SP015
PAST YEAR PAPERS
2010 - 2020

Compiled by
SHAFIQ RASULAN

SP015 PAST YEAR PAPERS 2010 - 2020

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SF017/2
Physics
Paper 2
Semester I
Session 2010/2011
2½ hours

SF017/2
Fizik
Kertas 2
Semester I
Sesi 2010/2011
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

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INSTRUCTIONS TO CANDIDATE:

This question booklet consists of **Section A** and **B**.

Answer **all** questions in **Section A**.

Answer **question 9** and **any three** questions in **Section B**. Only the **first four answers** in **Section B** will be evaluated.

Answers to both sections must be written in the answer booklet provided. Use a new page for each question.

The use of electronic calculator is permitted.

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SECTION A [30 *marks*]

*Answer **all** questions in this section.*

1 A 50 g marble is released from a height of 1 m above the floor. Calculate its momentum just before hitting the floor.

[3 *marks*]

2

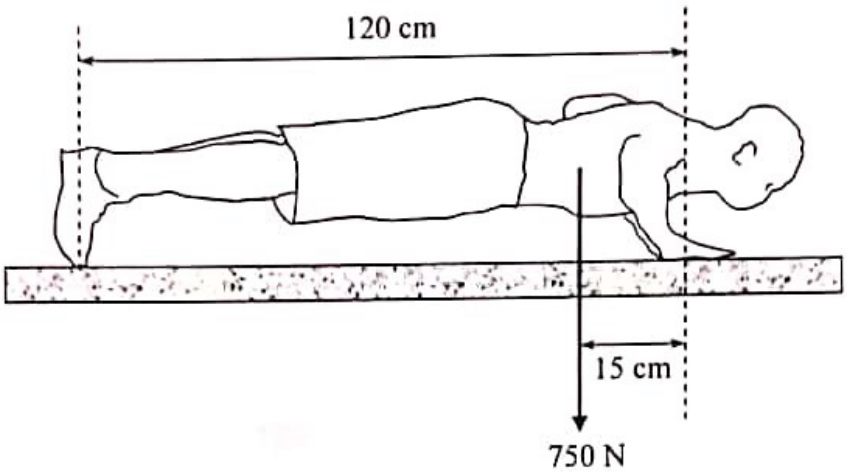

FIGURE 1

A 750 N athlete is doing a push-up exercise by putting his palms and toes on the floor as shown in **FIGURE 1**. The athlete's centre of mass is 15 cm from his palms. The horizontal distance between his toes and palms is 120 cm. Assume the posture of the athlete as a rigid body,

(a) draw a free body diagram of the athlete.

(b) calculate the force acting on each of his palms.

[4 *marks*]

3 A 0.2 kg ball, attached to the end of a string, is rotated in a horizontal circle of radius 1.5 m on a frictionless table surface. The string will snap when the tension exceeds 50 N.

(a) What is the maximum speed of the ball?

(b) If there were friction on the table, what will happen to the maximum speed of the ball? Explain your answer.

[4 *marks*]

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4 (a) State **one** difference of the accelerations between linear motion and that of simple harmonic motion.

(b) A mass m at the end of a spring vibrates vertically with a frequency of 0.9 Hz. When an additional 1.2 kg is attached to m, the frequency is 0.5 Hz. Calculate the value of m.

[4 *marks*]

5 The equation of a progressive wave is given as

$$y = 2\sin(10t + 5x) \text{ cm}$$

where t is in second and x in cm. Determine the propagation velocity of the wave.

[4 *marks*]

6 A spring stretches by 4 mm when a 1.5 kg mass is suspended at its end. Calculate the spring constant.

[3 *marks*]

7 A closed kettle contains hot water.

(a) State **three** factors that influence the rate of radiative heat loss from the kettle.

(b) Will the rate of heat loss be increased, decreased or unchanged if the surface of the kettle is painted black? Explain your answer briefly.

[4 *marks*]

8 (a) Define molar specific heat at constant pressure.

(b) The root mean square (rms) speed of gas molecules is to be reduced by 1%. If the gas temperature is 27 °C, at what temperature does it should be cooled down?

[4 *marks*]

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SECTION B [60 *marks*]

Answer ***question 9*** *and* ***any three*** *questions in this section.*

9 The period, T of a simple pendulum is given by

$$T = 2\pi\sqrt{\frac{l}{g}}$$

where l is the length of the string and g is the gravitational acceleration. In an experiment, the time for 20 oscillations for various lengths of string were measured and the results are shown in **TABLE 1**.

TABLE 1

Length of string, l (cm)	**Time for 20 oscillations (s)**	**Period, T (s)**	**T^2 (s^2)**
90.0	37.5		
80.0	36.0		
70.0	34.0		
60.0	31.5		
50.0	29.0		
40.0	26.5		
30.0	22.5		
20.0	19.0		

(a) Copy and complete **TABLE 1**. [4 *marks*]

(b) Plot a graph of T^2 versus l. [6 *marks*]

(c) Determine the gradient of the graph. [3 *marks*]

(d) Calculate the value of g using the gradient of the graph. [2 *marks*]

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10 A drunken motorist who is moving at a constant velocity of 90 km h^{-1} passes a stationary police patrol car. The patrol car immediately gives chase at a constant acceleration and catches up with the motorist after a distance of 10 km.

(a) Calculate the time taken by the patrol car to catch up with the motorist.

[2 *marks*]

(b) Calculate the acceleration of the patrol car.

[3 *marks*]

(c) Calculate the velocity of the patrol car when it catches up with the motorist.

[3 *marks*]

(d) On the same axes, sketch and label graphs of displacement versus time for both vehicles.

[5 *marks*]

(e) Given the power of police car is 180 kW, calculate the force of the car's engine at the instant it overtakes the motorist.

[2 *marks*]

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11

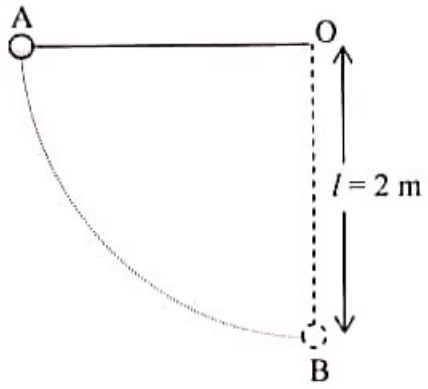

FIGURE 2

A small bob of mass 10 g is attached to the end of a massless string of length 2 m. The other end of the string is fixed at point O as shown in **FIGURE 2**. Initially the bob is held at point A which is at the same level as point O, keeping the string taut and then released. Determine

(a) the linear velocity of the bob at point B directly beneath point O.

[3 *marks*]

(b) the angular velocity of the bob at point B.

[2 *marks*]

(c) the tension of the string when the bob is at point B.

[4 *marks*]

(d) the linear velocity of the bob at a point midway through arc AB.

[3 *marks*]

(e) whether the linear velocity of the bob at point B be lower, higher or similar if the experiment is performed on the surface of the moon. Explain your answer briefly.

[3 *marks*]

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12 (a) Two 40 cm steel wires of different diameters are stretched by equal tensional force of 200 N. The diameter of the first wire is 98% to that of the second wire. When the first wire is plucked, it produces a sound of 350 Hz. Calculate

(i) the mass per unit length of the first wire.

(ii) the mass per unit length of the second wire.

(iii) the frequency of the sound produced by the second wire when plucked.

(iv) the frequency of the beat produced when both wires are plucked together.

[12 *marks*]

(b) (i) Define sound intensity.

(ii) How does the intensity of sound change with the sound wave amplitude, A and distance, r from its source?

[3 *marks*]

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13 (a) For two atoms,

(i) sketch a labeled graph of the interatomic potential energy, U against separation distance, r.

(ii) the interatomic potential energy is given by

$$U(r) = \frac{A}{r^{12}} - \frac{B}{r^{6}}$$

where A and B are empirical constants. Use the formula to derive the interatomic force, $F(r)$.

(iii) sketch a labeled graph of the interatomic force, F against separation distance, r using the same axes as the graph in **13**(a)(i).

[6 *marks*]

(b)

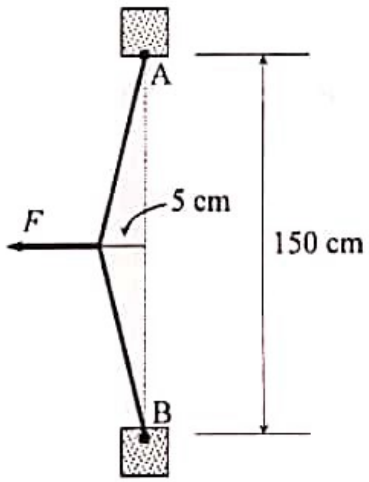

FIGURE 3

A steel wire AB, of length 150 cm and diameter 1 mm is fixed at both ends. A force F pulls the wire at the midpoint and causes a displacement of 5 cm as shown in **FIGURE 3**. If the Young modulus of the steel is 2 GPa, calculate the

(i) magnitude of F.

(ii) energy stored in the wire.

[9 *marks*]

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14 (a) What is meant by the isothermal process?

[1 *mark*]

(b) One cubic meter air initially at 27 °C and atmospheric pressure is compressed isothermally to half of its original volume. Then the air is allowed to expand isobarically back to its original volume.

(i) Using the same axes, sketch and label a p-V diagram of these two thermodynamic processes.

(ii) Calculate the pressure of the air after the isothermal compression.

(iii) Calculate the final temperature of the air.

(iv) Calculate the total work done for the whole process.

[14 *marks*]

END OF QUESTION BOOKLET

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

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

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List Of Selected Constant Values

Speed of light in vacuum	c	$= 3.00 \times 10^{8}$ m s^{-1}
Permeability constant	μ_0	$= 4\pi \times 10^{-7}$ H m^{-1}
Permittivity constant	ε_0	$= 8.85 \times 10^{-12}$ F m^{-1}
Elementary charge	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 $= 5.48 \times 10^{-4}$ u
Neutron mass	m_n	$= 1.67 \times 10^{-27}$ kg $= 1.008665$ u
Proton mass	m_p	$= 1.67 \times 10^{-27}$ kg $= 1.007825$ u
Deuteron mass	m_d	$= 3.34 \times 10^{-27}$ kg $= 2.014102$ u
Universal gas constant	R	$= 8.31$ J K^{-1} mol^{-1}
Rydberg constant	R_H	$= 109678$ cm^{-1} $= 1.097 \times 10^{7}$ 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	eV	$= 1.6 \times 10^{-19}$ J
Constant of proportionality for Coulomb's law	$k = \frac{1}{4\pi\varepsilon_0}$	$= 9.0 \times 10^{9}$ N m^2 C^{-2}
Atmospheric pressure	atm	$= 1.013 \times 10^{5}$ Pa
Density of water		$= 1000$ kg m^{-3}

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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*]

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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)

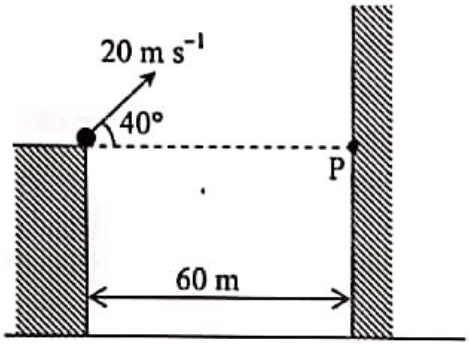

FIGURE 1

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*]

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3 (a)

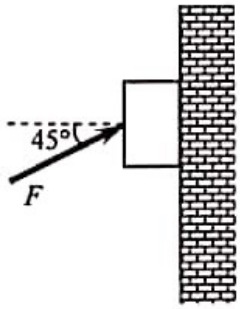

FIGURE 2

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)

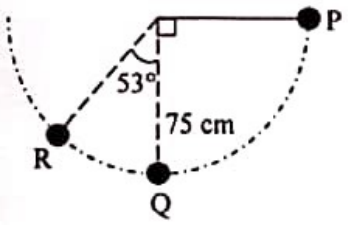

FIGURE 3

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*]

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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)

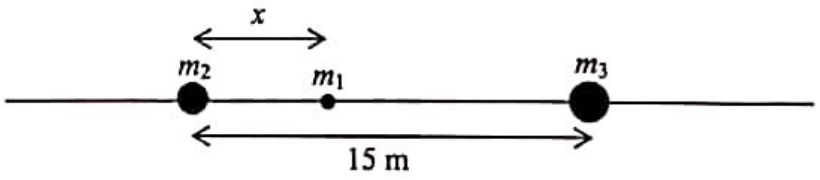

FIGURE 4

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*]

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

[2 *marks*]

(b)

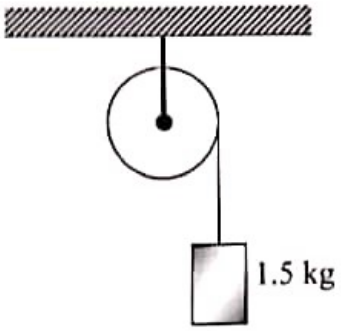

FIGURE 5

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)

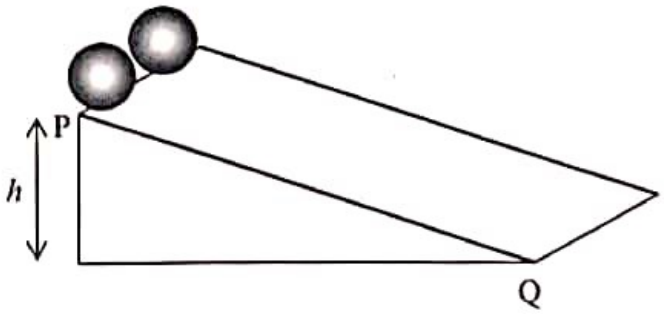

FIGURE 6

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*]

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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*]

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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*]

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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

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SF016/2
Physics
Paper 2
Semester I
Session 2012/2013
2½ hours

SF016/2
Fizik
Kertas 2
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*Answer **question 1** and **any other five** questions.*

1 A student measured the period of oscillation, T of a simple pendulum for six different lengths, l and the results are shown in **TABLE 1**.

TABLE 1

l (m)	T (s)	T^2 (s^2)
0.25	1.15	
0.50	1.43	
0.75	1.84	
1.00	2.02	
1.25	2.26	
1.50	2.45	

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

[2 *marks*]

(b) Plot a graph of T^2 against l.

[6 *marks*]

(c) Determine the gradient of the graph.

[4 *marks*]

(d) Given that

$$T = 2\pi\sqrt{\frac{l}{g}}$$

determine g from the gradient of the graph.

[3 *marks*]

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2 (a) A train initially at rest, accelerates uniformly until its speed reaches 8 m s^{-1} in 25 s. For the next 200 s, the train continues its journey with constant speed, before it slows down uniformly and comes to a complete stop in 20 s.

(i) Sketch a labeled graph of speed versus time for the whole journey.

(ii) Calculate the accelerations of the train for the three parts of the journey.

(iii) Determine the total distance travelled by the train.

[8 *marks*]

(b) An object is thrown vertically downward at 5 m s^{-1} from a height of 30 m. Calculate

(i) the speed of the object just before it hits the ground.

(ii) the time taken by the object to reach the ground.

[4 *marks*]

(c) A ball is thrown horizontally at 10 m s^{-1} from a height of 15 m above the ground. Calculate the horizontal range covered by the ball.

[3 *marks*]

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3 (a) (i) State the work-energy theorem.

(ii) A 0.5 kg box is initially at rest on a smooth horizontal surface. It is acted upon by a horizontal force for a distance of 3 m. If the final speed of the box is 5 m s^{-1}, calculate the magnitude of the force.

[4 *marks*]

(b)

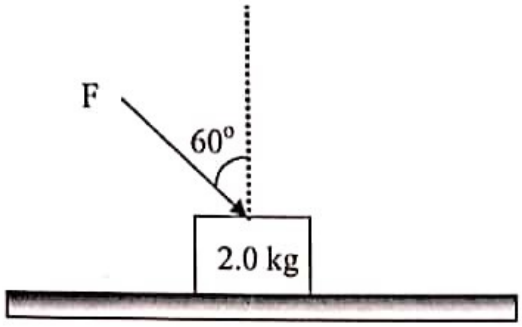

FIGURE 1

FIGURE 1 shows a 2.0 kg block is being pushed along a rough horizontal surface by a force F = 30 N at an angle 60° from the normal.

(i) Sketch a free body diagram for the block. Use common symbol for each force.

(ii) If the block moves at constant acceleration 0.5 m s^{-2}, calculate the coefficient of friction.

[8 *marks*]

(c) Two identical balls with speeds 4 m s^{-1} and 2 m s^{-1} collide head-on and stick together. Calculate their speed after the collision.

[3 *marks*]

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

(i) A car moves around a curve without skidding.

(ii) The moon orbiting the earth.

[2 *marks*]

(b)

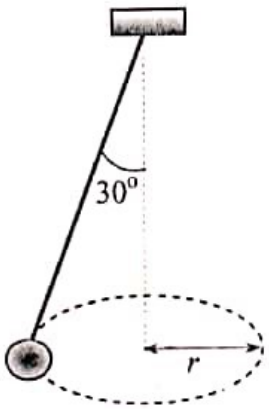

FIGURE 2

FIGURE 2 shows a bob revolves in a horizontal circle of radius r. The string has a length of 0.5 m and makes 30° with the vertical.

(i) Sketch the free body diagram for the bob.

(ii) Calculate the speed of the bob.

(iii) Calculate the period of revolution.

[8 *marks*]

(c) (i) Define gravitational field strength.

(ii) Sketch a labeled graph of gravitational field strength against distance from the centre of the earth up to three times the radius of the earth.

(iii) Given the mass and radius of planet Mars are 6.42×10^{23} kg and 3.40×10^{6} m, calculate the gravitational acceleration on the surface of the planet.

[5 *marks*]

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5 (a) State the conditions of equilibrium for a rigid body.

[2 *marks*]

(b) A disc rotates at 25 revolutions per minute and takes 15 s to come to rest. Calculate

(i) the angular acceleration of the disc.

(ii) the number of rotation the disc makes before it comes to rest.

(iii) the initial kinetic energy of the disc if its moment of inertia is 2.5 kg m^2.

[7 *marks*]

(c)

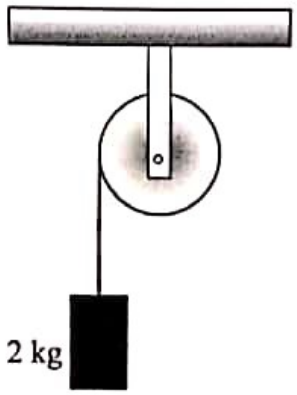

FIGURE 3

FIGURE 3 shows a 2 kg box hung by a cord wound on a light pulley is released from rest. The radius and the moment of inertia of the pulley are 0.25 m and 1.5 kg m^2. Calculate the acceleration of the box.

[6 *marks*]

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

[1 *mark*]

(b)

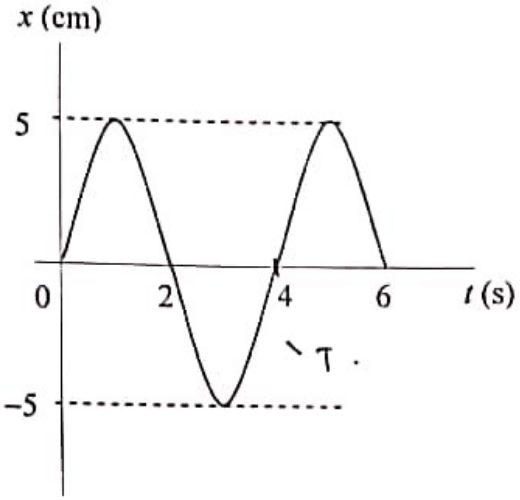

FIGURE 4

FIGURE 4 shows a displacement-time graph of simple harmonic motion. Determine

(i) the amplitude.

(ii) the frequency.

(iii) the angular velocity.

(iv) the equation for the simple harmonic motion.

[7 *marks*]

(c) A 175 g mass on a smooth surface is attached to a horizontal spring with a spring constant 8 N m^{-1}. The mass is set to oscillate by pulling it 10 cm from its equilibrium position and released. Calculate

(i) the period of the oscillation.

(ii) the maximum speed of the mass.

(iii) the total energy of the system.

[7 *marks*]

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7 (a) What is the difference between transverse wave and longitudinal wave? Give an example for each wave.

[2 *marks*]

(b) A progressive wave is represented by the following equation:

$$y = 10\sin\left(\frac{\pi}{4}t + x\right)$$

where y is in centimeter and t is in second. Determine

(i) the direction of wave propagation. - left.

(ii) the wavelength.

[4 *marks*]

(c) (i) Define sound intensity.

(ii) A 0.5 kg object is hung at the end of a string of mass 72 g and length 1.2 m. Calculate the speed of the wave propagation in the string when the system is disturbed.

[4 *marks*]

(d) (i) Define Young's modulus.

(ii) Sketch a labeled stress-strain graph of a ductile material.

(iii) A wire fixed to a ceiling has a length of 1.5 m and cross-sectional area 0.2 cm^2. The wire stretches by 0.15 cm when a 50 kg load is attached to its free end. Calculate the Young's modulus of the wire.

[5 *marks*]

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8 (a) Define

(i) heat.

(ii) temperature.

[2 *marks*]

(b) The length of a metal bar is 300 cm at −30 °C. Given the coefficient of linear expansion of the metal bar is $11 \times 10^{-6}\,°C^{-1}$, calculate the length of the bar at 80 °C.

[3 *marks*]

(c) (i) Write the ideal gas equation.

(ii) The pressure of a 50 cm^3 ideal gas at 25 °C is 75 Pa. Determine the number of molecules of the gas.

[4 *marks*]

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

(ii) In an isovolumetric process, a system is supplied with 250 J of heat. What is the change in its internal energy?

(iii) What is the work done by 1.56×10^{-4} moles of ideal gas that expands from 65 cm^3 to 135 cm^3 at a constant temperature of 40 °C?

[6 *marks*]

END OF QUESTION PAPER

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SF016/2
Physics
Paper 2
Semester I
Session 2013/2014
2½ hours

SF016/2
Fizik
Kertas 2
Semester I
Sesi 2013/2014
2½ jam

BAHAGIAN MATRIKULASI
KEMENTERIAN PENDIDIKAN MALAYSIA
MATRICULATION DIVISION
MINISTRY OF EDUCATION MALAYSIA

PEPERIKSAAN SEMESTER PROGRAM MATRIKULASI
MATRICULATION PROGRAMME EXAMINATION

FIZIK
Kertas 2
2 ½ jam

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

1

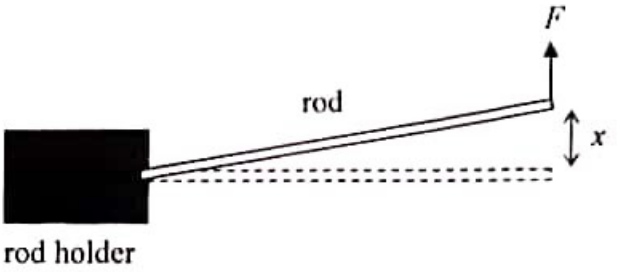

FIGURE 1

FIGURE 1 shows the deflection, x of a rod for different magnitudes of van der Waals force, F. The results of the measurement are given in **TABLE 1**.

TABLE 1

F (nN)	x (nm)
1.6	1.2
3.1	2.0
4.5	2.8
5.8	3.5
7.0	4.2
8.4	5.0

(a) Plot a graph of F against x.

[8 *marks*]

(b) Determine the gradient **and** the intercept of the graph.

[5 *marks*]

(c) (i) Write the equation for the straight line of the graph.

(ii) Determine the force constant, k of the rod.

[2 *marks*]

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2 (a)

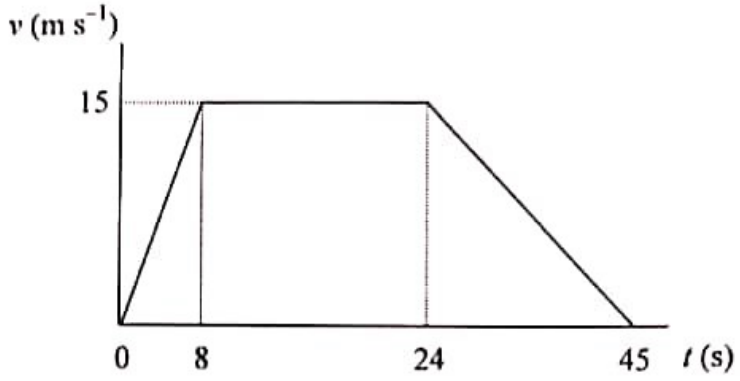

FIGURE 2

FIGURE 2 shows a velocity-time graph of a motion along a straight line.

(i) Calculate the average velocity **and** average acceleration of the entire motion.

(ii) Sketch a labelled displacement-time graph of the motion.

[7 *marks*]

(b)

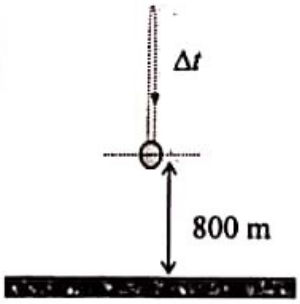

FIGURE 3

A bullet is fired vertically upwards with an initial speed of 600 m s^{-1}. Calculate the time interval, Δt for the bullet to be 800 m above ground as shown in **FIGURE 3.**

[3 *marks*]

(c) (i) Why is the displacement and velocity in a projectile motion can be analysed separately in the x and y-directions?

(ii) A projectile is launched with a velocity of 45 m s^{-1} at an angle of 60° from the horizontal. Determine the time when the velocity makes an angle 30° with the horizontal for first time.

[5 *marks*]

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3 (a) What is meant by impulse?

[1 *mark*]

(b)

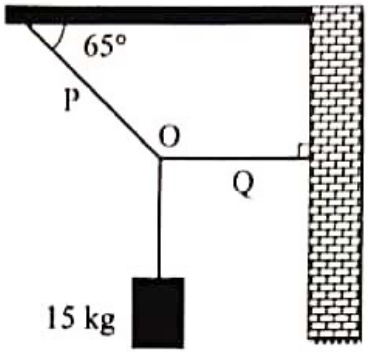

FIGURE 4

FIGURE 4 shows a 15 kg load held in equilibrium by ropes, P and Q fastened to the ceiling and the wall respectively.

(i) Sketch a free body diagram at point O.

(ii) Calculate the tension of ropes P **and** Q.

[7 *marks*]

(c)

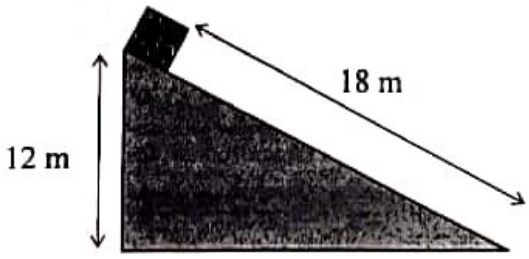

FIGURE 5

FIGURE 5 shows a block held at rest at the top of a 18 m long rough slope with coefficient of kinetic friction 0.19. The height of the box on the slope is 12 m. When released, the block slides down.

(i) Calculate the final speed of the block at the bottom of the slope.

(ii) If the mass of the block is increased, will the final speed of the block decrease, same or increase? Justify your answer.

[7 *marks*]

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4 (a) (i) Define centripetal force.

(ii) Why is the direction of centripetal acceleration always perpendicular to the velocity?

[3 *marks*]

(b) A 60 cm conical pendulum bob revolves freely. The pendulum string makes an angle of 37° with the vertical.

(i) Sketch and label a free body diagram of the pendulum bob.

(ii) Calculate the speed of the pendulum bob.

(iii) Calculate the angular velocity of the pendulum bob.

(iv) If the angle remains unchanged but a longer string is used, will the angular velocity decrease, same or increase? Justify your answer.

[9 *marks*]

(c) (i) Define gravitational field strength.

(ii) The mass and radius of the earth are 5.974×10^{24} kg and 6371 km respectively. Calculate the period of revolution of a satellite that is 100 km above the earth surface.

[3 *marks*]

Scanned by CamScanner

5 (a) Define

(i) angular acceleration.

(ii) moment of inertia.

(iii) angular momentum.

[3 *marks*]

(b) A ceiling fan is rotating at an angular speed of 300 rpm when the switch is turned off. It takes 45 s for the fan to stop. Calculate the

(i) average angular acceleration.

(ii) number of revolution the fan makes before it stops.

[4 *marks*]

(c)

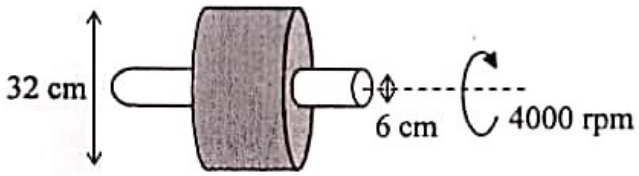

FIGURE 6

FIGURE 6 shows a 2.76 kg solid disc of diameter 32 cm with a 2.66 kg solid cylindrical axle of diameter 6 cm. The moment of inertia of the hollow disc is $\frac{1}{2}M_{\text{disc}}\left(R_1^{\,2}+R_2^{\,2}\right)$ where R_1 is radius of solid disc and R_2 is radius of cylindrical axle. The moment of inertia cylinder is $\frac{1}{2}M_{\text{cylinder}}R_2^{\,2}$. Calculate the

(i) moment of inertia of the system about the axis of the cylindrical axle.

(ii) energy required to rotate the system about the axis from an angular speed of 1000 rpm to 4000 rpm.

[5 *marks*]

(d) A solid sphere and a solid cylinder from rest roll without slipping down a slope from the same height. Both of them have the same mass and radius. Given the moment of inertia of the solid sphere and solid cylinder are $\frac{2}{5}MR^2$ and $\frac{1}{2}MR^2$ respectively, which one of them will reach the bottom of the slope first? Justify your answer.

[3 *marks*]

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6 (a) The displacement, x of a simple harmonic motion given by the equation,

$$\frac{d^2x}{dt^2} = -\omega^2 x$$

where ω is a constant associated with the motion. What is meant by the equation?

[1 *mark*]

(b)

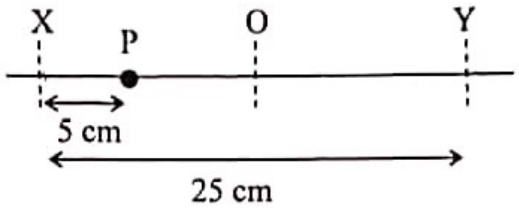

FIGURE 7

FIGURE 7 shows a bead executing a simple harmonic motion with a period of 1.8 s, along a straight line between points, X and Y which are 25 cm apart. Point O is at midpoint between X and Y.

(i) Write an equation for the displacement of the bead.

(ii) Calculate the magnitude of acceleration **and** velocity of the bead at point P.

(iii) Calculate the positions along XY when the kinetic energy and the potential energy of the bead are equal.

[9 *marks*]

(c) A vertical spring extends by 3 cm when a 100 g mass is suspended at its end.

(i) Calculate the period of oscillation of the spring when a mass of 150 g is added to the system.

(ii) If the spring with the same load is allowed to oscillate horizontally on a frictionless surface, will the period decrease, same or increase? Justify your answer.

[5 *marks*]

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7 (a) 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*]

(b) 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.

[7 *marks*]

(c) Define

(i) sound intensity.

(ii) Doppler effect.

[2 *marks*]

(d)

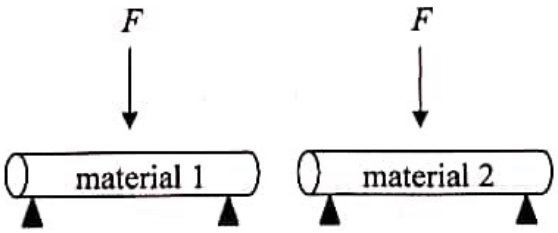

FIGURE 8

FIGURE 8 shows an identical force, F acting on two identical rods but made of different materials. What concept will be used to determine which rod will bend more? Explain your answer.

[2 *marks*]

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8 (a) Define the following thermodynamics processes:

(i) Adiabatic

(ii) Isobaric

[2 *marks*]

(b) (i) Calculate the heat transferred in 24 hours through a 2.4 m^2 metal sheet of thickness 1 cm when the temperature difference between the surfaces is 0.5 °C. Given the thermal conductivity coefficient of the metal is 16 $W\ m^{-1}\ K^{-1}$.

(ii) The mass of an empty 50 litres gas cylinder is 4.8 kg. The cylinder is filled with nitrogen gas up to a pressure of 60 atm. Given the room temperature 29 °C and the molecular weight of nitrogen 28, calculate the new mass of the cylinder.

[5 *marks*]

(c) Derive the equation for the work done in an isothermal process.

[3 *marks*]

(d)

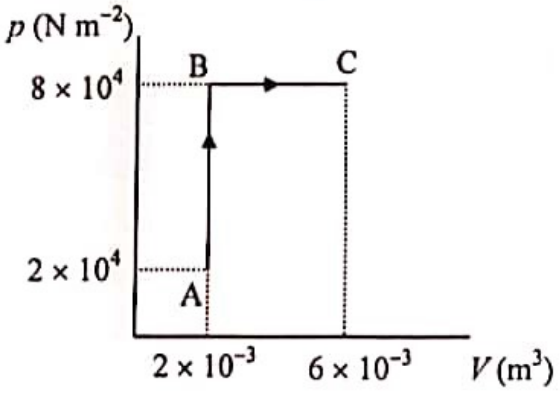

FIGURE 9

FIGURE 9 shows a *p-V* graph for a series of thermodynamic processes, ABC. In process AB and BC, 160 J and 600 J are added to the system respectively. Calculate the change of the internal energy during the process ABC.

[5 *marks*]

END OF QUESTION PAPER

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SF016/2
Physics
Paper 2
Semester I
Session 2014/2015
2½ hours

SF016/2
Fizik
Kertas 2
Semester I
Sesi 2014/2015
2½ jam

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

1 A mass M oscillating on a spring has a period T given by

$$T = 2\pi\sqrt{\frac{M}{k}}$$

where k is the spring constant. **TABLE 1** shows the time of 20 oscillations, t_{20} for each mass M.

TABLE 1

Mass M (kg)	Time for 20 oscillations t_{20} (s)	Period T(s)	T^2 (s^2)
0.2	10.2		
0.3	13.2		
0.4	14.6		
0.5	16.6		
0.6	17.8		
0.7	19.6		
0.8	20.6		

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

[2 *marks*]

(b) Plot a graph of T^2 against M.

[6 *marks*]

(c) Determine the gradient of the graph.

[4 *marks*]

(d) Calculate the spring constant k from the graph.

[3 *marks*]

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2 (a) Distinguish between distance and displacement.

[2 *marks*]

(b)

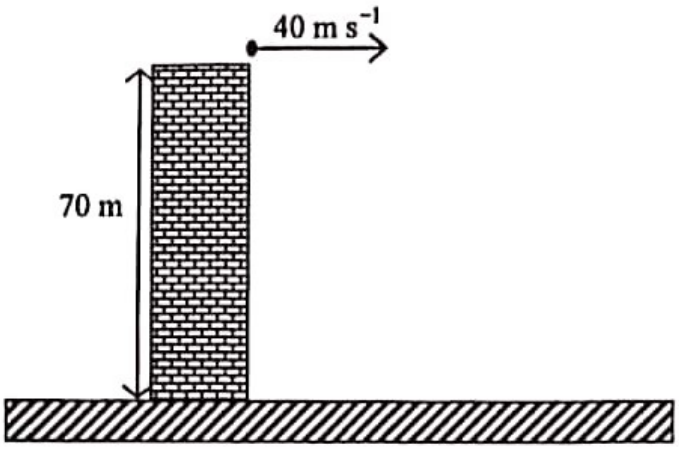

FIGURE 1

FIGURE 1 shows a stone is thrown horizontally with initial velocity 40 m s^{-1} from the top of 70 m high building.

(i) Sketch the path traversed by the stone to the ground **and** indicate the velocity components and resultant velocity of the stone 15 m from the ground.

(ii) Calculate the resultant velocity of the stone 15 m from the ground.

(iii) Sketch a graph of vertical acceleration versus time (a_y vs t) for the falling stone **and** label the value of acceleration.

(iv) Calculate the time of flight.

(v) Calculate the range.

[13 *marks*]

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3 (a) State the principle of conservation of linear momentum.

[1 *mark*]

(b) A 6.25 kg trolley moving with velocity 5.5 m s^{-1} hits a stationary 1.2 kg trolley. After the collision the trolleys stick together and move with a constant velocity. Calculate

(i) the velocity after the collision,

(ii) the loss of kinetic energy.

[4 *marks*]

(c)

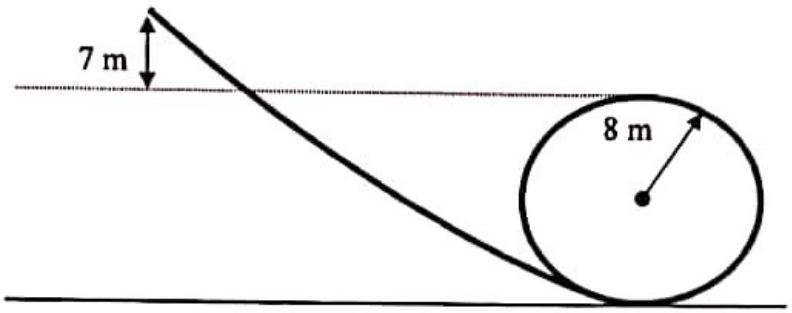

FIGURE 2

A theme park 'loop the loop' ride has a loop of radius 8 m. A 90 kg car goes around the inside of the loop after descending from vertical height of 7 m above the top of the loop as in **FIGURE 2**. Calculate

(i) the centripetal acceleration of the car,

(ii) the force exerted on the car when it is on the top of the loop.

[6 *marks*]

(d)

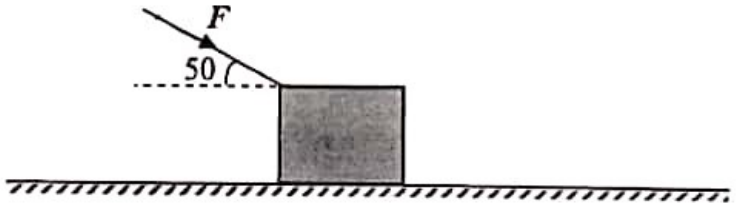

FIGURE 3

FIGURE 3 shows a 500 N force, *F* acts on a stationary 25 kg box lying on a rough surface. After 4 s, the speed of the box is 2 m s^{-1}. Calculate

(i) the frictional force on the box,

(ii) the coefficient of kinetic friction between the box and the rough surface.

[4 *marks*]

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4 (a) A body is performing a uniform circular motion.

(i) Explain why the body experiences a force despite it is moving with constant speed.

(ii) Write an equation of the force **and** state its direction.

[4 *marks*]

(b) Two ice skaters, each of mass 60 kg hold hands and spin in a circle with a period of 4.3 s. The distance between them is 1.44 m.

(i) Calculate the angular velocity.

(ii) Calculate the centripetal acceleration.

(iii) Calculate the pulling force that acts on each hand.

(iv) Describe their subsequent motion after they separate.

[4 *marks*]

(c) (i) State Newton's law of universal gravitation.

(ii) Calculate the acceleration of Earth's gravity at a distance of 500 km above the Earth's surface. The radius and the mass of the Earth are 6.4×10^6 m and 5.98×10^{24} kg respectively.

(iii) A satellite orbits the Earth in a period of 24 hours so that it is always at the same point above the Earth's surface. Calculate the radius of the orbit. The radius and the mass of the Earth are 6.4×10^6 m and 5.98×10^{24} kg respectively.

[7 *marks*]

Scanned by CamScanner

5 (a) (i) Define the moment of inertia of a rigid body about an axis.

(ii) At the instant a ceiling fan is switched off, the angular velocity of the fan is 65 rad s^{-1} and stop after 9 s. Calculate the number of rotation for the fan to stop completely.

[3 *marks*]

(b)

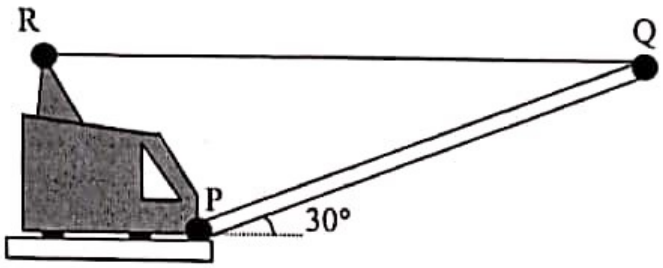

FIGURE 4

FIGURE 4 shows a crane with 8 m uniform arm PQ of mass 2400 kg pivoted at P. The arm is supported by a horizontal cable QR.

(i) Sketch **and** label all forces acting on the arm PQ.

(ii) Calculate the tension in cable QR.

(iii) If Q is raised by shortening cable QR, what is the effect to the tension of the cable? Explain your answer.

[8 *marks*]

(c) (i) Define angular momentum.

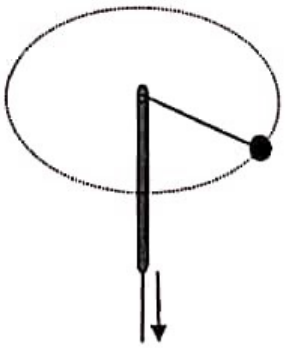

FIGURE 5

(ii) **FIGURE 5** shows a ball attached to one end of a string which is swung in a horizontal circle of radius 60 cm with an initial speed of 3 m s^{-1}. The other end of the string passes through a tube. If the string is slowly pulled downwards until the speed of the ball becomes 5 m s^{-1}, what is the radius of the ball circular path?

[4 *marks*]

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6 (a) State **TWO** properties of an object undergoing simple harmonic motion.

[2 *marks*]

(b) A 25 g block connected to one end of a spring is displaced 15 cm from its equilibrium position and released. The spring constant is 180 N m^{-1}.

(i) Write the acceleration a of simple harmonic motion equation of the block in term of displacement x.

(ii) Sketch the graph of displacement versus time of the block. Label the amplitude and the period of oscillation on the graph.

(iii) Calculate the instantaneous speed of the block at a distance 11 cm from the equilibrium position.

(iv) Calculate the total energy of the system.

(v) On the same graph sketch **and** label the variation of kinetic energy K and potential energy U versus displacement x. On the graph, indicate the maximum value of each curve (if any) and the amplitude.

(vi) The spring is removed and then the 25 g block is connected to a string. The string-block system oscillates as a simple pendulum. What effect on the period of oscillation if the mass of the block is reduced by half? Explain your answer.

[13 *marks*]

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7 (a) (i) Explain the formation of stationary wave.

(ii)

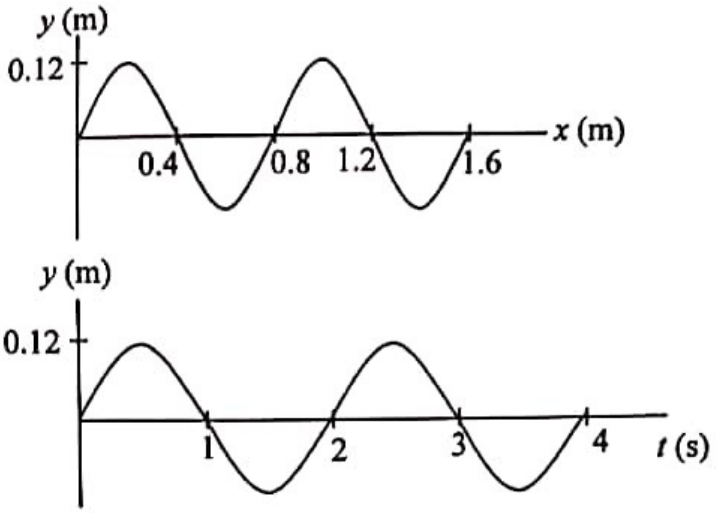

FIGURE 6

FIGURE 6 shows the graphs of displacement versus distance and displacement versus time of a progressive wave travelling in the positive-x direction. Write the wave equation.

[5 *marks*]

(b) (i) A teenager would like to double the fundamental frequency of his steel guitar string. Should he keep to the same string but double the tension or used another string of the same material and tension but change the diameter of the string? Explain your answer.

(ii) If his guitar plays out a sound with frequency 440 Hz and his friend's guitar produces sound at frequency 442 Hz, calculate the beat frequency heard by them.

[5 *marks*]

(c) (i) Explain plastic deformation of an elastic material.

(ii) A wire of diameter 0.5 mm has Young's modulus 2×10^{11} N m^{-2}. Calculate the strain if it is extended by 150 N load.

[5 *marks*]

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8 (a) Define the coefficient of area thermal expansion, β.

[1 *mark*]

(b)

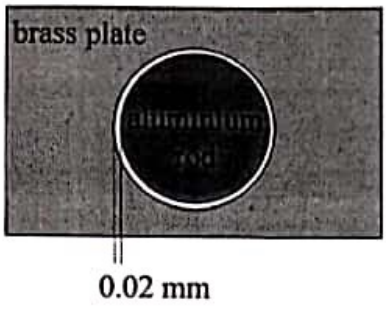

FIGURE 7

FIGURE 7 shows an aluminium rod with radius 5 cm and having a clearance of 0.02 mm completely around it within a hole in a brass plate at 20°C. The coefficient of linear thermal expansion of brass and aluminium are 1.9×10^{-5} °C^{-1} and 2.4×10^{-5} °C^{-1} respectively.

(i) Calculate the lowest temperature if both metals are heated until the clearance is zero.

(ii) Would such a tightly fit be possible if the plate is aluminium and the rod is brass and both metals are heated? Explain your answer.

[5 *marks*]

(c) A balloon is filled with helium at 25°C. The mass of a helium atom is 6.65×10^{-27} kg. Calculate the

(i) root mean square speed of the helium atoms.

(ii) kinetic energy of 0.5 mole helium atom.

[3 *marks*]

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SF016/2
Physics
Paper 2
Semester I
Session 2015/2016
$2\,^1/_2$ hours

SF016/2
Fizik
Kertas 2
Semester I
Sesi 2015/2016
$2\,^1/_2$ jam

BAHAGIAN MATRIKULASI
MATRICULATION DIVISION

PEPERIKSAAN SEMESTER PROGRAM MATRIKULASI
MATRICULATION PROGRAMME EXAMINATION

FIZIK
Kertas 2
2 ½ jam

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*Answer **question 1** and **any other 5** questions.*

1 In an experiment, a 400 g wooden block is pulled on a horizontal wooden surface. The limiting friction, f_s between the block and wooden surface is measured repeatedly by adding load, m on the block as given in TABLE 1.

TABLE 1

Length, l (cm)	Frequency, f(Hz)	Period, T(s)
14.2	256	
12.8	289	
10.9	325	
9.7	384	
8.6	444	
7.6	486	

2 (a) Describe a free falling body

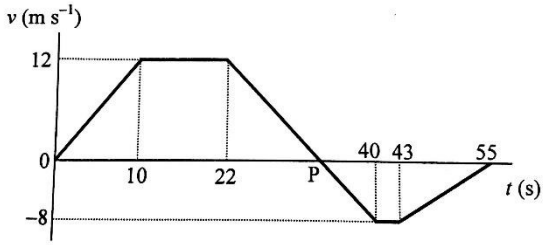

FIGURE 1

(b) **FIGURE 1** shows the velocity-time graph of a toy train moving on a straight track in 55 s.

(i) Determine the time and acceleration at point P when the velocity is zero.

(ii) Is the total distance travelled by the train less than, equal or greater than its total displacement? Justify your answer using calculation.

(c) A javelin is thrown with a speed of 55 m s^{-1} at an angle of 42^0 with the horizontal. Calculate the velocity of the javelin after 5 s.

3 (a) (i) How is force related to momentum?

(ii) State a physical quantity used to indicate the difference between elastic collision and inelastic collision.

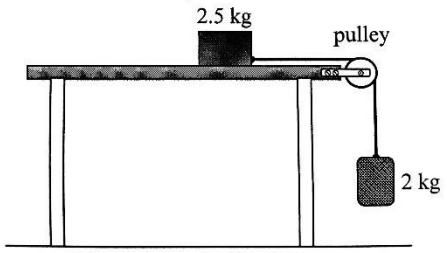

FIGURE 2

(b) **FIGURE 2** shows a 2.5 kg block connected to a 2 kg load by a light string through a pulley of negligible mass. The coefficient of kinetic friction between the block and table is 0.18. When the system is released, calculate the

(i) Acceleration of the block

(ii) Tension in the string.

(iii) Total kinetic energy of the system after the block has moved 0.6 m using the work – energy theorem.

(iv) Final velocity, v_f of the block

(c) Assuming that the mass of the pulley in question **3**(b) cannot be neglected,will the new final velocity of the block be lower, the same or higher than the v_f in **3**(b)(iv)? Explain your answer

4 (a) (i) What is meant by centripetal force?

(ii) A cyclist rides on a horizontal circular track. With the aid of an appropriate labeled force diagram, explain why the cyclist has to lean towards the centre of the track.

(iii) Refer to the cyclist in question 9a(ii). Let v be the maximum speed of the cyclist, r the radius of the track, μ the coefficient of friction between the tyres and track, and g the gravitational acceleration. Determine μ in terms of v, r and g.

(b) (i) State Newton's law of gravitation.

(ii) Sketch a graph of gravitational field strength, a_g against distance r from the surface of the Earth. Label the radius of the Earth, R on the graph.

(iii) The radius and mass of planet Mars are 3390 km and 6.42 x 10^{23} kg respectively. Calculate the acceleration due to gravity at the surface of the planet.

(c) (i) Derive the period of a satellite motion.

(ii) Calculate the distance from the centre of the Earth for a satellite to remain above the same location on the Earth equator. The mass of the Earth is 5.97 x 10^{24} kg.

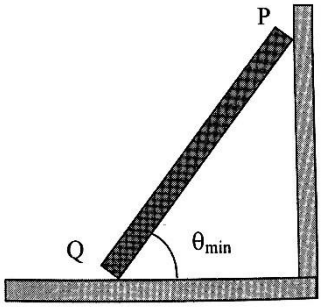

FIGURE 3

5 (a) **FIGURE 3** shows a uniform beam PQ of weight 240 N leaning on a smooth wall and resting on a rough floor with a minimum inclination angle θ_{min}. The coefficient of friction between the beam and floor is 0.25.

(i) State **two (2)** conditions for equilibrium of the beam.

(ii) Sketch **all** forces acting on the beam.

(iii) Determine the forces acting on the beam at P **and** Q.

(iv) Determine $\theta_{min.}$

(v) What will happen to the beam if the inclination angle is changed?

Consider both cases: $\theta_{new} < \theta_{min}$ and $\theta_{new} > \theta_{min}$ with θ_{new} less than 90°.

(b) A 15 N m torque acts on a grinding wheel after the power is switched off. Given the angular velocity of the wheel is 1200 *rpm* and its moment of inertia is 0.8 kg m^2, calculate the time for the wheel to stop.

6 (a) (i) Define Simple Harmonic Motion (SHM)

(ii) Sketch a graph of potential energy against displacement for SHM.

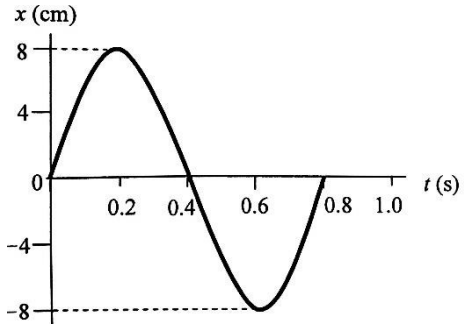

FIGURE 4

(b) A 0.2 kg object performs SHM with displacement, x from the equilibrium point as in **FIGURE 4.**

(i) Determine the amplitude.

(ii) Calculate the angular velocity.

(iii) Calculate the total energy of the system.

(c) The displacement x of a particle varies with time, t is given by

$$x = 4.0\ cos\ (2\pi t + \frac{\pi}{2})$$

where x is in cm and t in s. Calculate the

(i) frequency of the motion.

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

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

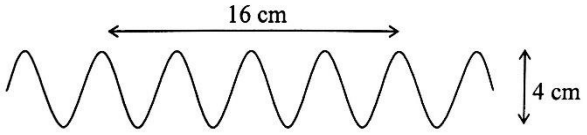

FIGURE 5

7 (a) **FIGURE 5** shows a progressive wave travelling at a speed of 24 m s^{-1} to the right.

(i) Determine the wave number.

(ii) Calculate the frequency of the wave.

(iii) Write the wave equation.

(b) A man stands by the roadside when an ambulance passes by him with constant velocity 18 m s^{-1}. The ambulance emits siren with frequency 256 Hz. The speed of sound is 340 m s^{-1}.

(i) Calculate the apparent frequency of the siren heard by the man before the ambulance passes by him.

(ii) Sketch a graph of the apparent frequency against distance travelled.

(iii) Sketch a graph of siren intensity against distance.

(c) (i) Why is Hooke's law not applicable in the case of plastic deformation?

(ii) A 50 cm wire has Young's modulus 175 GPa and diameter 0.25 mm. Calculate the force needed to elongate the wire 1.5 mm.

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

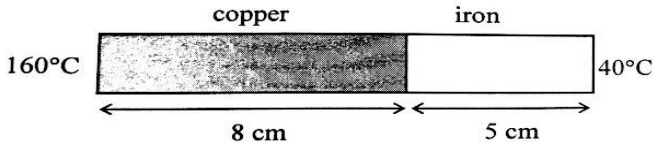

FIGURE 6

(ii) A composite rod is made by joining a copper rod of diameter 4 cm with an iron rod of similar diameter. The rod is insulated and its ends are kept at two different temperatures as shown in **FIGURE 6**. The coefficient of thermal conductivity of copper and iron are 385 W m^{-1} K^{-1} and 80 W m^{-1} K^{-1} respectively. Determine the temperature at the joint.

(b) (i) State the principle of equipartition of energy.

(ii) Calculate the *rms* speed of helium atoms at temperature 1 X 10^{-4} K. Molar mass of helium is 4 g mol^{-1} .

(c) (i) On the same p – V graph, sketch individual curve for isothermal, isobaric and adiabatic process.

(ii) Explain why a gas becomes colder when it expands adiabatically.

SF 016/2
Physics
Paper 2
Semester I
Session 2016/2017
2 ½ hours

SF 016/2
Fizik
Kertas 2
Semester I
Sesi 2016/2017
2 ½ jam

KEMENTERIAN PENDIDIKAN MALAYSIA

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

1 The period T of vibration of a tuning fork with density ρ, Young's modulus Y and length l is given by

$$T = kl\sqrt{\frac{\rho}{Y}}$$

where k is a constant. The values of length l and frequency f are given in **TABLE 1**.

TABLE 1

Length, l (cm)	Frequency, f (Hz)	Period, T(s)
14.2	256	
12.8	289	
10.9	325	
9.7	384	
8.6	444	
7.6	486	

The density and modulus Young of the tuning fork are 8.2×10^3 kg m^{-3} and 2.3×10^{11} N m^{-2} respectively.

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

[2 *marks*]

(b) Plot a graph of T versus l .

[7 *marks*]

(c) Determine the gradient of the graph.

[4 *marks*]

(d) Determine the constant k.

[2 *marks*]

2 (a) Define free falling body.

[1 *mark*]

(b)

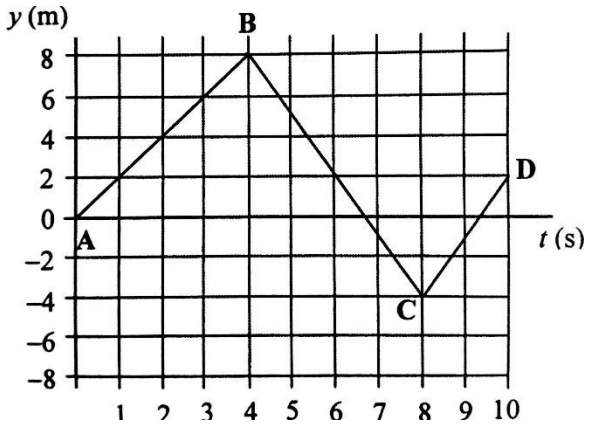

FIGURE 2

FIGURE 2 shows a displacement-time graph of a particle.

(i) Determine the total distance travelled by the particle.

(ii) Which segment of the journey does the particle move the slowest?

(iii) How many times does the particle return to its starting point?

[4 *marks*]

(c) A diver travelling at 100 km h^{-1} on a straight road suddenly sees a cow 32 m ahead and immediately applies the brake. His braking deceleration is 6 m s^{-2} . Calculate the

(i) speed when the car hits the cow

(ii) minimum time that he should apply the brake so that he does not hit the cow.

[4 *marks*]

(d) An archer standing on a cliff 48 m high shoots an arrow at an angle of 30^0 above the horizontal with a speed of 80 m s^{-1}. Calculate the

(i) duration the arrow is in the air

(ii) horizontal range of the arrow

[6 *marks*]

3 (a) State the principle of conservation of linear momentum. [1 *mark*]

(b)

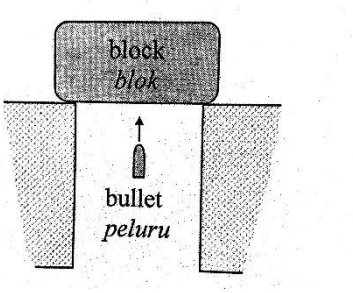

FIGURE 3.1

FIGURE 3.1 shows a 12 g bullet shot vertically into a 5 kg block and lifting it upwards to a maximum height of 4 mm. The bullet travelled for 1 ms in the block before stopping completely. Calculate the

(i) speed of the block and bullet just after collision.

(ii) impulse on the block.

(ii) depth of the bullet embedded in the block. [10 *marks*

(c)

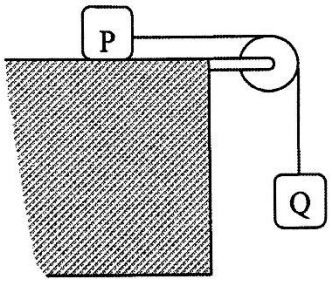

FIGURE 3.2

FIGURE 3.2 shows a stationary block P tied to a hanging block Q. The weight of block P is 25 N and the coefficient of static friction between block P and the horizontal surface is 0.4. Assume the pulley is smooth and the string is light.

(i) Sketch a free body diagram of block P.

(ii) Calculate the mass of block Q. [4 *marks*]

4 (a)

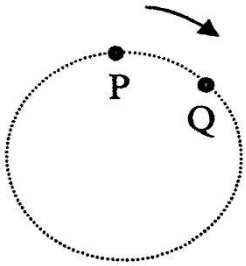

FIGURE 4.1

Sketch the change in the velocity of an object due to position P and Q which will show that the object is in a uniform circular motion as shown in **FIGURE 4.**1. [2 *marks*]

(b)

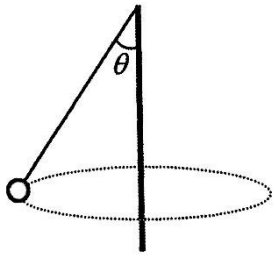

FIGURE 4.2

FIGURE 4.2 shows a 250 g bob suspended by a light string rotating in a horizontal circle of radius 30 cm with a linear speed of 2 m s^{-1}.

(i) Calculate the angle θ which the string makes with the vertical axis.

(ii) Calculate the tension in the string.

(iii) If the speed is increased, how would it affect the circular motion of the bob? Explain your answer .[6 *marks*]

(c) (i) State Newton's law of gravitation.

(ii) Sketch the graphs of gravitational field strength, a_g and gravitational potential, V versus distance, r from the surface of the earth.

(iii) The period of the moon orbiting Pluto is 4.8 days. The radius of the orbit is $4 \times 10^7\ m$. Calculate the mass of Pluto. [7 *marks*]

5 (a) (i) Define instantaneous angular acceleration.

(ii) State three (3) factors which affect the moment of inertia of a rigid body. [3 *marks*]

(b) A flywheel with moment of inertia 8 kg m^2 is acted upon by a constant torque of 50 N m. Calculate the

(i) angular acceleration.

(ii) time for it to rotate from rest to 70 rad s^{-1}.

(iii) power when the angular velocity is 50 rad s^{-1}. [4 *marks*]

(c)

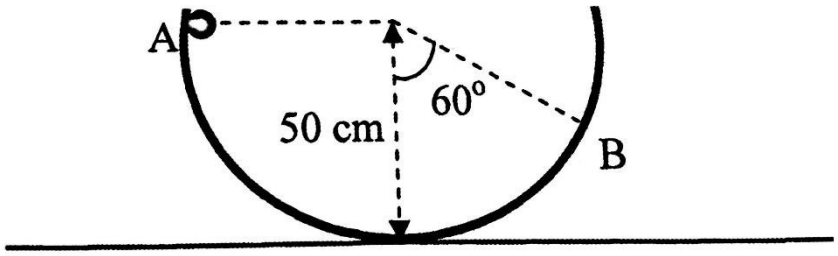

FIGURE 5.1

FIGURE 5.1 shows a tiny ball with mass , M is released from point A rolls without slipping on the inside surface of a hemisphere with radius of curvature 50 cm. The moment of inertia of the ball is $\frac{2}{5}MR^2$ where R is the radius of the ball. Calculate the speed of the ball at point B.

(d)

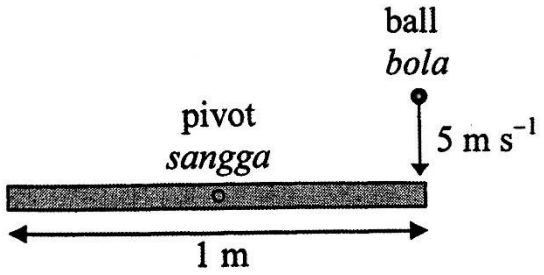

FIGURE 5.2

FIGURE 5.2 shows a top view of a 1m rod pivoted freely at its center and placed horizontally. A 20 g ball with velocity 5 m s^{-1} collides and stick at one end of the rod causing them to rotate. The moment of inertia of the ball –rod system is 0.02 kg m^2. Calculate the angular velocity of the rod.

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

(ii) Is a bouncing ball an example of simple harmonic motion? Explain your answer. [2 *marks*]

(b) A particle in simple harmonic motion along the x-axis starts from the equilibrium position and moves towards the right with an amplitude of 2 cm and a frequency of 1.5 Hz.

(i) Write the simple harmonic equation of the particle.

(ii) Calculate the maximum speed of the particle.

(ii) Calculate the acceleration of the particle at t = 3.2 s.

[5 *marks*]

(c) A 50 g object connected to a spring with a spring constant 35 N m^{-1} ocillates 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 the period of the oscillation if a load of 6 g is added to the object. [*8 marks*]

7 (a) (i) Explain the formation of stationary wave.

(ii) A violin string has a mass per unit length of 0.01 kg m^{-1} and experiences a tension of 0.36 N. Calculate the wavelength of the string if it vibrates at a frequency of 8 Hz.

(iii) The first overtone standing wave is formed in a 30 cm closed pipe. Sketch the wave and calculate its frequency. The speed of sound is 340 m s^{-1}. [8 marks]

(b) (i) What is Doppler effect for sound wave?

(ii) A car is travelling 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}.

[3 marks]

(c) A solid cylinder 10 m high and 10 cm in diameter is compressed by a

$1 \times 10^5\ kg$ load. Calculate the strain energy stored in the cyclinder. The Young's Modulus of cylinder is $1.9 \times 10^{11} Pa$. [4 marks]

8 (a) A 200 cm^3 glass cylinder is filled to the brim with mercury at 27^0 C. Calculate the amount of overflow when the temperature of the system increases to 100^0 C. The coefficient of linear expansion of the glass and mercury are $4 \times 10^{-6} K^{-1}$ and $6 \times 10^{-5} K^{-1}$ respectively. [4 *marks*]

(b) (i) Define the degree of freedom of gas molecules.

(ii) State the principle of equipartition of energy.

(iii) Two moles of a polyatomic ideal gas has volume of 0.05 m^3 at pressure 250 kPa. Calculate the internal energy and temperature of the gas. [6 *marks*]

(c)

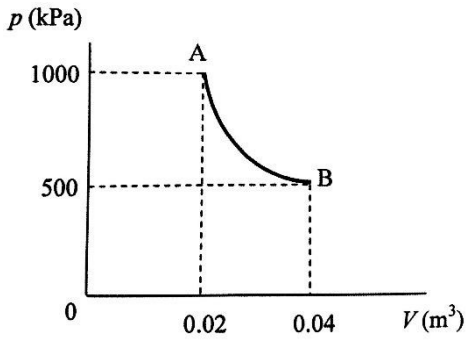

FIGURE 8

FIGURE 8 shows a p – V graph of an isothermal process at 600 K for two moles ideal gas in a cylinder with frictionless piston. If the internal energy at point A is 2.5×10^4 J, does the heat being absorbed or released during the process from A to B? Justify your answer. [5 *marks*]

SF016/2
Physics
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*Answer **question 1** and **any other 5** questions.*

1

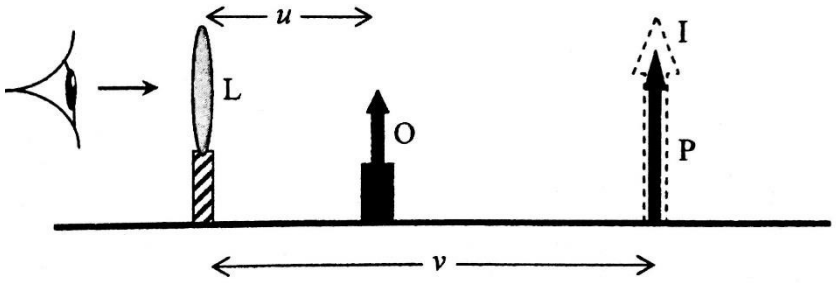

FIGURE 1

FIGURE 1 shows an experiment using a simple magnifier to determine the near point distance D of an eye. The magnified virtual image 1 (dotted line) of an object O was observed through a lens L. The object distance u was adjusted such that the image was formed in coincident with the locating pin P, preset at a fixed distance v = 30 cm. The respective values of u for different focal lengths f is shown in TABLE 1 . The magnification M is related to the focal length by

$$M = \frac{D}{f} + 1$$

f(cm)	u (cm)	$\frac{1}{f}\ (cm^{-1})$	$M = \frac{v}{u}$
8.00	6.65		
10.00	7.35		
12.00	8.50		
15.00	11.00		
20.00	11.60		
30.00	13.50		

Image distance, v = 30.0 cm

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

(b) Plot a graph of M against $\frac{1}{f}$.

(c) Determine the near point distance D from the graph.

2 (a) Define

(i) average velocity

(ii) instantaneous velocity

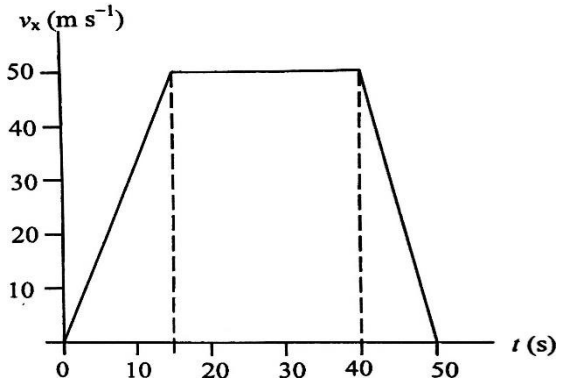

FIGURE 2

FIGURE 2 represents a part of the performance data of a car.

(i) Calculate the total distance travelled from the graph.

(ii) Draw a graph of its acceleration against time between t = 0 and t = 50 s. Show your calculation.

(c) A ball on the field was kicked with an initial velocity of 16.5 m s^{-1} at an angle of 35^0 above the horizontal line. After passing a maximum height, the ball hits the goal post bar at a height of 3 m from the ground.

(i) Determine the time taken by the ball to hit the bar.

(ii) Calculate the distance of the goal post from the footballer.

3 (a) State one (1) similarity and one (1) difference between elastic collision and inelastic collision .

(b) A tennis player hits a 0.06 kg ball horizontally approaching at 50 m s^{-1} perpendicular to his racquet's surface. He returns the shot at 40 m s^{-1} in the opposite direction.

(i) Calculate the impulse to the ball by the racquet.

(ii) How much work does the racquet do on the ball?

(iii) If the ball hits the plane of the racquet at an angle, will the impulse delivered to the ball increase, decrease or remain the same? Explain.

(c)

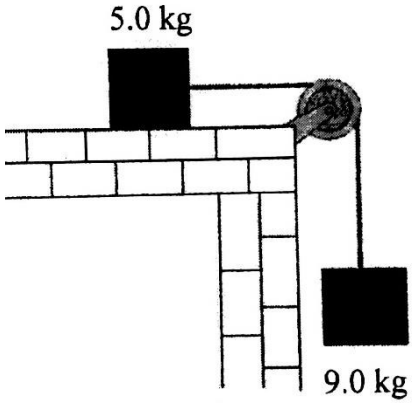

FIGURE 3

FIGURE 3 shows a 5 kg box placed on a frictionless horizontal table, is connected to a 9 kg hanging box by a string that passes over the pulley.

(i) Draw free-body diagrams of both boxes.

(ii) Determine the magnitude of the acceleration of both boxes.

(iii) Determine the magnitude of the tension in the string.

4 (a) (i) State the Newton's law of gravitation.

(ii) Define centripetal acceleration.

(b) The international space Station (ISS) is launch from the Earth and orbiting at an altitude of 350 km.

(i) Sketch and label the variation of the gravitational potential against distance from the surface of the earth experienced by the ISS during the journey.

(ii) The ISS has the weight of $4.22 \times 10^6\ N$ when it is measured on the surface of the earth. Given the mass and radius of the earth is $5.98 \times 10^{24}\ kg$ and $6.38 \times 10^6\ m$ respectively, calculate the weight of the ISS when in its orbit.

(c)

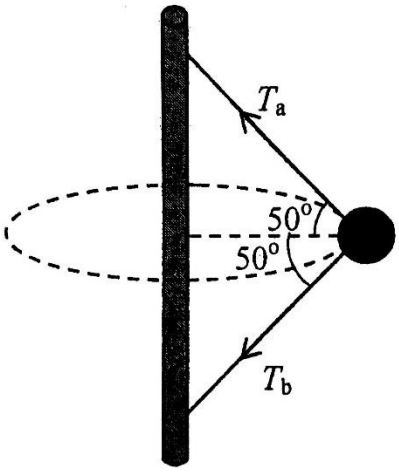

FIGURE 4

FIGURE 4 shows a 4 kg object is attached to a vertical rod by two strings. The object rotates in a horizontal circle of radius 1.3 m at constant sped 6 m s^{-1} . Calculate the

(i) tension T_a in the upper string.

(ii) tension T_b in the lower string.

5 (a) (i) State 2 conditions for the equilibrium of a rigid body.

(ii) Define angular momentum.

(b) A disc of 8 cm in radius rotates at a constant rate of 1200 revolutions per minutes about its central axis. Calculate the

(i) angular velocity in rad s^{-1}

(ii) tangential speed at a point 3 cm from its center.

(iii) distance travelled by a point at the edge of the disc in 2 s.

(c)

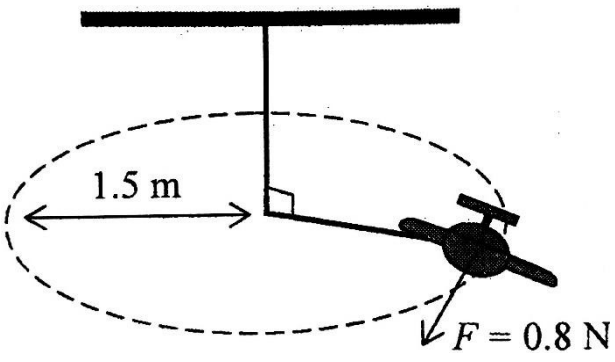

FIGURE 5

FIGURE 5 shows a 0.75 kg airplane model is attached by an arm rod of negligible mass flies in horizontal circle 1.5 m in radius. The airplane model acts a force of 0.8 N perpendicular to the rod. By assuming the airplane as a point mass, calculate the

(i) torque about the axis pasing through the center of the circle

(ii) angular acceleration of the airplane

(iii) linear acceleration of the airplane tangent to its flight path.

6 (a) Why a simple harmonic motion is a periodic motion without energy loss?

(b) In an engine, a 200 g piston oscillates in a simple harmonic motion with displacement varying according to $x(t) = 5 \cos 2t$ where x is in meter and t is in second.

(i) Write the expression for its vibrational velocity as a function of time, $v(t)$.

(ii) Sketch the graph of velocity against time of the piston for the first complete cycle starting from $t = 0$

(iii) Calculate the maximum acceleration of the system.

(iv) Calculate the total energy of the system.

(c) Explain by the derivation why the period of simple pendulum does not depend on the mass of the bob but the period of a mass –spring system depends on the mass of the load.

7 (a) (i) How does sound intensity change with distance from a point source?

(ii) In a longitudinal wave in a horizontal spring, the coils move back and forth in the direction of wave motion. If the coil speed is increased, does the wave propagation speed decrease, remain the same or increase? Explain tour answer.

(b) A progressive transverse wave travelling on a wire has amplitude of 0.2 mm and a frequency of 500 Hz with speed of 196 m s^{-1} .

(i) Write the displacement equation of the wave.

(ii) If the mass per unit length of the wire is 4.1 g m^{-1} calculate the tension of the wire.

(c) A submarine that travels in the water at a speed of 8 m s^{-1} and emits a sonar wave of frequency 1400 Hz is approaching another stationary submarine. Given

the speed of sound in water is 1530 m s^{-1} , calculate the apparent frequency as detected by the observer in the stationary submarine.

(d) A 20 cm cylindrical brass rod with diameter 6 cm is held vertically on its one circular flat end. A load of 5 kg is placed on its upper end. Given the Young's modulus of brass is $9.1 \times 10^{11}\ N\ m^{-2}$, calculate the strain energy of the rod.

8 (a) (i) Define heat.

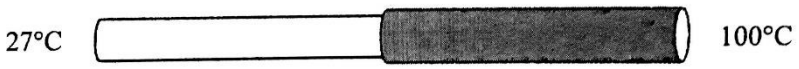

FIGURE 8.1

(ii) **FIGURE 8.1** shows a rod with both ends at different temperatures. The right half of the rod is insulated while the left half is not insulated. Sketch a graph of temperature against distance of the rod.

(b) (i) A $5 \times 10^{-3}\ m^3$ tank contains nitrogen at 27^0 C and pressure 1.2 atm. The gas pressure increases to 2.5 atm when the tank is heated. Given the molar mass of nitrogen is 28 g mol^{-1}, calculate the change in the rms speed of the nitrogen molecules.

(ii) At the same temperature, which gas has a greater energy per mole, a diatomic gas or a monoatomic gas? Explain your answer.

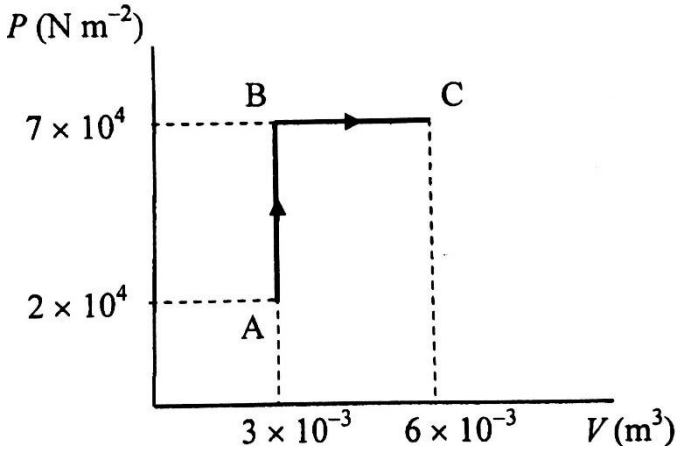

FIGURE 8.2

(c) **FIGURE 8.2** shows a series of thermodynamic processes ABC. During the process AB and process BC, 120 J of heat and 500 J of heat are added respectively. Calculate the change in the internal energy in the process ABC.

SP015/2
Physics 1
Paper 2
Semester I
Session 2018/2019
2½ hours

SP015/2
Fizik 1
Kertas 2
Semester I
Sesi 2018/2019
2½ jam

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Answer **all** questions.
*Jawab **semua** soalan.*

1 A girl pushes a box across the floor and causes it to undergo two displacements ***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 resultant displacement.

*Seorang gadis menolak sebuah kotak di atas lantai dan menyebabkan kotak itu bergerak dengan dua sesaran **A** dan **B**. Sesaran **A** ialah* 1.5 m *sepanjang paksi-x positif, manakala sesaran **B** ialah* 1.4 m *di sepanjang paksi-y positif. Tentukan magnitud dan arah sesaran paduan.*

[2 *marks*]
[2 *markah*]

2 (a) A car is moving with constant speed of 80 km h^{-1} when suddenly the driver sees a cat 50 m straight ahead of the car. The driver's reaction time is 0.5 s and the maximum deceleration of the car is 10 m s^{-2}.

Sebuah kereta bergerak dengan kelajuan malar 80 km j^{-1} *apabila tiba-tiba pemandu melihat seekor kucing* 50 m *di hadapan kereta. Masa reaksi pemandu ialah* 0.5 s *dan nyahpecutan maksimum kereta ialah* 10 m s^{-2}.

(i) Calculate the total distance travelled by the car from the moment the driver sees the cat until it stopped. What happens to the cat?

Hitung jumlah jarak yang dilalui oleh kereta dari saat pemandu melihat kucing hingga kereta berhenti. Apa yang terjadi kepada kucing tersebut?

(ii) Sketch acceleration against time graph to show the motion of the car.

Lakarkan satu graf pecutan melawan masa yang menunjukkan gerakan kereta.

[7 *marks*]
[7 *markah*]

(b) A man runs off a horizontal diving board with a speed of 2.5 m s^{-1} and falls into the swimming pool at a horizontal distance of 5.0 m from the end of the board. Determine the height of the diving board above the water surface.

Seorang lelaki berlari dari papan anjal mengufuk dengan laju 2.5 m s^{-1} *dan jatuh dalam kolam renang pada jarak ufuk* 5.0 m *dari hujung papan. Tentukan tinggi papan anjal dari permukaan air.*

[3 *marks*]
[3 *markah*]

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3 A fisherman on a stationary boat jumps off onto a jetty with a velocity of 1.5 m s^{-1}, causing the boat to move backwards.

Seorang nelayan dalam sebuah bot pegun melompat ke jeti dengan halaju 1.5 m s^{-1}, *menyebabkan bot terundur ke belakang.*

(a) If the mass of the fisherman and boat are 60 kg and 450 kg, determine the velocity of the boat.

Jika jisim nelayan dan bot ialah 60 kg *dan* 450 kg, *tentukan halaju bot.*

[3 *marks*]
[3 *markah*]

(b) If the fisherman's feet are in contact with the jetty for 10 ms, determine the magnitude of the average force exerted on his feet.

Jika kaki nelayan bersentuhan dengan jeti selama 10 ms, *tentukan magnitud daya purata yang dikenakan pada kakinya.*

[3 *marks*]
[3 *markah*]

4

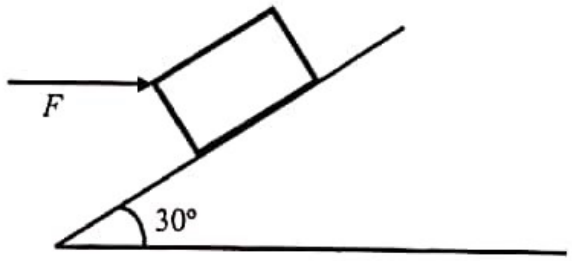

FIGURE 4
***RAJAH* 4**

FIGURE 4 shows an object of mass 2.0 kg placed on a rough plane inclined at 30° with the horizontal. The coefficient of kinetic friction between the object and the plane surface is 0.25. A constant horizontal force F = 50 N acts on the object and pushes it along the inclined plane with acceleration a.

***RAJAH* 4** *menunjukkan sebuah objek berjisim* 2.0 kg *diletakkan di atas satu satah kasar condong* 30° *dengan ufuk. Pekali geseran kinetik antara objek dan permukaan satah ialah* 0.25. *Satu daya malar ufuk* F = 50 N *bertindak ke atas objek dan menolak objek sepanjang satah condong dengan pecutan* a.

(a) Sketch a free body diagram showing all the forces acting on the object.

Lakarkan rajah jasad bebas menunjukkan semua daya yang bertindak ke atas objek.

[3 *marks*]
[3 *markah*]

(b) Calculate the acceleration of the object.

Hitung pecutan objek.

[4 *marks*]
[4 *markah*]

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5 (a)

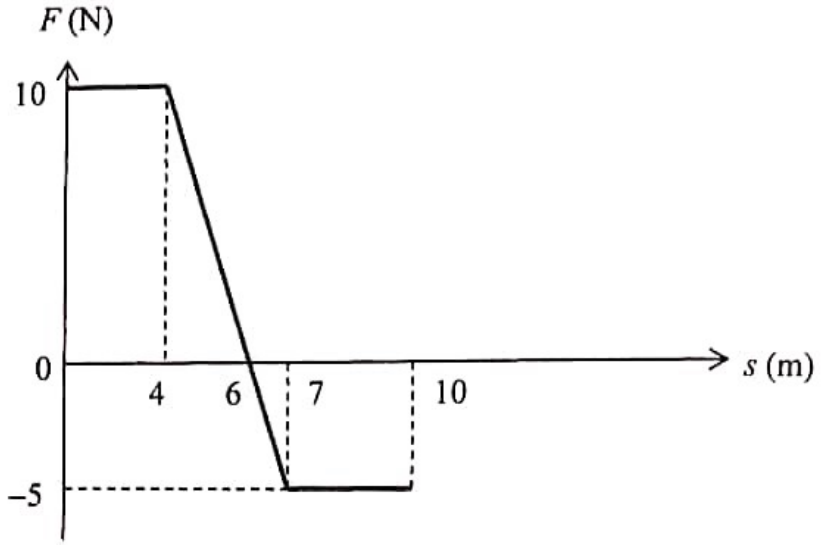

FIGURE 5.1
***RAJAH* 5.1**

An object of mass 2.0 kg travels along horizontal floor under the action of force F. **FIGURE 5.1** shows the graph of F against displacement s. The speed of the object at $s = 0$ is 10 m s^{-1}. Determine the speed of the object at $s = 10$ m.

Sebuah objek berjisim 2.0 kg *bergerak di sepanjang lantai mengufuk kerana tindakan daya F.* ***RAJAH* 5.1** *menunjukkan satu graf F melawan sesaran s. Laju objek pada s* = 0 *ialah* 10 m s^{-1}. *Tentukan laju objek pada s* = 10 m.

[4 *marks*]
[4 *markah*]

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(b)

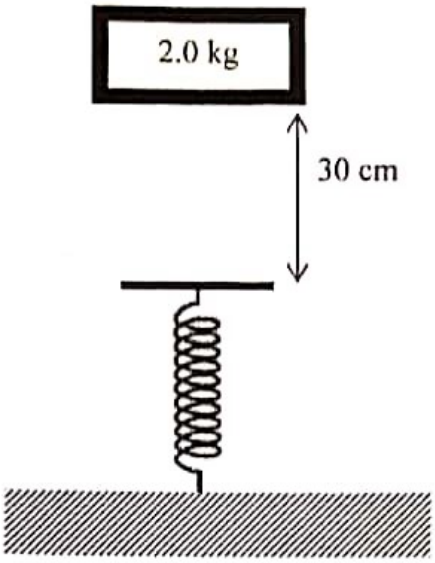

FIGURE 5.2
***RAJAH* 5.2**

An object of mass 2.0 kg is placed 30 cm directly above the top end of a vertical spring as shown in **FIGURE 5.2**. The spring constant $k = 2000$ N m^{-1}.

Satu objek berjisim 2.0 kg *diletakkan pada ketinggian* 30 cm *di atas spring tegak seperti yang ditunjukkan dalam* ***RAJAH* 5.2**. *Pemalar spring* $k = 2000$ N m^{-1}.

(i) Calculate the speed of the object just before striking the spring.

Hitung laju objek sebelum menghentam spring.

(ii) Determine the maximum compression x.

Tentukan mampatan maksimum x.

[6 *marks*]
[6 *markah*]

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6

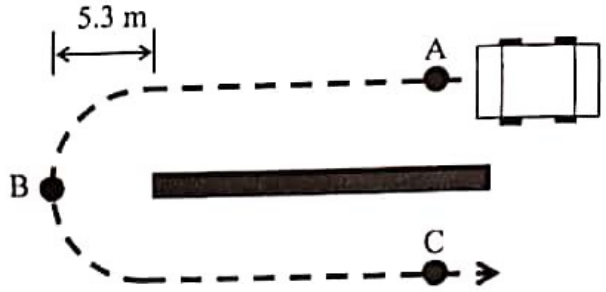

FIGURE 6
RAJAH 6

FIGURE 6 shows the top view of a U turn at a road divider. The radius of the circular curve is 5.3 m. A 950 kg car maintains a speed of 15.3 m s^{-1} along points A to C.

RAJAH 6 *menunjukkan pandangan atas satu pusingan* U *di pembahagi jalan. Jejari lengkung bulatan ialah* 5.3 m. *Sebuah kereta* 950 kg *kekal bergerak dengan kelajuan* 15.3 m s^{-1} *sepanjang titik* A *ke* C.

(a) Copy the path and indicate the directions of velocity and acceleration of the car at point B.

Salin jejak lintasan dan tandakan arah halaju dan pecutan kereta di titik B.

[2 *marks*]
[2 *markah*]

(b) Calculate the centripetal acceleration of the car at point B.

Hitungkan pecutan memusat kereta di titik B.

[1 *mark*]
[1 *markah*]

(c) Calculate the centripetal force on the car at point B.

Hitungkan daya memusat kereta di titik B.

[1 *mark*]
[1 *markah*]

(d) Determine the magnitude and the direction of the frictional force on the car at point B.

Tentukan magnitud dan arah daya geseran pada kereta di titik B.

[1 *mark*]
[1 *markah*]

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7 (a) In 2015, a triple star system HD 188753 was discovered in the constellation Cygnus. The primary star A has a mass of 2.11×10^{30} kg. The other two stars BC are close together with negligible separation distance and their combined masses is 3.24×10^{30} kg. The distance between star A and stars BC is 1.43×10^{9} m. Suppose that the system is an isolated system, calculate the

Pada 2015, *satu sistem bintang tetiga* HD 188753 *ditemui dalam gugusan Cygnus. Bintang primer* A *berjisim* 2.11×10^{30} kg. *Dua bintang lain* BC *berdekatan antara satu sama lain dengan jarak pisah yang boleh diabaikan dan jisim gabungannya ialah* 3.24×10^{30} kg. *Jarak di antara bintang* A *dan bintang* BC *ialah* 1.43×10^{9} m. *Andaikan sistem bintang ini adalah terpencil, hitung*

(i) gravitational force between star A and stars BC.

daya graviti antara bintang A *dan bintang* BC.

(ii) gravitational field strengths at star A.

kekuatan medan graviti pada bintang A.

[3 *marks*]
[3 *markah*]

(b) An 800 kg satellite is orbiting the Earth a circular path. The weight of the satellite while orbiting is half of its weight on Earth. Determine the (Given: mass of the Earth $M = 6.0 \times 10^{24}$ kg and radius of the Earth $R = 6.4 \times 10^{6}$ m)

Sebuah satelit 800 kg *mengorbit Bumi dalam satu lintasan membulat. Berat satelit ketika mengorbit adalah separuh daripada beratnya di Bumi. Tentukan* (*Diberi: jisim Bumi* $M = 6.0 \times 10^{24}$ kg *dan jejari Bumi* $R = 6.4 \times 10^{6}$ m)

(i) altitude of the satellite.

altitud satelit.

(ii) speed of the satellite in the orbit.

laju satelit di orbit.

[5 *marks*]
[5 *markah*]

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8 (a)

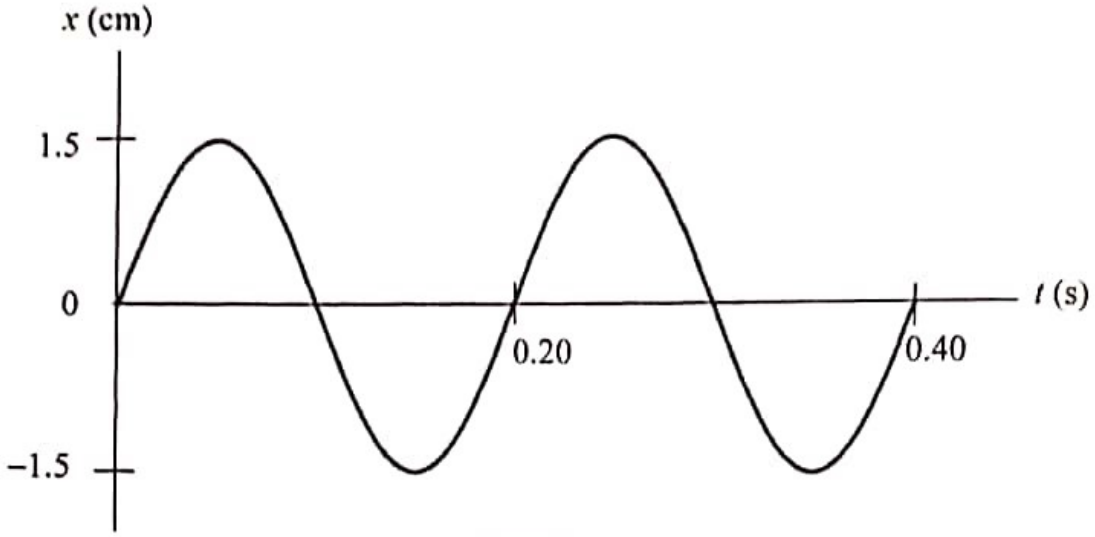

FIGURE 8
RAJAH 8

A 0.75 kg mass is attached to one end of a horizontal spring while the other end is fixed. **FIGURE 8** shows a graph of displacement versus time of the system which freely oscillates in a simple harmonic motion. Determine the

Sebuah jisim 0.75 kg *diikat pada satu hujung spring mengufuk manakala satu hujung lagi ditetapkan.* ***RAJAH 8*** *menunjukkan satu graf sesaran melawan masa bagi sistem yang berayun bebas dengan gerakan harmonik ringkas. Tentukan*

(i) equation of the displacement as a function of time.
persamaan sesaran dalam fungsi masa.

(ii) velocity and acceleration of the oscillation at any time t.
halaju dan pecutan ayunan pada sebarang masa t.

(iii) maximum speed and acceleration of the oscillation.
laju dan pecutan maksimum ayunan.

(iv) total energy of the system.
jumlah tenaga sistem.

[8 *marks*]
[8 *markah*]

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(b) A simple pendulum has a length of 1.5 m and mass of bob 10 g.
Satu bandul ringkas mempunyai panjang 1.5 m *dan jisim bob* 10 g.

(i) Calculate the period of the pendulum.
Hitung tempoh bandul.

(ii) If you want the period of the pendulum to be 1.0 s, calculate the new length of pendulum.
Jika kamu mahu tempoh bandul menjadi 1.0 s, *hitung panjang baharu bandul.*

(iii) If the bob is replaced by a new bob of mass 40 g, will the period remains the same? Justify.
Jika bob diganti dengan bob baharu berjisim 40 g, *adakah tempoh bandul kekal sama? Justifikasikan.*

[4 *marks*]
[4 *markah*]

9 (a) A progressive wave is described by $y = 5\sin 2\pi\left(10t - \frac{x}{5}\right)$ where x, y are in cm and t in s. Calculate the

Satu gelombang maju diwakili sebagai $y = 5\sin 2\pi\left(10t - \frac{x}{5}\right)$ *dengan* x, y *dalam* cm *dan* t *dalam* s. *Hitung*

(i) speed of the wave.
laju gelombang.

(ii) vibrational velocity at time $t = 0$ s, for the particle is at $x = 5.0$ cm.
halaju getaran pada masa $t = 0$ s, *bagi zarah pada* $x = 5.0$ cm.

[7 *marks*]
[7 *markah*]

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(b) A wire of mass 30 g is stretched between two points 100 cm apart with tensional force of 70 N. When the wire is plucked, standing waves are formed in the wire.

Seutas dawai berjisim 30 g *diregangkan di antara dua titik terpisah sejauh* 100 cm *dengan daya tegangan* 70 N. *Apabila dawai di petik, gelombang pegun terbentuk dalam dawai.*

(i) Calculate the fundamental frequency and the third overtone frequency of the wire.

Hitung frekuensi asas dan frekuensi nada lampau ketiga dawai.

(ii) If the tensional force of wire is doubled, determine the new fundamental frequency.

Jika daya tegangan dawai ditambah dua kali ganda, tentukan frekuensi asas baharu.

[6 *marks*]
[6 *markah*]

(c) A stationary loudspeaker radiates sound with a frequency of 1000 Hz uniformly in all directions. At a distance of 4.0 m the intensity of sound is 0.95 W m^{-2}. Calculate the

Sebuah pembesar suara pegun memancarkan bunyi dengan frekuensi 1000 Hz *seragam kesemua arah. Pada jarak* 4.0 m *keamatan bunyi ialah* 0.95 W m^{-2}. *Hitung*

(i) power of the loudspeaker.

kuasa pembesar suara.

(ii) frequency of the sound heard by a child if he approaches the sound at the speed of 10 m s^{-1}.

frekuensi bunyi yang didengari oleh seorang budak jika dia menghampiri bunyi pada laju 10 m s^{-1}.

(Speed of sound = 330 m s^{-1})
(*Laju bunyi* = 330 m s^{-1})

[3 *marks*]
[3 *markah*]

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10 An aluminium wire, initially 2.45 m long and diameter of 1.5 mm, is suspended from a rigid support with a load of 15 kg attached to its lower end. Young's modulus of aluminium is 7.0×10^{10} N m^{-2}. Calculate the

Seutas dawai aluminium, panjang asal 2.45 m *dan diameter asal* 1.5 mm, *digantung dari sokongan kukuh dengan beban berjisim* 15 kg *tergantung di hujungnya. Modulus Young aluminium adalah* 7.0×10^{10} N m^{-2}. *Hitung*

(a) extension of the wire.

pemanjangan dawai.

[3 *marks*]
[3 *markah*]

(b) strain energy stored in the wire.

tenaga terikan tersimpan dalam dawai.

[1 *mark*]
[1 *markah*]

11 The dimension of an aluminium wire at room temperature (27°C) is 150 m long and cross sectional area of 3.0×10^{-6} m^2. It is then melted to form a spherical ball. If the coefficient of linear thermal expansion of the aluminium is 22.2×10^{-6} m K^{-1}, calculate the

Dimensi seutas dawai aluminium pada suhu bilik (27°C) *ialah* 150 m *panjang dengan luas keratan rentas* 3.0×10^{-6} m^2. *Ia kemudian dileburkan bagi membentuk sebiji bola sfera. Jika pekali pengembangan terma linear aluminium ialah* 22.2×10^{-6} m K^{-1}, *hitung*

(a) volume of the spherical ball at room temperature.

isipadu bola sfera pada suhu bilik.

[2 *marks*]
[2 *markah*]

(b) change in the volume of the sphere if it is heated to 200°C.

perubahan isipadu sfera jika ia dipanaskan sehingga 200°C.

[2 *marks*]
[2 *markah*]

(c) change in the volume of the sphere if it is cooled to –7°C.

perubahan isipadu sfera jika ia disejukkan kepada –7°C.

[2 *marks*]
[2 *markah*]

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12 The pressure of a 0.02 m^3 monoatomic gas in a container is 2 atm. The mass of each atom is 3.351×10^{-23} g. Calculate the

Tekanan gas monoatomik berisipadu 0.02 m^3 *dalam satu bekas ialah* 2 atm. *Jisim setiap atom ialah* 3.351×10^{-23} g. *Hitung*

(a) average translational kinetic energy of the gas.

tenaga kinetik translasi purata gas.

[4 *marks*]
[4 *markah*]

(b) internal energy of the gas.

tenaga dalam gas.

[1 *mark*]
[1 *markah*]

(c) v_{rms} value at 27°C.

nilai v_{pmkd} *pada* 27°C.

[3 *marks*]
[3 *markah*]

13 One mole of an ideal gas is compressed isothermally from $4V$ to V. The work done on the gas is 4.5×10^3 J.

Satu mol gas ideal dimampatkan secara isoterma dari $4V$ *kepada* V. *Kerja yang dilakukan ke atas gas adalah sebanyak* 4.5×10^3 J.

(a) Sketch a p-V graph for this process.

Lakarkan satu graf p-V bagi proses ini.

[2 *marks*]
[2 *markah*]

(b) Calculate the heat transferred during the compression. Is the heat absorbed or released by the system?

Hitung haba yang dipindahkan semasa mampatan. Adakah haba diserap atau dibebaskan oleh sistem?

[2 *marks*]
[2 *markah*]

(c) Calculate the isothermal process temperature.

Hitung suhu proses isoterma.

[2 *marks*]
[2 *markah*]

END OF QUESTION PAPER
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Answer **all** questions.
*Jawab **semua** soalan.*

1 The gravitational acceleration a_g of an object on Earth is given by the equation, $a_g = \frac{GM}{r^2}$, where M and r is the mass and radius of Earth respectively. Determine the dimension of the constant G.

Pecutan graviti a_g bagi satu objek di bumi diberikan oleh persamaan, $a_g = \frac{GM}{r^2}$, dengan M dan r masing-masing ialah jisim dan jejari bumi. Tentukan dimensi bagi pemalar G.

[2 *marks*]
[2 *markah*]

2 (a) A boat with an initial speed of 30 m s^{-1}, decelerates at 3.5 m s^{-2} for 4.5 s before reaching a buoy. Calculate the speed of the boat at the buoy.

Sebuah bot dengan laju awal 30 m s^{-1}, *menyahpecut pada* 3.5 m s^{-2} *selama* 4.5 s *sebelum tiba di boya. Hitung laju bot di boya.*

[2 *marks*]
[2 *markah*]

(b)

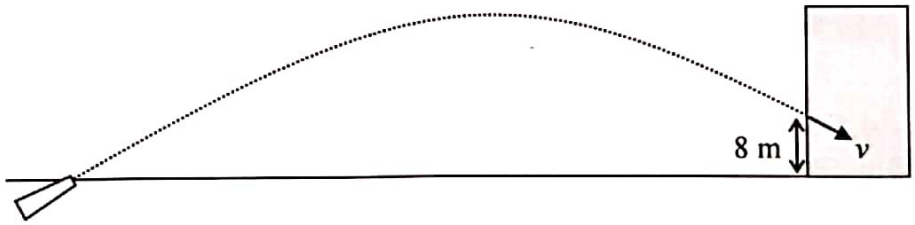

FIGURE 2
***RAJAH* 2**

FIGURE 2 shows a stream of water hitting a wall at a height of 8 m with a velocity of 40 m s^{-1} at an angle of 35° below the horizontal. Determine the initial velocity of the water as it leaves the nozzle.

***RAJAH* 2** *menunjukkan satu alur air menghentam satu dinding pada ketinggian* 8 m *dengan halaju* 40 m s^{-1} *pada sudut* 35° *ke bawah ufuk. Tentukan halaju awal air semasa keluar dari muncung paip.*

[8 *marks*]
[8 *markah*]

3 (a) Flour at mass rate 0.06 kg s^{-1} and velocity 15 m s^{-1} is poured vertically into a bowl. If the flour comes to a rest upon hitting the bowl, calculate the average force exerted by the flour on the bowl.

Tepung pada kadar jisim 0.06 kg s^{-1} *dan halaju* 15 m s^{-1} *dituang menegak ke dalam satu mangkuk. Jika tepung pegun setelah mengenai mangkuk, hitung daya purata yang dikenakan oleh tepung ke atas mangkuk.*

[3 *marks*]
[3 *markah*]

(b)

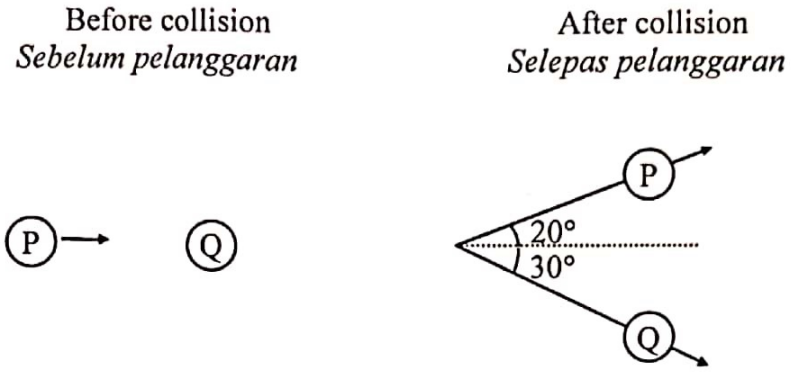

FIGURE 3
RAJAH 3

A 0.52 kg ball P moving at 0.69 m s^{-1} collides with a stationary ball Q. After the collision, the velocity of balls P and Q are 0.3 m s^{-1} and 0.45 m s^{-1} respectively as shown in **FIGURE 3**. Determine the mass of ball Q.

Satu bola P 0.52 kg *bergerak pada* 0.69 m s^{-1} *berlanggar dengan satu bola* Q *yang pegun. Selepas pelanggaran, halaju bola* P *dan* Q *masing-masing ialah* 0.3 m s^{-1} *dan* 0.45 m s^{-1} *seperti pada* ***RAJAH 3****. Tentukan jisim bola* Q.

[3 *marks*]
[3 *markah*]

4

FIGURE 4
***RAJAH* 4**

A man drags a 23 kg suitcase with a 45 N force at constant speed as shown in **FIGURE 4**. The frictional force on the suitcase is 18 N. With the help of a free-body diagram, calculate the coefficient of kinetic friction between the suitcase and floor.

Seorang lelaki mengheret satu bagasi 23 kg *dengan daya* 45 N *pada laju malar seperti pada* ***RAJAH* 4**. *Daya geseran pada bagasi ialah* 18 N. *Dengan bantuan satu gambar rajah jasad bebas, hitung pekali geseran kinetik di antara bagasi dengan lantai.*

[7 *marks*]
[7 *markah*]

5 (a)

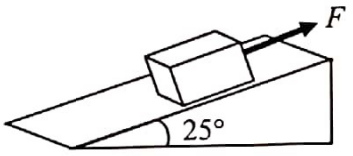

FIGURE 5
***RAJAH* 5**

FIGURE 5 shows a 15 kg block being pulled by a 100 N force at an initial speed of 2 m s^{-1} up an inclined plane. The block travels a distance of 6.2 m parallel to the inclined plane. The coefficient of kinetic friction is 0.14. By using the work-energy theorem, calculate the change in the kinetic energy of the block.

***RAJAH* 5** *menunjukkan sebuah bongkah* 15 kg *ditarik oleh daya* 100 N *pada laju awal* 2 m s^{-1} *ke atas satu satah condong. Bongkah itu melalui jarak* 6.2 m *selari dengan satah condong. Pekali geseran kinetik ialah* 0.14. *Dengan menggunakan teorem tenaga-kerja, hitung perubahan tenaga kinetik bongkah.*

[7 *marks*]
[7 *markah*]

(b) A 120 kg motorcycle accelerates uniformly from rest to 25 m s^{-1} in 5 s. Calculate the instantaneous power of the motorcycle at time $t = 3$ s.

Sebuah motosikal 120 kg *memecut secara malar dari pegun ke* 25 m s^{-1} *dalam* 5 s. *Hitung kuasa seketika motosikal pada masa* $t = 3$ s.

[3 *marks*]
[3 *markah*]

6 A 16 g ball is swung vertically using a 0.5 m string. Calculate the
Satu bola 16 g *dihayun menegak dengan menggunakan satu tali* 0.5 m. *Hitung*

(a) minimum tension in the string if the speed of the ball is 1.5 m s^{-1}.
tegangan minimum tali jika laju bola ialah 1.5 m s^{-1}.

[3 *marks*]
[3 *markah*]

(b) speed of the ball when the string breaks.
laju bola apabila tali putus.

[2 *marks*]
[2 *markah*]

7 A 120 kg satellite is orbiting the Earth at an altitude of 190 km. The radius and mass of the Earth are 6.4×10^6 m and 5.98×10^{24} kg respectively. Calculate the
Satu satelit 120 kg *mengorbit bumi pada altitud* 190 km. *Jejari dan jisim bumi masing-masing ialah* 6.4×10^6 m *dan* 5.98×10^{24} kg. *Hitung*

(a) gravitational potential energy of the satellite.
tenaga keupayaan graviti satelit.

[3 *marks*]
[3 *markah*]

(b) period of the satellite.
tempoh satelit.

[2 *marks*]
[2 *markah*]

(c) change in the speed of the satellite for it to break-free from the orbit.
perubahan laju satelit untuk ia terlepas dari orbit.

[3 *marks*]
[3 *markah*]

8 (a)

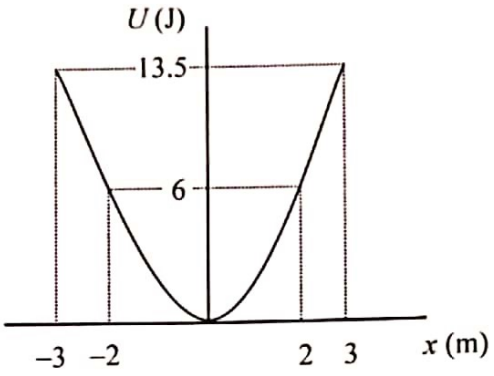

FIGURE 8
***RAJAH* 8**

FIGURE 8 shows the potential energy of a 0.5 kg object that undergoes a simple harmonic motion. Determine the

***RAJAH* 8** *menunjukkan tenaga keupayaan bagi satu objek* 0.5 kg *yang mengalami gerakan harmonik ringkas. Tentukan*

(i) velocity when time $t = 2$ s.
halaju apabila masa $t = 2$ s.

(ii) kinetic energy of the object when displacement $x = 1.5$ m.
tenaga kinetik objek apabila sesaran $x = 1.5$ m.

[8 *marks*]
[8 *markah*]

(b) An oscillating pendulum has length 0.3 m and 240 g bob. If the total energy is 0.06 J, calculate the amplitude of the oscillation.

Satu bandul yang berayun mempunyai panjang 0.3 m *dan ladung* 240 g. *Jika jumlah tenaga ialah* 0.06 J, *hitung amplitud ayunan.*

[4 *marks*]
[4 *markah*]

9 (a)

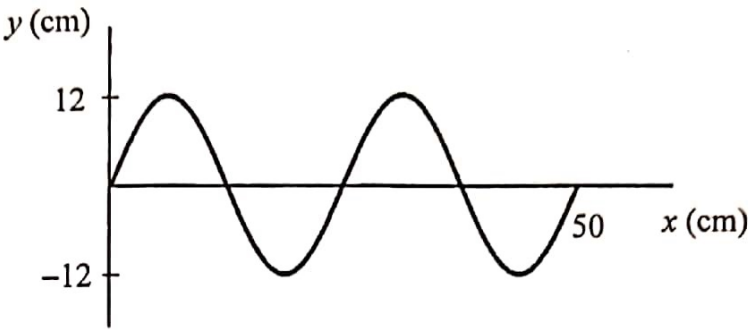

FIGURE 9
RAJAH 9

FIGURE 9 shows a graph of displacement y against distance x for a progressive wave propagating to the right in a string with mass 920 g, length 3 m and tension 15 N. Determine the progressive wave equation.

RAJAH 9 *menunjukkan satu graf sesaran y melawan jarak x bagi satu gelombang maju yang merambat ke kanan pada satu tali dengan jisim* 920 g, *panjang* 3 m *dan tegangan* 15 N. *Tentukan persamaan gelombang maju tersebut.*

[9 *marks*]
[9 *markah*]

(b) A 1.53 m closed pipe makes a humming sound at frequency 282 Hz when the wind blows across the open end. The speed of sound in air is 343 m s^{-1}. With the help of a diagram, determine the number of nodes in the standing wave.

Satu paip tertutup 1.53 m *menghasilkan satu bunyi berdengung pada frekuensi* 282 Hz *apabila angin bertiup merentasi hujung yang terbuka. Laju bunyi di dalam udara ialah* 343 m s^{-1}. *Dengan bantuan satu gambar rajah, tentukan bilangan nod gelombang pegun tersebut.*

[4 *marks*]
[4 *markah*]

(c) The frequency of whistle by a moving train and the frequency heard by a stationary observer are 520 Hz and 460 Hz respectively. If the speed of sound in the air is 343 m s^{-1}, calculate the speed of the train.

Frekuensi wisel keretapi yang bergerak dan frekuensi yang didengari oleh seorang pemerhati pegun masing-masing ialah 520 Hz *dan* 460 Hz. *Jika laju bunyi di dalam udara ialah* 343 m s^{-1}, *hitung laju keretapi tersebut.*

[3 *marks*]
[3 *markah*]

10 The diameter of a circular shoe heel is 13 mm. If both heels support 70% of the weight of a 54 kg woman, calculate the stress on both heels.

Diameter tumit kasut yang bulat ialah 13 mm. *Jika kedua-dua tumit mengampu* 70% *dari berat seorang wanita* 54 kg, *hitung tegasan pada kedua-dua tumit tersebut.*

[4 *marks*]
[4 *markah*]

11 (a) A gold rod is in contact with a silver rod. The gold end and the silver end of the compound rod is at 90 °C and 30 °C respectively. The silver rod has thermal conductivity 427 W m^{-1} K^{-1}, length 2.5 cm and cross-sectional area 7.85×10^{-5} m^2. If 341.3 J heat flows through the gold rod in 10 s, calculate the temperature at the contact surface.

Satu rod emas bersentuhan dengan satu rod perak. Hujung rod emas dan hujung rod perak masing-masing ialah pada 90 °C *dan* 30 °C. *Rod perak mempunyai kekonduksian terma* 427 W m^{-1} K^{-1}, *panjang* 2.5 cm *dan luas keratan rentas* 7.85×10^{-5} m^2. *Jika haba* 341.3 J *mengalir melalui rod emas dalam* 10 s, *hitung suhu pada permukaan bersentuhan.*

[4 *marks*]
[4 *markah*]

(b) The area of a metal plate changes from 120 m^2 to 120.059 m^2 when the temperature increases by 30 °C. Calculate the coefficient of linear expansion of the metal.

Keluasan bagi satu plat logam berubah dari 120 m^2 *ke* 120.059 m^2 *apabila suhu meningkat sebanyak* 30 °C. *Hitung pekali pengembangan linear bagi logam tersebut.*

[2 *marks*]
[2 *markah*]

12 A sealed cylinder contains 1.2×10^{24} helium atoms at initial pressure 1.04×10^5 Pa. The cylinder is heated until the final temperature and the change in the internal energy of the helium gas are 315 K and 1.6×10^3 J respectively. The molar mass of helium is 4 g mol^{-1}. Calculate the

Sebuah silinder tertutup rapat mengandungi 1.2×10^{24} *atom helium pada tekanan awal* 1.04×10^5 Pa. *Silinder dipanaskan sehingga suhu akhir dan perubahan tenaga dalam bagi gas helium masing-masing ialah* 315 K *dan* 1.6×10^3 J. *Jisim molar helium ialah* 4 g mol^{-1}. *Hitung*

(a) density of the helium gas.

ketumpatan gas helium tersebut.

[6 *marks*]
[6 *markah*]

(b) final pressure of the helium gas.

tekanan akhir gas helium tersebut.

[2 *marks*]
[2 *markah*]

13 A 0.8 m^3 container at 60 °C is filled with 0.6 mol ideal gas. The gas is isothermally compressed to a volume of 0.2 m^3. Then the gas expands isobarically to its initial volume. Calculate the total work done in the processes.

Satu bekas 0.8 m^3 *pada* 60 °C *diisikan dengan gas unggul* 0.6 mol. *Gas tersebut dimampatkan secara isoterma ke isi padu* 0.2 m^3. *Seterusnya gas itu mengembang secara isobarik ke isi padu asal. Hitung jumlah kerja yang dilakukan dalam proses-proses tersebut.*

[6 *marks*]
[6 *markah*]

END OF QUESTION PAPER
KERTAS SOALAN TAMAT