**Mid-Semester test**

Name : _____ Adm No : _____

Class : _____ Class S/N : _____

Date : _____ 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 help 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) i) What is a derived physical quantity?
   ii) List any three derived physical quantities and state their derived units. You may use the special names of derived units.

   b) State the dimension and SI unit of each of the following:

   i) difference in lengths, i.e. $L_2 - L_1$.
   ii) weight, $W$.
   iii) efficiency, e.

   c) The maximum elastic potential energy stored in the spring of an oscillating spring-mass system is given by $U_{max} = \frac{1}{2}kA^2$, where $k$ is the spring constant in N/m and $A$ is the amplitude in m. Determine the dimension of $U_{max}$.

   d) The equation for the period of a simple pendulum is $T = 2\pi\sqrt{\frac{l}{g}}$.

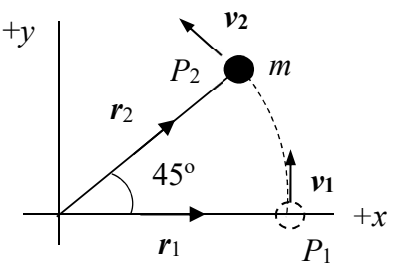
   Explain why the equation remains homogeneous even if $2\pi$ is missing.

2. A 1.0 kg mass $m$ moves at constant speed of 2.0 m/s from $P_1$ to $P_2$ along the circumference of a circle of radius 1.0 m on the $x$-$y$ plane as shown.

   a) Calculate the time taken from $P_1$ to $P_2$. [Hint: arc length = radius × angle in radians]

   b) Express the following vectors in terms of **i** and **j**.

   i) the vectors $\boldsymbol{r}_1$, $\boldsymbol{r}_2$ and $\Delta\boldsymbol{r}$.
   ii) the velocity vectors $\boldsymbol{v}_1$ and $\boldsymbol{v}_2$.
   iii) the average velocity $\boldsymbol{v}_{av}$.
   iv) the change in velocity $\Delta\boldsymbol{v}$.

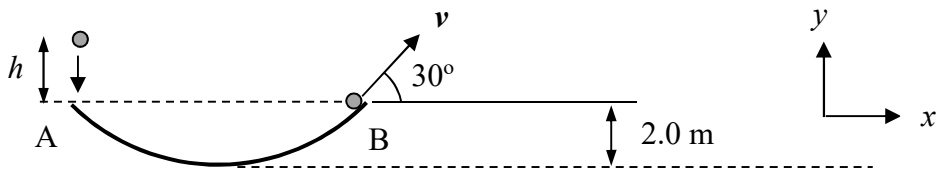


c) Did the mass have an acceleration during its journey from $P_1$ to $P_2$? Give reason for your answer.

3. a) The diagram shows a ball dropping onto point A of a smooth spherical dish and projected out at point B with speed 10.0 m/s at an angle of 30° with respect to the horizontal.

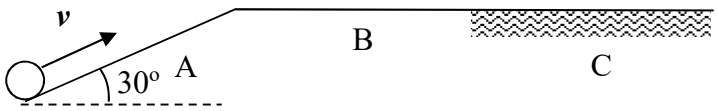
i) If the dish is not smooth, will it have any effect on the speed and exit angle of the ball at point B? Explain your answer. Assume the ball is projected out at point B.
ii) Write the vertical and horizontal components of $\boldsymbol{v}$ in terms of unit vectors **i** and **j**.
iii) How long will it take the ball to travel a horizontal distance of 2.0 m after exiting the dish at point B?
iv) What is the horizontal range of the ball at the level of point B?

b) How long (after exiting point B) will it take the ball to strike the surface 2.0 m below point B?




4. a) State Newton's First Law of motion.

b) The diagram below shows three segments of a surface. All segments are 2.0 m long. Segment A is smooth and inclined at 30°. Segments B and C are horizontal but B is smooth while C has coefficient of kinetic friction 0.25.




An object of mass 1.0 kg at the bottom of A is given an initial velocity directed along the inclined surface such that it can just reach the end of C.

i) Describe the motion of the object in the three segments.
ii) What is the initial velocity of the object?

c) What is the initial velocity of the object if it were to just stop at the top of A?

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