

1

SULIT*

960/2

STPM 2006

**PHYSICS (FIZIK)
PAPER 2 (KERTAS 2)**

Two and a half hours (Dua jam setengah)

PEJABAT PENDIDIKAN DAERAH MUAR

**TRIAL EXAM
(PEPERIKSAAN PERCUBAAN)**

Arahan kepada calon:

Jawab **semua** soalan dalam Bahagian A. Semua kerja **mestilah** ditunjukkan. Bagi perhitungan, nilai pemalar yang berkaitan dalam Buku Data **mestilah** digunakan. Bagi jawapan berangka, unit **mestilah** dinyatakan di mana-mana sesuai

Jawab mana-mana **empat** soalan daripada bahagian B. Untuk bahagian ini, tulis jawapan anda pada helaian jawapan yang dibekalkan. Mulakan setiap jawapan pada helaian kertas yang baru, dan susun jawapan anda mengikut tertib berangka. Ikat helaian jawapan anda bersama dengan buku soalan ini.

Buku Data dibekalkan.

Instruction to candidates:

Answer **all** questions in Section A. All working **must** be shown. For calculations, relevant values of constants in the Data Booklet **must** be used. For numerical answers, units **must** be quoted wherever they are appropriate.

Answer any **four** questions from Section B. For this section, write your answers on the answer sheets provided. Begin each answer on a fresh sheet of paper, and arrange your answers in numerical order. Tie your answer sheets to this booklet.

A Data Booklet is provided.

For examiner's use (Untuk kegunaan pemeriksa)	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
Total (Jumlah)	

Kertas soalan ini terdiri daripada halaman bercetak dan halaman kosong.
(This question paper consist of printed pages and blank page.)

© Majlis Peperiksaan PPD MUAR 2006

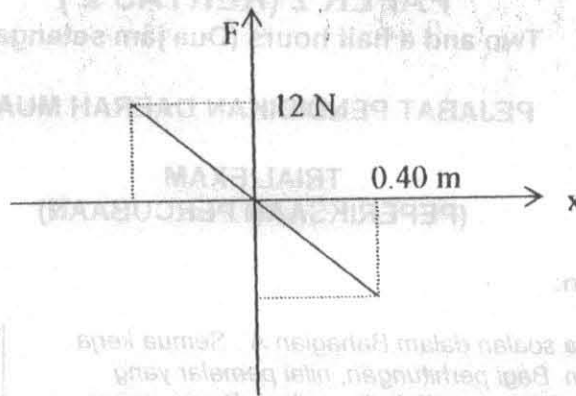
STPM 960/2

*Kertas soalan ini SULIT sehingga peperiksaan kertas ini tamat.

[Lihat sebelah
SULIT*

Section A (40 marks)
 (Answer all the questions in this section.)

1. A body of mass 0.30 kg moves with simple harmonic motion in a straight line. The relation between the force F acting on the body and its displacement x is shown in figure below.



Find

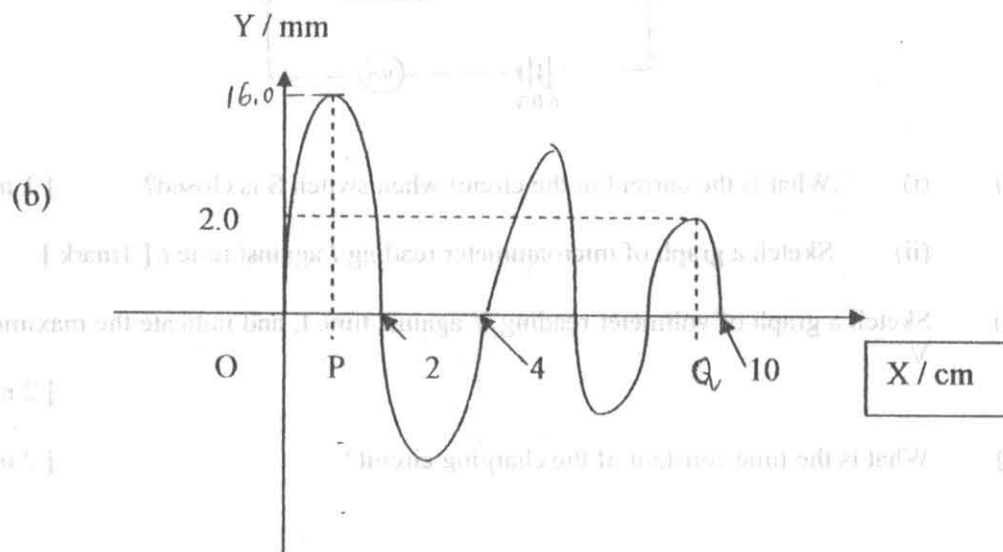
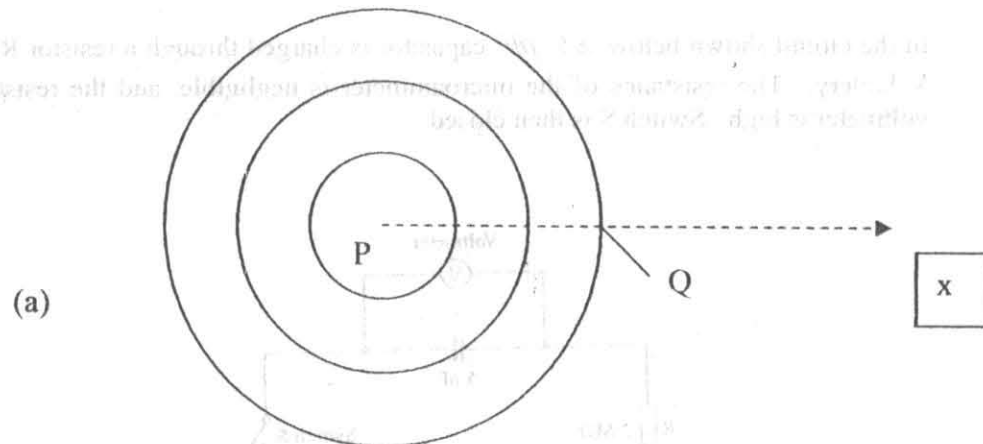
- (a) The amplitude of the motion. [1]
- (b) Its period. [3]
- (c) The maximum speed of the body. [1]

2. Sketch a velocity–time graph for an object thrown vertically upwards from the ground with initial velocity 20 ms^{-1} . What are the times after projection, the object is at the height of 15 m? [5]

3. The diagram (a) below shows water waves from a source at O. The displacement of the particles at a distance x from O at certain instances as shown in diagram (b).

(i) What is the wavelength of the water wave? [2]

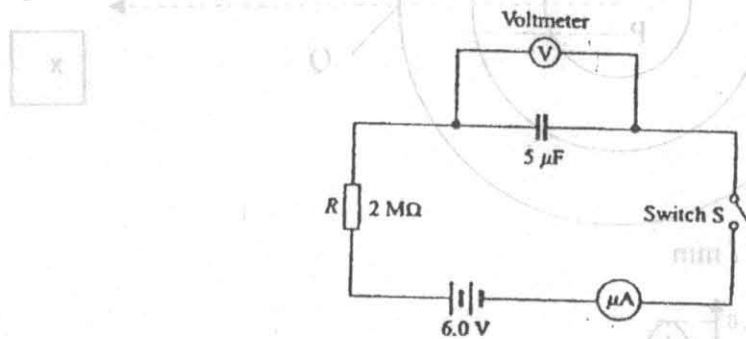
(ii) Calculate the $\frac{\text{intensity of water at Q}}{\text{intensity of water at P}}$ [3]



4. A closed container contains 2 moles of an ideal diatomic gas at the temperature 300K. The gas in the container is heated to a temperature 400 K but the pressure remains constant due to a leak in the container.

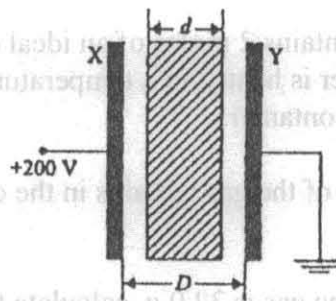
- a) How many molecules of the gas remains in the container at the temperature 400 K? [2]
- b) If the molar mass of the gas is 32.0 g, calculate the root mean square velocity of the molecules of the gas at the temperature 400k? [2]

5. In the circuit shown below, a $5 \mu\text{F}$ capacitor is charged through a resistor R using a 6.0 V battery. The resistance of the microammeter is negligible, and the resistance of the voltmeter is high. Switch S is then closed.



- (a) (i) What is the current in the circuit when switch S is closed? [1 mark]
 (ii) Sketch a graph of microammeter reading I against time t . [1 mark]
- (b) Sketch a graph of voltmeter reading V against time t , and indicate the maximum value of V . [2 marks]
- (c) What is the time constant of the charging circuit? [2 marks]

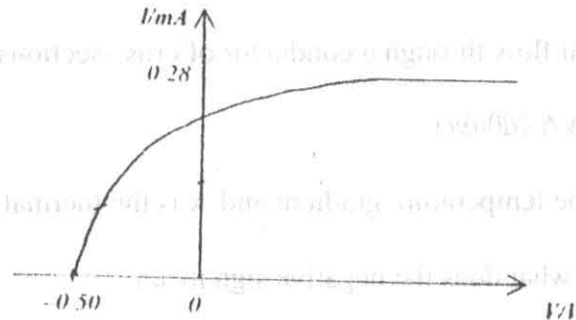
6. A metal block is placed in the middle of the space between two large metal plates X and Y as shown in the diagram below.



The X -plate is fixed at $+200 \text{ V}$ and the Y -plate is connected to the earth.

- (a) Sketch a graph to show how the electric potential V varies with the distance from the X -plate. [2]
- (b) Sketch a graph to show how the electric field strength E varies with the distance from the X -plate. [2]

7. The results of a photoelectric experiment involving a photocathode with work function 2.0eV is shown by the graph below. Only 5.0% of the incident ray produced photoelectrons in the experiment.



From the result of the experiment, determine

- (a) the energy for one incident photon. [3]
- (b) the number of photons per second reaching the photocathode. [3]
8. (a) State Bohr's postulate for an atom. [2]
- (b) Show that the energy of an atom E for Bohr's model is

$$E = -\frac{Z^2 m e^4}{8 \epsilon_0^2 h^2 n^2}$$

Z = proton number

m = mass of electron

h = Planck's constant

$n = 1, 2, 3, \dots$

[4]

Section B (60 marks)

Answer any four questions in this section.

9. a) In the kinetic theory of gases, gas molecules are assumed to always be in random motion.
- i) Hence explain why such molecules of gas have kinetic energy but no net momentum. [2]
- ii) Write down an equation of states for an ideal gas by defining your symbols clearly. [1]
- b) An ideal gas of mass M has a volume V at a pressure of p and absolute temperature of T . The root mean square velocity of the molecules of the gas is c and each molecule has a mass of m .
- i) Starting from the relationship $PV = \frac{1}{3} M c^2$, derive an expression for c , the root mean square velocity of the molecules for the gas in terms of m , T and Boltzmann's constant. [3]

ii) Hence estimate the temperature experienced by a spacecraft entering the Earth's atmosphere at a speed of $36\,000\text{ km h}^{-1}$. You can assume the Earth's atmosphere contains only molecules of nitrogen with relative atomic mass 14.0. [3]

(c) The rate of heat flow through a conductor of cross-sectional area A is given by

$$dQ/dt = -kA(d\theta/dx)$$

$d\theta/dx$ is the temperature gradient and k is the thermal conductivity.

(i) Explain what does the negative sign mean. [1]

(ii) One end of the long metal rod of uniform cross-sectional area is heated. State the conditions for a constant temperature gradient along the rod. [2]

(iii) A refrigerator wall of thermal conductivity $0.050\text{ W m}^{-1}\text{ K}^{-1}$, thickness 90 mm and an effective surface area of 5.6 m^2 has to be maintained at temperature of 25°C below the outside temperature. Calculate the minimum power of the refrigerator. [3]

10. a) (i) Explain what is meant by that a material is elastic. [1]

(ii) Differentiate between the elastic limit and the proportional limit. [2]

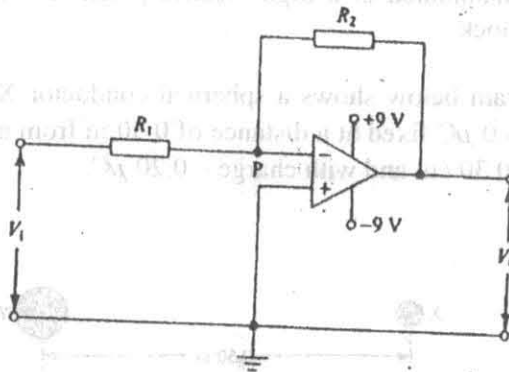
(iii) From the molecular aspects of views, describe briefly the behaviour of a copper wire and an elastic thread of equal dimensions when an equal increasing longitudinal force acts separately on them. [5]

b) Table below shows the result of an experiment to determine the Young Modulus of a wire. The wire is fixed at the upper end and the mass is hung at the lower end. The wire has initial length of 2.40 m and a diameter of 0.320 mm. Use a graphical method to determine the value of the Young Modulus of the wire

Load / kg	Reading scale / mm
0	3.15
0.200	3.70
0.400	4.20
0.600	4.65
0.800	5.10
1.00	5.55
1.200	6.00
1.400	6.50

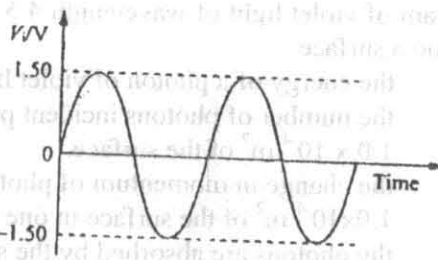
(c) State two common errors could be found in this experiment and ways to reduce them. [2]

11. The diagram below shows an inverting amplifier circuit using an ideal operational amplifier. R_1 is an input resistor and R_2 a feedback resistor.



- (a) What is meant by *negative feedback*? [1 mark]
- (b) State two advantages of negative feedback. [2 marks]
- (c) (i) Explain why point P in the above circuit is known as a virtual earth. [2marks]
- (ii) Derive an expression for the voltage gain of the above inverting amplifier circuit. [3 marks]

(d)



- (i) If $R_1 = 2.0 \text{ k}\Omega$, $R_2 = 10.0 \text{ k}\Omega$, and input voltage V_1 is as shown in the above graph, sketch a graph to show how output voltage V_0 varies with time. Indicate the value of the maximum voltage on your graph.

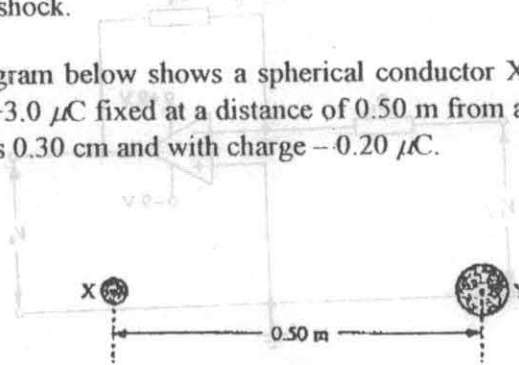
[3 marks]

- (ii) If $R_1 = 2.0 \text{ k}\Omega$, $R_2 = 20.0 \text{ k}\Omega$, sketch a graph of output voltage V_0 against time. State the advantage of selecting a small value of voltage gain.

[4 marks]

12. (a) (i) State *Gauss' law*. [2]
- (ii) Using Gauss' law, explain why a person inside a closed metallic cabin maintained at a high electric potential will not experience an electric shock. [3]

- (b) The diagram below shows a spherical conductor X of radius 0.15 cm and with charge $+3.0 \mu\text{C}$ fixed at a distance of 0.50 m from another spherical conductor Y of radius 0.30 cm and with charge $-0.20 \mu\text{C}$.



- (i) Calculate the force between the two spheres. [3]

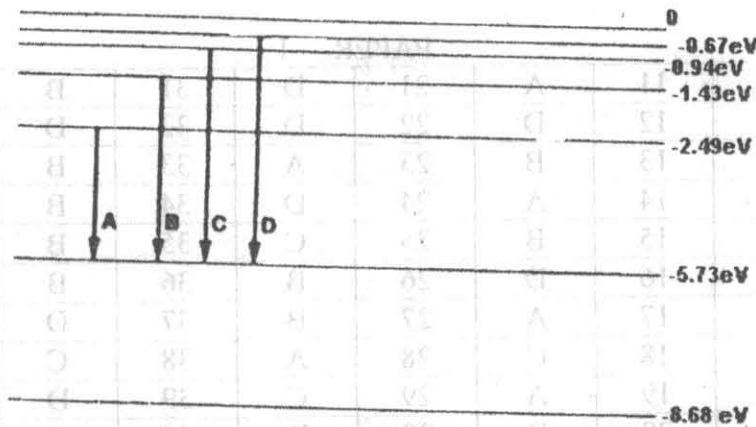
The two spheres is connected with a thin wire. The wire is then removed from the spheres.

- (ii) What is the charge on each of the sphere? [5]
- (iii) Is the force between the two spheres a force of repulsion or a force of attraction after the wire is removed? Explain your answer. [2]

13. (a) A parallel beam of violet light of wavelength $4.5 \times 10^{-7} \text{ m}$ and intensity 700 Wm^{-2} is incident normally on a surface.
- Calculate
- the energy of a photon of violet light, [1]
 - the number of photons incident per second on $1.0 \times 10^{-4} \text{ m}^2$ of the surface. [2]
 - the change in momentum of photons incident on $1.0 \times 10^{-4} \text{ m}^2$ of the surface in one second. Assume that the photons are absorbed by the surface. [2]

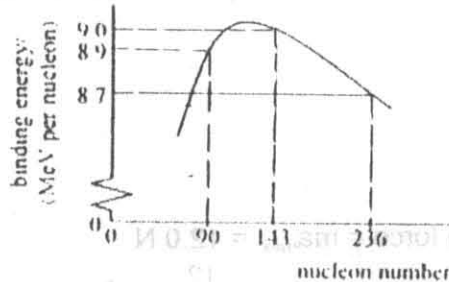
(b) The figure below illustrates some of the electron energy levels in an isolated atom of lithium.

- The outer electron of a lithium atom is in the lowest energy level shown. How many joules of energy required to remove this electron from the atom? [1]
- Which of the transitions A,B,C or D would lead to the emission of radiation of the shortest wavelength? [1]
- Calculate the wavelength of this radiation. [2]
- State the region of the electromagnetic spectrum in which this radiation lies. [1]



- (v) Sketch the appearance of the spectrum which these four transitions produce. [2]
- (vi) Draw four transitions of greater energy change which give rise to another set of wavelengths. [2]
- (vii) If the lithium atoms are initially in the lowest energy level, how many absorption lines might be detected? [1]

14 (a) The binding energy per nucleon varies with nucleon number in the way as shown in the graph below.



During a fission process with Uranium-236 nucleus, a Strontium-90 nucleus and a Xenon-143 nucleus are produced.

- (i) Use the values on the graph to calculate the energy released during this fission process. [3]
- (ii) Why does a release of energy occur when there is an increase in the binding energy per nucleon? [2]
- (iii) Explain briefly the controlled fission reaction in a nuclear reactor. [3]

(b) A nuclear submarine needs 500kW, which is provided by the fission of ^{235}U . The fuel is enriched uranium which may be 3% ^{235}U and the rest ^{238}U .

- (i) Calculate the number of atoms of ^{235}U in 1.0kg of this fuel. [2]
- (ii) The energy released at each fission is $3 \times 10^{-11}\text{J}$.
 - I. How many fissions per second are needed to provide the required power? [2]
 - II. How long will 1.0kg of fuel last? (in terms of days) [3]