LEAVING CERTIFICATE EXAMINATION, 1966

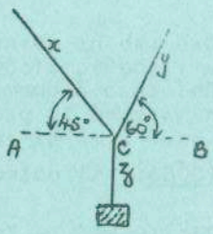
APPLIED MATHEMATICS - PASS

WEDNESDAY, 22nd JUNE - Afternoon, 2 to 4.30

Not more than *six* questions may be answered.
All questions are of equal value.
Mathematical Tables may be obtained from the Superintendent.

1. What is a vector quantity? Give examples.
Illustrate by diagram a vector $\vec{a}$, a vector $\vec{b}$ and the vector $(\vec{a} + \vec{b})$.
Show how to resolve a vector quantity $\vec{c}$ into (i) two perpendicular components (ii) two non-perpendicular components.
Two forces $\vec{P}$ and $\vec{Q}$ act at a point. The components of $\vec{P}$ in the direction of the x-axis and y-axis are 3 lbs. weight and 1 lb. weight respectively, and those of $\vec{Q}$ are 1 lb. weight and 2 lbs. weight respectively. Find the magnitude and the direction of the resultant of $\vec{P}$ and $\vec{Q}$.

2. What are the conditions under which three forces acting at a point would be in equilibrium?
Three light strings x, y, z, knotted at C support an object of mass 10 lbs. as in diagram. Calculate the tensions in x, y and z if the system is in equilibrium.
(NOTE: AB horizontal).



3. What is meant by the "centre of gravity" of a rigid body?
Where is the centre of gravity of (i) a lamina in the shape of a parallelogram, (ii) a triangular lamina?
On the same base AB and on opposite sides of it isosceles triangles CAB, DAB are drawn with altitude 12 inches and 6 inches respectively. Find the distance from AB of the centre of gravity of a lamina of the size and shape of CADB.

4. Explain "velocity" and "acceleration". Show that for a body moving in a straight line with constant acceleration f initial velocity $\vec{u}$ and velocity $\vec{v}$ at time t, that $v = u + ft$ and $s = ut + \frac{1}{2}ft^2$.
A body falling from rest under gravity takes 1·5 seconds to travel the last 90 leet before hitting the ground. From what height above the ground did it fall?

5. (i) A force of 2 lbs. wt. gives an acceleration of 3 ft. per second per second to a body of mass 10 lbs. on a rough horizontal plane. Calculate the coefficient of friction.
(ii) A particle starting from rest slides 8 ft. under gravity down a smooth slope on to a rough horizontal plane where it is brought to rest by friction in 16 ft. If the slope makes an angle of 30° with the horizontal calculate the coefficient of friction.

6. What is meant by "pressure at a point" in a liquid and "total thrust" on a plane surface immersed in a liquid?
A naval dock has a horizontal floor of area 60,000 sq. yds. Find the increase in total thrust on the dock floor caused by a rise of 20 ft. in the level of the water.
(Weight of 35 cu. ft. of water = 1 ton).

7. (i) A particle moves in a circle with uniform speed.
Show that the particle has an acceleration which is directed towards the centre of the circle.
(ii) A particle moving in a circle of radius $\frac{V}{\pi}$ ft. makes 30 revolutions per minute.
Show that it has a tangential velocity of V ft. per second.
A small satellite is orbiting the earth at a height of 200 miles directly above the equator, and completes a circle every 90 minutes. Assuming the earth is a sphere with radius 4,000 miles find the tangential velocity of the satellite.
(Neglect the motion of the earth).

8. Define the moment of a force about a given point. Forces of 3 lbs., wt. 7 lbs. wt., and 5 lbs. wt. act along the sides AB, BC, and CA respectively, of an equilateral triangle ABC.
Find the magnitude and the direction of the resultant and the moment of the resultant about C.

9. Define "work" and "horsepower".
The weight of a train is 250 tons. If the resistances to its motion on a level line amount to 15 lbs. wt. per ton, calculate the horsepower at which the engine is working if it maintains a speed of 40 m.p.h.
(i) on a level line,
(ii) moving up a gradient of 1 in 400, assuming the resistances to its motion (other than gravity) to be the same as on a level line.