2018-DSE
PHY

PAPER 2

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2018

Please stick the barcode label here.

Candidate Number									

PHYSICS PAPER 2

Question-Answer Book

11:45 am – 12:45 pm (1 hour)
This paper must be answered in English

INSTRUCTIONS

(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) This paper consists of **FOUR** sections, Sections A, B, C and D. Each section contains eight multiple-choice questions and one structured question which carries 10 marks. Attempt **ALL** questions in any **TWO** sections.

(3) Write your answers to the structured questions in the **ANSWER BOOK** provided. For multiple-choice questions, blacken the appropriate circle with an HB pencil. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.

(4) 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** the Answer Book.

(5) The Question-Answer Book and Answer Book will be collected **SEPARATELY** at the end of the examination.

(6) The diagrams in this paper are **NOT** necessarily drawn to scale.

(7) The last two pages of this Question-Answer Book contain a list of data, formulae and relationships which you may find useful.

(8) 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.

* A 1 5 O E 2 M C *

Section B : Atomic World

Q.2: Multiple-choice questions

2.1 In Rutherford's scattering experiment, the distance of closest approach of an α particle to a gold atom can be deduced. This distance is a good estimate of the upper limit of

A. the radius of an α particle.
B. the radius of a gold atom.
C. the radius of a gold nucleus.
D. the thickness of the gold foil.

A ○ B ○ C ○ D ○

2.2 Which of the following is/are the assumption(s) of the Bohr model of an atom ?

(1) The orbital radii of the electrons are quantized.
(2) The electric force between the nucleus and an electron provides the centripetal force for the circular motion.
(3) The total energy of an orbiting electron remains unchanged.

A. (2) only
B. (3) only
C. (1) and (2) only
D. (1), (2) and (3)

A ○ B ○ C ○ D ○

2.3 Which statements below about **spectra** are correct ?

(1) A steel rod heated to white hot emits a continuous spectrum.
(2) The dark lines in the absorption spectrum of an element match in frequency with the bright lines in this element's emission spectrum.
(3) The atomic spectrum of an element is a piece of evidence for the existence of energy levels in its atoms.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

A ○ B ○ C ○ D ○

2.4 According to the Bohr model of an atom when the electron of a hydrogen atom undergoes transition from an inner orbit to an orbit of larger radius, the hydrogen atom may have

A. absorbed a photon, and the electron's kinetic energy decreases.
B. absorbed a photon, and the electron's kinetic energy increases.
C. emitted a photon, and the electron's kinetic energy decreases.
D. emitted a photon, and the electron's kinetic energy increases.

A ○ B ○ C ○ D ○

Please stick the barcode label here.

2.5 Some hydrogen atoms in the second excited state (i.e. $n = 3$) subsequently produces a spectrum consisting of a series of discrete lines. How many spectral lines of different wavelengths are there in the spectrum ?

A. 1
B. 2
C. 3
D. 4

A B C D

2.6. Electrons, each of mass m and charge e, are being accelerated in a transmission electron microscope (TEM). Estimate the accelerating voltage of the TEM if the de Broglie wavelength of the electrons is λ.

A. $\frac{h^2}{me\lambda^2}$

B. $\frac{h^2}{2me\lambda^2}$

C. $\frac{me\lambda^2}{h^2}$

D. $\frac{2me\lambda^2}{h^2}$

A B C D

2.7 Which of the following statements about a scanning tunnelling microscope (STM) is/are correct ?

(1) It works like an optical microscope except that a high energy electron beam is used instead of visible light and a magnetic field acts as a lens.
(2) It can be used to show the arrangement of atoms at a conductive surface.
(3) The magnitude of the tunnelling current depends on the separation between the surface under investigation and the probe of the STM.

A. (1) only
B. (3) only
C. (2) and (3) only
D. (1), (2) and (3)

A B C D

2.8 Which statement below is **INCORRECT** ?

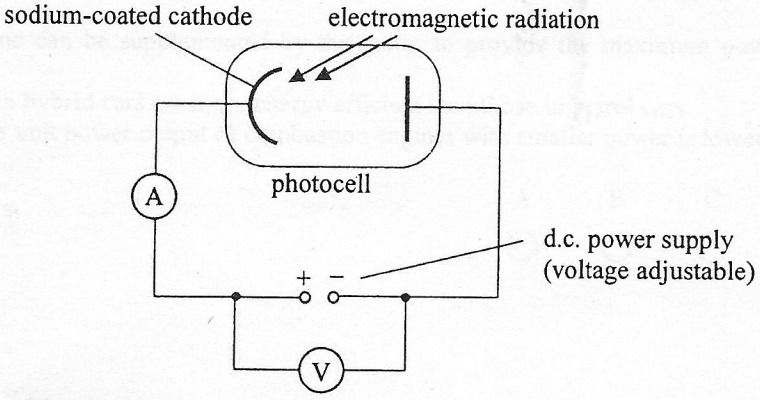
A. Nano particles of silver show a colour different from the colour of silver in bulk form.
B. Diamond is a poor thermal conductor and a poor electrical conductor as it does not have free electrons.
C. A carbon nanotube is much stronger than steel of the same size.
D. Carbon buckyballs such as C_{60} are formed by carbon atoms arranged in hollow cages.

A B C D

Q.2: Structured question

The set-up shown in Figure 2.1 can be used to measure the maximum kinetic energy of photoelectrons emitted from sodium metal when electromagnetic radiations of the same intensity but having different frequencies are incident on a sodium-coated cathode.

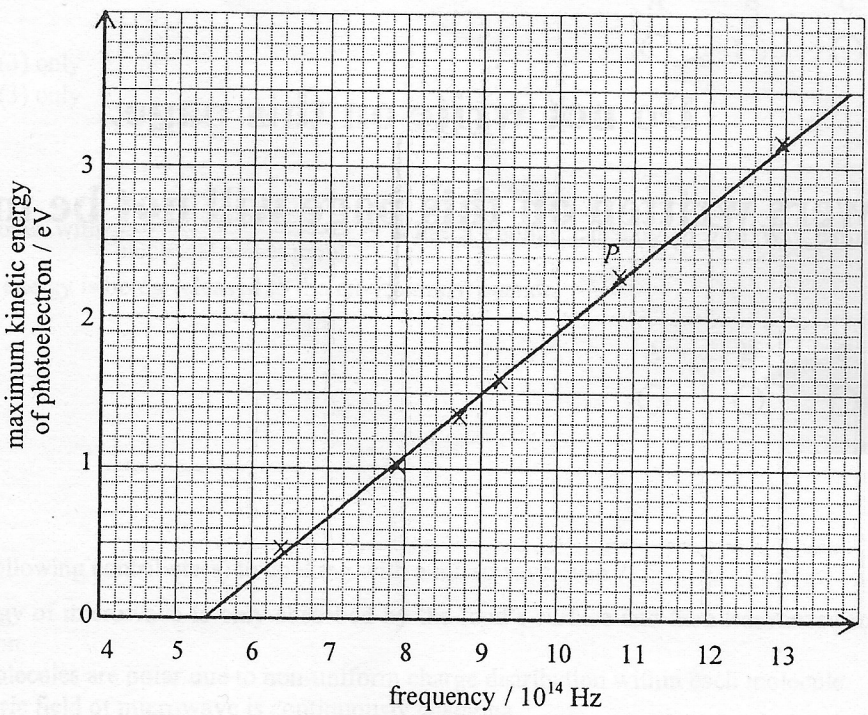
Figure 2.1



(a) Briefly describe how the maximum kinetic energy of photoelectrons can be measured using this set-up for a certain frequency (above the threshold value) of radiation. (2 marks)

(b) The graph in Figure 2.2 shows the results of the experiment.

Figure 2.2



(i) State the part of the electromagnetic spectrum from which radiation was used in obtaining data point *P*. (1 mark)

(ii) Find the slope of the graph and deduce its physical meaning. (3 marks)

(iii) Calculate the work function of sodium in eV. (2 marks)

(c) State the change, if any, in the graph obtained if the experiment is repeated with electromagnetic radiations of lower intensity. Explain. (2 marks)

Section C : Energy and Use of Energy

Q.3: Multiple-choice questions

3.1 Hybrid cars are usually equipped with combustion engines with smaller power than those in petrol cars because

(1) the combustion engine can be supplemented by the motor to provide the maximum power output of hybrid cars.
(2) combustion engines in hybrid cars are more energy efficient than those in petrol cars.
(3) the operation cost per unit power output of combustion engines with smaller power is lower.

A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only

A B C D
○ ○ ○ ○

3.2 Carbon dioxide emission associated with a passenger travelling in a MTR train for 1 km is about 50 g while that for a car is over 200 g. The possible reason(s) is/are

(1) The MTR train and the car need energy to move the vehicle itself.
(2) The energy efficiency in transporting a passenger for 1 km is higher in the case of the MTR train.
(3) No burning of fossil fuel is involved in the production of energy for the MTR train.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

A B C D
○ ○ ○ ○

3.3 An air-conditioner with $\frac{\text{cooling capacity}}{\text{electrical power input}} = 2$ has a cooling capacity of 746 W. Estimate the rate at which thermal energy is being released to the environment outside.

A. 373 W
B. 746 W
C. 1119 W
D. 1492 W

A B C D
○ ○ ○ ○

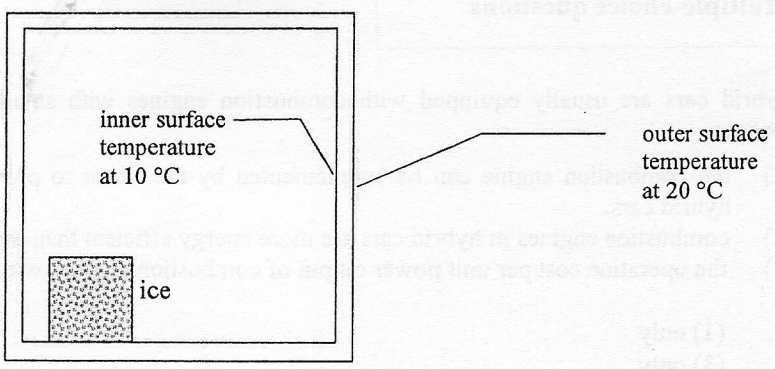
3.4 Which of the following contribute(s) to cooking with a microwave oven ?

(1) The energy of microwave is only absorbed by the food's surface and then transferred to its interior by conduction.
(2) Water molecules are polar due to non-uniform charge distribution within each molecule.
(3) The electric field of microwave is continuously changing.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

A B C D
○ ○ ○ ○

3.5 A piece of ice is placed inside a closed plastic box. The wall of the plastic box is 2 cm thick and the thermal conductivity of plastic is 0.03 $W\ m^{-1}\ °C^{-1}$.



The temperature of the inner and the outer surfaces of the wall are 10 °C and 20 °C respectively. What is the rate of heat exchange (per unit area) between the inside and outside of the box and the direction of heat flow ?

	rate of heat exchange (per unit area)	**direction of heat flow**
A.	15 $W\ m^{-2}$	into the box
B.	15 $W\ m^{-2}$	out of the box
C.	36 $W\ m^{-2}$	into the box
D.	36 $W\ m^{-2}$	out of the box

A ○ B ○ C ○ D ○

3.6 Which statement below about a house and its features **MUST BE** correct ?

A. Thermal conduction is less efficient in materials that are darker in colour.
B. It is more desirable for the Overall Thermal Transfer Value (OTTV) of a house to be larger in cold areas.
C. Wall painted in white reduces the Overall Thermal Transfer Value (OTTV) of a house.
D. Wall painted in white increases the reflection of sunlight.

A ○ B ○ C ○ D ○

3.7 A wind turbine generator delivers a certain electric power with a wind blowing normal at speed v. If the length of the turbine blades is increased by 25% and the overall efficiency of the turbine generator remains the same, estimate the wind speed blowing normal to the turbine that gives the same electric power.

A. 0.59 v
B. 0.64 v
C. 0.86 v
D. 0.93 v

A ○ B ○ C ○ D ○

3.8 In a nuclear reactor, uranium-235 is used as the fission fuel to generate electricity. When uranium-235 undergoes nuclear fission, 0.08% of its mass is converted to energy. If 20% of this energy becomes electrical energy, estimate the amount of uranium-235 used per second for generating 500 MW of electric power.

A. 1.4×10^{-6} kg
B. 3.5×10^{-5} kg
C. 8.2×10^{-3} kg
D. 1.0×10^{-2} kg

A ○ B ○ C ○ D ○

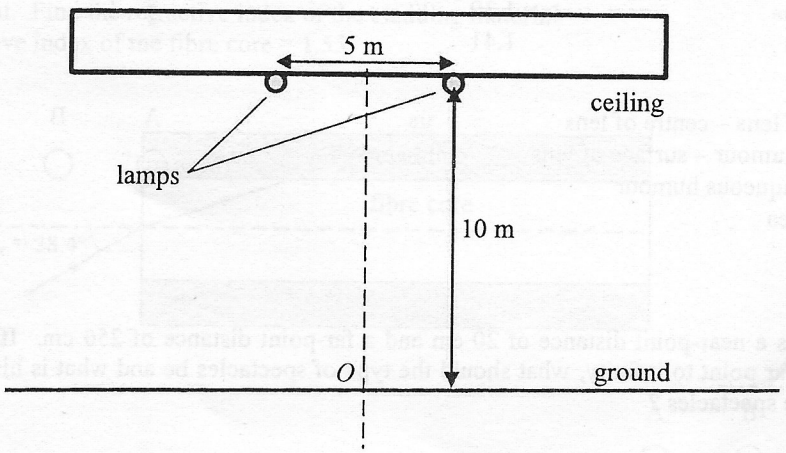
Q.3: Structured question

(a) (i) Incandescent lamps are far less energy efficient than other light sources like fluorescent lamps or light emitting diodes (LEDs). Explain why this is so in terms of how incandescent lamps produce light. (2 marks)

(ii) Two light sources of identical size and shape emit white light and green light respectively. If the light output power of them is the same, briefly explain which light source looks brighter. (2 marks)

(b) Figure 3.1 illustrates the simplified lighting arrangement within a tunnel in which two lamps each of luminous flux 10000 lumens are installed on the ceiling.

Figure 3.1



(i) Calculate the illuminance around point O on the ground mid-way between the two lamps. Take the lamps as point light sources and reflection is assumed negligible. (3 marks)

(ii) The specification of two kinds of lamps A and B are given below. In terms of efficacy, recommend which one the tunnel company should choose. (1 mark)

lamp	rated power	luminous flux
A	150 W	11000 lumens
B	135 W	10000 lumens

(iii) Figures 3.2(a) and 3.2(b) illustrate two arrangements of tunnel lights. In Figure 3.2(a), more lamps each with relatively lower luminous flux are used. In Figure 3.2(b), less lamps each with relatively higher luminous flux are used. The resultant average illuminance on the ground is the same in both cases.

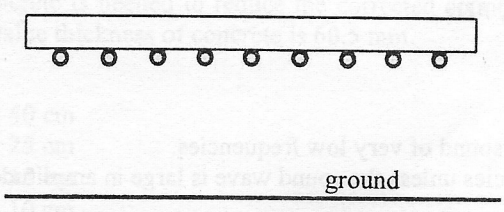


Figure 3.2(a)

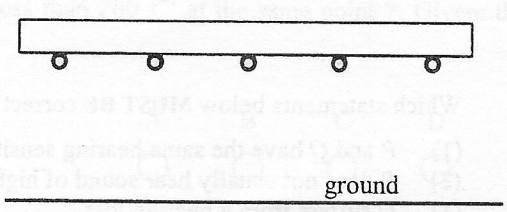


Figure 3.2(b)

State one advantage and one disadvantage of the arrangement in Figure 3.2(a) over that in Figure 3.2(b). (2 marks)