

[5251]-1001

F.E.

ENGINEERING MATHEMATICS - I

(2015 Pattern)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Solve Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7, or Q.8.
- 2) Neat diagrams must be drawn, wherever necessary.
- 3) Figures to the right indicate full marks.
- 4) Use of electronic pocket calculator is allowed.
- 5) Assume suitable data, if necessary.

Q1) a) Reduce the following matrix to its normal form and hence find the rank. [4]

$$A = \begin{bmatrix} 1 & 1 & -1 & 1 \\ 1 & -1 & 2 & -1 \\ 3 & 1 & 0 & 1 \end{bmatrix}$$

b) Show that $A = \begin{bmatrix} \cos \alpha & 0 & \sin \alpha \\ 0 & 1 & 0 \\ -\sin \alpha & 0 & \cos \alpha \end{bmatrix}$ is an orthogonal matrix. [4]

c) A square lies above real axis in argand diagram, and of its adjacent vertices are the origin and the point $5 + 6i$, find the complex numbers representing other vertices. [4]

OR

Q2) a) Verify Cayley-Hamilton theorem for

$$A = \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix} \text{ find } A^{-1} \quad [4]$$

b) If $\tan(x + iy) = i$, where x and y are real, prove that x is indeterminate and y is infinite. [4]

c) Considering the principal value, express in the form $a + ib$ the expression. $(\sqrt{i})^{\sqrt{i}}$. [4]

P.T.O.

Q3) a) Test the convergence of the series (any one) [4]

i) $\frac{1}{1+2} + \frac{2}{1+2^2} + \frac{3}{1+2^3} + \dots + \frac{n}{1+2^n} + \dots$

ii) $\sum_{n=1}^{\infty} \frac{10n+4}{n^3}$

b) Expand $(1+x)^{1/x}$ in ascending powers of x , expansion being correct upto second power of x . [4]

c) Find n^{th} derivative of $y = \frac{2x+3}{(x-1)(x-2)}$ [4]

OR

Q4) a) Solve any one [4]

i) $\lim_{x \rightarrow \frac{1}{2}} \frac{\cos^2 \pi x}{e^{2x} - 2xe}$

ii) $\lim_{x \rightarrow 1} (1-x^2)^{\frac{1}{\log(1-x)}}$

b) Using Taylor's theorem, express $5 + 4(x-1)^2 - 3(x-1)^3 + (x-1)^4$ in ascending powers of x . [4]

c) If $y = e^{a \sin^{-1} x}$, prove that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - (n^2+a^2)y_n = 0$ [4]

Q5) Solve any two

a) If $z^3 - zx - y = 4$ find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ [6]

b) If $u = \frac{xyz}{2x+y+z} + \log\left(\frac{x^2+y^2+z^2}{xy+yz}\right)$ Find $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z}$ [7]

c) If $x = u + v + w$, $y = uv + vw + uw$, $z = uvw$ and ϕ is a function of x, y, z then prove that $u\frac{\partial \phi}{\partial u} + v\frac{\partial \phi}{\partial v} + w\frac{\partial \phi}{\partial w} = x\frac{\partial \phi}{\partial x} + 2y\frac{\partial \phi}{\partial y} + 3z\frac{\partial \phi}{\partial z}$ [6]

OR

Q6) Solve any two

a) Find $\frac{dz}{dx}$ if $z = x^2y$ and $x^2 + xy + y^2 = 1$ [6]

b) If $u = \operatorname{cosec}^{-1} \sqrt{\frac{x^{1/2} + y^{1/2}}{x^{1/3} + y^{1/3}}}$

Prove that $x^2 u_{xx} + 2xy u_{xy} + y^2 u_{yy} = \frac{\tan u}{144} [\tan^2 u + 13]$. [7]

c) If $x = \frac{r}{2} [e^\theta + e^{-\theta}]$ and $y = \frac{r}{2} [e^\theta - e^{-\theta}]$ prove that $\left(\frac{\partial x}{\partial r}\right)_\theta = \left(\frac{\partial r}{\partial x}\right)_y$ [6]

Q7) a) If $x = v^2 + w^2, y = w^2 + u^2, z = u^2 + v^2$ find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$ [4]

b) Examine for functional dependence [4]

$$u = \sin^{-1}x - \sin^{-1}y, v = x\sqrt{1-y^2} - y\sqrt{1-x^2}$$

c) Find the extreme values of the function $f(x, y) = x^2 + y^2 + 6x + 12$. [5]

OR

Q8) a) If $ux + vy = 0, \frac{u}{x} + \frac{v}{y} = 1$ then using Jacobian find $\left(\frac{\partial u}{\partial x}\right)_y$. [4]

b) The focal length of a mirror is found from the formula : $\frac{1}{v} - \frac{1}{u} = \frac{2}{f}$.

Find the percentage error in f if u and v are both in error by $p\%$ each. [4]

c) Find the point on the surface $z^2 = xy + 1$ nearest to the origin, by using lagranges method. [5]



Total No. of Questions : 8]

SEAT No. :

P4418

[Total No. of Pages : 3

[5251]-1002

F.E. First Year (Engineering) (II Semester)

ENGINEERING PHYSICS

(2015 Pattern)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Neat diagram must be drawn wherever necessary.
- 2) Figure to the right indicate full marks.
- 3) Use of logarithmic table, slide rule, mollier charts, Electronics Calculator, and steam table is allowed.
- 4) Assume suitable data, if necessary.

- Q1) a) Explain the theory of formation of Newton's Rings? Hence, explain how the refractive index of liquid can be determined. [6]
- b) How many lines per cm are there on the surface of a plane transmission grating which gives 1st order of light of wavelength 6000Å at an angle of diffraction 30°. [3]
- c) List any three applications of ultrasonics. Explain any one of them in brief. [3]

OR

- Q2) a) What is reverberation? Give Sabine's formula for reberation time. What are the factors affecting reberberation time? Explain how it can be optimized by controlling these factors. [6]
- b) Calculate the length of an iron rod which can be used to produce ultrasonic waves of frequency 20 kHz Given, Young's modulus of iron $1.16 \times 10^{11} \text{ N/m}^2$. Density of iron = $7.23 \times 10^3 \text{ kg/m}^3$ [3]
- c) The resultant amplitude of a wave when monochromatic light is diffracted from a single slit $E_{\theta} = E_m (\sin \alpha)/\alpha$, specify the terms involved and derive condition of minima. [3]

P.T.O.

Q3) a) What are retardation plates? Give their types? Derive the expression for thickness for any one of them. [6]

b) Define the following: [3]

i) Stimulated emission

ii) Metastable State

iii) Population Inversion.

c) Calculate the band gap energy (in eV) in silicon, given that it is transparent to radiation of wavelength greater than 11000 Å.

$h : 6.63 \times 10^{-34}$ J-sec, $c = 3 \times 10^8$ m/s [3]

OR

Q4) a) Explain the working of P-N junction diode in [6]

i) Zero bias

ii) Forward Bias

iii) Reverse Bias

On the basis of energy level diagram.

b) The Hall coefficient of a specimen of doped silicon is found to be 3.66×10^{-3} m³/C. The resistivity of the specimen is 8.93 Ω-m. Determine the mobility of charge carriers. [3]

c) What is an optical resonator? What is its role in lasing? [3]

Q5) a) State and explain Heisenberg's Uncertainty Principle. Show that it is also applicable for energy and time. [6]

b) State and explain de-Broglie hypothesis of matter waves. Explain in brief any two properties of matter waves. [4]

c) Lowest energy of an electron trapped in an infinite potential well is 38 eV. Calculate the width of the well. ($e = 1.6 \times 10^{-19}$ C, $h = 6.63 \times 10^{-34}$ J-sec, $m_e = 9.1 \times 10^{-31}$ kg) [3]

OR

- Q6)** a) Starting from de-Broglie hypothesis, derive Schrödinger's time independent wave equation. [6]
- b) Explain tunneling effect. How is this principle used in a tunnel diode. [4]
- c) Calculate the de-Broglie wavelength for a 10 KeV proton. [3]
($m_p = 1.67 \times 10^{-27}$ kg, $h = 6.63 \times 10^{-34}$ J.s, $e = 1.6 \times 10^{-19}$ C).
- Q7)** a) Explain the following terms of superconductivity with the help of necessary figure. Give formula and graph wherever necessary. [6]
- i) Meissner effect
- ii) Critical Magnetic Field
- b) Give brief explanation of the optical properties of nanoparticles with the help of quantum confinement effect and G Mie equation. [4]
- c) Explain the formation of Cooper pairs in superconductors with the help of electron phonon interaction. [3]

OR

- Q8)** a) Explain chemical method for synthesis of nanoparticles by colloidal route with the help of LaMer diagram. Give one example of synthesis of metal nanoparticles. [6]
- b) Give the statement of Meissner effect and show that super conductors are perfectly diamagnetic. [4]
- c) Explain the Mechanical properties of Nanoparticles [3]



Total No. of Questions : 8]

SEAT No. :

P4419

[Total No. of Pages : 3

[5251]-1003

F.E. (Engineering) (Semester I & II)

ENGINEERING CHEMISTRY

(2015 Pattern)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Neat diagram must be drawn wherever necessary.
- 2) Figure to the right indicates full marks.
- 3) Assume suitable data wherever necessary.
- 4) Use of electronic pocket calculator is allowed (non-programmable).

- Q1)** a) What are the different types of hardness in water? Give procedure, reactions and formulae for determination of hardness using EDTA method. [6]
- b) Explain conductometric titration of strong acid with weak base using titration curve and reaction involved. [3]
- c) What is Kohlraush's law? State its applications. [3]

OR

- Q2)** a) Explain the pH metric titration of mixture of H_3PO_4 and HCl against standard. NaOH , giving chemical reactions, procedure, titration curve and calculations. [6]
- b) Define desalination of water. Explain reverse osmosis process for desalination of water [3]
- c) Zeolite bed was exhausted by softening 4000 liters of water, which requires 10 liters of 15% NaCl solution for regeneration. Calculate the hardness of water sample. [3]
- Q3)** a) What is glass transition temperature? Discuss any four factors affecting it? State its importance. [6]
- b) What is power alcohol? State its advantages and limitations. [3]
- c) The following observations were noted in the Boy's gas calorimeter experiment - Volume of gas burnt at STP = 0.1m^3 , Mass of cooling water used = 25 kg, Rise in temperature of circulating water = 9.1°C mass of steam condensed = 0.04 kg. Find the GCV and NCV of the fuel. [3]

P.T.O.

OR

- Q4)** a) Draw neat labelled diagram and give construction, working of Bomb calorimeter to determine GCV of a fuel. State the formula of GCV with the corrections. [6]
- b) Explain Solution polymerization technique with figure. Give its disadvantages. [3]
- c) Distinguish between: [3]

Thermosetting and Thermosoftening Resins

- Q5)** a) What are carbon nanotubes? Explain types with respect to their structure. Give its applications. [6]
- b) Write any four properties of hydrogen which make it difficult for storage and transportation. [4]
- c) Explain the isotopes of hydrogen ? Give any two applications. [3]

OR

- Q6)** a) Explain production of hydrogen by steam reforming of methane and coke with reaction conditions and removal of CO_2 . [6]
- b) What are molecular hydrides? Give preparation reaction, properties and applications of Germane. [4]
- c) What are saline hydrides? Give preparation reaction of sodium hydride with any two applications. [3]

- Q7)** a) State principle of electroplating. Discuss method with neat labelled diagram, reactions and applications. [6]
- b) What is electrochemical or wet corrosion? Explain the mechanism of oxygen absorption. [4]
- c) What is anodic and cathodic coating ? Which is more protective and why? [3]

OR

- Q8)** a) Explain the mechanism of dry corrosion. State the nature of oxide film formed in case of Na, Cu and Mo, along with chemical reactions. [6]
- b) What are surface conversion coatings. Discuss any two methods in detail for applying these coatings. [4]
- c) Discuss any three factors affecting rate of corrosion with respect to nature of metal. [3]



Total No. of Questions : 8]

SEAT No. :

P4422

[Total No. of Pages : 3

[5251]-1006

F.E. (Engineering) (Semester - II)

BASIC CIVIL AND ENVIRONMENTAL ENGINEERING

(2015 Pattern)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Neat diagram must be drawn wherever necessary.
- 2) Figure to the right indicates full marks.
- 3) Assume suitable data wherever necessary.
- 4) Use of electronic pocket calculator is allowed (non-programmable).

- Q1)** a) Explain the general role of civil engineer in any construction work. Support your answer with minimum 04 points. [4]
- b) Define 'Uniform Settlement' and 'Differential Settlement' of footings/ foundations. Show these settlements clearly in neat sketches. [4]
- c) State the general role of civil engineer in construction of National Highway. Support your answer with minimum 04 points. [4]

OR

- Q2)** a) State the general role of civil engineer in construction of Bunglow. Support your answer with minimum 04 points. [4]
- b) Draw a proportionate sketch (Sectional View) of a framed superstructure. Show (Label) following parts (components) in it: Plinth, Slab, Parapet, Flooring. [4]
- c) Justify the statement: Use of clay bricks should be avoided in constructions. (Give four points of justification). Also state two substitute materials for the clay bricks. [4]

P.T.O.

- Q3)** a) Define the fundamental axes of Dumpy Level with the help of neat sketch.[6]
b) Enlist any 06 steps to achieve environmental sustainability in day to day activities. [3]
c) Define Contour. Draw typical contours for the following features of RLs:[3]
i) Uniformly Sloping Ground
ii) Steeply Sloping Ground

OR

- Q4)** a) Explain in brief following methods of treatment of solid waste: [3]
i) Mechanical volume reduction.
ii) Thermal volume reduction.
iii) Manual component separation.
b) Explain–G.T.S., Permanent, and temporary benchmarks. [3]
c) Explain any three characteristics of contours with neat sketch. Also give any three uses of contour maps. [6]

- Q5)** a) Comment on statement “privacy and circulation are complementary to each other” with neat sketch. [7]
b) What do you understand by Eco-friendly materials in construction? Explain in detail. [6]

OR

- Q6)** a) Enlist the various principles of planning and explain in brief Aspect and Prospect with sketches. [6]
b) Explain in brief the following terms: [7]
i) Covered area
ii) Plinth area
iii) FSI
iv) Built up area
v) Floor area
vi) Carpet area
vii) Set back distance

- Q7)** a) Enlist any 02 global effects of air pollution. Explain with suitable sketch/equations, any 01 in detail. [6]
- b) State three ill effects of ozone layer depletion [3]
- c) Give WHO & NWC definitions of water pollution. Enlist any 02 sources of water pollution. [4]

OR

- Q8)** a) Compare solar energy and wind energy. Minimum 03 points of comparison are expected. [3]
- b) Define air pollution as per IS. Explain in brief any 04 sources of air pollution. [6]
- c) Explain in brief: what is land pollution. Explain in brief any 03 sources of land pollution. [4]



Total No. of Questions : 8]

SEAT No. :

P4423

[Total No. of Pages : 3

[5251]-1007

F.E. (Engineering) (II Semester)

ENGINEERING GRAPHICS - I

(2015 Pattern)

Time : 2 Hours]

[Max. Marks : 50

Instructions to the candidates :

- 1) Retain all construction lines.
- 2) Figure to the right indicates full marks.
- 3) Assume suitable data wherever necessary.
- 4) Use of electronic pocket calculator is allowed (non-programmable).

Q1) The point A of line AB is in H.P and 15 mm in front of V.P. Its front view and top view makes 51° and 48° with H.P. and V.P. respectively. Draw the projections of line AB if projector distance between end points of the line is 41 mm. Find its true length, true inclinations and locate its traces. [12]

OR

Q2) A hexagonal plate of 35 mm side is resting on one of its corner on the H.P. Draw projections of the plate when the plate surface makes an angle of 35° to H.P. and the diagonal passing through resting corner makes 22° inclination to V.P. [12]

Q3) A hexagonal prism of base 35 mm and height 85 mm is resting on one of its base corners. The vertical edge passing through the resting corner makes 45° inclination to H.P. Draw projections of the prism when the axis makes 22° inclination to V.P. [13]

OR

- Q4)** a) Draw a Parabola of 100 mm height and 150 mm base. [7]
- b) Draw the development of lateral surface of pentagonal prism of base side 30 mm and axis height 70 mm. [6]

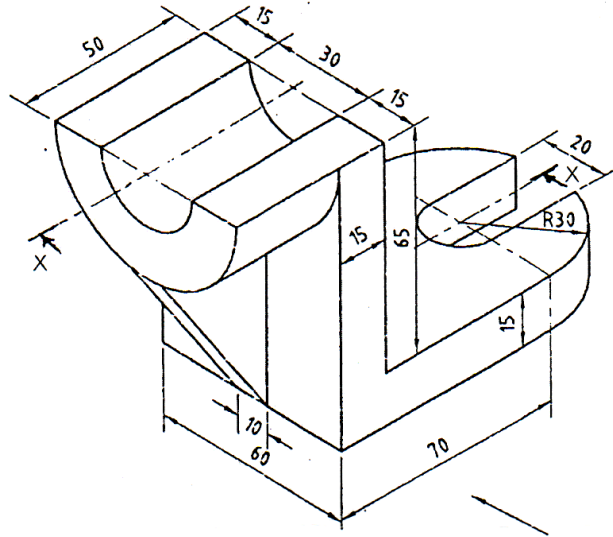
P.T.O.

Q5) For the pictorial view shown in the Figure draw,

[13]

- Sectional front view along the section XX
- Top view
- Left hand side view

Place all necessary dimensions. Use first angle method of projections.



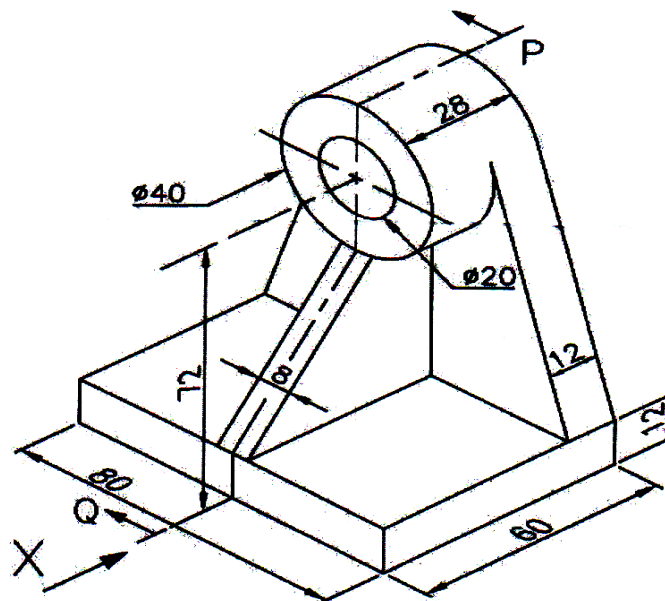
OR

Q6) For the pictorial view shown in the Figure draw,

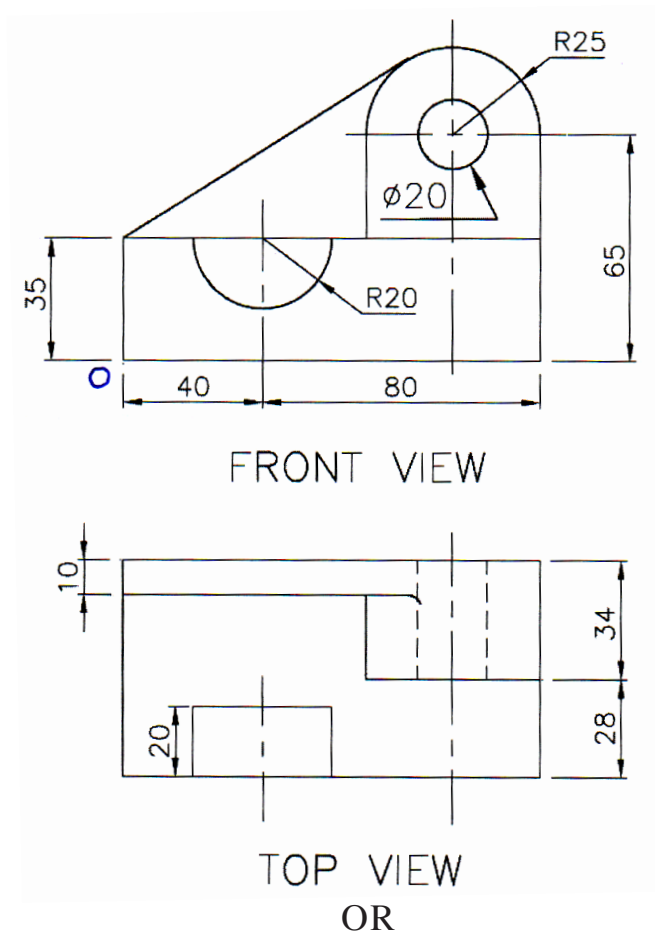
[13]

- Front view in the direction X
- Top view
- Sectional Right hand side view along PQ

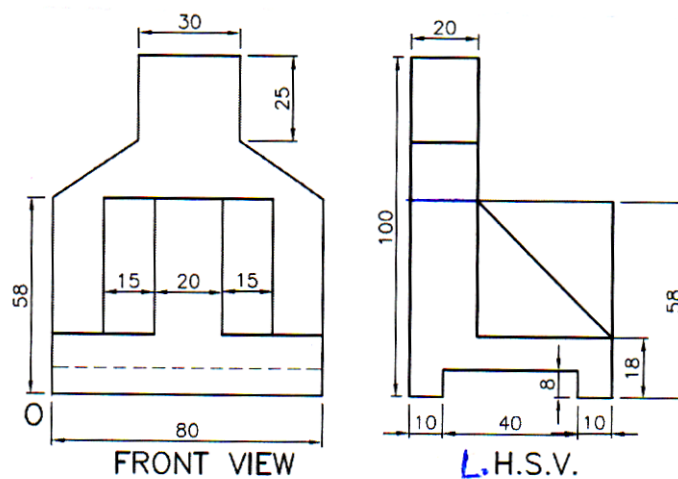
Place all necessary dimensions. Use first angle method of projections.



Q7) Figure shows front view and top view of an object. Draw Isometric view and show overall dimensions. **[12]**



Q8) Figure shows front view and right hand side view of an object. Draw Isometric view and show overall dimensions. **[12]**

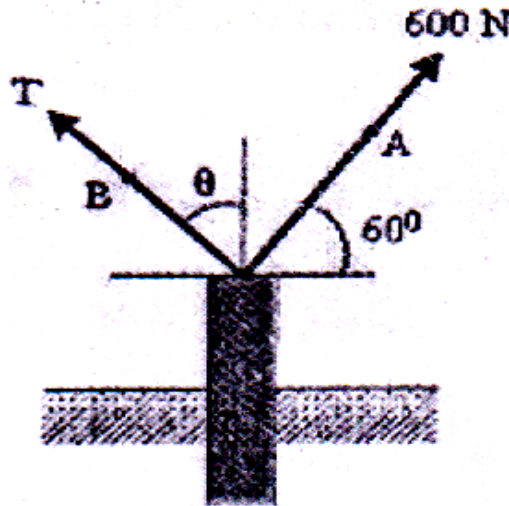


[5251]-1009
First Year Engineering (Semester - II)
ENGINEERING MECHANICS
(2015 Pattern)

*Time : 2 Hours]**[Max. Marks : 50**Instructions to the candidates:*

- 1) *Attempt Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6 and Q.7 or Q.8.*
- 2) *Neat diagrams must be drawn wherever necessary.*
- 3) *Figures to the right indicate full marks.*
- 4) *Assume suitable data, if necessary and clearly state.*
- 5) *Use of electronic pocket calculator is allowed.*

- Q1) a)** The post is to be pulled out of the ground using two ropes A and B as shown in Fig. Rope A is subjected to a force of 600 N and is directed at 60° from the horizontal. If the resultant force acting on the post is to be 1200 N vertically upward, determine the force T in rope B and the corresponding angle θ . [6]

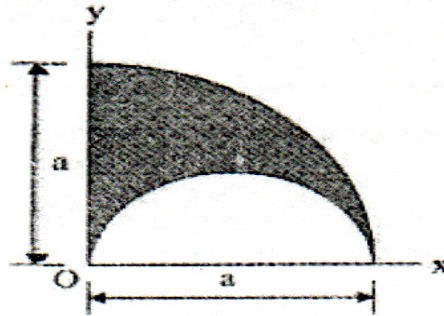


- b)** Two ships leave a port at the same time. The first, ship A steams 30° North-East at 16 kmph & the second ship B steams 40° South of East at 12 kmph. Determine the relative velocity of ship B with respect to ship A. [6]

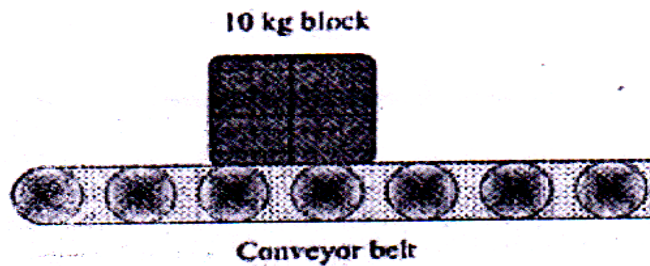
P.T.O.

OR

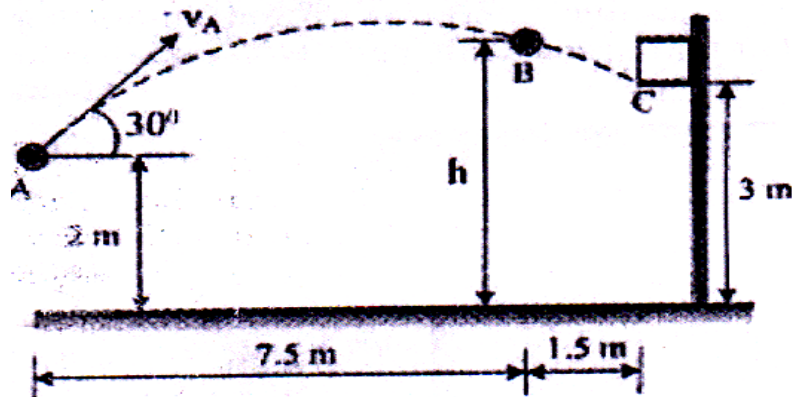
- Q2) a)** Locate the centroid C of the shaded area obtained by cutting a semicircle of diameter a from the quadrant of a circle of radius a as shown in Fig. with respect to origin O . [6]



- b)** The conveyor belt is designed to transport packages of various weights shown in Fig. Each 10kg package has a coefficient of kinetic friction $\mu_k = 0.15$. If the speed of the conveyor is 5m/s, and then it suddenly stop, determine the distance the package will slide on the belt before coming to rest. [6]



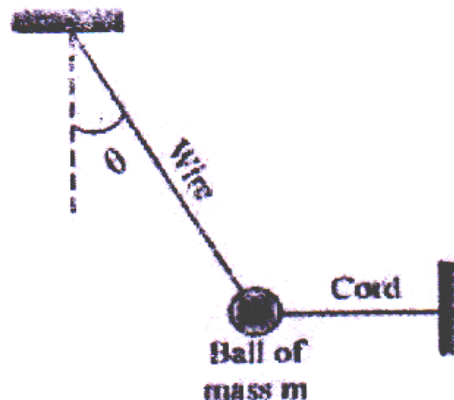
- Q3) a)** Measurements of a shot recorded on a videotape during a basketball game are shown in Fig. The ball passed through the hoop even though it barely cleared the hands of the player B who attempted to block it. Neglecting the size of the ball, determine the magnitude v_A of its initial velocity and height h of the ball when it passes player B. [6]



- b) A woman having a mass of 70 kg stands in an elevator which has a downward acceleration of 4 m/s^2 starting from rest. Determine work done by her weight and the work of the normal force which the floor exerts on her when the elevator descends 6 m. [6]

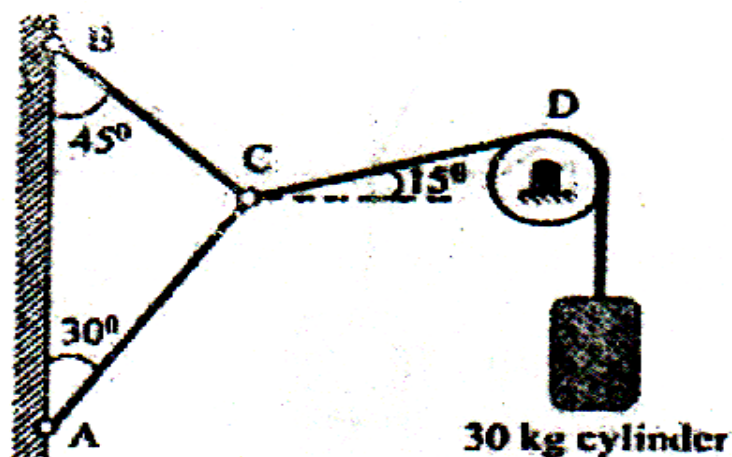
OR

- Q4) a)** The small ball of mass m and its supporting wire becomes a simple pendulum when the horizontal cord is served. Determine the ratio of the tension T in the supporting wire immediately after the cord is cut to that in the wire before the wire is cut. [6]

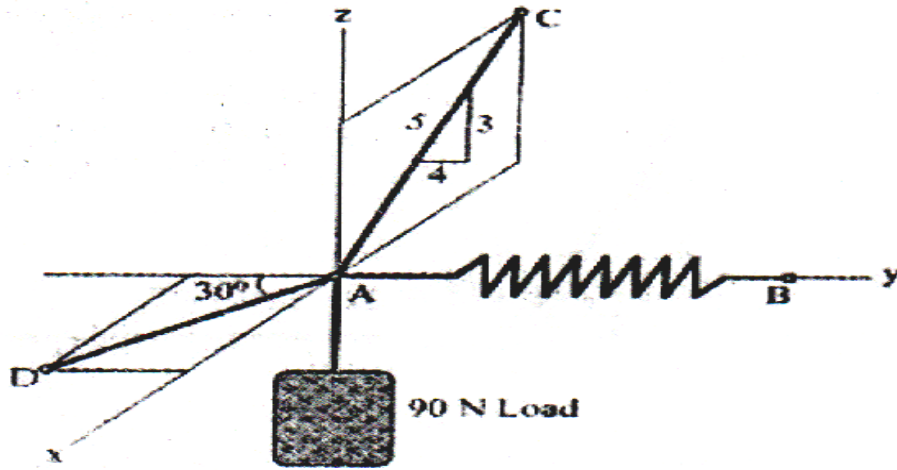


- b) A ball has a mass of 30 kg and is thrown upward with a speed of 15 m/s. Determine the time to attain maximum height using impulse momentum principle. Also find the maximum height. [6]

- Q5) a)** Three cables are joined at the junction C as shown in Fig. Determine the tension in cable AC and BC caused by the weight of the 30 kg cylinder. [6]

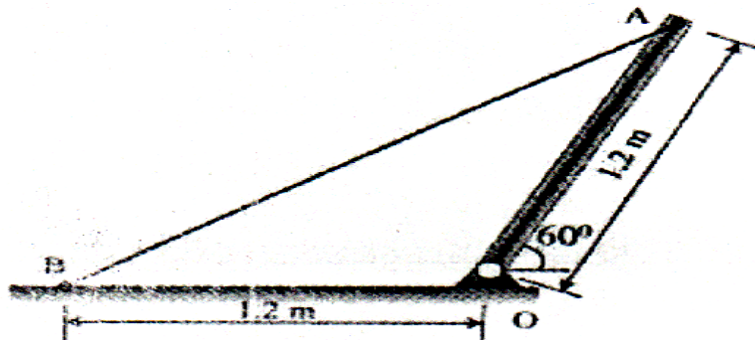


- b) A 90 N load is suspended from the hook shown in Fig. The load is supported by two cables and a spring having stiffness $k = 500 \text{ N/m}$. Determine the force in the cables and the stretch of the spring for equilibrium. Cable AD lies in the x - y plane and Cable AC lies in the x - z plane. [7]

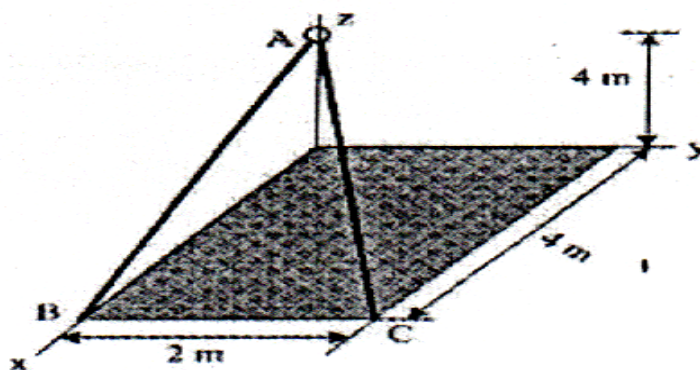


OR

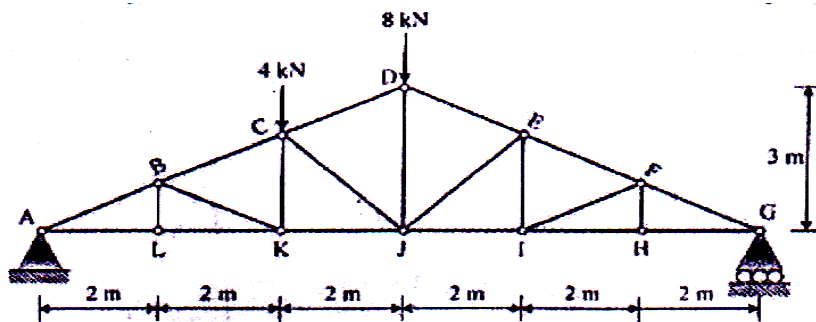
- Q6) a) The uniform 18 kg bar OA is held in position shown in Fig. by the smooth pin at O and the cable AB. Determine the tension T in the cable and the magnitude and direction of the external pin reaction at O. [7]



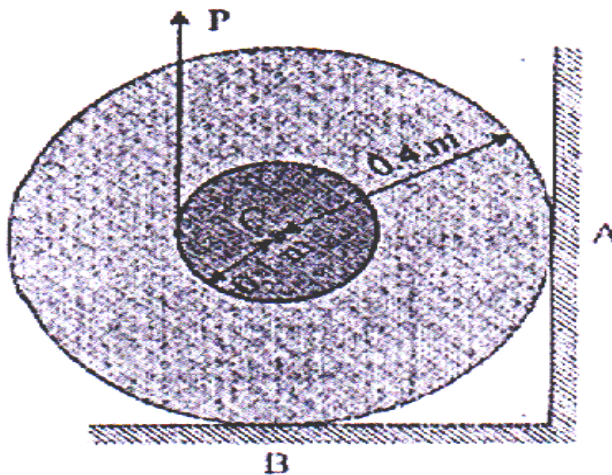
- b) The cables exert forces $F_{AB} = 100 \text{ N}$ and $F_{AC} = 120 \text{ N}$ on the ring at A as shown in Fig. Determine the magnitude of the resultant force acting at A. [6]



- Q7) a) The roof truss support the vertical loading shown in Fig. Determine the force in members BC, CK and KJ and state if these members are in tension or compression. [7]

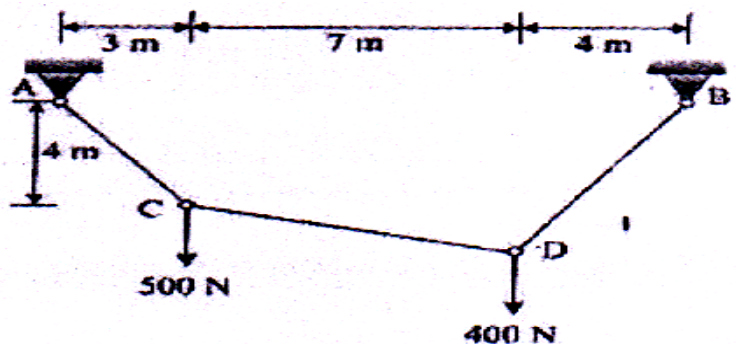


- b) The spool has a mass of 200 kg and rest against the wall and on the beam shown in Fig. If the coefficient of static friction at B is $\mu_B = 0.3$ and the wall is smooth, determine the friction force developed at B when the vertical force applied to the cable is $P = 800$ N. [6]



OR

- Q8) a) The cable segment support the loading as shown in Fig. Determine the support reaction and maximum tension in segment of cable. [7]



- b) A cable is passing over the disc of belt friction apparatus at a lap angle 180° as shown in Fig. If coefficient of static friction is 0.25 and the weight of block is 500 N, determine the range of force P to maintain equilibrium. [6]

