MOCK PSPM PHYSICS 1 SP015 (SET 3)

	Topic	Marks Allocated
1	Physical Quantities and Measurements	2
2	Kinematics of Linear Motion	10
3	Dynamics of Linear Motion	13
4	Work, Energy and Power	8
5	Circular Motion	5
6	Rotation of Rigid Body	
7	Oscillations and Waves	23
8	Physics of Matters	8
9	Kinetic Theory of Gases and Thermodynamics	11
	Total	**80**

INSTRUCTIONS TO CANDIDATE:

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

1 Given $z = xy$, where z has the dimension of L M^{-1} and y has the dimension of L T^{-1}. Determine the dimension of x

[2 marks]

2 (a) **FIGURE 1** shows the velocity−time graph for an object moving along a straight path. Calculate the

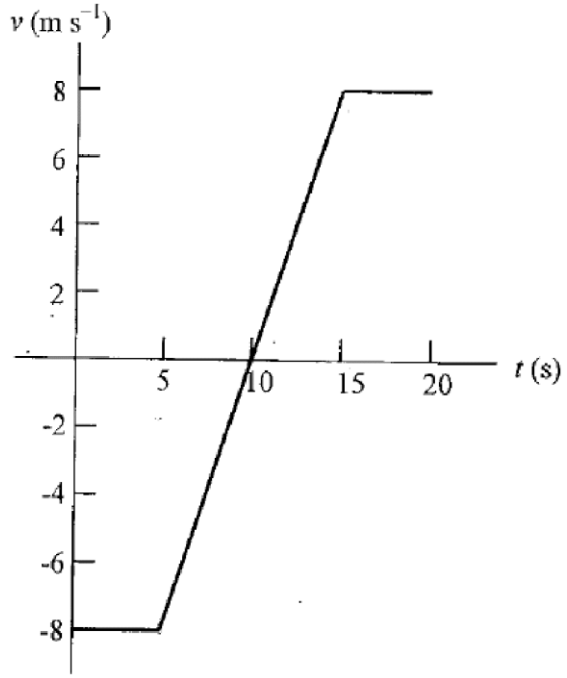

FIGURE 1

(i) average acceleration of the object during the time intervals 5.0 s to 15.0 s.
(ii) displacement **and** total distance traveled during the time intervals 5.0 s to 15.0 s.

[4 marks]

(b) A boy kicks a ball and the ball moves with an initial velocity of 25 m s^{-1} at an angle 35° to the horizontal. The ball reaches the maximum height before landing on a hillside as shown in the **FIGURE 2**.

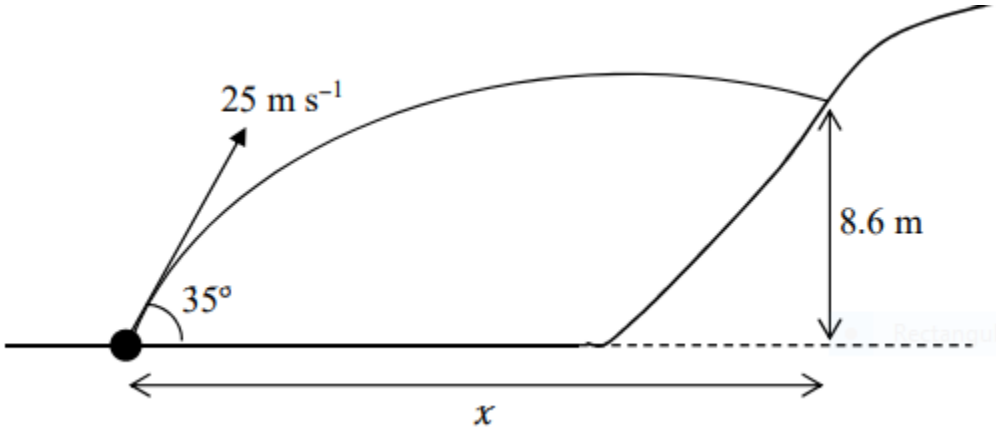

FIGURE 2

By neglecting air resistance, determine
(i) the time of flight of the ball,
(ii) the horizontal distance, x
(iii) the speed of the ball during the impact.

[6 marks]

3 (a) A tennis ball of mass 0.080 kg hits a wall at a speed of 32 m s^{-1} and rebounds at a speed of 22 m s^{-1}. Determine the average force on the ball if the impact between the ball and the wall last for 0.15 s.

[2 marks]

(b) A 2000 kg car moving east at 10.0 m s^{-1} collides with a 3000 kg car moving north. The cars stick together and move as a unit after the collision, at an angle of 40.0° north of east and a speed of 5.22 m s^{-1}. Find the speed of the 3000 kg car before the collision.

[3 marks]

(c)

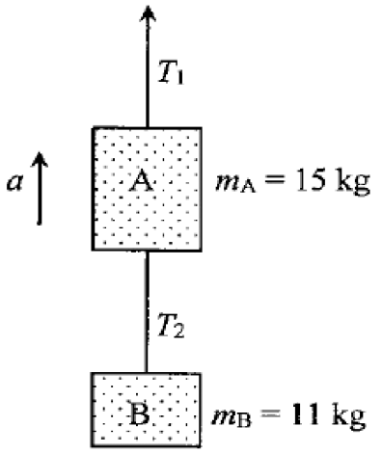

FIGURE 3

FIGURE 3 shows two blocks A and B with masses of 15 kg and 11 kg respectively are connected by a light string. If the blocks are pulled upwards with an acceleration of 2 m s^{-2} by a light string attached to block A,

(i) Draw free body diagrams for the system

(ii) Calculate the tensions T_1 and T_2.

[8 *marks*]

4 (a)

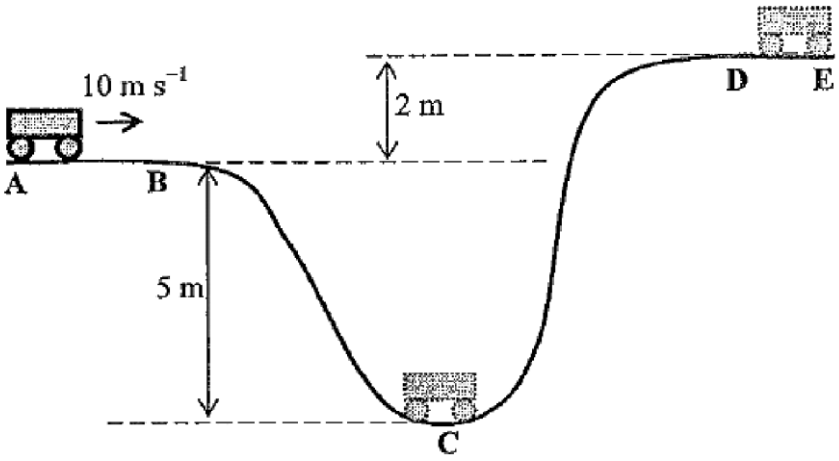

FIGURE 3

In **FIGURE 3**, a small cart of mass 4 kg moves on the frictionless track with a speed of 10 m s^{-1} along **AB**, down to **C** and climbs up to **D** and **E**.

(i) Calculate the change in potential energy of the cart between point **B** and **D**.

(ii) Calculate the speed of the cart at point **C**.

[5 marks]

(b) A toy train accelerates from rest to 0.620 m s^{-1} in 21 ms. The total mass of the train is 875 g. Calculate the average power delivered to the train.

[3 marks]

5

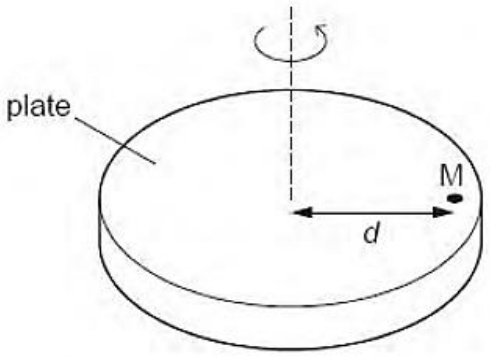

FIGURE 4

A horizontal flat plate is free to rotate about a vertical axis through its center as shown in **FIGURE 4**. A small mass M is placed on the plate, a distance 35 cm from the axis of rotation. The speed of rotation of the plate is gradually increased from zero until the mass is seen to slide off the plate. The maximum frictional force F between the plate and the mass is given by the expression $F = 0.72W$ where W is the weight of the mass M.

(a) Draw free body diagram for small mass M.

(b) Determine the maximum number of revolution of the plate per minute for the mass M to remain on the plate.

[5 marks]

6 (a) The simple harmonic motion of a 5 g particle is given by,

$$y(t) = 0.10sin4t$$

where y and t are displacement in meter and time in second respectively. Determine the

(i) velocity of the particle at $t = 5$ s

(ii) kinetic energy maximum of the particle

[4 marks]

(b) A vertical spring is stretched 0.02 m by a 10.0 N load. The system undergoes simple harmonic motion. Calculate the period of oscillation.

[4 marks]

(c) A progressive wave in a string of density 0.15 kg m^{-1} is given by

$$y(x,t) = 0.08\sin(9t + 2x)\pi$$

where x and y are in meter and t in second. Calculate the tension in the string.

[5 marks]

(d) A 0.48 m pipe is closed at one end. If the speed of sound in air is 340 m s^{-1}, calculate the

(i) first overtone frequency.

(ii) new fundamental frequency if the pipe has both ends opened.

[5 marks]

(e) A stationary observer hears a 1.1 kHz siren from a moving ambulance. The actual frequency of the siren is 1 kHz and the speed of sound wave in air is 340 m s^{-1}.

(i) Is the ambulance moving away or approaching the observer? Justify.

(ii) Calculate the speed of the ambulance.

[5 marks]

7 (a) A 1.5 m steel wire with cross sectional area of 1×10^{-6} m^2 is stretched by 2 mm by a force *F*. If the Young's modulus of the wire is 2×1011 Pa, calculate the force, *F*

[2 marks]

(b) A rectangular water tank with length 2 m, width 1.5 m and height 1 m, is insulated all around with an insulating material with 1.5 cm thickness. Ignoring the heat loss through its base, calculate the amount of heat loss in 1 hour if the temperature outside the tank is 22 ºC and the water temperature is at 96 ºC. The coefficient of thermal conductivity of the insulator is 3.78×10^{-2} W m^{-1} ºC^{-1}.

[3 marks]

(c) A copper wire and a steel wire have the same length at 25°C. Determine which wire will be longer at 100°C. Justify your answer by calculation.
The coefficient of linear expansion of copper and steel are 16×10^{-6} K^{-1} and 12×10^{-6} K^{-1} respectively.

[3 marks]

8 (a) A tank contains 125 moles of monatomic argon gas at a temperature of 10.3°C. Molar mass of argon gas is 40 g mol^{-1}.Calculate
(i) root mean square speed of gas.
(ii) change in the internal energy of the gas if the temperature increases to 50°C.

[6 marks]

(b) A cylinder fitted with a smooth piston contains 1.2 moles of ideal gas. Initially, the gas has temperature of 30 ºC at pressure of 38 kPa. The gas expands isothermally until its quadrupled in volume and then compressed isovolumetrically to a pressure of 38 kPa.
(i) Calculate the work done during the isothermal process.
(ii) Calculate the heat involved during the isothermal process.
(iii) Determine the work done on gas during isochoric process.
(iv) What process has to be done in order to return the gas to its initial state?

[5 marks]

END OF QUESTION PAPER

TOTAL MARKS OF EXAM PAPER: 80
CONTRIBUTION TO ASSESSMENT IN SP015: 40 %