This sample paper aims to illustrate the revised rubrics, instructions and paper layout, effective from the 2024 examination. The questions are adapted from past papers as follows:

Sample Paper (Paper 1 Section B)		**HKDSE**		**Topics**
Question Number	**Marks (Total: 84)**	**Year**	**Question Number**	
1	4	2021	1	Heat & Gases
2	7	2020	5	Force & Motion
3	6	2022	4	Force & Motion
4	6	2022	6	Wave Motion
5	5	2020	7	Wave Motion
6	5	2020	3	Electricity and Magnetism
7	6	2019	7	Electricity and Magnetism
8	5	2019	9	Electricity and Magnetism
9	6	2021	9	Radioactivity and Nuclear Energy
Short Questions subtotal: 50				
10	8	2022	2	Heat & Gases
11	9	2020	4	Force & Motion
12	8	2022	5	Wave Motion
13	9	2021	8	Electricity and Magnetism
Long Questions subtotal: 34				

20XX-DSE
PHY

PAPER 1B

B

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HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 20XX

Candidate Number									

PHYSICS PAPER 1

SECTION B : Question-Answer Book B

Sample Paper (2024 onwards)

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.

Short Questions Question No.	Marks
1	**4**
2	**7**
3	**6**
4	**6**
5	**5**
6	**5**
7	**6**
8	**5**
9	**6**
Long Questions Question No.	**Marks**
10	**8**
11	**9**
12	**8**
13	**9**

* A 1 5 0 E 0 1 B *

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

1. A 150 W immersion heater is used to keep the water in a large beaker boiling under standard atmospheric pressure. In 5 minutes, 0.016 kg of water boils away. Neglect any heat loss to surroundings.

   (a) Find the specific latent heat of vaporization of water, l. (2 marks)

A student puts a small metal sphere in the boiling water. After a few minutes, the sphere is quickly transferred to a polystyrene cup containing 100 g of water at a temperature of 20 °C. The cup of water is stirred gently and its highest temperature attained is 22 °C.
Given: specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$

   (b) Estimate the heat capacity C of the metal sphere. (2 marks)

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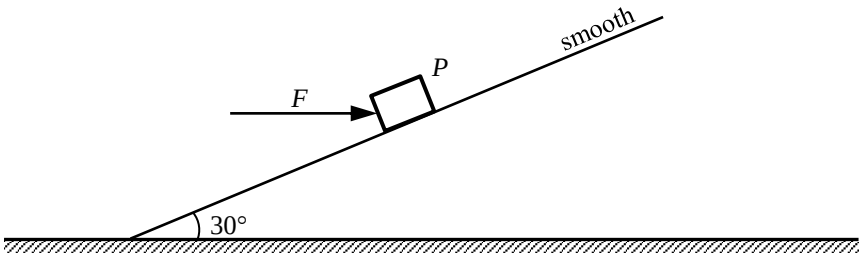

Figure 2.1

(a) A block *P* of mass 10 kg is kept stationary on a smooth incline by a horizontal force *F* as shown in Figure 2.1. The incline makes an angle of 30° with the horizontal. (g = 9.81 m s^{-2})

(i) On Figure 2.1, indicate and label all other forces acting on *P*. (2 marks)

(ii) Find the magnitudes of the force *F* and the force exerted by the block on the incline respectively. (3 marks)

(b) Now *F* is removed and neglect air resistance.

(i) What is the magnitude of the acceleration of the block ? (1 mark)

(ii) State whether the force exerted by the block on the incline would increase, decrease or remain unchanged when compared with that in (a)(ii). (1 mark)

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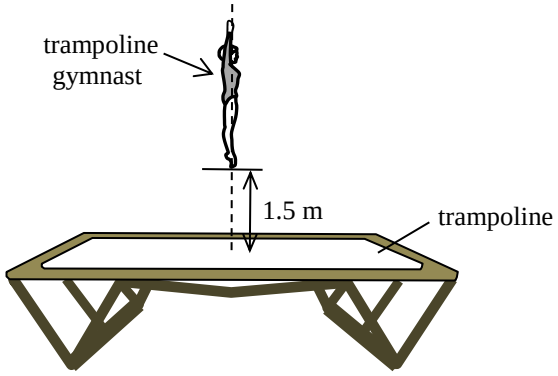

Figure 3.1

Figure 3.1 shows a trampoline gymnast of mass 50 kg performing a straight jump. Her feet are 1.5 m above the trampoline at the maximum height. Neglect air resistance and assume that the gymnast maintains this posture throughout the jump. (g = 9.81 m s^{-2})

(a) Find the kinetic energy of the gymnast just as her feet touch the trampoline on the way down from her jump. (2 marks)

(b) After touching the trampoline, the gymnast keeps on moving downward for 0.40 m further before she stops.

(i) Describe the energy transfer to the trampoline by the gymnast **after touching the trampoline**. (2 marks)

(ii) Estimate the average force exerted by the gymnast on the trampoline. (2 marks)

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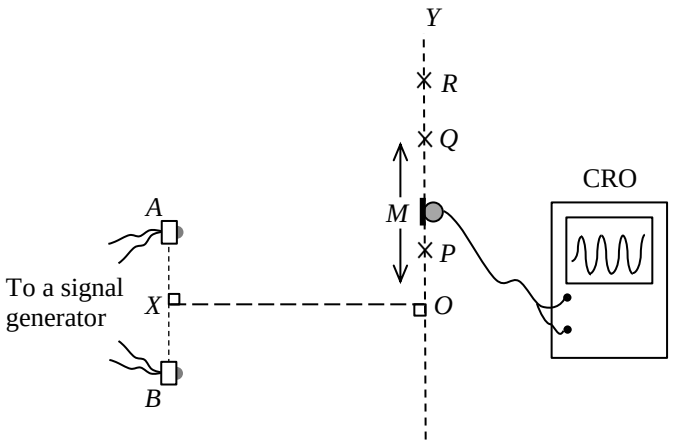
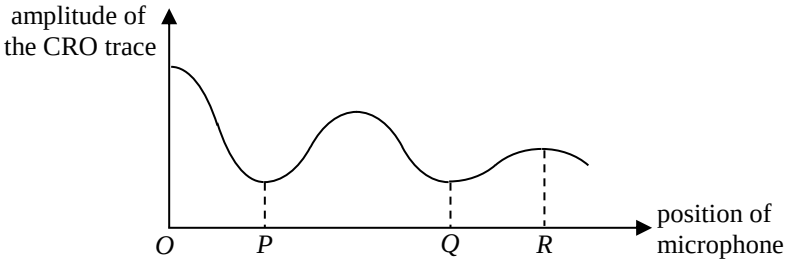
Figure 4.1



In Figure 4.1, two small identical loudspeakers *A* and *B* produce coherent sound waves. *X* is the mid-point of *AB*. A microphone *M* connected to a CRO is moved along *OY* to detect the loudness of the sound, with CRO trace of a larger amplitude representing a greater loudness. Figure 4.2 shows the result.

Figure 4.2



(a) Explain what is meant by **coherent** sound waves. (1 mark)

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(b) (i) Explain why sound of alternate maximum and minimum loudness is detected along *OY*. (2 marks)

(ii) The amplitude of the CRO trace at *P* is **not** zero. Suggest a possible reason. (1 mark)

(c) Given: $AQ = 2.17$ m, $BQ = 2.58$ m
Find the speed of sound in air if the frequency of the signal generator is 1200 Hz. (2 marks)

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5. Figure 5.1 shows an optical fibre which consists of a cylindrical glass core of refractive index n_g enclosed by a transparent cladding of refractive index n_c.

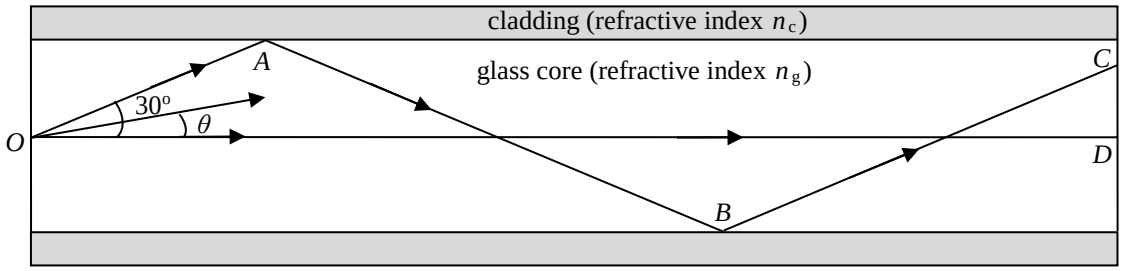

Figure 5.1

As shown in Figure 5.1, a point light source at *O* emits monochromatic light in all directions. Light ray *OA* makes an angle of 30° with the axis *OD* and is incident at the core-cladding boundary at *A* with an angle of incidence i_A.

(a) Find i_A. (1 mark)

(b) If i_A is just greater than the critical angle of that boundary, estimate $\frac{n_g}{n_c}$. (2 marks)

Inside the fibre, light can reach the right end of the fibre through many different paths making angles θ with the axis *OD*. Two of these paths, *OD* and *OABC*, have been drawn for reference.

(c) What phenomenon occurs at point *A* ? State the condition needs to be satisfied by θ such that this phenomenon **fails to occur**. (2 marks)

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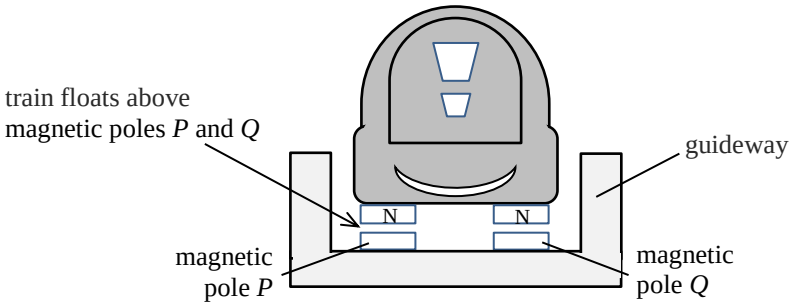
6. Read the following passage about a **magnetically levitated (maglev) train** and answer the questions that follow.

'A maglev train car is just a box with magnets on the four corners,' says Jesse Powell, the son of the maglev train inventor. The electromagnets employed have superconducting coils (i.e. coils with extremely low resistance). They therefore can generate magnetic fields 10 times stronger than ordinary electromagnets, enough to levitate and propel a train.



LEVITATION

Two sets of magnetic fields are set up for different functions. One is to make the train float a few centimetres above magnetic poles *P* and *Q* as shown while the other is a propulsion system run by an alternating current for moving the train car along the guideway by magnetic attraction and repulsion. This floating design enables a smooth movement of the train. Even when the train travels up to 600 km per hour, passengers inside experience less vibration than travelling on traditional trains.

(a) Explain why electromagnets employing superconducting coils can produce much stronger magnetic fields. (2 marks)

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(b) State the polarities of the magnetic poles *P* and *Q* and explain how this arrangement enables the train to float. (2 marks)

(c) Referring to the resistive forces experienced by the train, explain why a maglev train ride is faster. (1 mark)

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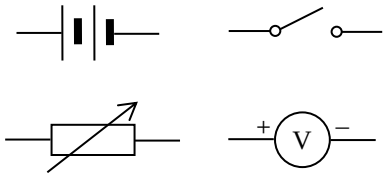
7. You are provided with a battery (of fixed e.m.f. ξ and internal resistance r), a variable resistor (with several known resistance values R to be selected), a switch, a voltmeter (assumed ideal) and a few connecting wires.



(a) With the aid of a circuit diagram, describe the procedure of an experiment to study how the terminal voltage V delivered by the battery depends on the resistance R connected to it. State **ONE** precaution of the experiment. (5 marks)

(b) Express V in terms of ξ, r and R. (1 mark)

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8. A rectangular coil *PQRS* of 20 turns, each having an area of 0.005 m^2, is placed in a uniform magnetic field *B* of strength 0.3 T pointing into the paper as shown in Figure 8.1.

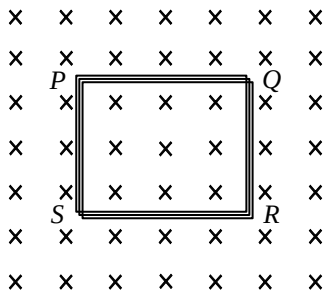

Figure 8.1

The strength of the magnetic field decreases uniformly to zero within 0.5 s.

(a) Explain why a current would be induced in the coil. (2 marks)

*(b) Calculate the change in total magnetic flux linkage through the coil (unit: Wb) and the value of the induced e.m.f. ξ in the coil. (3 marks)

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9. Potassium-40 ($^{40}_{19}K$) is a natural radioisotope of potassium.

(a) (i) What kind of decay does $^{40}_{19}K$ undergo if it decays to $^{40}_{20}Ca$? (1 mark)

(ii) As banana is rich in potassium, a student claims that the radiation emitted by $^{40}_{19}K$ after eating a few bananas can be detected outside the human body. Explain whether this claim is justified. (1 mark)

*(b) A banana typically contains 0.45 g potassium in which 0.012% by mass is $^{40}_{19}K$ while the rest is $^{39}_{19}K$.

Given: half-life of $^{40}_{19}K = 1.25 \times 10^9$ years
1 year = 3.16×10^7 seconds
mass of one mole of $^{40}_{19}K = 40.0$ g

(i) Estimate the number of moles of $^{40}_{19}K$ in a banana. (1 mark)

(ii) Deduce the activity, in Bq, of a banana. (3 marks)

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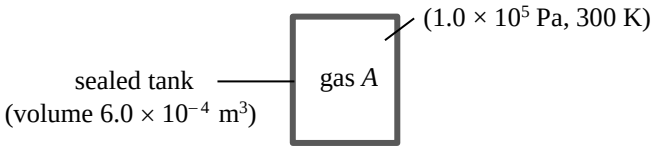
*10. Figure 10.1 shows a sealed tank of volume 6.0×10^{-4} m^3 containing a monatomic gas A at a pressure of 1.0×10^5 Pa and at a temperature of 300 K.

Figure 10.1

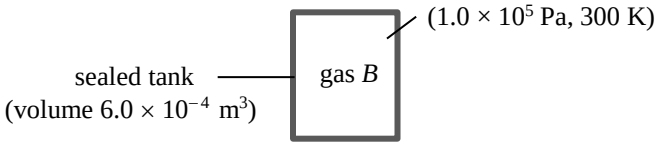


(a) (i) Estimate the number of gas molecules in the tank, N. (2 marks)

(ii) Estimate the average kinetic energy of the gas molecules, E_K. (2 marks)

(b) Figure 10.2 shows another identical tank containing monatomic gas B under the same pressure and temperature. A molecule of gas B has $\frac{1}{5}$ the mass of a molecule of gas A.

Figure 10.2



(i) State whether N and E_K of gas B are larger than, smaller than or the same as the corresponding values of those of gas A found in (a). (2 marks)

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(ii) Given that the root-mean-square speed ($c_{r.m.s.}$) of the molecules of gas *A* is 600 m s^{-1}, estimate $c_{r.m.s.}$ of the molecules of gas *B*. (2 marks)

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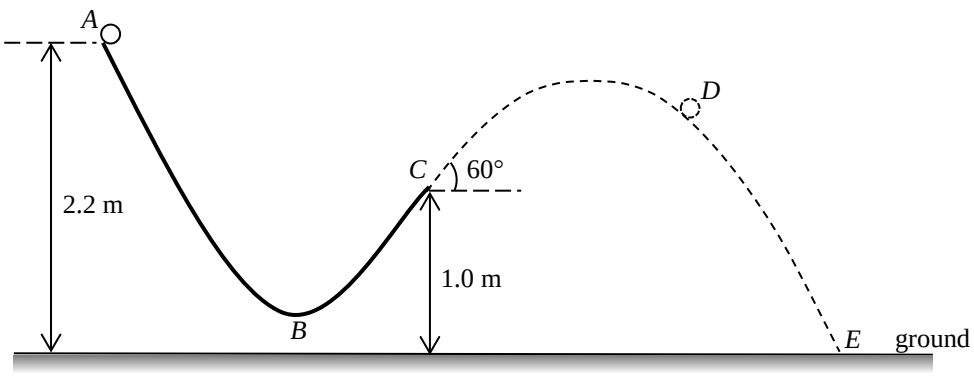
11. A small sphere is released from rest at point *A* and runs along a smooth track *ABC* as shown in Figure 11.1. The track around the lowest point *B* is approximately circular in shape.

Figure 11.1



The sphere leaves the track at point *C* where the track makes an angle of 60° with the horizontal. It finally reaches point *E* on the ground. Neglect air resistance. (g = 9.81 m s^{-2})

(a) Arrange the speeds of the sphere at points *A*, *B*, *C* and *D* respectively in descending order. (1 mark)

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(b) On Figure 11.1, use an arrow to indicate the acceleration of the sphere, if any, at point *D*. (1 mark)

(c) (i) Describe the energy conversion of the sphere when it goes along the track *ABC*. (2 marks)

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(ii) Hence find the speed of the sphere at point *C*. (2 marks)

*(iii) If the horizontal distance between points *C* and *E* is 2.55 m, calculate the time of flight of the sphere before reaching point *E*. (3 marks)

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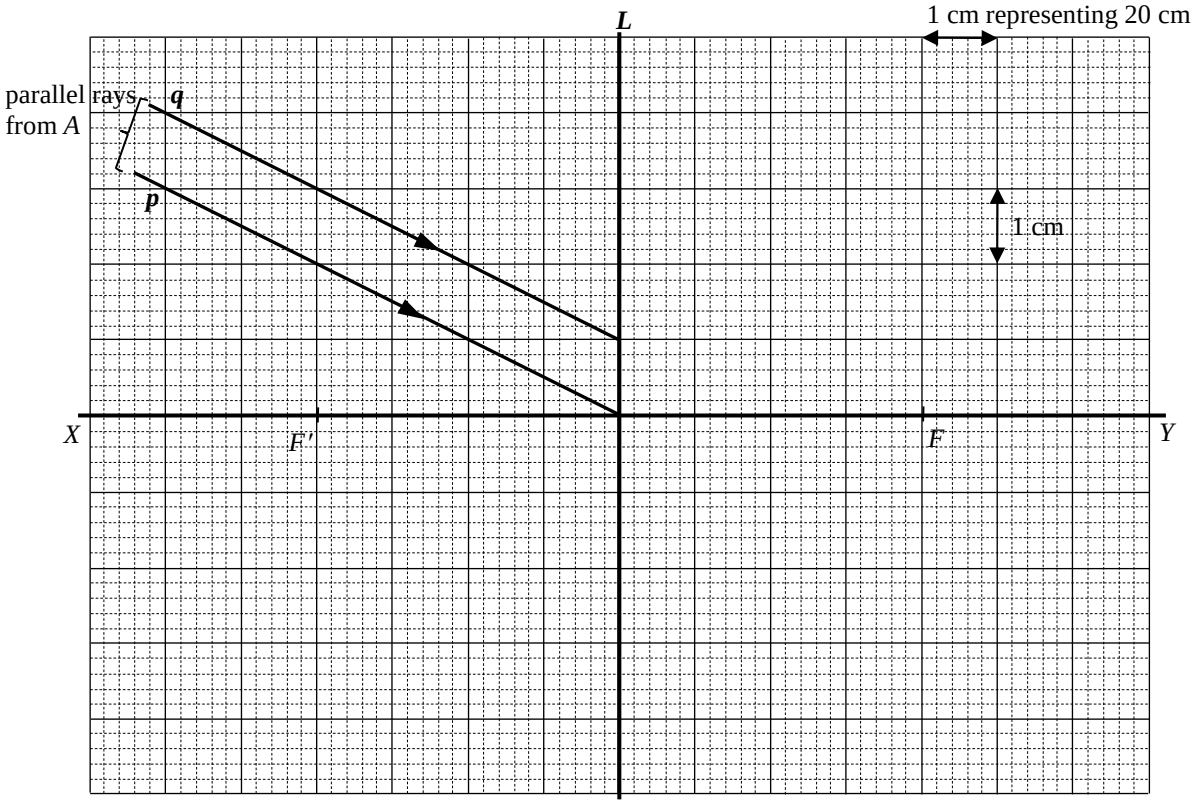
12. In the figure below, XY is the horizontal principal axis of a convex lens L with principal foci F and F'. p, q are parallel rays coming from point A of a distant object AB. (The object can be represented by a vertical arrow  but it is **not** shown on the figure and its end B is on the principal axis).



(a) (i) Draw the refracted rays of p and q so as to locate the image of A (denoted as A'). Hence mark the image $A'B'$ of object AB. (3 marks)

(ii) Suggest an experiment to verify whether a real image is formed in the above situation. (2 marks)

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(b) (i) Use the ray diagram drawn to estimate the ratio $\frac{\text{height of object } AB}{\text{distance of } AB \text{ from } L}$. The horizontal and vertical scales are 1:20 and 1:1 respectively. (2 marks)

(ii) Hence, estimate the height of object *AB* which is a lamp post at a distance of 200 m from lens *L*. (1 mark)

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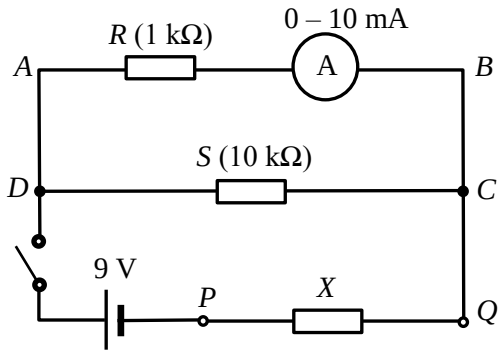

Figure 13.1

Figure 13.1 shows a circuit for measuring the resistance of resistor *X* connected across *P* and *Q*. The resistance of resistor *S* is 10 kΩ. The internal resistance of the 9 V cell and that of the ammeter are negligible.

When the switch is closed, the ammeter reads 8.5 mA.

(a) What is the potential difference (p.d.) between *A* and *B* ? (2 marks)

(b) Find the current passing through resistor *S*. (2 marks)

(c) Indicate on Figure 13.1 the direction of current in each of the three branches via *C*. (2 marks)

(d) Deduce the p.d. across resistor *X*. Hence, find the resistance of *X*. (3 marks)

END OF PAPER

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

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