

SECTION – AThere are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Define - (i) Rigidity modulus, (ii) Poisson's ratio (6)
- (b) Explain the effect of temperature on the elasticity of a material. (6)
- (c) Prove that for the three types of strain the work done per unit volume
 $= \frac{1}{2} \times \text{stress} \times \text{strain}$. (18)
- (d) The modulus of rigidity and Poisson's ratio of the material of a wire are
 $1.75 \times 10^{11} \text{ dynes/cm}^2$ and 0.28, respectively. Find the value of Young's modulus and
 Bulk modulus of the material of the wire. (5)

2. (a) Write short notes on -(i) Streamline flow (ii) Turbulent flow (iii) Equation of
 continuity. (12)
- (b) State Bernoulli's theorem. Apply Bernoulli's principle to obtain the expression for the
 velocity of efflux and the range of liquid issuing out through an orifice of a tank. (18)
- (c) Water enters the point A of a horizontal pipeline with the speed 20 m/s. The radii of
 the pipe at the points A and B are 0.75 cm and 0.25 cm, respectively. Find the pressure
 difference between the two points A and B (Density of water is 1000 kg/m^3). (5)

3. (a) Find the expression of critical velocity of a viscous fluid and write the physical
 significance of Reynold's number. (10)
- (b) Deduce Stoke's law and find the expression for terminal velocity of a spherical ball
 falling under gravity thorough a viscous fluid. (20)
- (c) Calculate the surface tension of a soap solution when the pressure inside a soap
 bubble of 0.5 cm diameter is 12 mm of mercury above the atmospheric pressure. Density
 of mercury is 13.6 gm/cm^3 . (5)

4. (a) What is the reason for failure of Galilean Transformation? (7)
- (b) Derive the set of equations of Lorentz transformation and explain the terms. (20)
- (c) A car is moving with a constant velocity 36 km/h. Show that driver in the car and an
 observer on the road both find the same value for the speed of light. (8)

PHY 157(MME)

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Write down the failures of classical wave theory about photoelectric effect? (6)
- (b) Using photoelectric effect experiment how would you determine the value of Planck's constant? (10)
- (c) Show that an electron can reside on the orbit but it can't reside inside the nucleus. (13)
- (d) An electron has a wavelength of 1 nm. Calculate kinetic energy of the electron. (6)
6. (a) Define nuclear fission and chain reaction with examples. (8)
- (b) Describe the various components of a nuclear reactor with diagram. (18)
- (c) What is Binding energy? Calculate Binding energy of a deuteron, Given, mass of Proton = 1.00728 a.m.u; mass of neutron = 1.00866 a.m.u.; mass of deuteron = 2.01361 a.m.u. (9)
7. (a) State Gauss' law. Why it is important in electrostatics? How Coulomb's law follows from Gauss' law? (13)
- (b) Find the electric field intensity \vec{E} at a point (i) inside and (ii) outside of a uniformly charged solid sphere. (16)
- (c) Two plates of a capacitor carry charges + Q and – Q. Each plate has area of 600 cm². Between the plates, the field is constant with a value of 300 kV/m and the field is zero outside the plates. Find Q. (6)
8. (a) Define magnetic field vector. If a metal wire of length l carrying a current I is placed at right angles to a uniform magnetic field \vec{B} , show that the force exerted on the wire is given by $\vec{F} = i \vec{\ell} \times \vec{B}$. (10)
- (b) Using Biot-Savart law find out the magnetic field at a point due to a long infinite current carrying wire. Obtain an expression for the magnetic field inside a long ideal solenoid using Ampere's law. (17)
- (c) A Solenoid has a mean diameter of 3 cm and length 2 m. It has four layers of 1000 turns each. Calculate the flux density at its centre when a current of 2.5 amp flows through it. Also calculate the flux at the centre. (8)
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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **HUM 101** (English)

Full Marks : 210

Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – AThere are **FOUR** questions in this Section. Answer any **THREE** including Q. No. 1 as compulsory.

1. Read the following passage carefully and answer the questions given below.

'Recycling refers to the process of treating used objects or materials so that they can be used again'.

(45)

It is often very interesting to note that how the Western countries make a fuss over such recycling processes with a certain possessiveness as if they were the first to invent it and now is suffering from the dire burden to enlighten the rest of the world about it. They also view it as a trendy, conscientious, responsible thing to do! And if we probe we will learn that by recycling they mean --- recycling paper to make paper, recycling glass to make glass, cans to cans and end up with tongue twisters like --- "Can you can a can, 'as a canner can can a can?" And within all these signs, all these brandings, all these publicity stunts we always feel how much they lack innovation. As our mom's old sarees were preserved, then sent to village-homes for 'kanthas' to be stitched; men's old shirts or dresses became dusters or wipe clothe; our old school note-books became packets for 'jhal muries', piles of old newspapers were sold to buy 'silly' things; broken utensils earned us 'kotkoties' ... and it is still thought that we do not recycle. So, we should start posing questions to the West, "Aren't you simply recycling ideas those we have recycled all along?"

We are not the West of Waste; we have just become the Waste of West.'

Questions:

- What is the passage about? Can you relate to your own experiences?
- What do you think is the Western funs about? Do you smell some fallacy?
- How do you think the writer feel about the recycling done in Bangladesh and what do you feel?
- Do you find any sense of nostalgia in the passage? Elaborate.
- What do you understand by the phrases "the West of Waste" and "the Waste of West"?

2. (a) What are the differences between Tender and Quotation?

(5)

(b) As the Credit Manager of Raphael Book Corner, New Market, Dhaka, you have received a request from the Director of Student Affairs of Holy Cross College for the supply of 1200 copies of Fundamental English each session on credit basis. Inventing the

Contd P/2

HUM 101(MME)

Contd ... Q. No. 2

- necessary details, write a letter either granting the credit or refusing it. In each case, explain and give reasons behind your decision. (15)
- (c) Write phonetic transcriptions of the following words (any five) (10)
yesterday, vision, communication, weather, about, smooth.
3. (a) Why is list of References important? Describe plagiarism. (5)
(b) Write a short essay on any one of the following: (10)
(i) Virtualization of Friendship (ii) Bangladesh as a cricketing Nation (iii) Session Jam
(c) Write a dialogue between two friends about women empowerment. (15)
4. (a) Transform the following sentences as directed (any five) (10)
(i) Catch me if you can. (Compound)
(ii) Spare the rod and spoil the child, (Simple)
(iii) I found that the clock had stopped. (Simple)
(iv) He must find wives for his three sons. (Compound)
(v) With your permission I will walk away. (Complex)
(vi) Death or disgrace is in store for you. (Complex)
(b) What are the principle of letter writing? (5)
(c) Write short notes on any three of the following: (15)
(i) Front Matter of a Report.
(ii) Adjustment letters
(iii) Different parts of a paragraph
(iv) Questionnaire
(v) The three types of Credit Letters.

SECTION - B

There are **FOUR** questions in this Section. Answer Q. No. 5 and any **TWO** from the rest.

5. (a) Explain with reference to the context any two from the following: (15)
(i) Theoretically - and secretly, of course - I was all for the Burmese and all against their oppressors, the British."
(ii) "He was as much a stranger to the stars as were his innocent customers."
(iii) "So you see, sooner or later, we shall be rescued."
(b) Answer any one of the following: (15)
(i) What 'perplexing and upsetting' situation had the writer of "Shooting an Elephant" been undergoing?

HUM 101(MME)

Contd ... Q. No. 5(b)

(ii) 'Golding's characters are the shadows of different aspects of human characteristics' - Elucidated the statement with reference to the text.

(c) Answer any three of the following:

(15)

(i) What were the "endless discussion" about the shooting of the elephant?

(ii) Describe the symbolic significance of the children's lighting fire in "Fire on the Mountain."

(iii) Why did the writer no more accept Bertrand Russell as his guide?

(iv) "He must have a nightmare" - who said this, when and why?

(v) Why were the passers by so easily attracted to the astrologer?

6. (a) Correct any ten of the following sentences:

(15)

(i) I sat under the feet of my great teachers.

(ii) Of Jasmine and Monika, I like the later.

(iii) The month proceeding July was, of course, June.

(iv) The teacher told he and I to leave early.

(v) If we can work slow and steady, we can finish by noon.

(vi) He had a need and interest in athletics.

(vii) We shall combine the three departments into one.

(viii) I can't help but think that he must be mistaken.

(ix) she never sees none of her old friends any more.

(x) He is seldom ever on time for his lectures.

(xi) I told him what to do with a smile.

(xii) It was a proved answer to the problem.

(b) Give the meanings of and make sentences with any ten of the following words:

(15)

Pauper, simulate, molest, tepid, cryptic, facile, ordeal, hamlet, augment, limpid, remnant, hubbub.

7. (a) Amplify the idea contained in any one of the following:

(30)

(i) However mean your life is, meet it and live it, do not shun it and call it hard names.

(ii) Youth is full of pleasure, age is full of care.

8. Write a précis of the following passage with a suitable title.

(30)

In our new society there is a growing dislike of original, creative men. The manipulated do not understand them; the manipulators rear them. The tidy committee men regard them with horror, knowing that no pigeonholes can be found for them. We could do with

HUM 101(MME)

Contd ... Q. No. 8

a few original, creative men in our political life - if only to create some enthusiasm, release some energy - but where are they? We are asked to choose between various shades of the negative. The engine is falling to pieces while the joint owners of the car argue whether the foot brake or the handbrake should be applied. Notice how the cold, colourless men without ideas and with no other passion but a craving for success, get on in this society, capturing one plum after another and taking the juice and taste out of them. Sometimes you might think the machines we worship make all the chief appointments, promoting the human beings who seem closest to them. Between midnight and dawn, when sleep will not come and all the old wounds begin to ache, I often have a nightmare vision of a future world in which there are billions of people all numbered and registered, with not a gleam of genius any where, not an original mind, a rich personality, on the whole packed the twin ideals of over time, organization and quantity, will have won for ever.

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L-1/T-2/MME

Date : 04/06/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **ME 141** (Engineering Mechanics)

Full Marks : 210

Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION - A

There are **FOUR** questions in this Section. Answer any **THREE** questions.

1. (a) Collar *A* and ^{block}*B* are connected by a cable passing over three pulleys *C*, *D* and *E* as shown in Fig. for Q. No. 1(a). Pulleys *C* and *E* fixed, while *D* is attached to a collar which is pulled downward with a constant velocity of 90 mm/s. At $t = 0$, collar *A* starts moving downward from position *K* with a constant acceleration and no initial velocity. Knowing that the velocity of collar *A* is 300 mm/s as it passes through point *L*, determine (i) change in elevation of pulley *D* (ii) the velocity, and the acceleration of block *B* when collar *A* passes through *L*. (25)
- (b) A motorist is traveling on a curved section of highway of radius 1000 m at the speed of 72 km/h as shown in Fig. for Q. 1(b). The motorist suddenly applies the brakes, causing the automobile to slow down at a constant rate. Knowing that after 10 s the speed has been reduced to 36 km/h, determine the acceleration of the automobile immediately after the brakes have been applied. (10)
2. (a) The two blocks *A* and *B* as shown in Fig. for Q. 2(a) are originally at rest. Neglecting the mass of the pulley and the effect of friction in the pulleys and between the blocks and inclination determine the acceleration of each block. (23)
- (b) The velocities of commuter trains *A* and *B* are as shown in Fig. for Q. 2(b). Knowing that the speed of each train is constant and that *B* reaches the crossing 10 min after *A* passed through the same crossing, determine the relative velocity of *B* with respect to *A*. (12)
3. (a) A spring is used to stop a 50-kg package which is moving down a 20° incline as shown in Fig. for Q. 3(a). The spring has a constant $k = 30$ kN/m and is held by cables so that it is initially compressed 50 mm. Knowing that the velocity of the package is 2 m/s when it is 8 m from the spring and neglecting friction, determine the maximum additional deformation of the spring in bringing the package to rest. (20)
- (b) Collar *A* moves upward with a constant velocity of 1.5 m/s shown in Fig. for Q. 3(b). At the instant shown when $\theta = 30^\circ$, determine the angular velocity of rod *AB*. (15)

ME 141(MME)

4. (a) The magnitude and direction of the velocities of two identical frictionless balls before they strike each other are as shown in Fig. for Q. 4(a). Assuming $e = 0.90$, determine the magnitude and direction of the velocity of each ball after the impact. (18)
- (b) In the engine system shown in Fig. for Q. No. 4(b), the crank AB has a constant clockwise angular velocity of 3000 rpm. For the crank position indicated, determine the angular velocity of the connecting rod BD . (17)

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) The 28 kg collar A slides on a frictionless vertical rod and is connected to a counter weight C (30 kg) as shown in Fig. for Q. No. 5(a). Determine 'h' for maintaining equilibrium of the system. (18)
- (b) For the brake pedal shown in Fig. for Q. No. 5(b), find the direction and magnitude of the smallest force P that creates 104 N.m CW moment about B. (17)
6. (a) A 2800 kg fork lift truck as shown in Fig. for Q. No. 6(a) is used to lift a 1500 kg crate. Determine the reactions at each of the two (i) front wheels A, (ii) rear wheels B. (18)
- (b) One end of rod AB rests in the corner A and the other end is attached to cord BD. The rod supports 200 N load at mid point C. Find the reactions at A and tension in the cord BD. Refer to Fig. for Q. No. 6(b). (17)
7. (a) Determine the forces in members AB and AD of the truss shown in Fig. for Q. No. 7(a). (18)
- (b) For the structure shown in Fig. for ^{Q. No.} 7(b) joints at A, D and C all are pin connected. A force and a couple act ^{at} point B. Neatly draw the free body diagrams of member ACB and member CD. Ignore self-weight. Calculate the force in member CD and reactions at pin A. (17)
8. (a) A 60 kg cabinet, as shown in Fig. for Q. No. 8(a), can be locked to prevent their rotation. Given $\mu_s = 0.35$ (between floor and casters). If the casters at both A and B are locked, Calculate : (i) the force P required to move the Cabinet to the right. (ii) the value of 'h' when the Cabinet tips over. (AB = 500 mm). (18)
- (b) Determine the polar moment of inertia and the corresponding radius of gyration for the shaded area shown in Fig. for Q. No. 8(b). Take $a = 20$ mm. (17)
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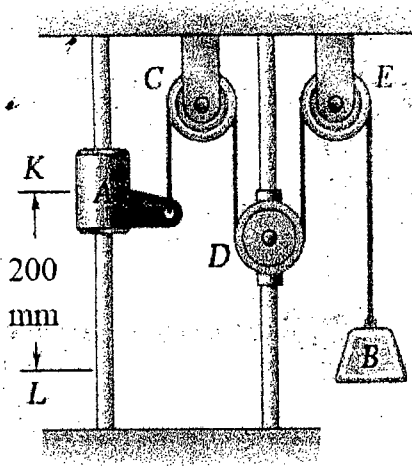


Fig. for Q. 1(a)

$V_A = 72 \text{ km/h}$

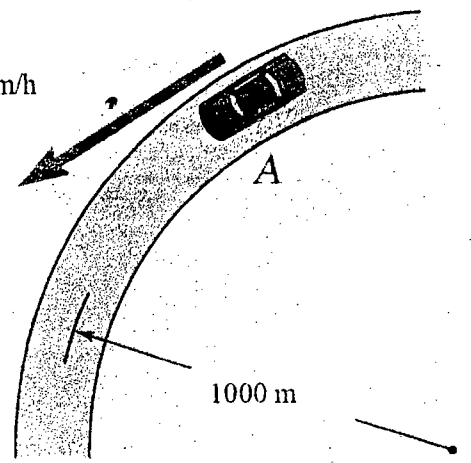


Fig. for Q. 1(b)

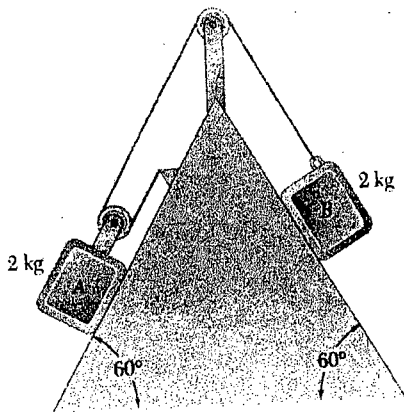


Fig. for Q. 2(a)

Fig. for Q. 2(b)

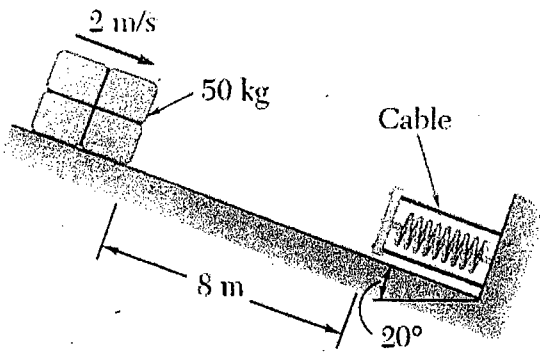


Fig. for Q. 3(a)

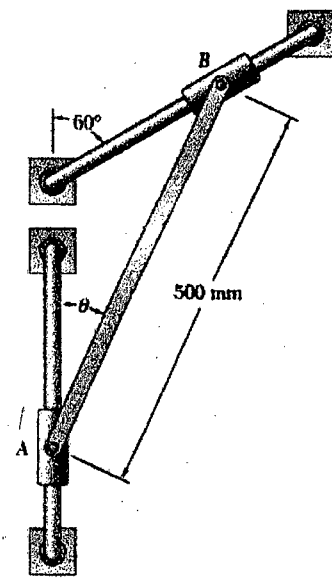


Fig. for Q. No. 3(b)

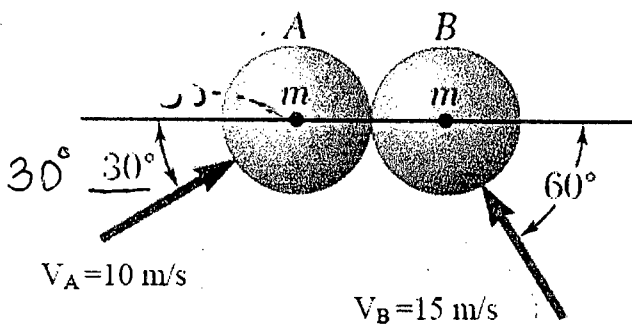


Fig. for Q. 4(a)

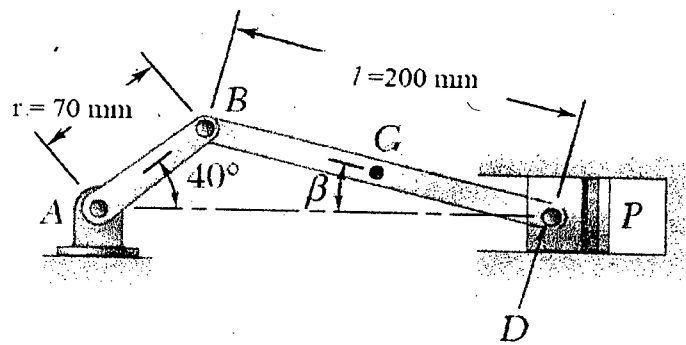
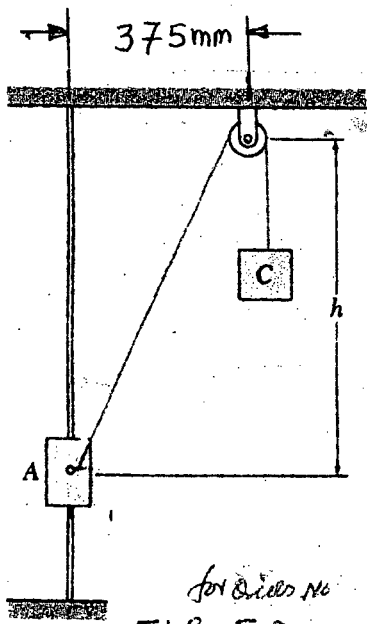


Fig. for Q. No. 4(b)



for Ques. No
FIG. 5a

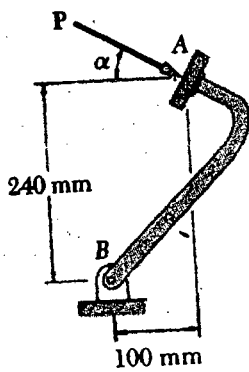


FIG. 5b

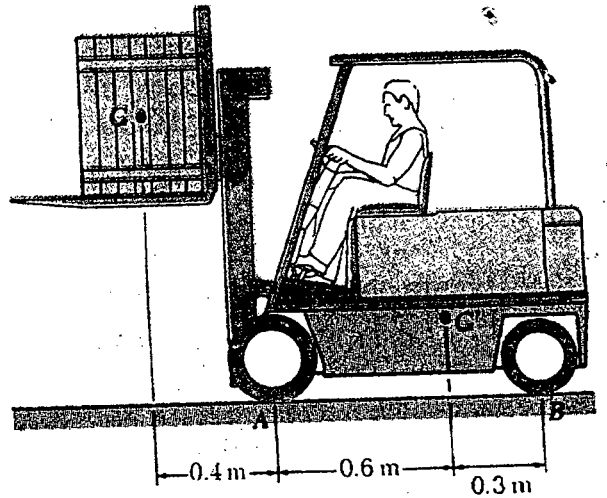
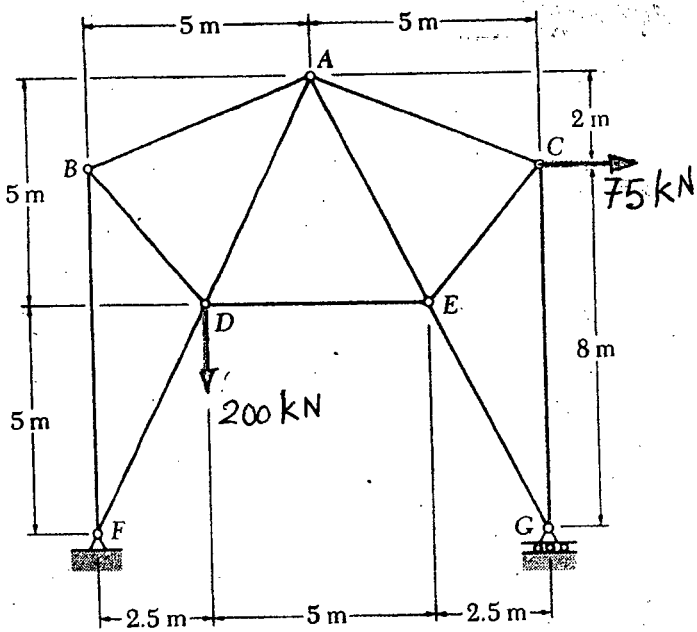


FIG. 6a

for Ques. No



for Ques. No
FIG. 7a

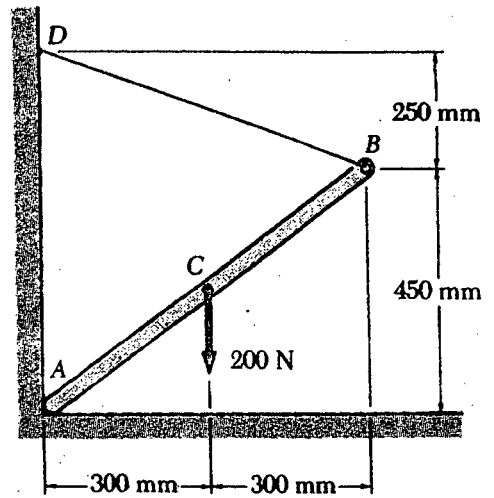
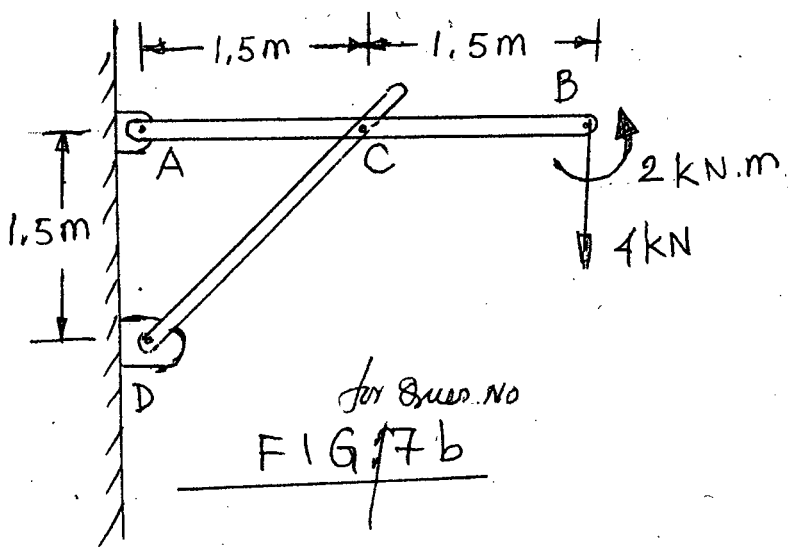


FIG. 6b

for Ques. No



for Ques. No
FIG. 7b

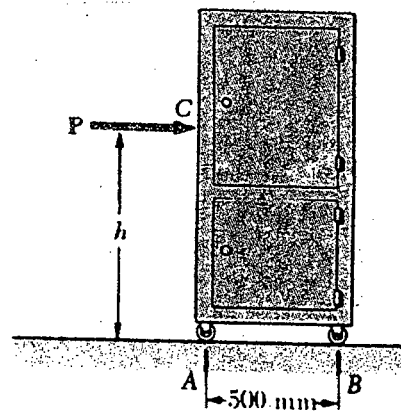


FIG. 8a

for Ques. No

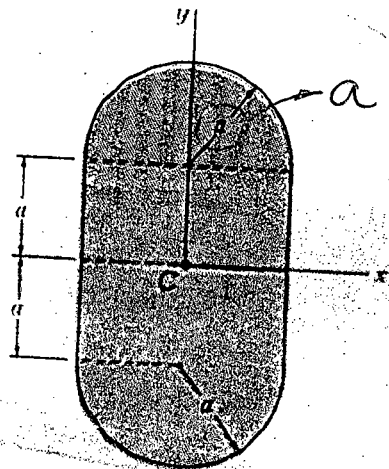


FIG. 8b

for Ques. No

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L-1/T-2/MME

Date : 11/06/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **MATH 173** (Vector Analysis and Metrics)

Full Marks : 210

Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION - A

There are **FOUR** questions in this Section. Answer any **THREE** questions.

1. (a) Show that ^{any} vector **d** can be expressed as a linear combination of three non coplanar vectors **a**, **b** and **c**. Are the points $(-1, 4, -3)$, $(3, 2, -5)$, $(-3, 8, -5)$ and $(-3, 2, 1)$ coplanar? (14)
- (b) If $\mathbf{a} = \mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$, $\mathbf{b} = -2\mathbf{i} + \mathbf{j} + \mathbf{k}$, $\mathbf{c} = 10\mathbf{j} - \mathbf{k}$. determine u, v, w so that $(\mathbf{a} \times \mathbf{b}) \times \mathbf{c} = u\mathbf{a} + v\mathbf{b} + w\mathbf{c}$. (14)
- (c) A particle acted on by constant forces $4\mathbf{i} + \mathbf{j} - 3\mathbf{k}$ and $3\mathbf{i} + \mathbf{j} - \mathbf{k}$ is displaced from the point $(1, 2, 3)$ to the point $(5, 4, 1)$. Find the total work done by the forces. (7)
2. (a) If $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ and $r = |\mathbf{r}|$, find $\nabla^2 r^n$ and show that $\nabla^2 \left(\frac{1}{r} \right) = 0$. (15)
- (b) Find the angle of intersection at the point $(4, -3, 2)$ of spheres $x^2 + y^2 + z^2 = 29$ and $x^2 + y^2 + z^2 + 4x - 6y - 8z - 47 = 0$. (12)
- (c) Show that $\text{curl grad } \phi = 0$. (8)
3. (a) Define directional derivative and normal derivative. Find the values of a, b, c so that the directional derivative of $\phi = ax^2 + by^2 + cz^2$ at the point $(1, 1, 2)$ has the greatest magnitude 4 in the direction parallel to y-axis. (10)
- (b) Evaluate $\oint_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F} = (2x + y^2)\mathbf{i} + (3y - 4x)\mathbf{j}$ and C is the boundary of the region enclosed by the curves $y = x^2$ and $y^2 = x$. (10)
- (c) Evaluate $\iint_S \mathbf{F} \cdot n dS$ where $\mathbf{F} = 4x\mathbf{i} + 2y^2\mathbf{j} + z^2\mathbf{k}$ and S is the surface of the region bounded by $x^2 + y^2 = 4$, $z = 0$ and $z = 3$. (15)
4. (a) Verify Green's theorem in the plane for $\oint_C [(x^2 + y^2)dx - 2xydy]$, where C is the rectangle bounded by $y = 0$, $x = 0$, $y = b$, $x = a$ (17)
- (b) State Gauss's divergence theorem and using this theorem evaluate $\iint_S \mathbf{F} \cdot n dS$ for $\mathbf{F} = x^2\mathbf{i} + y^2\mathbf{j} + z^2\mathbf{k}$ taken over the surface of the solid cut off by the plane $x + y + z = a$ from the first octant. (18)

MATH 173(MME)**SECTION - B**

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Define Symmetric and Skew Symmetric matrices with examples. For a square matrix A , show that $A + A'$ is Symmetric and $A - A'$ is skew Symmetric. (10)

- (b) Solve the following system of linear equations (15)

$$x_1 + x_2 - x_3 + x_4 + 2x_5 = 1$$

$$2x_1 - x_2 + x_3 + 5x_4 + 4x_5 = 2$$

$$3x_1 + 2x_2 - 2x_3 + 5x_4 + 6x_5 = 3$$

- (c) Find $A(\text{adj}A)$ of the matrix $A = \begin{bmatrix} 1 & 2 & 2 \\ 1 & 3 & 2 \\ 1 & 2 & 3 \end{bmatrix}$ and verify from it that $A(\text{adj}A) = |A|I$. (10)

6. (a) Compute the inverse of $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 6 \\ 3 & 4 & 5 & 7 \\ 4 & 5 & 5 & 7 \end{bmatrix}$ by using elementary row operations.

Hence verify your answer. (15)

- (b) Find the Canonical matrix row equivalent to the following matrix.

$$A = \begin{bmatrix} 1 & 2 & 1 & 0 \\ 3 & 2 & 1 & 2 \\ 2 & -1 & 2 & 5 \\ 5 & 6 & 3 & 2 \end{bmatrix}. \text{ Also find the rank of the matrix } A. \quad (20)$$

7. (a) Reduce $A = \begin{bmatrix} 1 & -2 & 1 & 3 \\ 4 & -1 & 5 & 8 \\ 2 & 3 & 3 & 2 \end{bmatrix}$ to the normal form B and compute the matrices P and Q

such that $PAQ = B$, where A and B are equivalent matrices. (15)

- (b) Reduce to diagonal form the following symmetric matrix by congruent

transformations and interpret ^{the} result in terms of quadratic form $A = \begin{bmatrix} 3 & 2 & -1 \\ 2 & 2 & 3 \\ -1 & 3 & 1 \end{bmatrix}$. (20)

8. (a) State Cayley-Hamilton theorem. Find the characteristic equation of the matrix

$$A = \begin{bmatrix} 1 & -1 & 1 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{bmatrix} \text{ and verify the Cayley-Hamilton theorem for it. Also find its inverse.} \quad (15)$$

- (b) Define eigen values and eigen vectors of a matrix. Find the eigen values and the

corresponding eigen vectors of the matrix $A = \begin{bmatrix} 5 & -1 & 1 \\ -1 & 2 & -4 \\ 1 & -4 & 2 \end{bmatrix}$. Also find the

characteristic space of A . (20)

SECTION – AThere are **FOUR** questions in this Section. Answer any **THREE**.

- (a) Write a mechanism for the peroxide initiated addition of HBr to propene. Suggest a possible reason why the peroxide effect is observed for HBr and not for HCl. (9+2)

(b) Identify compound (A), C₄H₁₀O, from the following data: (6)

 - (A) + Br₂/CCl₄ → No reaction
 - (A) + Na → Bubble formation
 - (A) + HCl/ZnCl₂ → Immediate cloudiness

(c) Discuss the solvent effect on SN1 and SN2 reactions. (10)

(d) Complete the following reaction and show the mechanism as well (8)

$$\text{CH}_3 - \text{C}(\text{CH}_3)_2 - \text{CHOH} - \text{CH}_3 \xrightarrow[\text{Heat}]{80\% \text{ H}_2 \text{ SO}_4} \rightarrow$$
- (a) Define "aromaticity". Discuss aromaticity of benzene with reference to Hückel rule. (6)

(b) Write down the properties associated with aromaticity. (8)

(c) Write down the structures of the following and apply Hückel rule to show that whether they are aromatic or non-aromatic (10)

 - Cyclo-octatetraene
 - Cyclopropenyl Cation
 - Anthracene
 - Pyridine.

(d) How can you prepare toluene? Give the mechanism of electrophilic reaction in toluene. (5+6)
- (a) What are organohalobenzene compounds? Classify them. Give three methods of preparation of organohalobenzene compounds. (1+2+6)

(b) Benzyl chloride is more reactive than chlorobenzene in nucleophilic displacement reaction. - Explain. (8)

(c) How can you synthesize cumene and propyl benzene from benzene? (5+5)

(d) How can phenylacetic acid be synthesized from toluene? (8)
- (a) What is "diazotization"? How diazotization is carried in aniline? Give mechanism. (2+8)

(b) Give three important reactions of benzenediazonium chloride. (12)

(c) -NH₂ group is ortho and para-directing whereas -NO₂ is meta-directing in substitution reaction. - Explain. (6)

(d) How will you distinguish between aniline and benzylamine? (7)

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SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) What is pyridine? Draw the resonance structures and orbital picture of pyridine. (8)
- (b) Deduce a tentative structure for pyridine by degradative methods and confirm it by a synthesis. (10)
- (c) State with reactions what happens when pyridine is treated with (3×2=6)
- (i) KNO_3 and H_2SO_4 at 300°C
- (ii) Fuming H_2SO_4 and HgSO_4 at 230°C
- (iii) NaNH_2 and liq. NH_3 at 100°C
- (d) Explain with examples that the five membered heterocycles undergo electrophilic substitution reaction preferentially at C-2 and C-5 positions instead of C-3 and C-4 positions. (11)
6. (a) State, how furfural undergoes the following reactions. (4×3=12)
- (i) Cannizzaro reaction (ii) Perkin's reaction and (iii) Claisen-Schmidt condensation
- (b) With a commercial method for the synthesis of the condensed ring heterocycle indigo. (5)
- (c) Write with reactions what happens when indigo is subjected to (3×2=6)
- (i) Oxidation with HNO_3
- (ii) Reduction with $\text{Na}_2\text{S}_2\text{O}_4$ and NaOH
- (d) How would you carry out the following conversions? (4×3=12)
- (i) 2 - Chlorothiophene from thiophene
- (ii) Furan - 2 - sulphonic acid from furan
- (iii) 2 - Phenylazopyrrole from pyrrole
- (iv) 2, 5 - Dihydropyrrole from pyrrole
7. (a) Briefly discuss how the structure of the alkaloid nicotine was established. (9)
- (b) Apply Hofmann's method of exhaustive methylation for conversion of reduced pyridine into 1, 3 - pentadiene. (8)
- (c) What is optical isomerism? Give a brief account of the optical isomerism of tartaric acid. (12)
- (d) Write three-dimensional formulas both enantiomers of the following molecular and give (R) and (S) designation for each pair of enantiomers: (3+3=6)
- (i) 2-chlorobutane
- (ii) 2-butanol

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8. (a) Draw the structure of the compounds: (4×2=8)
- (i) 7-methyl bicyclo [2. 2. 1] heptane
 - (ii) spiro [4.5] decane
 - (iii) E-4-isopropyl-3-methyl-3-heptene
 - (iv) 4-vinyl cyclopentane.
- (b) Write a step by step mechanism for the reaction of ethylalcohol with conc. H₂SO₄ at 130°C to form diethyl ether. (8)
- (c) How will you synthesize: (4×3=12)
- (i) acetone from propyne
 - (ii) butyne from propyne
 - (iii) 2 - Chloroethanol from ethane
 - (iv) isopropyl alcohol from propene
- (d) Write a note on conformations of butane. (7)
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