SP015

Physics 1

Semester 1

Session 2023/2024

2 hours

KOLEJ MATRIKULASIJOHOR

TRIAL 1

INSTRUCTIONS TO CANDIDATE:

This question paper consists of **8** questions. **Total marks** of the paper are **80**
Answer **ALL** questions.
Refer to list provided for the selected constant values and formulae.
The use of electronic calculator is permitted.

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

QUESTIONS	MARKS
1	/2
2	/10
3	/13
4	/8
5	/5
6	/23
7	/8
8	/11
Total	**/80**

Answer **ALL** of the following questions.

1 Verify the homogeneity of equation $a = \frac{1}{2}(u + v)t^2$ where a is acceleration, *u* and *v* are velocities, and *t* is time.

[2 *marks*]

2 (a)

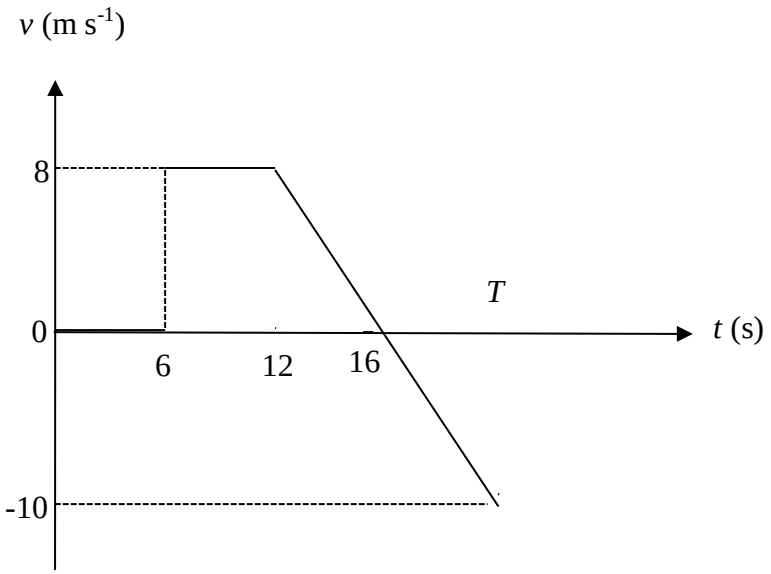

FIGURE 2.1

FIGURE 2.1 shows a graph of velocity against time for a remote-control car travelling along a straight horizontal track.

(i) Sketch a graph of displacement against time from 6 s to 12 s.

(ii) Determine the value of T.

[*5 marks*]

(b)

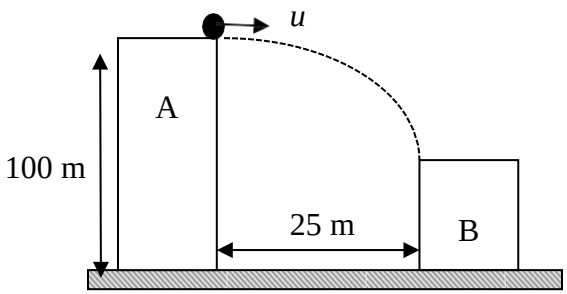

FIGURE 2.2

FIGURE 2.2 shows a ball is thrown from the top of the building A with an initial horizontal speed of u. The ball reaches the top of another building B after 1.8 s. The height of building A is 100 m. Calculate the

(i) initial speed, u of the ball.

(ii) height of building B.

[*5 marks*]

3 (a) A bullet of mass 2 g is fired horizontally with a velocity of 800 m s^{-1}. It hits a wooden block initially at rest and embedded inside it. Both of them move with a common velocity of 3.19 m s^{-1}. Determine the

(i) mass of the wooden block.

(ii) type of collision.

[*6 marks*]

(b)

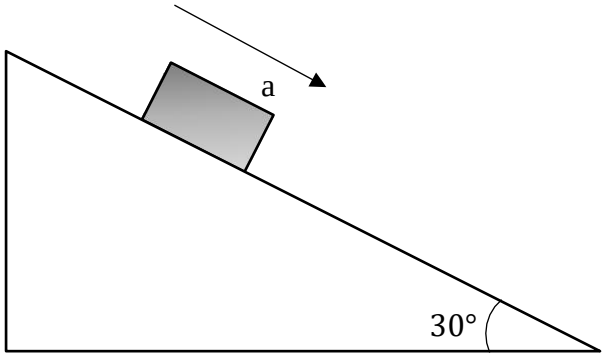

FIGURE 3.1

A box of mass 2 kg is placed on an inclined rough surface as shown in **FIGURE 3.1**. It is released from rest and accelerates at a constant rate of 4.0 m s^{-2}.

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

(ii) Determine the coefficient of kinetic friction.

[*7 marks*]

4 (a) An object with a mass of 5 kg is lifted vertically upwards for a distance of 10 m in 2 s. Calculate the

(i) work done by gravity on the object.

(ii) potential energy gained by the object.

(iii) average power exerted to lift the object.

[*4 marks*]

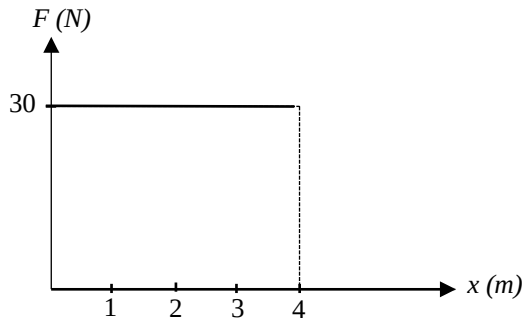

FIGURE 4.1

(b) A person applies a horizontal force to a stationary 40 kg box and pushes it from point A to point B. **FIGURE 4.1** shows variations of horizontal force with displacement of the box during the process.

(i) Determine the work done by the applied force to displace the box from point A to point B.

(ii) By using work-energy theorem calculate the velocity at point B.

[4 *marks*]

5 (a) A High - Volume Low Speed fan with diameter of 480 cm is used in order to circulate air. If this fan is spinning with angular velocity 200 rpm, calculate the

(i) frequency of the motion

(ii) centripetal acceleration of the tips of fan blade.

[3 *marks*]

(b) A car is making a turn at a 45 m radius roundabout. The coefficient of friction between the tyres of the truck and the road is 0.5. Calculate the maximum speed so the car can make a turn without skidding.

[2 *marks*]

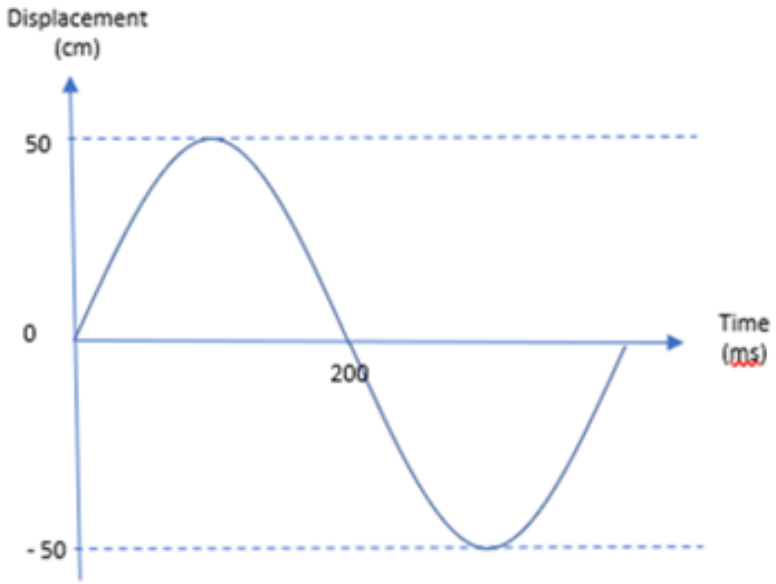

FIGURE 6.1

6 (a) **FIGURE 6.1** show the displacement of a particle undergoing a simple harmonic motion.

(i) Determine the angular frequency of the motion

(ii) Sketch velocity against time graph for the particle.

[4 *marks*]

(b) Two identical sinusoidal progressive waves travelling in opposite directions undergo superposition to produce a standing wave with the wave function

$$y = 3\ cos\ 0.2x\ sin\ 50t$$

where y and x are in meters and t in seconds. Determine

(i) the amplitude of the standing wave.

(ii) the maximum velocity of the wave.

(iii) the distance between two consecutive antinodes.

[6 *marks*]

(c) A guitar string is tied down at both ends and placed under a tension of 180 N. A guitarist plucks the string of length 80 cm and mass of 0.2 g to produce its fundamental frequency.

(i) Sketch the stationary wave pattern formed in the guitar string at its fundamental frequency. Label all the nodes and antinodes at their respective positions.

(ii) Calculate the fundamental frequency.

(iii) The same length of string with different mass 3.3 g is replaced into the guitar under the same tension. Explain quantitatively, what will happen to the fundamental frequency formed?

[9 *marks*]

(d) A lorry producing 1.00 kHz waves moves toward a stationary listener at one-half the speed of sound. Does the apparent frequency of the sound wave heard by the listener increase or decrease when the lorry moves toward him? Given the speed of the sound in air is $340\ m\ s^{-1}$.

[4 *marks*]

7 (a) A copper wire with initial length of 0.755 m and cross-sectional area $3.75 \times 10^{-7} m^2$ is stretched until it reaches 0.766 m. Calculate the force applied to the wire.

[Young Modulus copper is 1.30×10^{11} Pa]

[2 *marks*]

(b) In a state of steady state, a well-insulated copper rod of length 25.0 cm and diameter of 1.6 cm. One end held at 100 °C while the opposite end remains at 0 °C. Calculate the rate of heat flow through the rod.

[Thermal conductivity copper is $380\ W\ m^{-1}K^{-1}$]

[3 *marks*]

(c) A metal coin having a coefficient of linear expansion $2.5 \times 10^{-5}\ ℃^{-1}$ with diameter of 2.00 cm at a temperature of 20 ℃, determine the coin's diameter when the temperature is raised to 60 ℃.

[3 *marks*]

8 (a) A 2 mol hydrogen gas has a temperature of 380.26 K. Assuming the gas behaves ideally, calculate the internal energy of the gas.

[2 *marks*]

(b) A gas is confined in a container undergoes A thermodynamic process where it absorbs 1500 J of heat from its surroundings. If the internal energy decreases by 800 J calculate the work done by the gas during the process.

[2 *marks*]

(c)

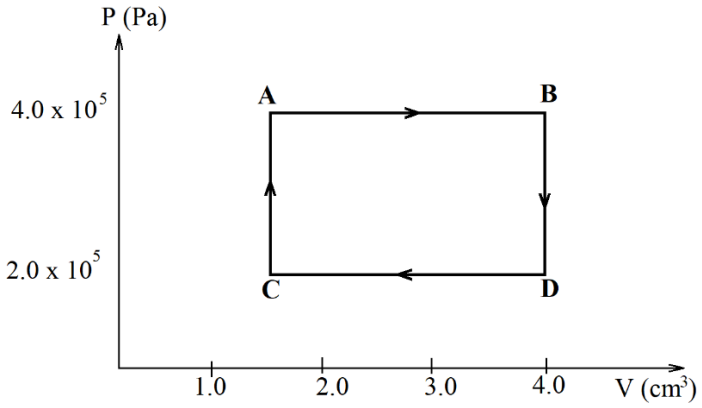

FIGURE 8.1

FIGURE 8.1 shows a monoatomic gas that contained in a piston undergoes various processes. Determine its internal energy at point B.

[3 *marks*]

(d)

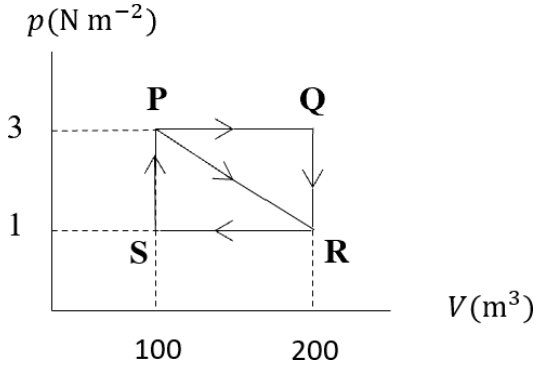

FIGURE 8.2

FIGURE 8.2 shows a $P - V$ graph of an ideal gas. If the change of an internal energy from **P** to **R** is $+300$ J. Determine

(i) the work done by the system during the process of **R** to **S**

(ii) the heat energy during the process **RSP**

[4 *marks*]

END OF QUESTION PAPER