SIR ARTHUR LEWIS COMMUNITY COLLEGE

ACADEMIC YEAR (2024/2025) – SEMESTER ONE

END OF SEMESTER EXAMINATION

COURSE CODE : **MAT237**

COURSE TITLE : **Particle Mechanics**

LECTURER(S) : **Allison Drysdale-Felix**

DATE : **16th December 2024**

TIME : **9 a.m. – 11 a.m.**

DURATION : **2 hours**

STUDENT ID # : _____

GENERAL INFORMATION AND INSTRUCTIONS

- Students must sign **IN** and **OUT** on the examination class list.
- Write your ID number on the question paper.
- There are five (5) questions on five (5) pages.
- Answer ALL questions in the space provided using **BLUE** or **BLACK** ink

Question	Student's mark	Max score
1		7
2		8
3		10
4		14
5		19
Total		58

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Formulae

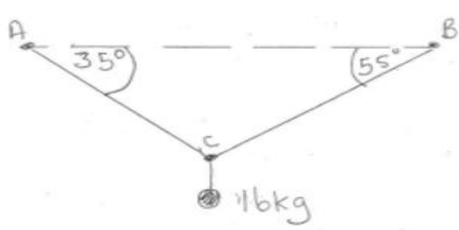
$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

1. Two forces of magnitudes 9 N and 12 N act on a body. The angle between the forces is 50 ° and the resultant R acts at an angle of θ to the 12 N force. Calculate R and θ. [6]

2. A load of mass 16 kg is supported in equilibrium by two ropes inclined at 35° and 55° to the horizontal as shown in the diagram above.



   a. Draw a clearly labelled *triangle of forces* for the above system. [2]

b. Hence find the tension in **each** rope. [4]

3. A racing car emerging from a bend reaches a straight stretch of road. The start of the road is at the point *O* and there are two marker points, *A* and *B*, further down the road. The distance *OA* = 64 m and the distance OB = 250 m. The car passes *O* at time 0 seconds, moving with constant acceleration, passes *A* and *B* at times 2s and 5s respectively. Find:

   a. The acceleration and the initial speed of the car [6]

b. The speed of the car at B. [2]

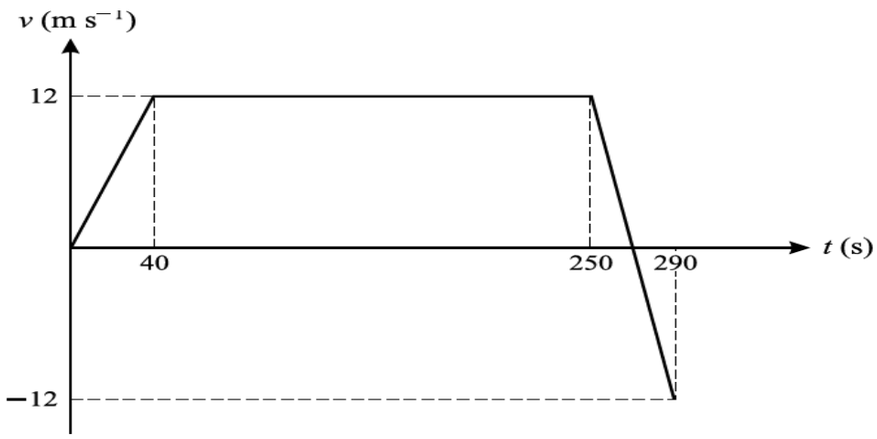
4. A carriage of mass 1200 kg rests on a track which is inclined at 30° to the horizontal. A force ***P*** inclined to the track on the same place as the carriage, causes the carriage to move up the track with a constant speed. The coefficient of friction between the carriage and the track is 0.2.

   a. Draw all the forces acting on the carriage. [4]

   b. Find the value of the normal reaction and the maximum frictional force. [4]

   c. Determine the magnitude of ***P.*** [4]

5.



A particle starts from the point A and travels in a straight line. The diagram shows the (t, v) graph, consisting of three straight line segments, for the motion of the particle during the interval $0 \leq t \leq 290$.

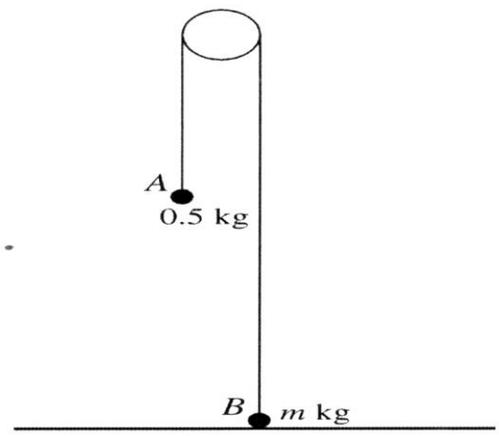
(i) Calculate the acceleration of the particle during the first 40 seconds. [2]

(ii) Find the displacement of the particle after 250 seconds. [2]

(iii) Given that the particle takes 270 seconds to reach a velocity of zero, find the displacement of the particle when $t = 290$ [2]

(iv) Find the total distance travelled by the particle during the interval $0 \leq t \leq 290$. [2]

6. Particles A and B, of masses 0.5 kg and m kg respectively, are attached to the ends of a light inextensible string which passes over a smooth fixed pulley. Particle B is held at rest on the horizontal floor and particle A hangs in equilibrium (see diagram). B is released and each particle starts to move vertically. A hits the floor 3 seconds after B is released. The speed of each particle when A hits the floor is $6\,ms^{-1}$.



For the motion while A is moving downwards, find:

(i) the acceleration of A [2]

(ii) the tension in the string [3]

(iii) Find the value of m. [3]

EXTRA SPACE FOR OTHER WORKING. NUMBER QUESTIONS ACCORDINGLY.

END OF EXAMINATION