SP015/2
Physics
Paper 2
Semester I
Session 2023/2024
2 hours

SP015/2
Fizik
Kertas 2
Semester I
Sesi 2023/2024
2 jam

KEMENTERIAN
PENDIDIKAN
MALAYSIA

KOLEJ MATRIKULASI PERAK

PRA-PSPM

FIZIK

Kertas 2

2 jam

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU.

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

Name: _____

Matric. No.: _____

Class: _____

NO.	MARKS	
1	2	
2	10	
3	13	
4	8	
5	5	
6	23	
7	8	
8	11	
TOTAL	80	

INSTRUCTION TO CANDIDATE:

This question paper consists of **8** questions. Answer **all** the questions.
The use of electronic calculator is permitted.

LIST OF SELECTED CONSTANT VALUES

Speed of light in vacuum	c	$= 3.00 \times 10^{8}$ m s^{-1}
Permeability of free space	μ_o	$= 4\pi \times 10^{-7}$ H m^{-1}
Permittivity of free space	ε_o	$= 8.85 \times 10^{-12}$ F m^{-1}
Elementary charge magnitude	e	$= 1.60 \times 10^{-19}$ C
Planck constant	h	$= 6.63 \times 10^{-34}$ J s
Electron mass	m_e	$= 9.11 \times 10^{-31}$ kg $= 5.49 \times 10^{-4}$ u
Neutron mass	m_n	$= 1.674 \times 10^{-27}$ kg $= 1.008665$ u
Proton mass	m_p	$= 1.672 \times 10^{-27}$ kg $= 1.007277$ u
Deuteron mass	m_d	$= 3.34 \times 10^{-27}$ kg $= 2.014102$ u
Molar gas constant	R	$= 8.31$ J K^{-1} mol^{-1}
Rydberg constant	R_H	$= 1.097 \times 10^{7}$ m^{-1}
Avogadro constant	N_A	$= 6.02 \times 10^{23}$ mol^{-1}
Boltzmann constant	k	$= 1.38 \times 10^{-23}$ J K^{-1}
Gravitational constant	G	$= 6.67 \times 10^{-11}$ N m^2 kg^{-2}
Free-fall acceleration	g	$= 9.81$ m s^{-2}
Atomic mass unit	1 u	$= 1.66 \times 10^{-27}$ kg $= 931.5 \ \frac{\text{MeV}}{c^2}$
Electron volt	1 eV	$= 1.6 \times 10^{-19}$ J
Constant of proportionality for Coulomb's law	$k = \frac{1}{4\pi\varepsilon_o}$	$= 9.0 \times 10^{9}$ N m^2 C^{-2}
Atmospheric pressure	1 atm	$= 1.013 \times 10^{5}$ Pa
Density of water	ρ_w	$= 1000$ kg m^{-3}

Answer all question.

1. A girl push a box across the floor and causes it to undergo two displacement **A** and **B**. Displacement **A** is 1.5 m along the positive x-axis, while displacement **B** is 1.4 m along the positive y-axis. Determine the *magnitude* **and** *direction* of the displacement.

[2 marks]

2. (a) A bullet is shot from a gun at a speed of 345 m s^{-1} towards a piece of box with 5.5 cm thickness and emerges with speed of 260 m s^{-1}. Calculate the

(i) deceleration through the box.

(ii) time taken to get through the box.

[4 marks]

(b) A water rocket is launched upward from ground at speed ***u***. The rocket returns to the ground 8 seconds later. Determine

(ii) the value of ***u***?

(ii) maximum height can be achieved by the rocket.

(iii) velocity of the rocket just before it hits the ground.

[6 marks]

3. (a)

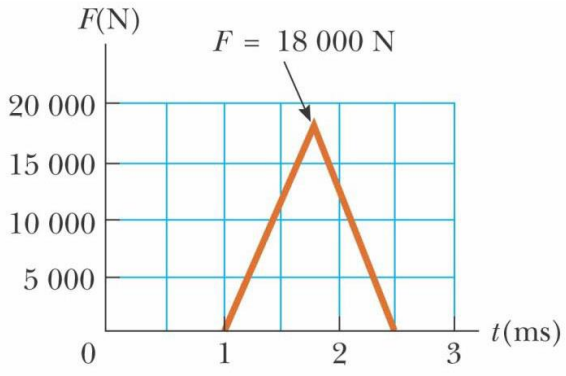

FIGURE 1

An estimated force-time curve for a baseball struck by a bat is shown in **FIGURE 1**. From this curve, determine

(i) the impulse delivered to the ball,

(ii) the average force exerted on the ball.

[4 marks]

(b) An object **P** of mass 8 kg moving at 4 m s^{-1} collides with a second object **Q** of mass 6 kg moving at 5 m s^{-1} in the opposite direction. After collision, object **P** moves in opposite direction at 1 m s^{-1}. Determine the velocity of object **Q** after the collision

[2 marks]

(c)

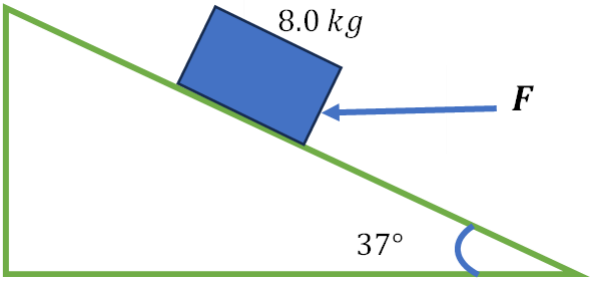

FIGURE 2

A 8 kg box is held in equilibrium on a rough slope by a horizontal force F as shown in **FIGURE 2**. The coefficient of friction between the box and the slope is 0.15. The magnitude of force F may vary from a certain minimum value to a maximum value.

(i) Sketch a free body diagram for the box when force F has its minimum value. Label all forces.

(ii) Determine the minimum magnitude of the force F **and** the normal force act on the box.

[7 marks]

4. (a) A block of mass 2 kg is pushed 1.5 m along a frictionless horizontal table by a constant 10 N force directed 30° above the horizontal. Calculate the work done by

(i) the applied force.

(ii) the force of gravity.

[3 marks]

(b)

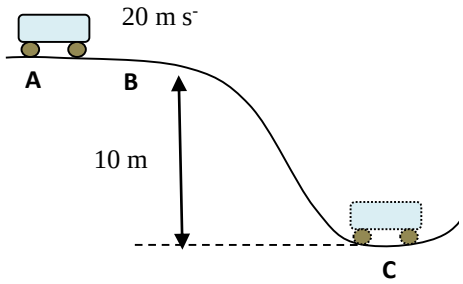

FIGURE 3

In **FIGURE 3**, a small cart of mass 8 kg moves on the frictionless track with a speed of 20 m s^{-1} along **AB** and down to **C**. Calculate the

(i) kinetic energy of the cart as it moves along **AB.**

(ii) potential energy of the cart at point **B**.

(iii) speed of the cart at point **C**.

[5 marks]

5. A ball of a mass 4.0 kg is attached to the end of a 1.2 m long string and whirled around in a circle that describes a **vertical plane**.

(a) Calculate the minimum speed that the ball can be moving at and still maintain a circular path? Sketch a **free body diagram**.

(b) At this speed, calculate the maximum tension in the string?

[5 marks]

6. (a)

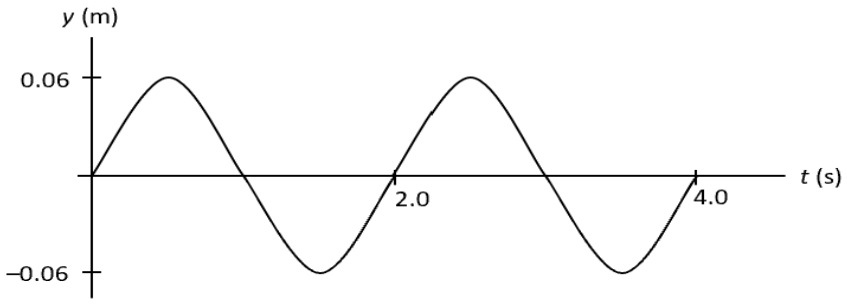

FIGURE 4

FIGURE 4 shows the displacement versus time graph for an object performing a simple harmonic motion. Based on the graph,

(i) determine the angular frequency.

(ii) determine the maximum velocity

(iii) write the simple harmonic motion equation.

[5 marks]

(b) A 50 g object connected to a spring with a spring constant 35 N m^{-1} oscillates with amplitude 4 cm on a horizontal frictionless surface. Calculate the

(i) total energy of the system.

(ii) speed of the object at displacement 1.6 cm.

(iii) change in the period of oscillation if a load of 6 g is added to the object.

[7 marks]

(c) A progressive wave is represented by equation,

$$y\,(x, t) = 1200 \sin (314t - 0.42x)$$

where x and y are in cm and t is in second. Determine the

(i) velocity of the wave.

(ii) maximum velocity of the particle.

[4 marks]

(d) A mechanical wave propagates at 550 m s^{-1} along a string stretched to a tension of 800 N. The string oscillates at fundamental frequency 440 Hz. Calculate the

(i) mass per unit length of the string.

(ii) length of the string.

(iii) frequency of the second overtone **and** sketch the waveform of the overtone.

[5 marks]

(e) A car is traveling at 25 m s^{-1} emits a sound of frequency 1100 Hz approaches a stationary observer. Calculate the apparent frequency of the sound heard by the observer. The speed of sound is 340 m s^{-1}.

[2 marks]

7. (a) A metal wire of length 75 cm and diameter 0.13 cm stretches by 0.035 cm when a load of 8 kg is hung on its end. Calculate the Young's modulus of the wire.

[2 marks]

(b) A 55 m^2 composite wall of a building consists of brick and concrete with the thickness of 12.0 cm and 24.0 cm respectively. The temperature of the outer surface of the brick and concrete is 40 °C and 20 °C respectively. (Given coefficient of thermal conductivity of brick and concrete are 0.6 W m^{-1} $°C^{-1}$ and 0.8 W m^{-1} $°C^{-1}$ respectively.)

(i) Determine the temperature of the interface between the brick and the concrete.

(ii) How much heat flows through the concrete in 1 hour?

[6 marks]

8. (a) The temperature in outer space is about 3.5 K and it is estimated that there is about one hydrogen molecule per cm^3. The mass of a hydrogen molecule is 3.346×10^{-27} kg. Calculate the

(i) rms speed of the hydrogen molecules.

(ii) hydrogen density in outer space.

(iii) pressure of hydrogen gas at the outer space.

(iv) mean translational kinetic energy of the hydrogen molecules.

[8 marks]

(b)

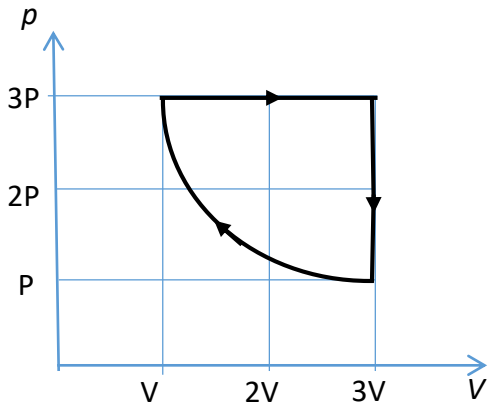

FIGURE 5

FIGURE 5 shows the *p*-*V* graph of the thermodynamics processes experienced by an ideal gas. The values of *p* and *V* are 2×10^5 Pa and 3×10^{-2} m^3 respectively. Calculate the heat transferred during the whole thermodynamics processes.

[3 marks]

END OF QUESTION PAPER