BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1   B. Sc. Engineering Examinations 2020-2021

Sub : **NAME 117** (Hydrostatics and Stability)

Full Marks : 210   Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable values for missing data if any.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Describe the IMO intact stability criteria for a ship. (12)

(b) What is the importance of inclining experiment for a ship? Briefly describe the procedure of conducting the inclining experiment. (13)

(c) A mass of 6 tonne is moved transversely through a distance of 14 m on a ship of 4300 tonne displacement, when the deflection of an 11 m pendulum is found to be 120 mm. The transverse distance is 7.25 m above the keel. Determine the height of the centre of gravity above the keel. (10)

2. (a) A cargo carrier has displacement of 35000 tonnes and KG 9 m. Construct the statical stability curve for the following GZ values: (20)

Heel (degrees)	5	10	15	20	30	45	60	75	90
GZ (m)	0.12	0.43	0.87	1.32	2.0	2.39	1.91	0.71	−0.60

Also from the stability curve find the followings:

(i) the range of stability

(ii) the angle of vanishing stability

(iii) the maximum righting lever and angle of the heel at which it occurs

(iv) the approximate initial metacentric height.

(b) Define dynamic stability of a ship. (15)

A ship of 10000 tonnes displacement has the following righting levers when inclined:

Heel (degrees)	0	10	20	30	40	50
GZ (m)	0.0	0.02	0.12	0.21	0.30	0.33

Calculate the dynamical stability to 50 degrees heel.

3. (a) Define centre of flotation, statical stability and metacentric height. (6)

(b) Derive the expression for righting lever of a wall-sided vessel. (20)

(c) A wall-sided vessel has GM of 5 m and BM = 10 m. Determine the value of righting lever at 5°, 10° and 15°. (9)

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4. (a) A ship of 9900 tonnes displacement has KM = 7.3 m and KG = 6.4 m. She has yet to load two 50 tonnes lifts with her own gear and the first lift is to be placed on deck on the inshore side (KG 9 m and C.G. 6 m out from the centre line). When the derrick plumbs the quay, its head is 15 m above the keel and 12 m out of the centre line. Calculate the maximum list during the operation. (15)

(b) A ship has a displacement of 3000 tonnes. On the vessel, there is a rectangular double bottom tank having length 15 m long and 8 m wide. This tank is partially filled with ballast water of density 1025 kg/m^3. If the GM_T without free surface effect is 0.18 m, calculate the virtual loss in GM_T and the final GM_T when double bottom has: (20)

    (i) No divisional bulkhead is fitted

    (ii) One transverse bulkhead is fitted at midlength

    (iii) One longitudinal bulkhead is fitted on the centre line

    (iv) Two longitudinal bulkhead are fitted giving three equal divisions.

SECTION – B

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

5. (a) Determine the error involved in calculating the moment of inertia using Simpson's First Rule about the base of the area under the curve $y = 6 + 4x - x^2$ between the limits $x = 0$ and $x = 2$. (20)

(b) The half-breadths in meter of the midship section of a ship at waterlines spaced 4 meter apart are: (15)

Waterline	0	1	2	3	4
Half-breadths	6.40	10.90	12.80	13.60	14.20

Find the area between Nos. 3 and 4 waterlines and the height of the centroid of this layer above the base.

6. (a) A ship 520 ft long, whose displacement in salt water is 12,350 tons, floats at a waterline whose half ordinates at evenly-spaced sections starting from the after perpendicular are: (27)

3.40, 15.70, 25.70, 31.0, 32.50, 32.60, 29.80, 22.20, 11.50 and 0.0 ft.

Find where a weight of 250 tons should be placed in order that the draught on the after perpendicular should remain unchanged.

The height of the center of gravity above the center of buoyancy may be taken as 12 ft; and in calculating the properties of the waterplane, the appendage abaft the after perpendicular may be neglected.

(b) Find the relationship between the vertical prismatic coefficient, the midship section coefficient and the block coefficient. (8)

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7. (a) What is the difference between heel and list of a ship? (5)

   (b) A vessel of constant rectangular cross-section is 150 ft long, 35 ft beam and floats on an even-keel draught of 6 ft. A compartment 50 ft long amidships is bilged. Find the effect of this on the initial stability using the lost-buoyancy and added weight methods of calculation. The value of KG before bilging is 6 ft. (30)

8. (a) Define lightweight, deadweight and displacement of a ship. (9)

   (b) A ship of length 520 ft has a load displacement of 18,230 tons and longitudinal center of buoyancy 9.20 ft abaft amidships. At a waterline tangential to the margin line the areas of immersed sections are given below. (26)

Stations	A.P	1/2	1	$1\frac{1}{2}$	2	3	4	5	6	7	8	$8\frac{1}{2}$	9	$9\frac{1}{2}$	F.P
Area (ft^2)	380	855	1240	1615	1930	2290	2350	2320	2260	2040	1430	1015	600	245	0

   Determine the length and position of the flooded compartment for this condition assuming a permeability of 70 percent.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-I/T-I B. Sc. Engineering Examinations 2020-2021

Sub : **HUM 111** (English)

Full Marks : 140   Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions including Q. No. 1 as compulsory.

1. (a) Explain with reference to the context any <u>one</u> of the following: **(8)**

   (i) "Oh! My poor Matilda! Mine were false. They were not worth over five hundred francs!"

   (ii) "There lay a young man, fast asleep – sleeping so soundly, so deeply, that he was far, far away from them both."

   (b) Answer any one of the following: **(10)**

   (i) What is the meaning of life, happiness and success? Discuss based on your understanding of the story "The Bet" by Anton Chekhov.

   (ii) Analyse the character of Laura Sheridan in the story "The Garden Party". How is she different from the other members of her family?

   (c) Answer any three of the following: **(12)**

   (i) What kind of life was Mathilda forced to lead in order to pay off the debt?

   (ii) Why did Laura say "Forgive my hat" to the body of Mr. Scott in "The Garden Party"?

   (iii) Why did Mrs. Forestier fail to recognize Mathilda?

   (iv) Why did the banker argue that death penalty was more moral and humane than life imprisonment?

   (v) Why Laura wanted to stop the garden-party when she heard about the accident?

2. (a) Recast and correct any <u>ten</u> of the following sentences: **(20)**

   (i) It is I who is to make the call.

   (ii) She is used to get up early in the morning.

   (iii) I swim better than he.

   (iv) Neither of the roads lead to the railway station.

   (v) We couldn't decide on where to go for dinner, so we ended eating at home.

   (vi) Could you describe out IT manager the problem?

   (vii) Of the three, tea, coffee and cocoa, the latter is his favourite.

   (viii) Ten new members have been enrolled, and seven resigned.

   (ix) We regret informing you that your application has been denied.

   (x) Due to the weather, the flight is late.

   (xi) She made the boy to do the whole work

   (xii) We have less candidates for this position than we expected.

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3. (a) Give the meanings of any <u>ten</u> of the following words: **(10)**

Captive, Eradicate, Impromptu, Pessimist, Agitate, Obsolete, Shabby, Chasm, Moron, Vendor, Reconcile, Forbearance.

(b) Make sentences with any <u>ten</u> of the following words. **(10)**

Get across, Turn down, Vigilance, Supersede, Mumble, Lullaby, Impartial, Dubious, Concurrence, Avarice, Lay aside, Strain.

4. Write a précis of the following passage with a suitable title: **(20)**

It is physically impossible for a well-educated or brave man to make money the chief object of his thoughts, just as it is for him to make his dinner the principal object of them. All healthy people like making money - ought to like it, and enjoy the sensation of winning it; but the main object of their life is not money: it is something better than money. A good soldier, for instance, mainly wishes to do his fighting well. He is glad of his pay – very properly so, and justify grumbles when you keep him ten years without it – still, his main notion of life is to win battles, not to be paid for winning them. So of clergyman's object is essentially to baptize and preach, not to be paid for preaching. A sincere doctor desires to cure the sick, and, if they are good doctors and the choice were fairly put to them, they would rather cure their patient, and lose their fee than kill him and get it. And so, with all the other brave and rightly trained men; their work is first, their fee second – fee is very important no doubt, but still second.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions including Q. No. 5.

5. Read the following text carefully and answer the questions that follow: **(30)**

The art of academic writing is not easy to master. It is a formal skill, which, requires precision and accuracy, and is perfected by continuous and dedicated practice. Academic writing is the skilful exposition and explanation of an argument, which the writer has carefully researched and developed over a sustained period of time. It is a time-consuming activity and demands patience and perseverance. But the joy of reading and sharing with others, one's succinctly composed piece of argument, is incomparable.

Before beginning to write, the writer must ask himself or herself a few question-why am I writing? What is it that I intend to share with other? What purpose will my writing serve? Have I read enough about the topic or theme about which I am going to write? If one is hesitant to answer even one of the aforementioned questions, one better not write at all? Because academic writing is a serious activity – it makes one part of a shared community of readers and writers who wish to disseminate and learn from well-argued pieces of writing.

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Contd... Q. No. 5

The structure of an argumentative essay should take the form of – introduction, Body and the conclusion. The introduction should function as the work which draws the reader in and holds his attention, the body should include cogent and coherently linked paragraphs and the conclusion should re-state the argument and offer a substantial ending to the piece.

Questions:

(i) What do you mean by academic writing?

(ii) Why is reading an important part of writing?

(iii) Select an appropriate title for the text.

(iv) Why should one work oneself the question mentioned in the second passage?

(v) What are the components of the structures of an argumentation essay?

(vi) Write down the meaning of the following words used in the text:

Precision, Succinctly, Disseminate, hook, cogent.

6. (a) Suppose you are Pavel. Recently you have received a parcel containing some course book for your study. But after receiving the parcel you found some unnecessary book those you do not need, Now, write a complaint letter to the library you ordered for those books. **(10)**

(b) Write phonetic transcription for the following words: (Any five) **(10)**

Pleasure, Angel, Book, Fragile, edge, Truth.

7. (a) Write a dialogue between two maritime engineers about innovations in maritime engineering in Bangladesh context. **(10)**

(b) Write a short essay on any one of the following topics: **(10)**

(i) Your favorite book

(ii) Ocean pollution and ways to prevent it.

(iii) The Higher Education system in Bangladesh.

8. (a) Transform the following sentences (any five) as directed: **(10)**

(i) He declared his innocence (Make it Complex)

(ii) This is the place where I was borne (Make it Simple)

(iii) He will certainly come today. (Make it Complex)

(iv) Farhana is meritorious and honest. (Make it Complex)

(v) He left after I had come. (Make it Simple)

(vii) Nepu kept her promise. (Make it Compound)

(b) Write short notes on any Two of the following: **(10)**

(i) Linking words;

(ii) Diphthongs;

(iii) Components of back matter of a formal report.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1   B. Sc. Engineering Examinations 2020-2021

Sub: **PHY 113** (Structure of Matter, Electricity, Magnetism and Modern Physics)

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) Describe Lorentz-Fitzgerald contraction, time-dilation and show the variations graphically.   **(10)**

(b) Show that to define momentum and energy of a mass-less particle the relation of relativistic energy needs to be generalized as, $E = \sqrt{(m_0^2 c^4 + p^2 c^2)}$, where the symbols have their usual meaning.   **(14)**

(c) Explain Heisenberg's uncertainty principle in case of wave particle duality. An observer on a spacecraft moving at 0.70 c relative to the earth finds that a car takes 5.0 hr to make a trip from Chattogram to BUET campus. How long does the trip take to the driver of the car?   **(5+6)**

2. (a) Briefly explain the results of photoelectric effect from quantum point of view.   **(8)**

(b) How does X-ray photon losses its energy during passing through the matter? Show that the wavelength of a photon scattered by an electron is $\lambda' = \lambda + \lambda_c(1 - \cos\varphi)$, where the symbols have their usual meaning.   **(17)**

(c) X-rays of wavelength 10 pm are scattered from a target electron. Find the wavelength of X-rays scattered through 45°. Maximum wavelength presents in the scattered X-rays and the maximum kinetic energy of the recoil electron.   **(10)**

3. (a) Why electron does not exist in nucleas?   **(8)**

(b) What is binding energy per nucleon? Draw and explain the binding energy per nucleon versus atomic mass number curve.   **(4+6)**

(c) Define half life $(T_{\frac{1}{2}})$ and mean-life $(\bar{T})$ for a radioactive specimen. Show that mean-life of a radioactive specimen is reciprocal of the disintegration constant and $\bar{T} = 1.44 T_{\frac{1}{2}}$.   **(2+2+10+3)**

4. (a) Why the interatomic or intermolecular bonds exist in solid? Distinguish between primary and secondary bonds.   **(10)**

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Contd... Q. No.4

(b) Distinguish between lattice energy and cohesive energy of an ionic crystal. Draw a typical unit cell of KC1 crystal. Find out an expression for lattice energy of KC1 crystal. **(18)**

(c) Briefly explain the type of bond would be expected for each of the following materials: (i) Calcium fluoride (CaF_2), (ii) Cadmium telluride (CdTe), and (iii) Tungsten (W). **(7)**

SECTION – B

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

5. (a) Distinguish between crystalline and amorphous solids from the crystallographic point of view. **(7)**

(b) Give a brief definition of a unit cell. Draw typical unit cells for various space lattices in cubic and hexagonal close-packed crystal systems and hence calculate number of atoms per unit cell for each of them. Establish the relationship between atomic radius and lattice constant for cubic crystal structure. **(20)**

(c) Mention the lattice parameters of hexagonal crystal system. Calculate c/a ratio for an ideal hexagonal crystal structure. **(8)**

6. (a) Briefly describe the crystal structures of *CsCl* and *NaCl* with neat sketches. Derive expressions for pacing factor for these structures in terms of atomic radii of *Na*, *Cs* and *Cl*. **(11)**

(b) What are the Miller indices? Derive an expression relating the Miller indices and interplaner distance for a crystal system. What would be the relationship for cubic crystal system? **(19)**

(c) A metal in BCC structure has a lattice constant 3.5 Å. Draw (200) crystal plane of that metal. Calculate the number of atoms per sq. mm area in the (200) plane. **(5)**

7. (a) Explain the similarities and dissimilarities between Coulomb's law and gravitational law. **(5)**

(b) Consider a charged plastic rod of length L with a total amount of charge Q is lying along the X-axis with its centre at the origin. Calculate the electric field at a point which is at a distance y from the centre of the rod on the Y-axis. **(18)**

(c) What are the factors upon which the capacity of a capacitor depends on? Derive an expression for the capacitance of a spherical shaped capacitor. **(12)**

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8. (a) State and explain Biot-Savart law. **(5)**

(b) Explain the mechanism of Hall effect and hence show that the number of charge carries pe unit volume of a copper strip is given by $n = \frac{Bi}{Vle}$, where V is the Hall voltage, l is the length of the strip, B is the magnetic field, e is the charge of electron, and i is the current flowing through the strip. **(15)**

(c) Explain the microsopc view of Ohm's law and hence show that the resistivity of metal is given by $\rho = \frac{m}{e^2 n\tau}$, where τ is the mean free time of collision, n is the number of free electrons per volume, m and e are the mass and charge of electron, respectively. What is the mean free time τ between collisions for the conduction electrons in copper? Given that the resistivity and the number of conduction electrons per unit volume in copper are 16.9×10^{-8} $\Omega.m$ and $8.49 \times 10^{28} m^{-3}$, respectively. **(15)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2020-2021

Sub: **CHEM 117** (Chemistry – I)

Full Marks: 210   Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks

SECTION – A

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

1.   (a) How does the variation in atomic size across a transition series contrast with the change across the main-group elements of the same period? Why? **(10)**

(b) What is the crystal field splitting energy? How does it arise for an octahedral field of ligands? How is it different for a tetrahedral field of ligands? **(12)**

(c) What factors determine whether a given complex will be diamagnetic or paramagnetic? Consider the complex ion $[CoF_6]^{3-}$. **(13)**

   i. What is the geometry?

   ii. Which is a more likely color for this ion to absorb, red or blue?

   iii. Would you expect this complex to be high or low spin?

2.   (a) Distinguish between an absorption spectrum and an emission spectrum. With which did Bohr work? **(8)**

(b) What physical meaning is attributed to Ψ^2? What does "electron density in a tiny volume of space" mean? **(6)**

(c) Draw the radial probability distribution plot for n = 1 and n = 2. Explain what it means for the peak in the radial probability distribution plot for the n =1 level of an H atom to be at 0.529 Å. Is the probability of finding an electron at 0.529 Å from the nucleus greater for the 1s or the 2s orbital? **(10)**

(d) What is orbital penetration? How is it related to shielding? Use the orbital penetration effect to explain the difference in relative orbital energies of a 3p and a 3d electron in the same atom. **(11)**

3.   (a) The VSEPR model was developed before any xenon compounds had been prepared. Thus, these compounds provided an excellent test of the model's predictive power. What would you have predicted for the shapes of XeF_2, XeF_4 and XeF_6? **(12)**

(b) Predict the shape, state hybridization of the central atom, and give the ideal bond angle(s) and any expected deviatins for: (i) AlF_6^{3-} (ii) IF_4^{+} **(12)**

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Contd... Q. No. 3

(c) Use an MO diagram and the bond order you obtain from it to answer the followings
with explanation: **(11)**

    (i) Is O_2^- stable?

    (ii) Is O_2^- paramagnetic?

    (iii) What is the outer (valence) electron configuration of O_2^-?

4.   (a) How are the Arrhenius and Brønsted-Lowry acid-base definitions different? How
are they similar? Name two Brønsted-Lowery bases that are not Arrhenius bases. Can
you do the same for acids? Explain. **(10)**

(b) Across a period, how does the electronegativity of a nonmetal affect the acidity of
its binary hydride? **(7)**

(c) Perchloric acid, $HClO_4$, is the strongest of the halogen oxoacids, and hypoiodous
acid, HIO, is the weakest. What two factors govern this difference in acid strength? **(8)**

(d) What are hard and soft acids and bases? Explain with examples. On the basis of
HSAB principle, why HgS is insoluble and $Hg(OH)_2$ is soluble in dil. HCl? **(10)**

SECTION – B

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

5.   (a) Define order of reaction. Explain how you can determine the order of reaction by
differential method. **(10)**

(b) Derive an expression for the rate constant of a second order reaction. Show that for
such a reaction the higher the initial concentration, the smaller is the value of half-life. **(15)**

(c) A second order reaction in which the initial concentration of both the reactants are
the same is 25% complete in 600s. How long will it take for the reaction to go to 75%
completion? **(10)**

6.   (a) State the law of mass action. How can you use this law to express the equilibrium
constant of a reaction? **(10)**

(b) Starting from the relation $\Delta G° = -RTlnK$, obtain the expression for the variation of
equilibrium constant with temperature. From the expression how can you assess the
exothermic and endothermic nature of chemical reactions. **(15)**

(c) At 2000 K, $\Delta G°$ for the reaction $N_2 + O_2 = 2NO$ is given by $\Delta G° = (92048 -
10.46T)$ joule. Calculate Kp for the reaction at this temperature. **(10)**

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7. (a) What is osmotic pressure? Equimolar aqueous solutions of glucose and sodium chloride do not have the same osmotic pressure – Explain **(10)**

(b) Starting from the Clapeyron-Clausius equation find the expression for the depression of freezing point of solvent due to the addition of a non-volatile solute in it. Use the expression to determine the molar mass of the solute. **(15)**

(c) 0.440 g of a substance dissolved in 22.2g of benzene lowered the freezing point of benzene by 0.567 °C. Calculate the molar mass of the substance (given that for benzene $K_f = 5.12$ °C/m) **(10)**

8. (a) What is standard hydrogen electrode? What are the roles of platinum used in standard hydrogen electrode. **(10)**

(b) How is electrical energy obtainable from a cell reaction related to the cell potential? How can you use the relation to determine the enthalpy and entropy changes of a chemical reaction occurring within the cell? **(15)**

(c) At 25 °C the value of the emf for the reversible cell.

$$Pb, PbCl_2 (s) | KCl (aq) | AgCl (s), Ag$$

is 0.4902 V and the temperature coefficient is 1.86×10^{-4} volt per degree. Calculate the values of ΔG and ΔH at 25 °C. **(10)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1   B. Sc. Engineering Examinations 2020-2021

Sub: **MATH 181** (Differential Calculus and Integral Calculus)

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) Draw a graph of the function $f(x)$ as defined below. Also test the continuity and differentiability of $f(x)$ at the points $x = 1$ and $x = 2$.   **(15)**

$$f(x) = \begin{cases} x & ; \quad x < 1 \\ 2 - x & ; \quad 1 \le x \le 2 \\ -2 + 3x - x^2 ; & x > 2 \end{cases}$$

(b) If $y = sin[ln(x^2 + 2x + 1)]$, show that $(x+1)^2 y_{n+2} + (2n+1)(x+1) y_{n+1} + (n^2 + 4)y_n = 0$.   **(10)**

(c) If 40 square feet of metal sheet is to be used in the construction of an open tank with a square base, find the dimensions of the tank in order that its capacity is the largest possible.   **(10)**

2. (a) Evaluate: $\displaystyle \lim_{x \to 0} \frac{x - sin^{-1} x}{sin^3 x}$.   **(10)**

(b) Verify mean value theorem for the function $f(x) = (x-1)(x-2)(x-3)$ in the interval [0, 4] and hence find all possible values of 'C' in the theorem, where C ε [0, 4].   **(10)**

(c) Obtain the first three terms in the expansion of $ln(1 + tan x)$ in powers of 'x'.   **(15)**

3. (a) Show that the normal at any point on the curve   **(15)**

$$\begin{cases} x = a(cos\,\theta + \theta\,sin\,\theta) \\ y = a(sin\,\theta - \theta\,cos\,\theta) \end{cases}$$

is at a constant distance from the origin.

(b) If $u(x, y) = ln\left(\dfrac{x^3 + y^3}{x + y}\right)$; $x + y \ne 0$ show that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = 2$ and hence evaluate

$x^2 \dfrac{\partial^2 u}{\partial x^2} + 2xy \dfrac{\partial^2 u}{\partial x \partial y} + y^2 \dfrac{\partial^2 u}{\partial y^2}$.   **(20)**

4. (a) Show that the locus of the centre of curvature of the parabola $y^2 = 4ax$ is $4(x - 2a)^3 = 27ay^2$.   **(18)**

(b) Find the asymptotes of the curve represented by   **(17)**

$$x^3 + 3x^2 y - xy^2 - 3y^3 + x^2 - 2xy + 3y^2 + 4x + 7 = 0.$$

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SECTION – B

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

5.   Evaluate the following integrals:

(a) $\int \dfrac{dx}{(1+x)\sqrt{(1+2x-x^2)}}$.   **(12)**

(b) $\int \dfrac{x^2}{\sqrt{9-x^2}} dx$.   **(12)**

(c) $\int \dfrac{xe^x}{\sqrt{(1+x)^2}} dx$.   **(11)**

6.   (a) Obtain a reduction formula for $\int tan^n x\, dx$ and hence evaluate $\int tan^5 x\, dx$.   **(12)**

(b) Evaluate: $\displaystyle\int_0^a \sqrt{a^2-x^2}\, dx$.   **(12)**

(c) Evaluate: $\displaystyle\lim_{n\to\infty}\left\{\left(1+\dfrac{1}{n^2}\right)^{\frac{2}{n^2}}\left(1+\dfrac{2^2}{n^2}\right)^{\frac{4}{n^2}}\left(1+\dfrac{3^2}{n^2}\right)^{\frac{6}{n^2}}\cdots\left(1+\dfrac{n^2}{n^2}\right)^{\frac{2n}{n^2}}\right\}$.   **(11)**

7.   Evaluate the following integrals:

(a) $\displaystyle\int_0^\infty x^7 e^{-2x^2}\, dx$.   **(10)**

(b) $\displaystyle\int_0^{\frac{1}{2}\pi} cos^6\theta\, sin^4\theta\, d\theta$.   **(10)**

(c) Find the area enclosed by the Cardioid $r = a(1+\cos\theta)$ and the circle $r = \dfrac{3}{2}a$.   **(15)**

8.   (a) Find the volume and the surface area of the paraboloid of the revolution formed by revolving the parabola $y^2 = 4ax$ about the x-axis and bounded by the section $x = 4$.   **(20)**

(b) Find the arc length of the curve $x = \dfrac{1}{3}(y^2+2)^{3/2}$ from $y = 0$ to $y = 1$.   **(15)**

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