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

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Fizik
Kertas 2
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2½ jam

KEMENTERIAN PENDIDIKAN MALAYSIA

BAHAGIAN MATRIKULASI
MATRICULATION DIVISION

PEPERIKSAAN SEMESTER PROGRAM MATRIKULASI
MATRICULATION PROGRAMME EXAMINATION

FIZIK
Kertas 2
2 ½ jam

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

Kertas soalan ini mengandungi **23** halaman bercetak.
This question paper consists of **23** *printed pages.*

*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*]

2 (a) Distinguish between distance and displacement.

[2 *marks*]

(b)

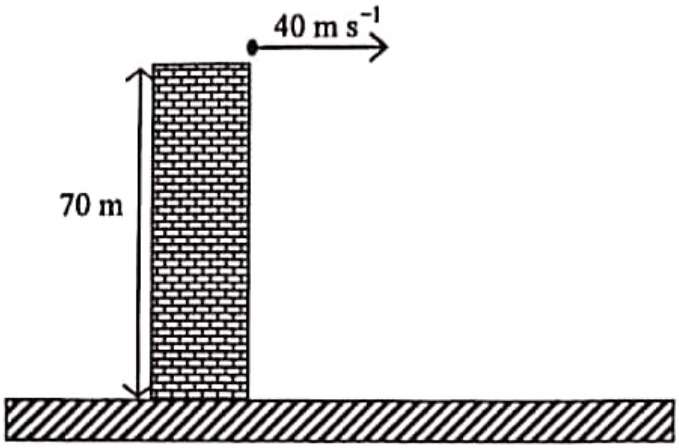

FIGURE 1

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*]

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)

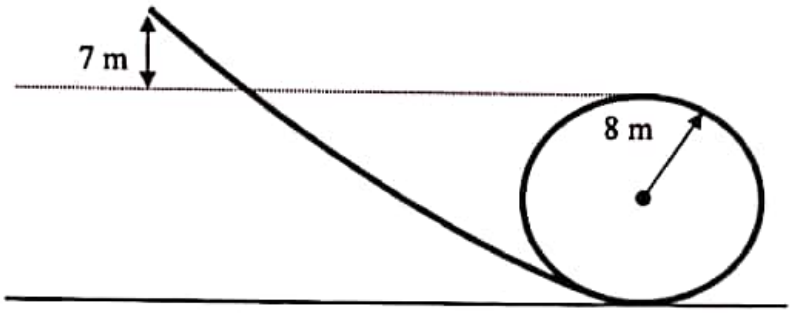

FIGURE 2

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)

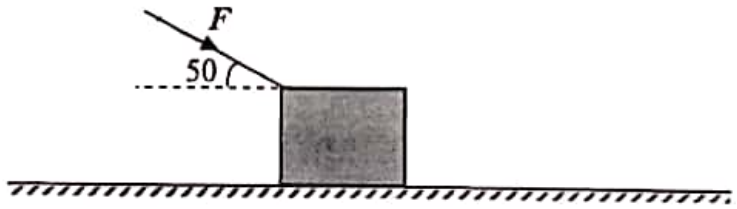

FIGURE 3

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*]

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*]

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)

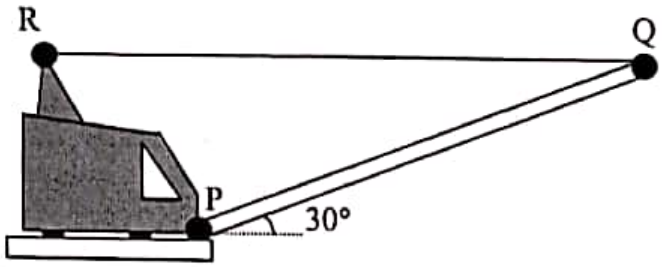

FIGURE 4

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.

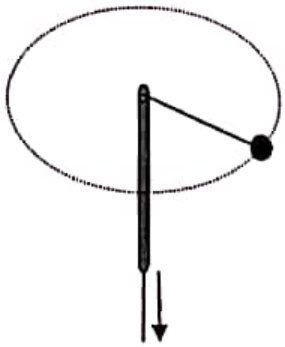

FIGURE 5

(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*]

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*]

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

(ii)

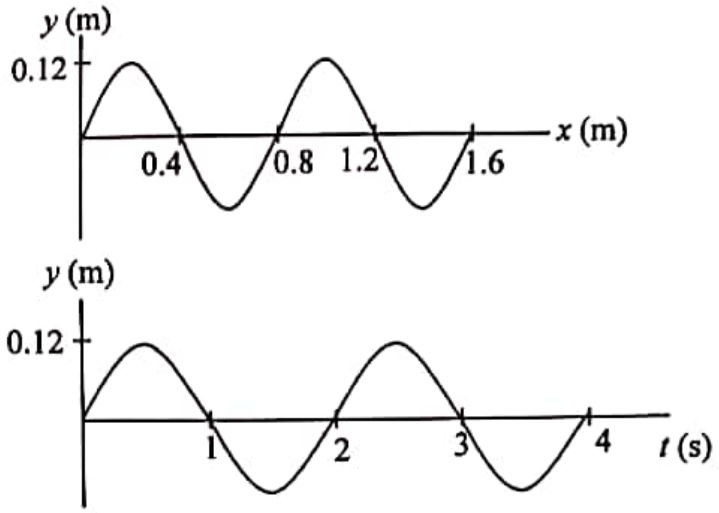

FIGURE 6

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*]

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

[1 *mark*]

(b)

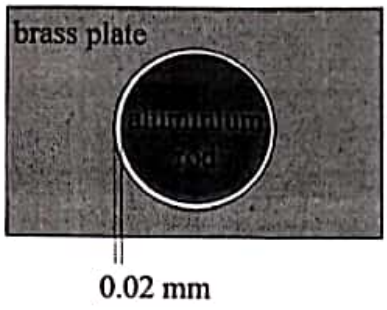

FIGURE 7

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*]