PO LEUNG KUK TANG YUK TIEN COLLEGE
MOCK EXAMINATION (18/19)

Form	:	6	Date	:	Jan 31, 2019
Subject	:	Physics	Time	:	08:30 - 11:00
Paper	:	IB	Class	:	_____(____)
Full Mark	:	84 (Section B)	Name	:	_____

This paper must be answered in English

INSTRUCTIONS FOR SECTION B

1 Follow the instructions given in the announcement before the start of the examination. You should write your Name, Class and Class number in the spaces provided on this page.

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 supplied on request. Write your Name, Class and Class number on each sheet and fasten them with string **INSIDE** this Question-Answer book.

6 No extra time will be given to candidates for filling in their personal information after the 'Time is up' announcement.

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
/6	/9	/10	/10	/8	/7	/5	/7	/11	/11

Grand Total: _____ /84

Answer **ALL** questions. Write your answers in the spaces provided.

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1. Alan is preparing a pot of hot soup. He heats up the soup from 25 °C to 100 °C in 15 minutes on a gas stove. The soup is then boiled on the same gas stove for another 5 minutes.

(a) The mass of the soup is 8 kg and its specific heat capacity is 4200 J kg^{-1} $°C^{-1}$.

(i) Find the energy transferred to the soup during the first 15 minutes. (1 mark)

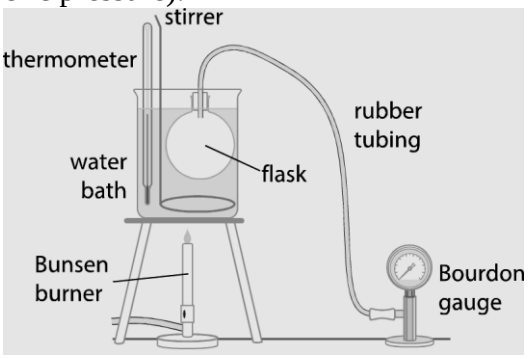
(ii) Estimate how much water has been boiled away during the next 5 minutes. The specific latent heat of vaporization of water is 2.26×10^6 J kg^{-1}. (2 marks)

(b) After Alan removes the pot from the stove, the soup keeps boiling for more than one minute.

(i) Given that the heat capacities of a clay pot and a metal pot is roughly the same. From the information, guess whether the pot is made of metal or clay. Briefly explain your answer. (2 marks)

(ii) Why does the soup still boil after the pot is removed from the stove? (1 mark)

2. Brian and his groupmates are going to study the relationship between gas pressure and gas temperature under fixed gas volume using the setup below. Before heating, the water bath is at room temperature 25 °C. The air inside the flask is also at room temperature and has a pressure of 1.0×10^5 Pa (atmospheric pressure).



Brian heats up the water gently. For every 5 °C (approximately), he stops the heat and stirs the water well before taking readings.

(a) The water is heated up to 80 °C. What is the expected gas pressure when 80 °C is reached? (2 marks)

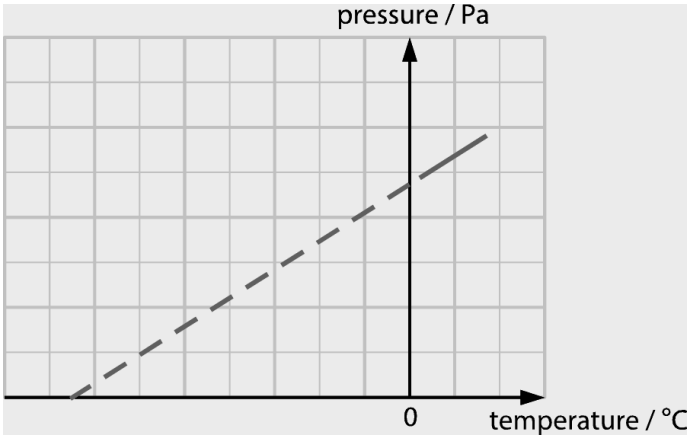
(b) Brian and his groupmates found that the recorded gas pressure at 80 °C is slightly lower than expected. Brian's two groupmates give different explanations for this.

Groupmate *A*: The heat loss from the water to the surroundings makes the final gas pressure slightly lower.

Groupmate *B*: The volume inside the rubber tubing is not taken into account in the experiment. This makes the total gas volume larger than expected, and thus the final gas pressure lower than expected.

Do you agree with them? Comment on their explanations. Give your own explanation if you do not agree with them. (4 marks)

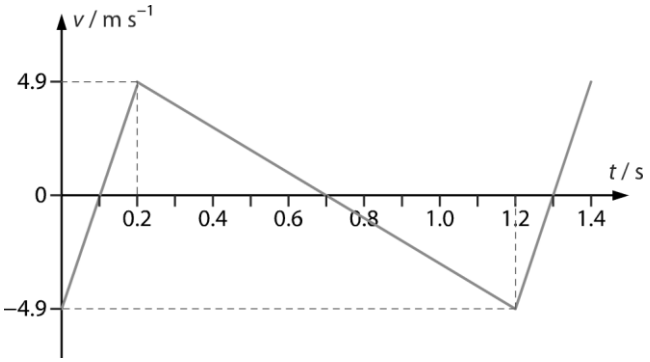
(c) The results obtained are plotted in the graph below.



(i) Using kinetic theory, briefly explain why the gas pressure increases as the temperature increases. (2 marks)

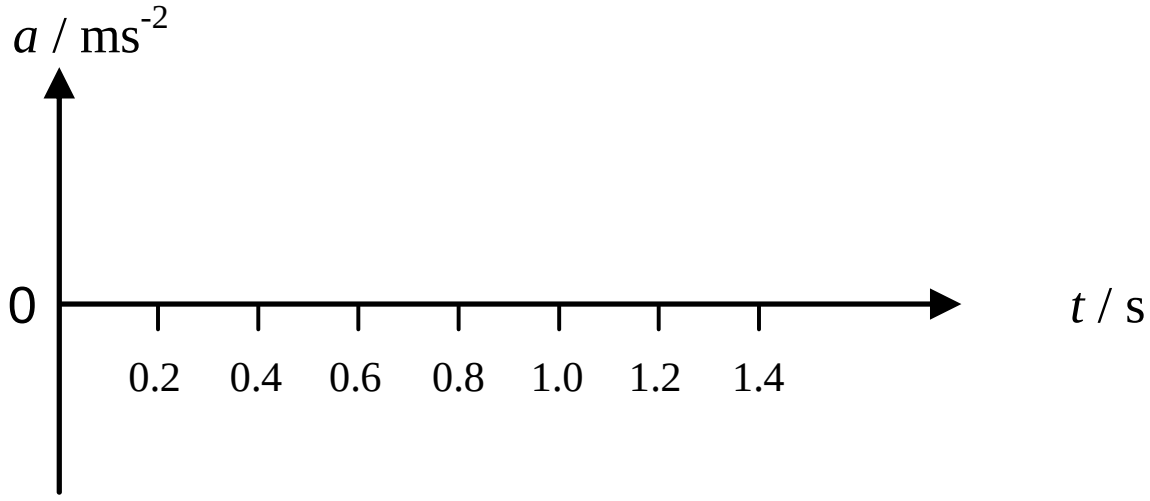
(ii) If a larger flask containing more air molecules is used to repeat the experiment, how would the graph obtained change? (The air inside the flask is again at atmospheric pressure at the start.) (1 mark)

3. Carl is jumping on a trampoline. His mass is 60 kg. The graph on the right shows how his velocity v varies with time t. The upward direction is taken as positive.



(a) From the v–t graph, find the height difference between his lowest position and his highest position. (2 marks)

(b) (i) Sketch the corresponding acceleration–time (a–t) graph of him. (2 marks)



(ii) When was he in contact with the trampoline? (1 mark)

(iii) Find the magnitude of the force that the trampoline acted on him when he was in contact with it. (3 marks)

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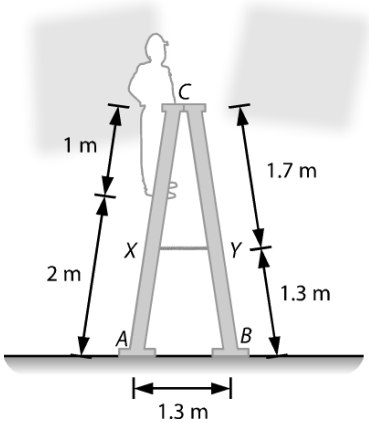
(c) Was the total energy of Carl conserved when he was jumping on (and in contact with) the trampoline? Briefly explain. (2 marks)

4. A painter of mass 70 kg is standing on a stepladder as shown. He is standing on the ladder 2 m from the bottom (measured along the ladder). The two halves of the ladder are connected by a horizontal rope *XY*.



Neglect the frictional forces from the ground, the weight of the stepladder and the weight of the rope.

(a) What can you say about the net force and the net moment on the ladder about any point when it is at rest? (1 mark)

(b) (i) Find the horizontal distance of the painter from *A*. (1 mark)

(ii) Hence, find the normal reaction forces on the ladder at *A* and *B*. (4 marks)

(c) What is the tension in *XY*? (2 marks)

(d) The painter accidentally falls from the ladder. Luckily, he is able to land the ground with his feet. He bends his knees during the impact. This reduces the collision force on him and the chance to topple. Briefly explain why bending the knees could reduce the collision force and the chance to topple. (2 marks)

5. A space laboratory orbits around the Earth in a circular orbit. Its distance from the centre of the Earth is 6736 km. The mass of the Earth is 5.97×10^{24} kg.

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(a) Estimate the gravitational field strength of the Earth at the orbit of the space laboratory.

(2 marks)

(b) A 70-kg astronaut is in the space laboratory. What is the net force acting on the astronaut? (1 mark)

(c) Estimate the period of the space laboratory in minutes. (3 marks)

(d) If a new component of mass 500 kg is added to the space station, how would the period of the space station change? Explain briefly. (2 marks)

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6. A beam of monochromatic light passes through a double slit and reaches a screen. The following pattern can be observed on the screen.

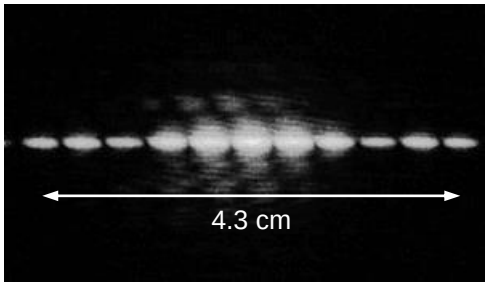

Figure 6.1

The separation between the two slits is 0.1 mm and the screen is 80 cm away from the double slit.

(a) Calculate the wavelength of the light. (3 marks)

(b) If a double slit with a smaller slit separation is used, how will the fringe separation change? (1 mark)

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(c) If the double slit is replaced by a single slit of slit width 1 mm, what can be observed on the screen? Explain briefly. (3 marks)

7. The following items are provided to set up an experiment to estimate the internal resistance of a battery.

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a battery
an ammeter
a voltmeter
a fixed resistor
a switch
connecting wires

Draw a circuit diagram for the experimental set-up and describe the procedures of the experiment. State the physical quantities to be measured and an equation for finding the internal resistance of the battery. (5 marks)

8. A square coil of side length 2 cm is moved between a pair of slab-shaped magnets with unlike poles facing each other. The following figure shows the position of the coil at time $t = 0$.

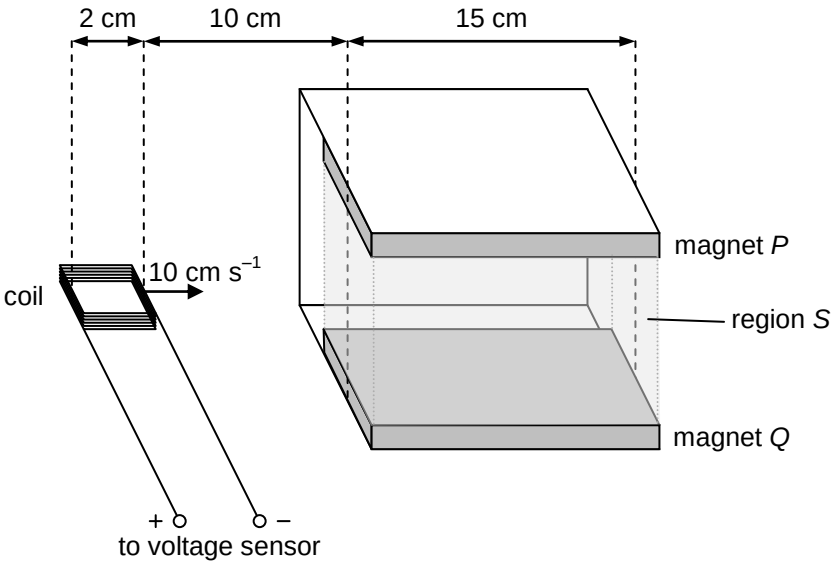

Figure 8.1

S is the region between the two magnets and is shaded in Figure 8.1. The coil moves horizontally through region *S* at a constant speed of 10 cm s^{-1}. Assume that a uniform magnetic field points from magnet *Q* to magnet *P* in region *S*, and there is no magnetic field outside region *S*.

(a) (i) Sketch a graph to show how the voltage sensor reading varies with time from $t = 0$ to $t = 3$ s. (3 marks)

(ii) The coil has 50 turns. The magnetic flux density in region S is 5×10^{-4} T. Calculate the maximum magnitude of the e.m.f. induced in the coil when it travels through the magnetic field. (2 marks)

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(b) Suggest **TWO** methods that can increase the induced e.m.f. in the coil. (2 marks)

9. In a cathode ray oscilloscope (CRO), electrons emitted from an electron gun pass through two pairs of parallel metal plates and are directed towards a certain position on a screen. The following figure shows the path of an electron when it travels between the first pair of parallel plates which are placed horizontally. *S* is the region between the two plates and is shaded as shown. Assume that the electric field in region *S* is uniform, and there is no electric field outside region *S*.

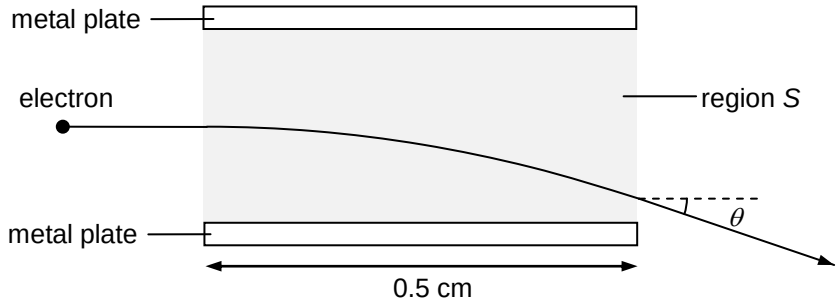

Figure 9.1

Before entering *S*, the electron travels at 3×10^7 m s^{-1} horizontally. The two plates carry opposite charges and are 0.15 cm apart. Each plate is 0.5 cm long. When the electron is in region *S*, its acceleration is 1.8×10^{16} m s^{-2} downwards. The effect of gravity is negligible.

(a) State the direction of the electric field between the plates. (1 mark)

(b) Find the electric field strength between the plates. (3 marks)

(c) Find the time needed for the electron to travel through region *S*. (2 marks)

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(d) When the electron leaves region *S*, its velocity makes an angle θ to the horizontal. Find θ. (4 marks)

(e) If the separation between the parallel plates decreases while the potential difference remains unchanged, how will the value of θ change? Assume that the electron will not collide with the plates. (1 mark)

10. When a neutron bombards with a nitrogen-14 ($^{14}_{7}N$) nucleus, carbon-14 ($^{14}_{6}C$) and another particle *X* may be formed.

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(a) Write an equation for the above nuclear reaction. What is *X*? (2 marks)

(b) The carbon-14 formed in the reaction is radioactive. It will undergo β decay and change back to nitrogen-14.

(i) Which nuclide, nitrogen-14 or carbon-14, is more stable? (1 mark)

(ii) State **ONE** similarity and **ONE** difference between β radiation and γ radiation.

(2 marks)

(c) Carbon-14 dating can be used to determine the age of ancient remains. In a sample of an ancient piece of wood, 1 g of carbon has an activity of 0.065 Bq. In a living plant, 1 g of carbon has an activity of 0.26 Bq. The half -life of carbon-14 is 5730 years.

(i) Estimate the age of this ancient piece of wood. (2 marks)

(ii) Above-ground nuclear tests in the 20th century increased the amount of carbon-14 in the atmosphere significantly. How does this affect the accuracy of the estimation in (c)(i)? Explain briefly. (2 marks)

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(iii) Is performing carbon-14 dating harmful to our health? Explain briefly. (2 marks)

END OF PAPER