

Model Questions 2073

Candidates are required to give their answer in their own words as far as practicable. The figures in the margin indicate full marks.

Young modulus for steel = $2 \times 10^{11} \text{Nm}^{-2}$

Specific heat capacity of copper = $390 \text{Jkg}^{-1}\text{K}^{-1}$

Specific heat capacity of Iron = $470 \text{Jkg}^{-1}\text{K}^{-1}$

Specific heat capacity of water = $4190 \text{Jkg}^{-1}\text{K}^{-1}$

Universal gas constant = $8.31 \text{Jmol}^{-1}\text{K}^{-1}$

Thermal conductivity of Aluminium = $205.0 \text{Wm}^{-1}\text{K}^{-1}$

Thermal conductivity of Brass = $109.0 \text{Wm}^{-1}\text{K}^{-1}$

Charge of electron = $1.6 \times 10^{-19} \text{C}$

Mass of electron = $9.1 \times 10^{-31} \text{kg}$

Acceleration due to gravity = 10m/s^2

Coefficient linear expansion of aluminium = $2.4 \times 10^{-5} \text{K}^{-1}$

Coefficient linear expansion of brass = $2.0 \times 10^{-5} \text{K}^{-1}$

Set - I

Group 'A'

1. Answer, in brief, any six questions:

[6x2=12]

- a. Two vectors have equal magnitudes and their resultant also has the same magnitude. What is the angle between the two vectors?
- b. It can hurt our foot more to kick a big rock than a small pebble. Why?
- c. A man carrying a bucket of water is walking on a level road with a uniform velocity. Does he do any work on the bucket while carrying It?
- d. If the earth suddenly stops rotating about its axis, what would be the effect on acceleration due to gravity at
 - i. the equator
 - ii. the poles?
- e. Why is it more difficult to move a stone tied with a longer string than a stone tied with a shorter string?
- f. Does the centre of gravity of a solid body always lie within the material of the body? Explain.
- g. Hot soup gives better taste than cold one, why?

2. Answer, in brief, any two questions: [2x2=4]

- a. Why is it sometimes possible to loosen caps on screw top bottles by dipping the cap briefly in hot water?
- b. Dews are formed in the early morning hours, why?
- c. Compare the internal energy of a compressed gas with that of the rarefied gas at the same temperature.

3. Answer, in brief, any one question: [2]

- a. Convex mirrors are used as rear view mirrors in cars, why?
- b. A lens is immersed in water. Is there any change in its focal length? Explain.

4. Answer, in brief, any one question: [2]

- a. Can a charged body attract an uncharged body? Explain.
- b. What happens to the capacity and potential difference of a charged capacitor when a dielectric medium is inserted between its plates?

Group 'B'

5. Answer any three questions: [3x4=12]

- a. A projectile is fired at an angle θ with the horizontal. Show that its trajectory is parabola. Derive expressions for the maximum height attained and the time of its flight.
- b. Describe the motion of a conical pendulum and derive an expression for its time period.
- c. Define simple harmonic motion. Deduce a relation for total energy of a simple harmonic oscillator.
- d. Define Young's modulus of elasticity. Deduce an expression for the energy stored in a stretched wire.

6. Answer any two questions: [2x4=8]

- a. State and explain Boyle's law and Charles's law. Use these laws to derive the ideal gas equation for n -moles of a gas.
- b. What is efficiency of a heat engine? Describe the working of a petrol engine with the help of its P-V diagram.
- c. State and explain Newton's law of cooling. Describe with mathematical detail a method for the determination of specific heat capacity of a liquid.

7. Answer any one question: [4]

- a. Define lateral shift. Derive an expression for it. Show in a graph the variation of lateral shift with the angle of incidence.
- b. Draw a labelled diagram and describe the working of a compound microscope with final image at near point. Also, obtain an expression

for its magnifying power.

8. Answer any one question: [4]

- a. State and explain Gauss's theorem and use it to find the electric field intensity due to a line charge.
- b. Define potential gradient and electric field intensity. Establish a relation between them.

Group 'C'

9. Answer any three numerical questions: [3x4]

- a. In a physics lab experiment, a 6 kg box is pushed across a flat table by a horizontal force F .
 - i. If the box is moving at a constant speed of 0.35 m/s and the coefficient of kinetic friction is 0.12, what is the magnitude of F ?
 - ii. If the box is speeding up with a constant acceleration of 0.18 m/s², what will be the magnitude of F ?
- b. Taking the earth to be uniform sphere of radius 6400km, calculate the total energy needed to raise a satellite of mass 1000 kg to a height of 600 km above the ground and to set it into circular orbit at that altitude.
- c. An electric fan is turned off, and its angular velocity decreases uniformly from 500 rev/min to 200 rev/min in 4 seconds. Find the angular acceleration and the number of revolutions made by the motor in the 4 sec interval.
- d. Eight spherical raindrops of equal size are falling vertically through air with a terminal velocity of 0.15 m/s. What would be the terminal velocity, if they coalesce to form a big drop?

10. Answer any two numerical questions: [2*4=8]

- a. A glass flask with volume 200 cm³ is filled to the brim with mercury at 20°C. How much mercury overflows when the temperature of the system is raised to 100°C?
- b. A rod 1.3 m long consists of a 0.8 m length of aluminium joined end to end to a 0.5 m length of brass. The free end of the aluminium section is maintained at 150°C and the free end of the brass piece is maintained at 20°C. No heat is lost through the sides of the rod. At a steady state, what is the temperature at the point where the two metals are joined? [$K_a = 205 \text{ W/mK}$, $K_b = 110 \text{ W/mK}$]
- c. A gas in a cylinder is initially at a temperature of 17°C and pressure $1.01 \times 10^5 \text{ N/m}^2$. If it is compressed adiabatically to one-eighth of its original volume, what would be the final temperature and pressure of the gas?

11. The dispersive powers for crown and flint glass are 0.013 and 0.026 respectively. Calculate the focal lengths of the lenses which form an achromatic doublet of focal length 80 cm, when placed in contact.
12. A parallel plate capacitor with air as the dielectric has a capacitance of 6×10^{-4} pF and is charged by a 100V battery. Calculate the charge and the energy stored in the capacitor.

Set - II

Group 'A'

1. **Answer, in brief, any six questions:** **6×2 = 12**
 - a. Check dimensionally the correctness of the Stoke's formula, $F = 6\pi\eta r v$, where symbols have their usual meanings.
 - b. A woman in an elevator lets go of her briefcase but it does not fall to the floor. How is the elevator moving?
 - c. If there is a net force acting on a particle in uniform circular motion, why does the particle's speed not change?
 - d. An astronaut inside a small space ship orbiting around the earth does not experience any gravity. But an astronaut on the moon which is also orbiting around the earth does experience gravity. Why?
 - e. Does the centre of gravity of a solid body always lie within the material of the body? Explain.
 - f. If the ice on the polar caps of the earth melts, how will it affect the duration of the day? Explain.
 - g. Small air bubbles rise slowly while big bubbles rise rapidly through the liquid. Why?
2. **Answer, in brief, any two questions:** **2x2=4**
 - a) Groundnuts are fried along with sand, Why?
 - b) Dews are formed in the clear night but not in the cloudy night. Explain why?
 - c) Explain the significance of second law of thermodynamics.
3. **Answer, in brief, any one question:** **2**
 - a) A concave mirror is often used as an aid for applying cosmetics to the face, why?
 - b) Sun glasses have curved surfaces but their power is zero, why?

4. Answer, in brief, any one question: 2

- a) What is potential gradient? How is it related with the electric field intensity?
- b) Can we give any desired charge to a capacitor? Explain.

Group 'B'

5. Answer any three questions: 3x4=12

- a. Define angle of repose. Show that the angle of repose and the angle of friction are equal for the given pair of surfaces.
- b. What is escape velocity? Derive an expression for the escape velocity on the surface of the earth.
- c. Define moment of inertia. Obtain an expression for the moment of inertia of a thin and uniform rod about an axis passing through the centre and perpendicular to its length.
- d. What is capillarity? Deduce a relation for the height of liquid column rise in a capillary tube when one end is dipped in the liquid.

6. Answer any two questions: 2x4 =8

- a) Define coefficients of real and apparent expansion of a liquid, and establish a relation between them.
- b) Using the postulates of kinetic theory of gases, deduce an expression for the pressure exerted by an ideal gas on the walls of a container.
- c) What is an isothermal process? Derive the relation, $PV^\gamma = \text{constant}$, where symbols have their usual meanings.

7. Answer any one question: 4

- a. What is chromatic aberration in lens? Deduce the condition for achromatism in two thin lenses in contact.
- b. Describe the structure and working of an astronomical telescope at normal adjustment with a suitable ray diagram. Also, calculate its magnifying power.

8. Answer any one question: 4

- a. What is electrostatic induction? Explain with necessary diagrams, a method of charging a body positively by induction.
- b. State and explain Gauss's theorem and use it to find the electric field due to a charged sphere at a point
 - (i) outside the sphere and (ii) inside the sphere.

Group 'C'

9. Answer any three numerical questions: 3×4 = 12

- a) A batter hits a baseball so that it leaves the bat with an initial speed 37 m/s at an angle of 53° . Find the position of the ball and the magnitude and direction of its velocity after 2 seconds. Treat the baseball as a projectile.
- b) A little red wagon with mass 7 kg moves in a straight line on a frictionless horizontal surface. It has an initial speed of 4 m/s and then is pushed 3 m in the direction of the initial velocity by a force of 10 N. Calculate the wagon's final speed and the acceleration produced by the force.
- c. A body of mass 200 gm is executing simple harmonic motion with amplitude of 20 mm. The maximum force which acts upon it is 0.80 N. Calculate its maximum velocity and its period of oscillation.
- d. A uniform steel wire of density 8000 kg m^{-3} weighs 20 gm and is 2.5 in long. It lengthens by 1 mm when stretched by a force of 80 N. Calculate the value of the Young's modulus of steel and the energy stored in the wire.

10. Answer any two numerical questions: 2×4=8

- a. In an experiment on the specific heat of a metal, a 200 gm block of metal at 150°C is dropped in a copper calorimeter of mass 270 gm containing 150 cm³ of water at 27°C . The final temperature is 40°C . Calculate the specific heat of the metal.
- b. A pot with a steel bottom 8.5 mm thick rest on a hot stove. The area of the bottom of the pot is 0.15 m². The water inside the pot is at 100°C and 390 gm of water is evaporated every 3 minute. Find the temperature of lower surface of the pot which is in contact with the stove.
- c. A Carnot's engine has 25% efficiency with a sink at 9°C . By how many degrees should the temperature of the source be increased in order to raise the efficiency to 70% ?

11. A ray of light is refracted through a prism of angle 60° . Find the angle of incidence so that the emergent ray just grazes in the second face. Refractive index of the material of the prism is 1.45. 4

12. Two capacitors of capacitances 4 μF and 12 μF respectively, are connected in series. The combination is then connected momentarily

across a 200V battery. Find the charge and potential difference across each capacitor.

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Set - III

Group 'A'

1. Answer, in brief, any six questions: [6×2=12]

- a. The diameter of a steel rod is given as $56.47 \pm 0.02\text{mm}$. What does it mean?
- b. If the displacement of a body is proportional of square of time, state whether the body is moving with uniform velocity or uniform acceleration.
- c. Does the centre of gravity of a solid body always lie within the material of the body? Explain with example.
- d. Why is it more difficult to revolve a stone by tying it to a longer string than by tying it to a shorter string?
- e. An astronaut in a space capsule orbiting the earth experiences weightlessness: Why?
- f. Why the small liquid drops are spherical while large drops are flat?
- g. Why is it easier to pull a body than to push it?

2. Answer, in brief, any two questions: [2×2=4]

- a. What is triple point? Show that there exist a single value of triple point.
- b. Why specific heat capacity of gas at constant pressure is greater than its specific heat capacity at constant volume?
- c. Explain on the basis of kinetic theory that the pressure of a gas increases with increase of temperature.

3. Answer, in brief, any one question: [2×1=2]

- a. What is illuminance? Does the direction of incidence of light affect illuminance of surface? Explain.
- b. State the necessary conditions for the production of a pure spectrum.

4. Answer, in brief, any one question: [2×1=2]

- a. Why does bodies get electrified when they are rubbed together for a while?
- b. Can we give any desired quantity of charge to a capacitor?

Group 'B'

- 5. Answer any three questions:** [3×4=12]
- Define centripetal and centrifugal forces. Derive an expression for the force acting on a body moving with uniform speed along a circular path.
 - Write expressions for work done by a constant and a variable force. Show that the work done by the resultant force on a particle is equal to the change in kinetic energy of the particle.
 - What are characteristics of simple harmonic motion? Show that motion of vertical mass-spring system is simple harmonic and hence derive formula for its time period.
 - State and prove Bernoulli's theorem for the steady flow of an incompressible and non-viscous flow.
- 6. Answer any two questions:** [2×4=8]
- Distinguish between real and apparent expansion of liquid. Describe with mathematical detail, a method to determine real expansivity of a liquid.
 - Describe the working of diesel engine with a P-V diagram. What are its merits and demerits?
 - Use the concepts of the kinetic theory of gases to derive an expression for pressure exerted by the gas on the walls of a container. Extend your result to establish a relation between pressure and average kinetic energy of the gas.
- 7. Answer any one question:** [4×1=4]
- Define principal focus and the power of lens. Derive the formula for the focal length of two thin lenses in contact.
 - What is lateral shift? Deduce lateral shift in terms of thickness of a slab and the angle of incidence of light.
- 8. Answer any one question:** [4×1=4]
- Define capacitance of a capacitor. Deduce an expression, for energy stored in a charged capacitor.
 - Define potential difference and potential gradient. Obtain an expression for the potential difference between two points in electric field due to a point charge.

Group 'C'

- 9. Answer any three numerical questions:** [3×4=12]
- A 550N physics student stands on a bathroom scale in an elevator. As the elevator starts moving the scale reads 450N. Draw free body diagram of the problem and find the magnitude and direction of the acceleration of the elevator.
 - Taking the earth to be uniform sphere of radius 6400km and the value of g at the surface to be 10ms^{-2} , calculate the total energy needed to raise a satellite of mass 2000kg to a height of 800km above the ground and to set it into circular orbit at that altitude.
 - Calculate the work done in stretching a steel wire 100cm in length and of cross-sectional area 0.030cm^2 when a load of 100N is slowly applied before the elastic limit is reached.
 - A constant torque of 500Nm turns a wheel which has a moment of inertia 20kgm^2 about its center. Find the angular velocity gained in 2 second and the kinetic energy gained.
- 10. Answer any two numerical questions:** [2×4=8]
- A copper pot with mass 0.5kg contains 0.170kg of water at a temperature of 20°C . A 0.250kg block of iron at 85°C is dropped into the pot. Find the final temperature assuming no heat loss to the surroundings.
 - Five moles of an ideal gas are kept at constant temperature of 53°C while the pressure of the gas is increased from 1.00atm to 3.00atm. calculate work done by the gas.
 - A rod 1.300m long consists of a 0.800m length of aluminium joined end to end to a 0.500m length of brass. The free end of the aluminium section is maintained at 150°C and the free end of the brass piece is maintained at 20°C . No heat is lost through the side of the rod. At steady state what is the temperature of the point when two metals are joined.
- 11. The eyepiece of a refracting telescope has a focal length of 90cm. The distance between objective and eyepiece is 1.8m and the final image is at infinity. What is the angular magnification of the telescope?** [4]
- 12. What distance must an electron move in a uniform potential gradient 200Vcm^{-1} in order to gain kinetic energy $3.2\times 10^{-18}\text{J}$?** [3]

Set - IV

Group 'A'

1. Answer, in brief, any six questions: [6×2=12]

- The length of rod is exactly 1cm. An observer records the readings as 1.0cm, 1.00cm, and 1.000cm, which is the most accurate measurement?
- Given two vectors $\vec{A} = 4.00 \hat{i} + 3.00 \hat{j}$ and $\vec{B} = 5.00 \hat{i} - 2.00 \hat{j}$. Find the magnitude of each vector.
- At what condition does a body become weightless at the equator?
- A handle or a knob is fixed at the free end of the door. Explain why?
- What is elastic limit and breaking stress?
- Why is a suction effect experienced by a person standing close to the platform at a station when a fast train passes?
- Why does a cricketer lower his hand while catching cricket ball?

2. Answer, in brief, any two questions: [2×2=4]

- What is the difference between saturated and unsaturated vapour?
- When a gas expands adiabatically, it does work on its surroundings. But, if there is no heat input to the gas where does energy come from?
- On reducing the volume of a gas at constant temperature, the pressure of a gas increase. Why?

3. Answer, in brief, any one question: [1×2=2]

- Define Luminous intensity of source. What is its unit?
- When white light dispersed by a prism, red light appears at the top of the spectrum whereas violet at the bottom, why?

4. Answer, in brief, any one question [1×2=2]

- What is electrostatic shielding?
- Two charged conductors are touched mutually and then separated. What will be the charge on them?

Group 'B'

5. Answer any three questions: [3×4=12]

- State Newton's laws of motion. How does it lead to the principle of conservation of linear momentum?
- What is a geostationary satellite? Derive an expression for the time period of the satellite revolving around the earth.

- c. Define moment of inertia and radius of gyration. Derive an expression for the kinetic energy of rotation of a rigid body.
- d. Define surface tension and angle of contact. Deduce an expression for rise of a liquid in a capillary tube.

6. Answer any two questions: [2×4=8]

- a. State and explain Newton's law of cooling. Describe with mathematical detail a method for the measurement of specific heat capacity of a liquid.
- b. Explain the term, Thermodynamic process. Obtain an expression for the work done by a gas during adiabatic expansion.
- c. State and explain Stefan's law of black body radiation. Can a perfect black body be realized in practice?

7. Answer any one question: [1×4=4]

- a. Discuss the phenomenon of refraction through a prism. Derive an expression for the refractive index of the material of the prism in terms of the angle of minimum deviation.
- b. With a ray diagram, explain the working of a compound microscope. Obtain an expression for its magnifying power, when the image is at near point.

8. Answer any one questions: [1×4=4]

- a. What is electric flux? State and explain Gauss law in electrostatics. Use it to find electric field intensity due to infinite plane sheet of charge.
- b. Obtain relations for equivalent capacitance for capacitors connected in series and parallel.

Group 'C'

9. Answer any three numerical questions: [3×4=12]

- a. An airplane is flying with a velocity of 90.0m/s at an angle of 23.0° above the horizontal. When the plane is 114m directly above a dog that is standing on level ground, a suitcase drops out of luggage compartment. How far from the dog will the suitcase land? You can ignore air resistance.
- b. You throw a 20N rock vertically into the air from ground level. You observe that when it is 15m above the ground, it is travelling at 25m/s upward. Use the work-energy theorem to find (i) its speed as it left the ground and (ii) its maximum height.
- c. A stone with mass 0.8kg is attached to one end of a string 0.9m long. The string will break if its tension exceeds 600N. The stone is whirled in a horizontal circle, the other end of the string remains fixed. Find the maximum speed, the stone can attain without breaking the string.

- d. Castor oil at 20°C has a coefficient of viscosity 2.42 Ns/m^2 and density 940 kg/m^3 . Calculate the terminal velocity of steel ball of radius 2.00 mm falling under gravity in the oil, taking density of steel as 7800 kg/m^3 .

10. Answer any two numerical questions: [2×4=8]

- a. The marking on an aluminium ruler and a brass ruler are perfectly aligned at 0°C . How far apart will the 20.0 cm marks be on the two rulers at 100°C , if precise alignment of the left hand ends of the rulers is maintained? Coefficient of linear expansion of aluminium and brass are $2.5 \times 10^{-5} \text{ K}^{-1}$ and $2.0 \times 10^{-5} \text{ K}^{-1}$, respectively.
- b. A cylindrical tank has a tight fitting piston that allows the volume of the tank to be changed. The tank originally contains 0.11 m^3 of air at a pressure of 3.4 atm . The piston is slowly pulled out until the volume of the gas is increased to 0.390 m^3 . If the temperature remains constant what is the final value of the pressure?
- c. A diesel engine performs 2200 J of mechanical work and discards 4300 J of heat each cycle. (i) How much heat must be supplied to the engine in each cycle? (ii) How is the thermal efficiency of the engine?

11. An optical fiber with refractive index 1.72 is surrounded by a glass coating having refractive index 1.50. Find the critical angle for total internal reflection at the fiber glass interface. [4]

12. An electron of mass $9.1 \times 10^{-31} \text{ Kg}$ and charge $1.6 \times 10^{-19} \text{ C}$ is situated in a uniform electric field of intensity $1.2 \times 10^4 \text{ Vm}^{-1}$. Find the time it takes to travel 1 cm from rest. [3]

Set - V

GROUP – A

1. Answer in brief any six questions. 6×2=12

- a. A student writes $\sqrt{\frac{R}{2Gm}}$ for escape velocity. Check the correctness of the formula by using dimensional analysis.
- b. Is a vector necessarily changed, if it is rotated through an angle?
- c. If there is a net force on a particle in uniform circular motion why does not the particles speed change?
- d. What is different in the positions of a girl carrying a bag in one hand and that of a girl carrying a bag in each hand?

- e. Why is concrete with steel reinforcing rods embedded in it stronger than plain concrete?
- f. When some wax is rubbed on a cloth it becomes water proof. Explain.
- g. A Piece of ice is floating in water. Will the water level rise if the ice melts completely?

2. Answer in brief any two questions. 2×2=4

- a. How could you determine whether two bodies have the same temperature if it is impossible to put them in contact with each other?
- b. In the ideal gas equation, could an equivalent Celsius temperature be used instead of the Kelvin one if an appropriate numerical value of the constant R is used?
- c. Why are you more uncomfortable on a hot day when the humidity is high than when it is cooled?

3. Answer in brief any one question. 1×2=2

- a. If three identical prisms are combined, is it possible to pass a beam that emerges undispersed?
- b. What are the factors on which the illuminance of a surface depends?

4. Answer in brief any one question. 1×2=2

- a. It is difficult to perform electrostatic experiments on humid days, why?
- b. Suppose the two plates of a capacitor have different areas. When the capacitor is charged by connecting it to a battery, do the charges on two plates have equal magnitude? Explain.

GROUP – B

5. Answer any three questions. 3×4=12

- a. Derive Newton's 1st law and 3rd law of motion using Newton's 2nd law of motion.
- b. What is satellite? Derive an expression for total energy required for a satellite orbiting around the earth at a height h from surface of earth.
- c. What is SHM? Discuss theory of simple spring- mass system and derive an expression for its time period and frequency.
- d. What is terminal velocity? Derive an expression for terminal velocity of an air bubble rising through a viscous liquid.

6. Answer any two questions. 2×4=8

- a. Define cubical expansivity of a liquid. Describe how the cubical Expansivity of a liquid may be determined by the use of balanced columns.
- b. On the basis of kinetic theory of gas deduce the relation $P = \frac{1}{3} \rho c^2$.

Where the symbols have their usual meaning.

- c. Describe the working of diesel engine with the help of P-V diagram.

7. Answer any one question

1×4=4

- a. What is lateral shift? Derive an expression for it due to parallel edged glass slab. How does the lateral shift vary with the increase in angle of incidence?
- b. Describe with a labeled ray diagram the constriction and working of a compound microscope for normal use. Hence calculate the magnifying power.

8. Answer any one question.

1×4=4

- a. State and explain coulomb's law of electrostatics. Define one coulomb charge.
- b. How can a number of capacitors be connected to increase and decrease the effective capacitance? Find the respective expressions for the effective capacitance in each case.

GROUP – C

9. Solve any three numerical problems.

3×4=12

- a. An airplane is flying with a velocity of 90 m/s at an angle of 23° above the horizontal when the plane is 114 m directly above a dog that is standing on level ground a suitcase drops out of the luggage component how far from the dog will the suitcase land? you can ignore air resistance ($g = 10 \text{ m/s}^2$)
- b. A car of mass 625 kg starts from rest and climbs up an inclined road of angle 12° to the horizontal and attains speed of 36 km/h in 300 sec. if the resistance to the motion of the car up the plane is 0.045 N per kg of the car find out the power of the car engine ($g = 10 \text{ m/s}^2$)
- c. A disc of moment of inertia $5 \times 10^{-4} \text{ kgm}^2$ is rotating freely about the axis through its center at 40 rps. Calculate the new revolution per minute. If wax of max 0.02kg is dropped gently onto the disc 0.08m away from the axis.
- d. The narrow bores of diameter 3 mm and 6 mm are joined together to form a U- shaped tube open at both ends. If the tube contains water what is difference in its level in the two limbs of the tube. (surface tension of water = $73 \times 10^{-3} \text{ N/m}$)

10. Solve any two numerical problems.

2×4=8

- a. A mixture of 250 gm of water and 200 gm of Ice. At 0°C is kept in a

calorimeter which has a water equivalent of 50 gm. If 200 gm of steam at 100°C is passed through this mixture. Calculate the final temperature and weight of the content of the calorimeter. [$L_f = 80\text{ Cal/gm}$ $L_v = 540\text{ cal/gm}$]

- b. An ice box made of 1.5 cm thick Styrofoam has dimensions $60\text{ cm} \times 60\text{ cm} \times 30\text{ cm}$. It contains ice at 0°C and is kept in a room at 40°C . Find the rate at which the ice is melting. Latent heat of fusion of Ice = $3.36 \times 10^5\text{ J/Kg}$. [Thermal conductivity of styrofoam = $0.04\text{ W/m}^{\circ}\text{C}$]
- c. Gas in a cylinder initially at a temperature of 10°C and pressure $1.01 \times 10^5\text{ N/m}^2$ is to be compressed adiabatically to one eighth of its volume, find the final pressure and temperature. (Ratio of molar heat capacities = 1.40)

11. An object is placed at a distance of 25 cm from a convex lens of focal length 20 cm. on placing a convex mirror 40 cm behind the lens, the image coincides with the object itself. What is the focal length of the convex mirror? **4**

12. Two charges $+1 \times 10^{-6}\text{ C}$ and $-4 \times 10^{-6}\text{ C}$ are separated by a distance of 2 m. Determine the position of the null point. **3**