SF016/2
Physics
Paper 2
Semester 1
Session 2011/2012
2½ hours

SF016/2
Fizik
Kertas 2
Semester I
Sesi 2011/2012
2½ jam

BAHAGIAN MATRIKULASI
KEMENTERIAN PELAJARAN MALAYSIA
MATRICULATION DIVISION
MINISTRY OF EDUCATION MALAYSIA

PEPERIKSAAN SEMESTER PROGRAM MATRIKULASI
MATRICULATION PROGRAMME EXAMINATION

FIZIK

Kertas 2

2 jam 30 minit

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU.
DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

Kertas soalan ini mengandungi **21** halaman bercetak.
This question paper consists of **21** *printed pages.*

INSTRUCTIONS TO CANDIDATE:

This question paper consists of **8 questions**.

Answer **question 1** and **any other five** questions. Only the **first six answers** will be graded.

All answers must be written in the answer booklet provided. Use a new page for each question.

The use of electronic calculator is permitted.

List Of Selected Constant Values

Speed of light in vacuum	c	$= 3.00 \times 10^{8}\ \text{m s}^{-1}$
Permeability constant	μ_0	$= 4\pi \times 10^{-7}\ \text{H m}^{-1}$
Permittivity constant	ε_0	$= 8.85 \times 10^{-12}\ \text{F m}^{-1}$
Elementary charge	e	$= 1.60 \times 10^{-19}\ \text{C}$
Planck constant	h	$= 6.63 \times 10^{-34}\ \text{J s}$
Electron mass	m_e	$= 9.11 \times 10^{-31}\ \text{kg}$ $= 5.48 \times 10^{-4}\ \text{u}$
Neutron mass	m_n	$= 1.67 \times 10^{-27}\ \text{kg}$ $= 1.008665\ \text{u}$
Proton mass	m_p	$= 1.67 \times 10^{-27}\ \text{kg}$ $= 1.007825\ \text{u}$
Deuteron mass	m_d	$= 3.34 \times 10^{-27}\ \text{kg}$ $= 2.014102\ \text{u}$
Universal gas constant	R	$= 8.31\ \text{J K}^{-1}\ \text{mol}^{-1}$
Rydberg constant	R_H	$= 109678\ \text{cm}^{-1}$ $= 1.097 \times 10^{7}\ \text{m}^{-1}$
Avogadro constant	N_A	$= 6.02 \times 10^{23}\ \text{mol}^{-1}$
Boltzmann constant	k	$= 1.38 \times 10^{-23}\ \text{J K}^{-1}$
Gravitational constant	G	$= 6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2}$
Free-fall acceleration	g	$= 9.81\ \text{m s}^{-2}$
Atomic mass unit	1 u	$= 1.66 \times 10^{-27}\ \text{kg}$ $= 931.5\ \frac{\text{MeV}}{c^2}$
Electron volt	eV	$= 1.6 \times 10^{-19}\ \text{J}$
Constant of proportionality for Coulomb's law	$k = \frac{1}{4\pi\varepsilon_0}$	$= 9.0 \times 10^{9}\ \text{N m}^2\ \text{C}^{-2}$
Atmospheric pressure	atm	$= 1.013 \times 10^{5}\ \text{Pa}$
Density of water		$= 1000\ \text{kg m}^{-3}$

*Answer **question 1** and **any other five** questions.*

1 A stone is released from various heights, h. The respective time taken, t to reach the ground is given in **TABLE 1**. The relationship between h and t is given by

$$h=\frac{1}{2}gt^2$$

where g is the acceleration due to gravity.

TABLE 1

h (m)	t (s)	$2h$ (m)	t^2 (s^2)
2.00	0.60		
4.00	0.85		
6.00	1.14		
8.00	1.32		
10.00	1.40		
12.00	1.49		
14.00	1.71		

(a) Copy and complete **TABLE 1.**

[2 *marks*]

(b) Plot a graph of $2h$ against t^2.

[7 *marks*]

(c) Determine the gradient of the graph.

[4 *marks*]

(d) From the graph, calculate the acceleration due to gravity, g.

[2 *marks*]

2 (a) A plane travels at three times the speed of sound. If the speed of sound in air is 343 m s^{-1}, how far it travels in 10 minutes?

[2 *marks*]

(b) A ball is thrown vertically upwards. It reaches a maximum height and returns to its initial position.

(i) Is the acceleration of the ball zero at the maximum height? State the reason for your answer.

(ii) Sketch **TWO** graphs: displacement against time **and** velocity against time for the whole journey of the ball.

[6 *marks*]

(c)

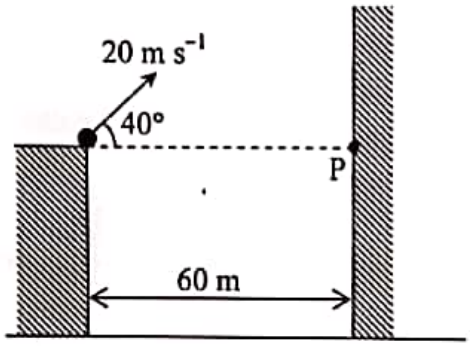

FIGURE 1

FIGURE 1 shows a ball being thrown from the top of a building towards a wall 60 m away. The initial velocity of the ball is 20.0 m s^{-1} at 40° to the horizontal.

(i) How much time does it take to hit the wall?

(ii) What is the distance between P and the position the ball strike the wall?

(iii) What is the speed of the ball when it strikes the wall?

[7 *marks*]

3 (a)

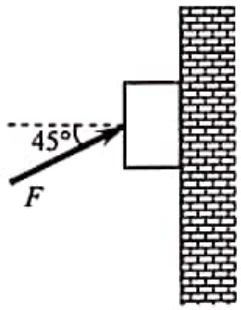

FIGURE 2

FIGURE 2 shows a 0.4 kg block being pushed against a rough vertical wall by a force F at an angle 45° with respect to the horizontal. The block remains stationary.

(i) Sketch a free body diagram of all the forces acting on the block.

(ii) If the coefficient of static friction, $\mu_s = 0.20$, what is the magnitude of F?

[5 *marks*]

(b)

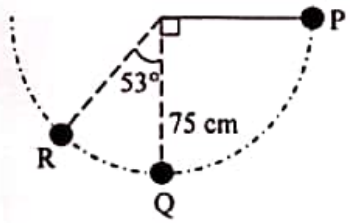

FIGURE 3

FIGURE 3 shows a 0.8 kg pendulum bob being released from rest at P. Calculate the

(i) work done by gravity on the bob at R.

(ii) speed of the bob at Q.

[4 *marks*]

(c) An 8 g bullet moving at 50 m s^{-1} strikes a wooden block. The bullet undergoes uniform deceleration and stopped 12 cm inside the block. Calculate the

(i) time taken for the bullet to stop.

(ii) impulse on the block.

(iii) average force experienced by the block.

[6 *marks*]

4 (a) Name the force that is responsible for the following motion:

(i) A satellite orbiting the earth.

(ii) A ball attached to a string that swirls horizontally.

[2 *marks*]

(b) A 3500 kg car enters a curve of radius 10 m on a flat road at 30 m s^{-1}.

(i) Calculate the net horizontal force required to keep the car moving around the curve without slipping.

(ii) State the force that enables the car to successfully negotiate the curve.

[3 *marks*]

(c) A 1000 kg satellite is in an orbit 350 km above the earth surface. Calculate the

(i) speed of the satellite.

(ii) period of the satellite.

(iii) radial acceleration of the satellite.

[6 *marks*]

(d)

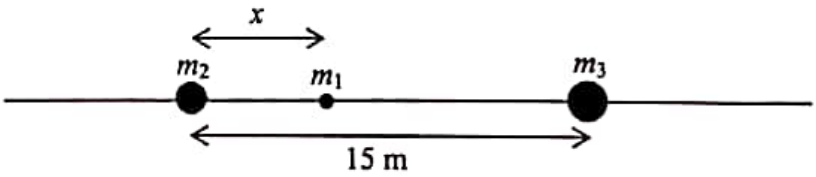

FIGURE 4

FIGURE 4 shows a mass m_1 positioned between two masses, $m_2 = 40$ kg and $m_3 = 60$ kg. m_2 and m_3 are separated by 15 m. m_1 is placed at a distance x from m_2.

(i) Sketch and label the forces acting on mass m_1 due to m_2 and m_3.

(ii) Determine x when m_1 will experience zero net gravitational force.

[4 *marks*]

5 (a) State **TWO** factors that determine the moment of inertia of a body.

[2 *marks*]

(b)

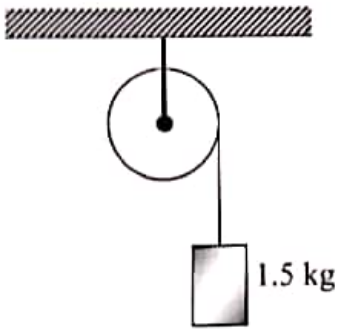

FIGURE 5

FIGURE 5 shows a 1.5 kg block is hung by a light string which is wound around a pulley of radius 20.0 cm. The moment of inertia of the pulley is 2.0 kg m^2. When the mass is released from rest, calculate the

(i) torque exerted on the pulley.

(ii) angular velocity of the pulley at $t = 4.2$ s.

(iii) number of revolutions made by the pulley in 4.2 s.

[7 *marks*]

(c)

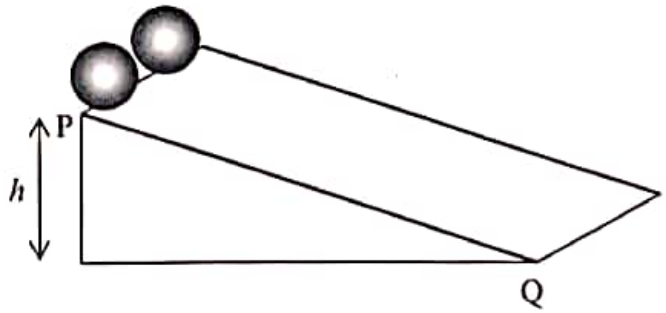

FIGURE 6

A solid sphere and a hollow sphere have the same mass, m and radius, r. **FIGURE 6** shows both spheres are released simultaneously from rest at P and roll down on an inclined plane. Which sphere will arrive first at Q? Show your answer.

(Moment of inertia of the spheres: $I_{solid} = \frac{2}{5}mr^2$ and $I_{hollow} = \frac{2}{3}mr^2$)

[6 *marks*]

6 (a) What is meant by simple harmonic motion?

[1 *mark*]

(b) An object of mass 50 kg suspended from a spring undergoes a simple harmonic motion with a period of 6.0 s.

(i) Calculate the angular velocity of the motion.

(ii) What additional mass should be added to the spring so that it oscillates with a period of 8.0 s?

[5 *marks*]

(c) A 200 g object is connected to a spring and moves along the x-axis in a simple harmonic motion about the origin. The position of the object is given by

$$x = 0.5 \cos (0.4\pi t - 0.25)$$

where x is in centimeter and t in seconds. Calculate the

(i) frequency of the motion.

(ii) velocity of the object at $t = 2$ s.

(iii) acceleration of the object at $t = 2$ s.

(iv) total energy of the system.

[9 *marks*]

7 (a) Describe

(i) transverse wave.

(ii) longitudinal wave.

[2 *marks*]

(b) (i) Explain Doppler's effect for sound wave.

(ii) What frequency will be heard by a moving observer travelling at 25 m s^{-1} towards a stationary siren that emits a sound of frequency 280 Hz?

(Velocity of sound in air = 343 m s^{-1})

(iii) Sketch a graph of apparent frequency against distance travelled by an object.

[5 *marks*]

(c) (i) Define stress and strain.

(ii) What is meant by plastic deformation?

(iii) Sketch a labelled graph of stress against strain showing the elastic and plastic deformation regions for a ductile metal under tension.

[6 *marks*]

(d) A 20.0 kg mass is hung from a 2.0 m long vertical wire. If the wire is elongated by 3.0 mm, calculate the strain energy stored in the wire.

[2 *marks*]

8 (a) (i) Define the coefficient of linear thermal expansion.

(ii) A pair of eyeglass frame is made of epoxy plastic. At 20 °C, the frame has circular lens holes of radius 2.20 cm. If the coefficient of linear expansion of the epoxy is 3×10^{-4} °C^{-1}, to what temperature must the frame be heated so that a lens of radius 2.21 cm fits the frame?

[4 *marks*]

(b) An insulated spherical glass bulb of radius 2.5 cm, thickness 0.4 mm whose outer surface temperature is 30 °C dissipates 55 W of heat.

(i) Given the thermal conductivity of glass is 0.84 J s^{-1} m^{-1} °C^{-1}. Calculate the temperature of the inner surface of the bulb.

(ii) Sketch a labelled temperature against distance graph of the heat conduction through the bulb.

[5 *marks*]

(c) (i) State the first law of thermodynamics.

(ii) If a system loses 1200 J of heat when 800 J of work done on it, what is the change in its internal energy?

(iii) Three moles of an ideal gas expands from 50 cm^3 to 120 cm^3 at a constant temperature of 30 °C. Calculate the heat transferred to the surroundings by this process.

[6 *marks*]

END OF QUESTION PAPER