B**. (*2 marks*)

Q6 G482 Jan 2012 paper

5 a Figure 5 shows a ball of mass 0.050 kg resting on the strings of a tennis racket held horizontally.



▲ Figure 5

(i) On a copy of Figure 5, draw and label arrows to represent the **two** forces acting on the ball. (*2 marks*)

(ii) Calculate the difference in magnitude between the two forces on the ball when the racket is accelerated upwards at $2.0\,m\,s^{-2}$. (*2 marks*)

b The ball is dropped from rest at a point 0.80 m above the racket head. The racket is fixed rigidly. Assume that the ball makes an elastic collision with the strings and that any effects of air resistance are negligible.

Calculate

(i) the speed of the ball just before impact, (*2 marks*)

(ii) the momentum of the ball just before impact, (*1 mark*)

(iii) the change in momentum of the ball during the impact, *(1 mark)*

(iv) the average force during the impact for a contact time of 0.050 s. *(1 mark)*

c The two forces you have drawn in **(a)(i)** are not a pair of forces as required by Newton's third law of motion. However each of these forces does have a corresponding equal and opposite force to satisfy Newton's third law. Describe these equal and opposite forces and state the objects on which they act. *(4 marks)*

Q1 2824 Jan 2010 paper

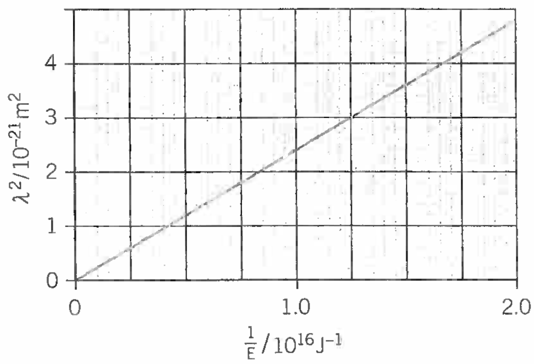
6 **a** Show that the momentum p of a particle is given by the equation $p = \sqrt{2Em}$, where m is the mass of the particle and E is its kinetic energy. *(3 marks)*

b Slow-moving neutrons from a nuclear reactor are used to investigate the structure of complex molecules such as DNA. Neutrons can be diffracted by DNA. The mass of a neutron is 1.7×10^{-27} kg.

(i) Calculate the de Broglie wavelength of a neutron of kinetic energy 6.2×10^{-21} J. *(4 marks)*

(ii) Suggest why these slow-moving neutrons can be diffracted by DNA. *(1 mark)*

c Charged particles are accelerated in a laboratory by a group of scientists. The de Broglie wavelength of the particles is λ and their kinetic energy is E. Figure 6 shows a graph of λ^2 against $\frac{1}{E}$ for these accelerated particles.



▲ **Figure 6**

Use Figure 6 to determine the mass m of the particles. *(4 marks)*