Mid-Semester Test

Time allowed : 1 hour

Instructions

Answer all **4** questions. Each question carries **25 marks**. Take g = 9.80 m/s^2

This question paper consists of **2** pages. You can use the A4 handwritten formula sheet compiled by you.

You are reminded that cheating during test is a serious offence.

All working in support of your answer must be shown. Answers must be to appropriate significant figures.

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1. a) State the following:

   i) SI unit of force in terms of base units.
   ii) dimension of force.

   b) The turning effect of a force, M, is defined by $M = Fd$, where is force and d is perpendicular distance between the direction of F and the pivot. Find the dimension of M and state its SI unit.

   c) The work done by a constant force, W, is defined by $W = Fs$, where F is force and s is displacement in the direction of F. Show that the dimensions of W is the same as that of M.

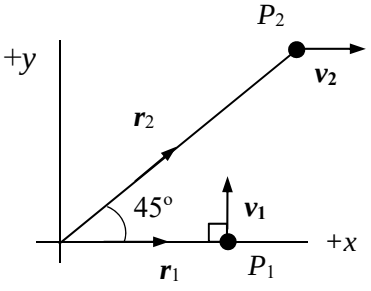
   d) Can the SI unit of M be written as joule (J)? Give reason for your answer.

   e) Explain why the equation $v^2 = v_{0x}^2 + a(x - x_0)$ is dimensionally correct but physically incorrect. The variables in the equation have their usual meaning.

2. A particle moves with a constant speed 2.0 m/s from P_1 to P_2 along a path (which is not shown in the diagram below). In the diagram, r_1 is 1.0 m and r_2 is 2.0 m. The journey took 2.0 s.

   a) Sketch one possible path traversed by the particle, taking note that $\boldsymbol{v}_1$ and $\boldsymbol{v}_2$ are instantaneous velocities at P_1 and P_2 respectively and are perpendicular to each other.

   b) Express the following in terms of **i** and **j**:
      i) $\boldsymbol{r}_1$, $\boldsymbol{r}_2$ and $\Delta\boldsymbol{r}$.
      ii) average velocity, $\boldsymbol{v}_{av}$, for the journey.
      iii) $\boldsymbol{v}_1$ and $\boldsymbol{v}_2$.
      iv) average acceleration, $\boldsymbol{a}_{av}$, for the journey.

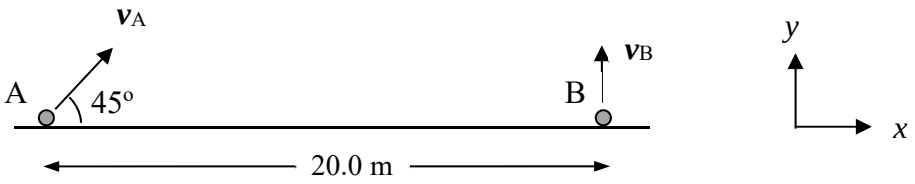
   

   c) Using the dot product, find the angle between $\boldsymbol{v}_{av}$ and $\boldsymbol{v}_1$.

3. a) Define "projectile motion".

b) Object A is launched with an initial speed v_A = 20.0 m/s at 45° with respect to the ground. Object B is launched with an initial speed v_B = 15.0 m/s vertically. The launch point of B is 20.0 m from A as shown in the diagram.

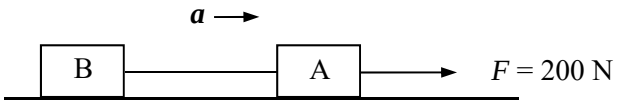
i) How high is B at t = 1.0 s?
ii) Write the vertical and horizontal components of initial velocities, $\boldsymbol{v}_A$ and $\boldsymbol{v}_B$, respectively, in terms of unit vectors **i** and **j**.
iii) How long does it take for A to travel 20.0 m horizontally.
iv) Show that A and B will not collide.



4. a) Define friction.

b) The diagram below shows two objects A and B resting on a rough surface and connected by a 2.0 m string. Object A is towed by a 200 N horizontal force to the right. The mass of A is 20 kg while that of B is 10 kg. The coefficient of kinetic friction is 0.5.

i) Draw the free body diagrams of A and B.
ii) Determine the tension in the string and acceleration of the two objects.
iii) Determine the velocity of A and B when t = 5.0 s.



c) If at t = 5.0 s, F is removed, describe the motion of A and B and determine if A and B will collide.

**********End**********