SP015

Physics
Semester I
Session 2020/2021
2 hours

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Fizik
Semester I
Sesi 2020/2021
2 jam

KEMENTERIAN PENDIDIKAN MALAYSIA

BAHAGIAN MATRIKULASI
MATRICULATION DIVISION

PEPERIKSAAN SEMESTER PROGRAM MATRIKULASI
MATRICULATION PROGRAMME EXAMINATION

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

Kertas Soalan ini mengandungi 15 halaman bercetak.

This question paper consists of 15 printed pages.

1 Hooke's Law states that below elastic limit, the restoring force F in a spring is proportional to elongation x given by $F = -kx$. While Newton's second law states that $F = ma$, where m is mass and a is acceleration. Determine the dimension and the SI base unit of the spring constant k.

2 A student took 15 minutes to cycle from his house to school. He starts from rest and reaches a maximum speed of 4.0 m s^{-1} in 5.0 minutes at constant acceleration. After reaching the maximum speed, he decelerates uniformly to 2.0 m s^{-1} in 3.0 minutes and continues cycling to this speed for 5.0 minutes. He then took 2.0 minutes to decelerate uniformly to stop.

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

(b) Calculate the acceleration of the bicycle for the time segments of 0 – 5 minutes and 13 – 15 minutes.

(c) Determine the total distance from his house to school.

3 A 20 g bullet is fired and travels with speed of 800 m s^{-1}. It hits a 5.0 kg wooden block initially at rest and stucked inside causing the block to move.

(a) Determine the final velocity of the bullet and the block immediately after the block is hit.

(b) Show that the collision is inelastic.

4

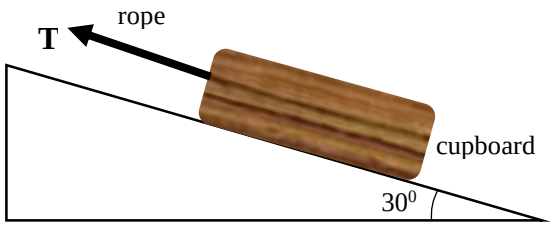

FIGURE 4

FIGURE 4 shows a 40 kg cupboard being pulled up along a rough inclined plane 30^0 to the horizontal by a light rope. The cupboard moves at constant velocity. The coefficient of kinetic friction between the cupboard and the inclined plane is 0.50.

(a) Draw a free body diagram of the cupboard.

(b) Determine the magnitude of the frictional force and tension acting on the cupboard.

5

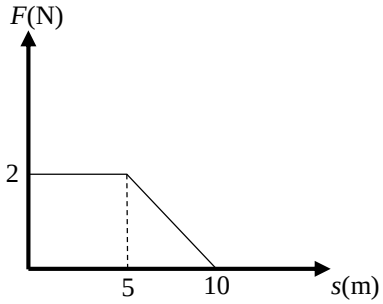

FIGURE 5

(a) A 2.0 kg object moving with an initial velocity 5.0 m s^{-1} is acted on by a force of 2.0 N. **FIGURE 5** shows the force-displacement graph of the above motion. Determine the velocity of the object at 10 m displacement.

(b) A car with mass 1500 kg is moving with a constant force, *F* acting on it along its direction of motion. Upon achieving a speed of 20 m s^{-1} it delivers a maximum power of 100 kW. Later the car enters a 50 m rough road and decelerates to a speed of 10 m s^{-1}. Determine the

(i) constant force, *F*

(ii) work done to overcome the frictional force on the rough road.

6 A 20 g stone tied at the end of an inelastic string rotates in a horizontal circle. The length of the string is 1.0 m and the stones rotates with a constant angular velocity of 2.0 revolution per second.

(a) Draw a free body diagram of the stone.

(b) Calculate the centripetal acceleration of the stone.

7 A 100 kg asteroid is located between the earth and the sun. The distance of the asteroid from the centre of the earth is 1.5×10^{10} m and from the centre of the sun is 1.37×10^{11} m. The mass of the earth and the sun are 6.00×10^{24} kg and 2.00×10^{30} kg respectively. Determine the

(a) magnitude and direction of the resultant force on the asteroid.

(b) acceleration of the asteroid.

8

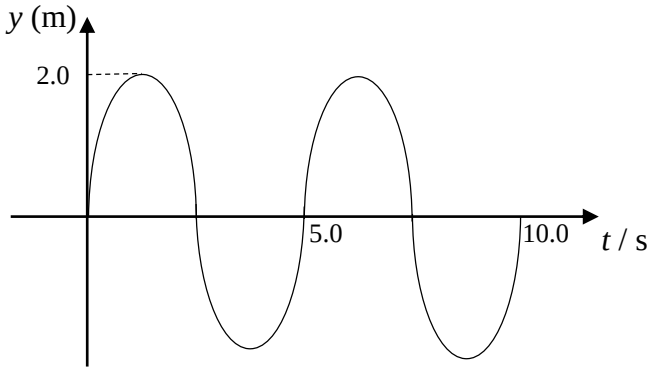

FIGURE 8

FIGURE 8 shows the displacement-time graph of a body performing simple harmonic motion.

(a) Determine the amplitude, angular frequency and maximum speed of the motion.

(b) Deduce the expression for the motion.

(c) Sketch time-velocity graph for this motion.

9 (a) A stretched wire of length 1.0 m is fixed at both ends. The speed of the transverse wave in the wire is 10 m s^{-1}. If the mode of the vibration is third overtone, calculate the

(i) wavelength.

(ii) frequency of third overtone.

(iii) lowest resonant frequency of the wire.

(b) A train with velocity of 40 m s^{-1} is approaching an observer standing on a platform. The frequency of the siren from the train is 1600 Hz. Assuming the speed of sound in air is 330 m s^{-1}, determine the

(i) frequency of the sound heard by the observer

(ii) frequency of the sound heard by the observer when the train is leaving the platform.

10 A 1.5 m steel wire is stretched 2.0 mm by force *F*. The diameter of the steel wire is 4.0 mm. The Young's modulus of steel is 2.0×10^{11} N m^{-2} . Determine the force *F* applied on the wire.

11 A perfectly insulated aluminium rod has length 50 cm and cross sectional area 3.0 cm^2. At the steady state, the temperature at 0 cm and 50 cm ends are 150 ^{0}C and 50 ^{0}C.
(Thermal conductivity of aluminium is 210 W m^{-1} K^{-1})

(a) Sketch a labelled graph of temperature against distance.

(b) Calculate the temperature gradient along the rod.

(c) Calculate the rate of heat flow in the rod.

12 A container contains 3.0 mol of nitrogen gas at 30 ^{0}C. If nitogen gas behave like an ideal gas, calculate the

(a) total translational kinetic energy of the gas molecules.

(b) internal energy of the gas.

(c) root mean square speed of the nitogen molecules if the mass is 28 g mol^{-1} .

13 The pressure of a tyre rises from 200 kPa to 400 kPa at constant temperature 30 ^{0}C. Assuming the air in the tyre acts as an ideal gas, calculate the

(a) work done per mole of the air.

(b) heat transferred in this process.

END OF QUESTIONS