2012-DSE
PHY

PAPER 1B

B

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HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2012

Candidate Number									

PHYSICS PAPER 1

SECTION B : Question-Answer Book B

This paper must be answered in English

INSTRUCTIONS FOR SECTION B

(1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5, 7 and 9.

(2) Refer to the general instructions on the cover of the Question Paper for Section A.

(3) Answer **ALL** questions.

(4) Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) Graph paper and supplementary answer sheets will be provided on request. Write your Candidate Number, mark the question number box and stick a barcode label on each sheet, and fasten them with string **INSIDE** this Question-Answer Book.

(6) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

Question No.	Marks
1	**7**
2	**4**
3	**7**
4	**11**
5	**8**
6	**8**
7	**10**
8	**8**
9	**7**
10	**7**
11	**7**

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Section B: Answer **ALL** questions. Parts marked with * involve knowledge of the extension component. Write your answers in the spaces provided.

1. Cappuccino is an Italian style coffee topped with a layer of frothy milk (Figure 1.1).

Figure 1.1

Frothy milk is made by bubbling steam through milk, which is held in a metallic jug (Figure 1.2). Steam is ejected from the steam wand of a cappuccino machine (Figure 1.3).

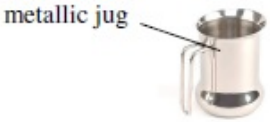

Figure 1.2

Figure 1.3

Given: specific latent heat of vaporization of water = 2.26×10^6 J kg^{-1}
specific heat capacity of water = 4200 J kg^{-1} ºC^{-1}
specific heat capacity of steam = 2000 J kg^{-1} ºC^{-1}
specific heat capacity of milk = 3900 J kg^{-1} ºC^{-1}

(a) Calculate the total amount of heat released when 20 g of steam at 110ºC cools to 100ºC and condenses to water at 100ºC. (3 marks)

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(b) 20 g of steam at 110ºC is bubbled through 200 g of milk at 15ºC to make frothy milk. Using the result in (a), estimate the temperature of the frothy milk. (2 marks)

(c) Would the actual temperature of frothy milk be higher than, equal to or lower than the value found in (b) ? Explain. (2 marks)

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*2. A gas bubble rises from the bottom of a lake to the water surface. Its radius increases from 0.8 cm to 1.0 cm.

(a) If the gas pressure in the bubble at the water surface is 1.01×10^5 Pa, find the gas pressure in the bubble when it is at the bottom of the lake. Assume that the temperature of the gas in the bubble remains constant. (2 marks)

(b) Use kinetic theory to explain the change in gas pressure in the bubble as its volume increases. (2 marks)

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*3.

Figure 3.1

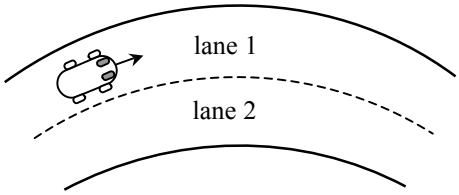

Figure 3.1 shows the top view of a horizontal road with two circular lanes. A car of mass 1200 kg moves with constant speed in lane 1 of radius 45 m.

(a) (i) Name the force that provides the centripetal force for the car. If the maximum value of this force is 8000 N, calculate the highest speed of the car such that it can keep in lane 1. (3 marks)

(ii) Suppose the car takes lane 2 instead of lane 1 and the maximum value of the force providing the centripetal force is still 8000 N. Would the car's highest speed in lane 2 be smaller than, larger than or the same as that found in (a)(i) ? Explain. (2 marks)

(b) Explain why the chance of skidding would increase if there are oil patches on the road surface in Figure 3.1. (2 marks)

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4. Train A initially travels at a speed of 60 m s^{-1} along a straight horizontal railway. Another identical train B travels ahead of A in the same direction on the same railway. Due to mechanical failure, B is only travelling at 20 m s^{-1} (Figure 4.1).

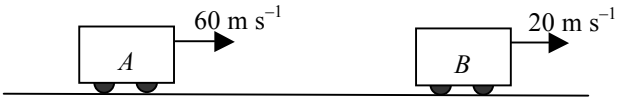
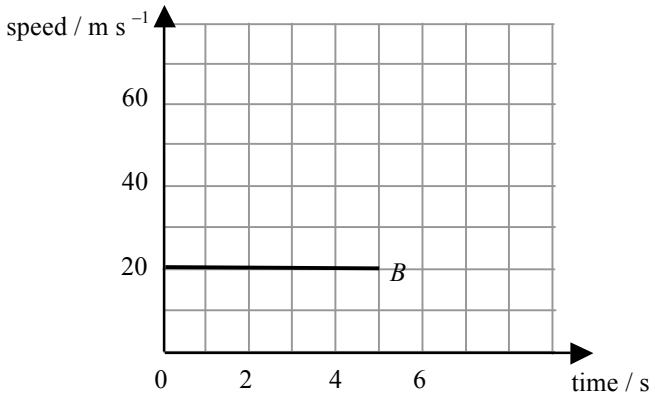


Figure 4.1

At time t = 0, A and B are x m apart, the captain of A receives a stopping signal and immediately A decelerates at 4 m s^{-2} while B continues to travel at 20 m s^{-1}. A eventually collides with B after 5 s. Neglect air resistance.

(a) (i) Find the speed of A just before collision. (2 marks)

(ii) The graph below shows how the speed of B varies with time within this 5 s. Sketch on the same graph the variation of the speed of A within the same period. (1 mark)



(iii) Based on the above information, determine the separation x of the two trains at t = 0. (3 marks)

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(b) *A* and *B* locked together after collision.

(i) Find the speed of them just after collision. (2 marks)

(ii) If the collision time between the trains is 0.2 s and the mass of each train is 5000 kg, find the magnitude and direction of the average impact force acted on *A* during collision. (3 marks)

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5. (a) A bow and arrow is a kind of projectile weapon. The string of a bow is drawn taut by a hunter with a force of 60 N and an arrow of mass 0.2 kg is held stationary as shown in Figure 5.1.

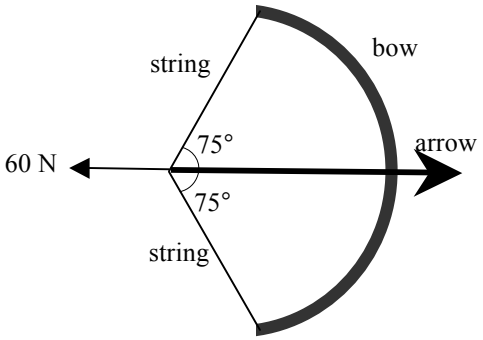

Figure 5.1

(i) Find the tension of the string. Neglect the weight of the arrow. (2 marks)

(ii) Estimate the energy stored in the taut string if the initial speed of the arrow is 45 m s^{-1} when released. Assume that the bow is rigid and neglect the mass of the string. (2 marks)

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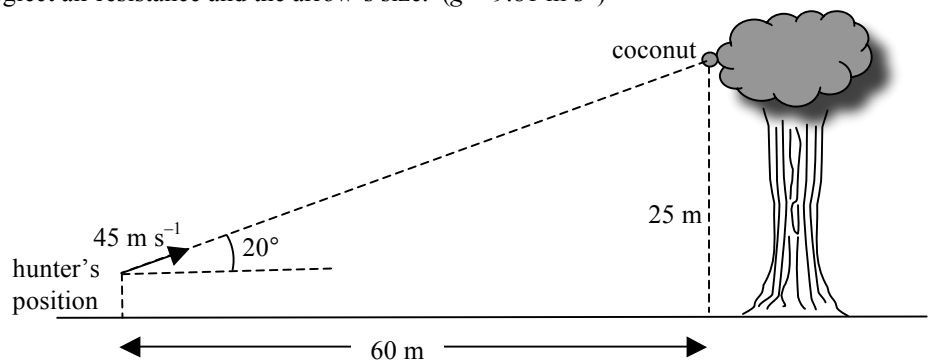
*(b) The hunter stands at about 60 m away from a tree as shown in Figure 5.2. He uses the bow to release the arrow in order to shoot a coconut held by a monkey (not shown in the figure) in the tree. The coconut is at a height of 25 m from the ground. The hunter aims directly at the coconut and the arrow leaves the bow at a speed of 45 m s^{-1} making an angle of 20º to the horizontal. At the moment the hunter releases the arrow, the monkey drops the coconut such that it falls vertically from rest. Neglect air resistance and the arrow's size. (g = 9.81 m s^{-2})

Figure 5.2



(i) Find the time taken for the arrow to hit the coconut. (2 marks)

(ii) Find the height of the coconut from the ground at the moment the arrow hits it. (2 marks)

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6. In a ripple tank, circular water waves are produced by two vibrators S_1 and S_2 of the same frequency vibrating in phase. Their separation is 3.5 λ, where λ is the wavelength of the waves. Figure 6.1 shows the two circular waves propagating on the water surface at a certain moment. Line L is a line connecting all points P which have path difference $S_1P - S_2P = 0$.

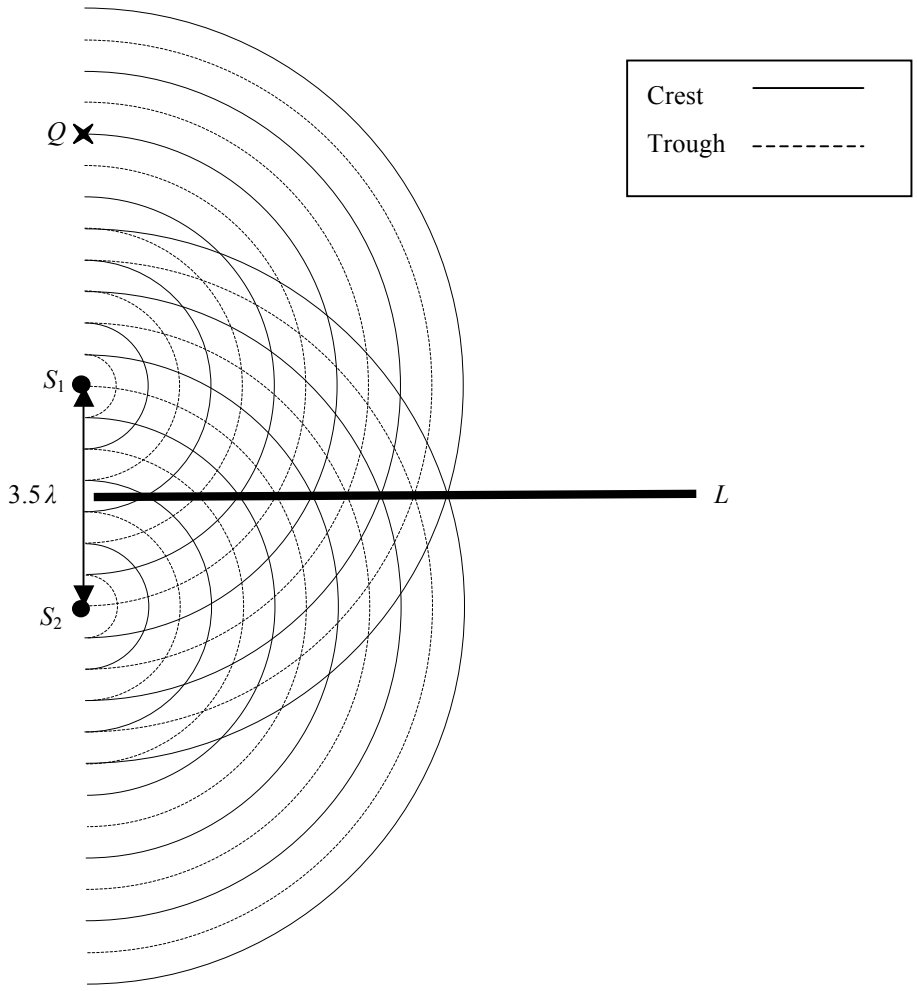

Figure 6.1

(a) Draw and label a line in Figure 6.1 connecting all points P which have path difference

(i) $S_1P - S_2P = \lambda$ (label it as L_1)

(ii) $S_1P - S_2P = -\frac{3}{2}\lambda$ (label it as L_2)

What would happen to L_1 and L_2 if the separation between S_1 and S_2 is reduced slightly ? (3 marks)

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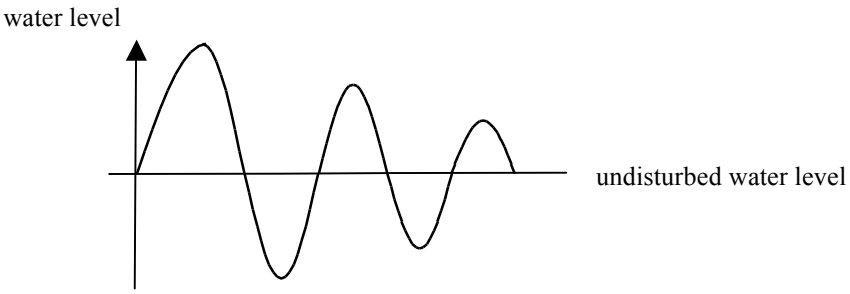
(b) Figure 6.2 shows the profile of the water level along line L at a certain instant. Sketch on the same figure the profile at a time $\frac{T}{2}$ later, where T is the period of the water waves. (1 mark)

Figure 6.2



(c) Q is a point on the line joining S_1 and S_2 as shown in Figure 6.1. State the kind of interference that occurs at Q and give a reason for this occurrence. (2 marks)

*(d) A similar double-slit set-up is used for the demonstration of the interference of light in which the separation between slits S_1 and S_2 is 0.5 mm and the screen is at 2.5 m from the slits. Calculate the average separation between adjacent bright fringes on the screen for a monochromatic light of wavelength 550 nm. (2 marks)

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7. A luminous object *PQ* is placed 15 cm in front of a convex lens *AB* as shown in Figure 7.1.

(a) The focal length of the lens is 5 cm.

(i) Use a graphical method to find the location of the image of the object. Clearly draw all the construction lines on Figure 7.1 and state the nature of the image. (4 marks)

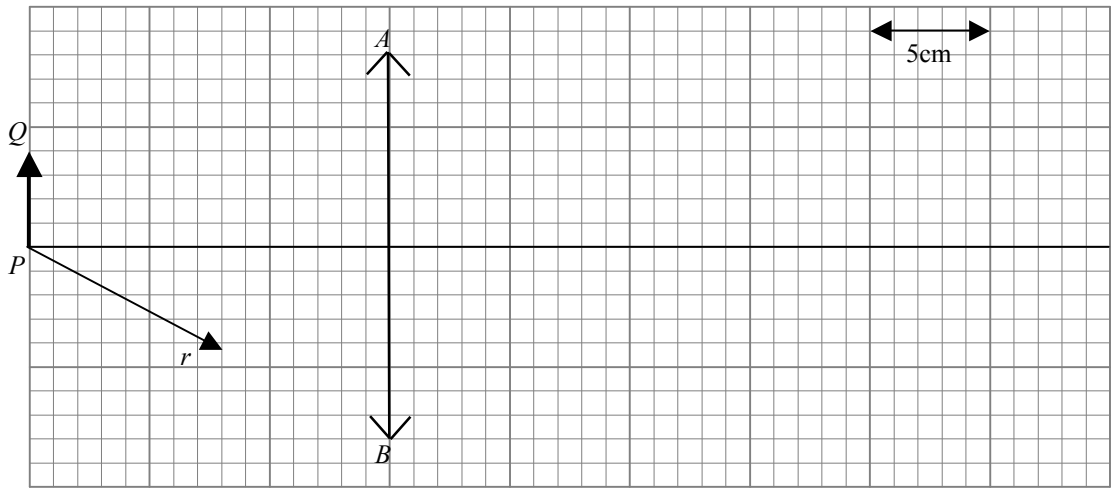

Figure 7.1

(ii) Complete the path of ray *r* on Figure 7.1 to show how it travels after passing through the convex lens. (1 mark)

(b) Suppose that a convex lens of focal length 10 cm is used instead while the size of the lens and the object distance of *PQ* from the lens remain unchanged.

*(i) Use the lens formula to find the image distance. Find also the linear magnification of the image. (3 marks)

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(ii) Compare the brightness of this image with that in (a). Explain. (2 marks)

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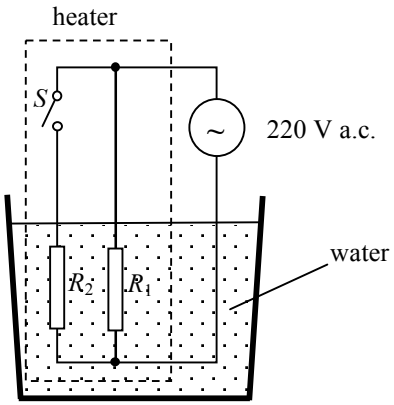
8. In the circuit shown in Figure 8.1, resistors R_1 and R_2 represent the heating elements in a heater using mains supply. Both resistors are immersed in water.

Figure 8.1



The heater can be operated in two modes, namely, heating and keeping warm, and it is controlled by the switch *S*. The power consumed by the heater in the heating mode is 550 W and in the mode of keeping warm is 88 W. The mains voltage is 220 V a.c.

(a) In which mode is the heater operating when switch *S* is open ? (1 mark)

(b) Find the resistance of R_1. (2 marks)

(c) When switch *S* is closed, calculate the current passing through resistor R_2. (3 marks)

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*(d) What is the *peak value* of the sinusoidal current flowing through the heater when switch *S* is closed ? (2 marks)

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9. Read the following description about the 'shaver supply unit' in bathrooms and answer the questions that follow.

> The danger of electric shock is particularly high in bathrooms. Normal electric socket outlets should not be installed in bathrooms. As electric shavers and toothbrushes are becoming popular these days, a special unit, called 'shaver supply unit' is now common in bathrooms to provide electricity just for these low power consumption electric appliances (Figure 9.1).
>
> The shaver supply unit consists of a transformer in which the secondary is not earthed and is completely isolated from the 220 V a.c. mains supply connecting to the primary. It can be used with 220 V or 110 V shavers.

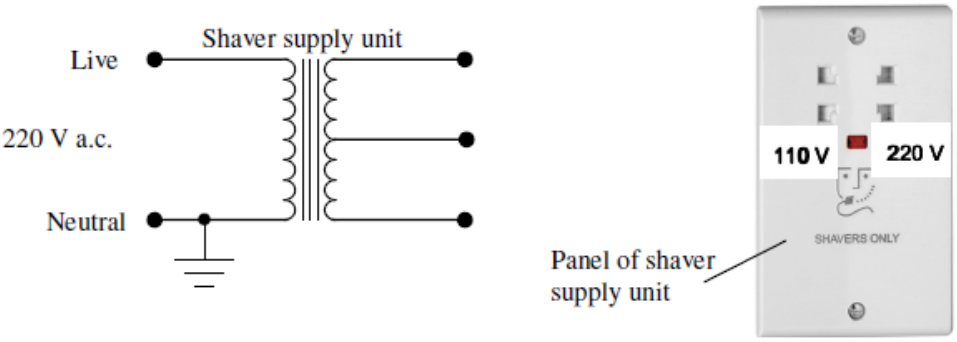

Figure 9.1

(a) Explain why the chance of electric shock is high in bathrooms. (2 marks)

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(b) Explain what would happen if the human body touches

(i) the live wire of the mains supply in the primary circuit; (2 marks)

(ii) one of the conducting wires in the shaver circuit outlet. (2 marks)

*(c) What is the turns ratio of the primary coil to the secondary coil of the transformer so as to provide 110 V ? (1 mark)

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10. You are given a long conducting wire, a pair of slab-shaped magnets on steel yoke and a light-beam galvanometer for detecting small currents. With the aid of a diagram, describe an experiment to investigate **TWO** factors affecting the e.m.f. induced in a conductor when it moves in a magnetic field. (7 marks)

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11. Radium−226 ($^{226}_{88}\mathrm{Ra}$) undergoes α-decay into radon (Rn).

(a) Write a nuclear equation for the decay. (2 marks)

*(b) Given : mass of a radium nucleus = 226.0254 u
mass of a radon nucleus = 222.0176 u
mass of an α-particle = 4.0026 u
Calculate the energy released in the decay in MeV. (2 marks)

(c) 1 curie (Ci) is defined as the activity of 1 g of radium. The activity of a radium source used in laboratories is about 5 μCi. Estimate the number of radium atoms in this source and hence find its activity expressed in disintegrations per second. The half-life of radium−226 is 1600 years and take the mass of one mole of radium as 226 g. (1 μCi = 1×10^{-6} Ci) (3 marks)

END OF PAPER

Sources of materials used in this paper will be acknowledged in the *Examination Report and Question Papers* published by the Hong Kong Examinations and Assessment Authority at a later stage.

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