XI PHYSICS

"NUMERICALS"

Prepared by: Muhammad Hassam

"THE SCOPE OF PHYSICS"

Q.1: Find the area of a rectangular plate having length (21.3 $\pm$ 0.2)cm and width (9.80 $\pm$ 0.10)cm.

Q.2: Calculate (a) the circumference of a circle of radius 3.5 cm and (b) area of a circle of radius 4.65 cm.

Q.3: Show that the expression $S = V_i t + \frac{1}{2} at^2$ is dimensionally correct, when S is a co-ordinate and has unit of length, V_i is velocity, a is acceleration, and t is time.

Q.4: Suppose the displacement of a particle is related to a time according to expression $S = ct^3$. What are the dimensions of the constant c.

Q.5: Estimate the number of litres of gasoline used by all Pakistan's car each year:
Given:
No. of cars in Pakistan = 500000. Average distance traveled per year by each car = 16000 km gasoline consumption 6km/litre.

"SCALARS & VECTORS"

Q.1: State which of the following are scalars and which are vectors:

(i) Weight	(ii) Calorie	(iii) Specific heat
(iv) Momentum	(v) Density	(vi) Energy
(vii) Volume	(viii) Distance	(ix) Speed
(x) Magnetic field intensity	(xi) Entropy	(xii) Work
(xiii) Centripetal force	(xiv) Temperature	(xv) Charge
(xvi) Gravitation potential	(xvii) Shearing stress	(xviii) Frequency
(xix) Kinetic energy	(xx) Electric field intensity.	

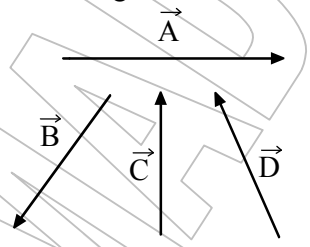
Q.2: Find the resultant of the following displacement:

A = 20 km 30° south of east;
B = 50 km due west;
C = 40 km north east;
D = 30 Km 60° south of west.

Q.3: An aeroplane flies 400 km due west from city A to city B then 300 km north east to city C, and finally 100 km north to city C. How far is it from city A to D? In what direction must the aeroplane had to return directly to city A from city D?

Q.4: Show graphically that –(A – B) = -A + B

Q.5: Given vector A, B, C and D as shown in figure below Construct (a) 4A – 3B – (2C + 2D)



Q.6: The following forces act on a particle P:

$F_1 = 2i + 3j – 5k$, $F_2 = -5i + j + 3k$, $F_3 = i – 2j + 4k$, $F_4 = 4i – 3j – 2k$,

measured in newtons Find (a) the resultant of the force (b) the magnitude of the resultant force

Q.7: If A = 3i – j – 4k, B = -2i + 4j – 3k and C = i + 2j – k, find

(a) 2A – B + 3C, (b) $|A + B + C|$,
(c) $|3A – 2B + 4C|$, (d) a unit vector parallel to 3A – 2B + 4C

Q.8: Two tugboats are towing a ship. Each exerts a force of 60000N, and the angle between the two ropes is 60°. Calculate the resultant force on the ship.

Q.9: The position vectors of points P and Q are given by $r_1 = 2i + k$, $r_2 = 4i – 3j + 2k$. Determine PQ in terms of rectangular unit vector i, j and k and find its magnitude.

Q.10: Prove that the vectors A = 3i + j – 2k, B = -i + 3j + 4k and C = 4i – 2j – 6k can form the sides of a triangle. Find the length of the medians of the triangle.

Q.11: Find the rectangular components of a vector A, 15 unit long when it form an angle with respect to +ve x-axis of (i) 50°, (ii) 130° (iii) 230°, (iv) 310°.

Q12: Two vectors 10 cm and 8 cm long form an angle of (a) 60° (b) 90° and (c) 120°. Find the magnitude of difference and the angle with respect to the larger vector.

Q.13: The angle between the vector A and B is 60°. Given that $|A| = |B| = 1$, calculate
(a) $|B - A|$; (b) $|B + A|$

Q.14: A car weighing 10,000 N on a hill which makes an angle of 20° with the horizontal. Find the componentsof car's weight parallel and perpendicular to the road.

Q.15: Find the angle between A = 2i + 2j – k and B = 6i – 3j + 2k.

Q.16: Find the projection of the vector A = i – 2j + k onto the direction of vector B = 4i – 4j + 7k.

Q.17: Find the angles α, β, γ which the vector A = 3i – 6j + 2k makes with the positive x, y, z axis respectively.

Q.18: Find the work done in moving an object along a vector r = 3i + 2j – 5k if the applied force is F = 2i – j – k.

Q.19: Find the work done by a force of 30,000 N in moving an object through a distance of 45 m when: (a) the force is in the direction of motion: and (b) the force makes an angle of 40° to the direction of motion. Fins the rate at which the force is working at a time when the velocity is 2m/s.

Q.20: Two vectors A and B are such that $|A| = 3$, $|B| = 4$, and A.B = -5, find
(a) the angle between A and B
(b) the length $|A + B|$ and $|A - B|$
(c) the angle between (A + B) and (A – B)

Q.21: If A = 2i – 3j – k, B = i + 4j – 2k.
Find (a) A x B (b) B x A (c) (A + B) x (A – B)

Q.22: Determine the unit vector perpendicular to the plane of A = 2i – 6j – 3k and B = 4i + 3j – k.

Q.23: Using the definition of vector product, prove the law of sines for plane triangles of sides a, b and c.

Q.24: If r_1 and r_2 are the position vectors (both lie in xy plane) making angle θ_1 and θ_2 with the positive x-axis measured counter clockwise, fins their vector product when

(i) $\|r_1\| = 4$ cm	$\theta_1 = 30^o$	$\|r_2\| = 3$ cm	$\theta_1 = 90^o$
(ii) $\|r_1\| = 6$ cm	$\theta_1 = 220^o$	$\|r_2\| = 3$ cm	$\theta_1 = 40^o$
(iii) $\|r_1\| = 10$ cm	$\theta_1 = 20^o$	$\|r_2\| = 9$ cm	$\theta_1 = 110^o$

"MOTION"

Q.1: In an electron gun of a television set, an electron with an initial speed of 10^3 m/s enters region where it is electrically accelerated. It emerges out of this region after 1 micro second with speed of $4x10^5$ m/s. What is the maximum length of the electron gun? Calculate the acceleration.

Q.2: A car is waiting at a traffic signal and when it turns green, the car stats ahead with a constant acceleration of 2 m/s^2. At the same time a bus traveling with a constant speed of 10 m/s overtakes and passes the car.
(a) How far beyond its starting point will the car overtake the bus?
(b) How fast will the car be moving?

Q.3: A helicopter ascending at a rate of 12 m/s. At a height of 80m above the ground, a package is dropped.How long does the package take to reach the ground?

Q.4: A boy throws a ball upward from the top of a cliff with a speed of 14.7 m/s. On the way down it just misses the thrower and fall the ground 49 metres below. Find
(a) How long the ball rises?
(b) How high it goes?
(c) How long it is in air and
(d) with what velocity it strikes the ground.

Q.5: A helicopter weighs 3920 Newton. Calculate the force on it if it is ascending up at a rate of 2 m/s^2. What will be force on helicopter if it is moving up with the constant speed of 4 m/s?

Q.6: A bullet having a mass of 0.005 kg is moving with a speed of 100 m/s. It penetrates into a bag of sand and is brought to rest after moving 25cm into the bag. Find the deceleration force on the bullet. Also calculate the time in which it is brought to rest.

Q.7: A car weighing 9800 N is moving with a speed of 40 km/h. On the application of the brakes it comes to rest after traveling a distance of 50 metres. Calculate the average retarding force.

Q.8: An electron in a vacuum tube starting from rest is uniformly accelerated by an electric field so that it has a speed $6x10^6$ m/s after covering a distance of 1.8cm. Find the force acting on the electron. Take the mass of electron as $6.1x10^{-31}$ kg.

Q.9: Two bodies A & B are attached to the ends of a string which passes over a pulley, so that the two bodies hang vertically. If the mass of the body A is 4.8 kg. Find the mass of body B which moves down with an acceleration of 0.2 m/s^2. The value of g can be taken as 9.8 m/s^2.

Q.10: Two bodies of masses 10.2 kg & 4.5 kg are attached to the ends of a string which passes over a pulley in such a way that the body of mass 10.2 kg lies on a smooth surface and the other body hangs vertically. Find the acceleration of the bodies and tension of the string and also the force, which the surface exerts, on the body of mass 10.2 kg.

Q.11: A 100 grams bullet is fired from a 10 kg gun with a speed of 1000 m/s. What is the speed of recoil of the gun?

Q.12: A 50 grams bullet is fired into a 10 kg block that is suspended by a long cord so that it can swing as a pendulum. If the block is displaced so that its centre of gravity rises by 10cm, what was the speed of the bullet?

Q.13: A machine gun fires 10 bullets per second into a target. Each bullet weighs 20 gm and had a speed of 1500 m/s. Find the force necessary to hold the gun in position.

Q.14: A cyclist is going up a slope of 30° with a speed of 3.5 m/s. If he stops pedaling, how much distance will he move before coming to rest? (Assume the friction to be negligible).

Q.15: The engine of a motorcar moving up 45° slop with a speed of 63 km/h stops working suddenly. How far will the car move before coming to rest? (Assume the friction to be negligible).

Q.16: In question no. 15, find the distance that the car moves, if it weighs 19.600N and the frictional force is 2000 N.

Q.17: In the Figure 3.22 find the acceleration of the masses and the tension in the string.

Q.18: Two blocks are connected as shown in figure 3.23. If the pulley and the planes on which the blocks are resting are frictionless, find the acceleration of the blocks and the tension in the string.

Q.19: Two blocks each weighing 196N rest on planes as shown in figure 3.24. If the planes and pulleys are frictionless, find the acceleration and tension in the cord.

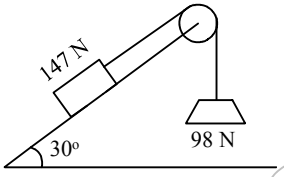


Fig. 3.22

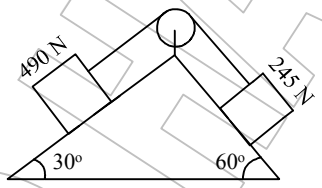


Fig. 3.23

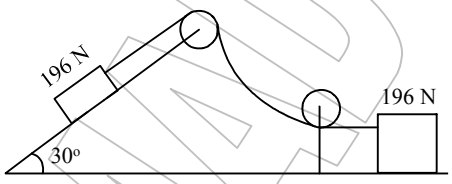


Fig. 3.24

EXTRA NUMERICALS

Q.1: A stone is thrown vertically upwards. If it takes 30 seconds to return to the ground, how high does the stone go?

Q.2: A car starts from rest and moves with a constant acceleration. During the 5th second of its motion, it covers a distance of 36 metres. Calculate (a) the acceleration of the car (b) the total distance covered by the car during this time.

Q.3: A stone is thrown up with a velocity of 245 m/s. At what times will it be at a height of 14.7 m? Explain the meaning of the two possible values of t.

Q.4: A car is moving with a velocity of 12 m/s and covers a distance of 40 m during the 6th second of its motion. Calculate total distance covered by the car in 6 seconds if its acceleration is uniform.

Q.5: A stone is dropped from a cliff. During the last second of its motion, it covers a distance of 30 m. Find the height of the cliff.

Q.6: A balloon is ascending at the rate of 14.7 m/s. When it is at a height of 98 m above the ground, a package. Calculate time taken by the package to reach the ground.

Q.7: A rocket is fired vertically upward from its launching pad. It moves up for 60 seconds with a vertical acceleration of 30 m/s^2. Its fuel is then exhausted, and it moves like a free body. What is the maximum altitude reached?

Q.8: A boy thrown a ball vertically upward with a speed of 25 ms^{-1}. On its way down, it is caught at a point 5 m above the ground. How fast was it coming down at this point? How long did the trip tak12e?

Q.9: A car accelerates uniformly from rest for half a minute with an acceleration of 1.2 m/s^2. It then travels at a constant speed for 1.5 minutes before slowing down with a uniform acceleration to come to rest in 20 second. Calculate the total distance traveled by the car.

Q.10: A body starting with a velocity of 2 m/s travels 50 meters in the sixth second. Calculate the distance traveled in 6 seconds if its acceleration is uniform.

Q.11: An inclined plane makes an angle of 40° with the horizontal. A body weighing 4 kN initially at rest, moves down the slope. Calculate the distance traveled by the body in 5 seconds if force of friction is 1.5 kN.

EXAMPLES NUMERICALS

Q.3.1: As the traffic light turns green, a car starts from rest with a constant acceleration of 4 m/s^2. At the same time, a motorcyclist traveling with a constant speed of 36 km/s, overtakes and passes the car. Find (a) How far beyond the starting point will the car overtakes the motorcyclist (b) what will be speed of the car at the time when it overtakes the motorcycle.

Q.3.2: A car starts from rest and moves with a constant acceleration. During the 5th second of its motion, it covers a distance of 36 metres. Calculate (a) the acceleration of the car (b) the total distance covered by the car during this time.

Q.3.3: A ball is dropped from the top of a tower. If it takes 5 seconds to hit the ground, find the height of the tower and with what velocity will it strike the ground.

Q.3.4: A ball is thrown vertically upward with a velocity of 98 m/s.
(a) How high does the ball rise?
(b) How long does it take to reach its highest point?
(c) How long does the ball remain in air?
(d) With what speed does the ball return to the ground?

Q.3.5: A car mass 1000 kg traveling at a speed of 36 km/hour is brought to rest over a distance of 20 metres, find (i) average retardation (ii) average retarding force.

Q.3.6: Two bodies A and B are attached to the ends of a string which passes over a pulley so that the two bodies hang vertically. If the mass of body A is 5 kg and that of body B is 4.8 kg. Find the acceleration and tension in the string. The value of g is 9.8 m/s^2.

Q.3.7: A truck starts from rest at the top of a slope which is 1m high and 49m long. Find its acceleration and speed at the bottom of the slope assuming that friction is negligible.

"MOTION IN TWO DIMENSIONS"

Q.1: A rescue helicopter drops a package of emergency ration to a stranded party on the ground. If the helicopter is traveling horizontally at 40 m/s at a height of 100 m above the ground, (a) where does the package strike the ground relative to the point at which it was released? (b) What are the horizontal and vertical component of the velocity of the package just before it hits the ground?

Q.2: A long-jumper leaves the ground at an angle of 20° to the horizontal and at a speed of 11m/s (a) How far does he jump? What is the maximum height reached? Assume the motion of the long jumper is that of projectile.

Q.3: A stone is thrown upward from the top of a building at an angle of 30 to the horizontal and with a initial speed of 20 m/s. If the height of building is 45 m. (a) Calculate the total time the stone in flight (b) What is the speed of stone just before it strikes the ground? (c) Where does the stone strike the ground?

Q.4: A ball is thrown in horizontal direction from a height of 10 m with a velocity of 21 m/s (a) How far will it hit the ground from its initial position on the ground? and with what velocity?

Q.5: A rocket is launched at an angle of 53° to the horizontal with an initial speed of 100 m/s. It moves along its initial line of motion with an acceleration of 30 m/s^2 for 3s. At this time the engine falls and the rocket proceeds to move as a free body. Find (a) the maximum altitude reached by the rocket (b) its total time of flight, and (c) its horizontal range.

Q.6: A diver leaps from a tower with an initial horizontal velocity component of 7 m/s and upward velocity component of 3 m/s. find the component of her position and velocity after 1 second.

Q.7: A boy standing 10m from a building can just barely reach the roof 12m above him when he throws a ball at the optimum angle with respect to the ground. Find the initial velocity component of the ball.

Q.8: A marter shell is fired at a ground level target 500m distance with an initial velocity of 90 m/s. What is its launch angle?

Q.9: What is the take off speed of a locust if its launch angle is 55° and its range is 0.8m?

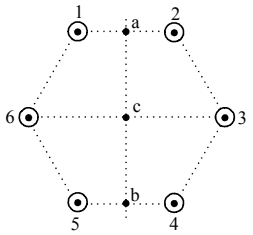
Q.10: A car is traveling on a flat circular track of radius 200m at 20 m/s and has a centripetal acceleration $a_c = 4.5\ m/s^2$ (a) If the mass of the car is 1000 kg, what frictional force is required to provide the acceleration? (b) if the coefficient of static frictions μ_s is 0.8, what is the maximum speed at which the car can circle the track?

Q.11: The turntable of a record player rotates initially at a rate of 33 rev/min and takes 20s to come to rest (a) What is the angular acceleration of the turntable, assuming the acceleration is constant? (b) How many rotation does the turntable make before coming to rest? (c) If the radius of the turntable is 0.14m, what is the magnitude of the tangential acceleration of the bug at time t = 0?

Q.12: Tarzan swings on a vine of length 4m in a vertical circle under the influence of gravity. When the vine makes an angle of $\theta = 20^o$ with the vertical, Tarzan has a speed of 5 m/s. Find (a) his centripetal acceleration at this instant, (b) his tangential acceleration, and (c) the resultant acceleration.

"TORQUE ANGULAR MOMENTUM & EQUILIBRIUM"

Q.1: Locate the centre of mass of a system of particles each of mass 'm', arranged to correspond in position to the six corners of a regular (planar) hexagon.



Q.2: Find the position of centre of mass of five equal-mass particles located at the five corners of a square-based right pyramid with sides of length 'l' and altitude 'h'.

Q.3: The mass of the sun is 329.390 times the earth's mass and the mean distance from the centre of the sun to the centre of the earth is 1.496×10^8 km. Treating the earth and sun as particles with each mass concentrated at the respective geometric centre, how far from the centre of the sun is the C.M (centre of mass) of the earth-sun system? Compare this distance with the mean radius of the sun (6.9960×10^5 km)

Q.4: A particle of mass 4 kg moves along the x-axis with a velocity v = 15t m/s, where t = 0 is the instant that the particle is at the origin.

Q.5: A particle of mass 'm' is located at the vector position r and has a linear momentum vector p. The vector r and p are non zero. If the particle moves only in the x, y plane, prove that

Q.6: A light rigid rod 1m in length rotates in the xy-plane about a pivot through the rod's centre. Two particles of mass 2kg and 3kg are connected to its ends. Determined the angular momentum of the system about the origin at the instant the speed of each particle is 5m/s.

Q.7: A uniform beam of mass 'M' supports two masses m_1 and m_2. If the knife edge of the support is under the beam's centre of gravity and m_1 is at a distance 'd' from the centre, determine the position of m_2 such that the system is balanced.

Q.8: A uniform ladder of length l and weight W = 50 N rests against a smooth vertical wall. If the coefficient of friction between the ladder and the ground is 0.40, find the minimum angle θ_{min} such that the ladder may not slip.

Q.9: A ladder with a uniform density and a mass 'm' rests against a frictionless vertical wall at an angle of 60°. The lower end rests on a flat surface where the coefficient of friction (static) is 0.40. A student with a mass (M = 2m) attempts to climb the ladder. What fraction of the length 'L' of the ladder will the student have reached when the ladder begins to slip?

Q.10: A particle of mass 0.3 kg moves in the xy-plane. At the instant its coordinates are (2, 4)m, its velocity is (3i + 4j)m/s. At this instant determine the angular momentum of the particle relative to the origin.

Q.11: A uniform horizontal beam of length 8m and weighing 200N is pivoted at the wall with its far end supported by a cable that makes an angle of 53° with the horizontal. If a person weighing 600N stands 2m from the wall, find the tension and the reaction force at the pivot.

"GRAVITATION"

Q.1: A 10 kg mass is at a distance of 1 m from a 100 kg mass. Find the gravitational force of attraction when
(i) 10 kg mass exerts force on the 100 kg mass (ii) 100 kg mass exerts force on the 10 kg mass

Q.2: Compute gravitational acceleration at the surface of the planet Jupiter which has a diameter as 11 times as compared with that of the earth and a mass equal to 318 times that of earth.

Q.3: The mass of the planet Jupiter 1.9×10^{27} kg and that of the sun is 2.0×10^{30} kg. If the average distance between them is 7.8×10^{11} m, find the gravitational force of the sun on Jupiter.

Q.4: The radius of the moon is 27% of the earth's radius and its mass is 1.2% of the earth's mass. Find the acceleration due to gravity on the surface of the moon. How much will a 424N body weight there?

Q.5: What is the value of the gravitational acceleration at a distance of (i) earth's radius above the earth's surface? (ii) Twice earth's radius above the earth's surface?

Q.6: At what distance from the center of the earth does the gravitational acceleration have one half the value that it has on the earth's surface?

Q.7: Compute the gravitational attraction between two college students of mass 80 & 50 kg respectively, 2m apart from each other. Is this force worth worrying about?

Q.8: Determine the gravitation between the proton and the electron in a hydrogen atom, assuming that the electron describes a circular orbit with a radius of 0.53×10^{-10} m (mass of proton = 1.67×10^{-27} kg, mass of electron = 9.1×10^{-31} kg).

Q.9: A women with a mass of 45 kg is standing on a scale in an elevator. The elevator accelerates with a constant acceleration of 1.2 m/s^2. What is the women's weight as measured by her in the elevator.

"WORK, POWER & ENERGY"

Q.1: Calculate the work done by a force F specified by $F = 3i + 4j + 5k$ in displacing a body from position B to position A along a straight path. The position vectors A & B are respectively given as $r_A = 2i + 5j - 2k$ & $r_B = 7i + 3j - 5k$

Q.2: A 2000 kg car traveling at 20 m/s comes to rest on a level ground in a distance of 100 m. How large is the average frictional force tending to stop it?

Q.3: A 100-kg man is in a car traveling at 20 m/s. (a) Find his kinetic energy. (b) The car strikes a concrete wall and comes to rest after the front of the car has collapsed 1 m. The man is wearing a seat bell and harness. What is the average force exerted by the belt and harness during the crash?

Q.4: When an object is thrown upward, it rises to a height 'h'. How high is the object, in terms of h, when it has lost one-third of its original kinetic energy?

Q.5: A pump is needed to lift water through a height of 2.5 m at the rate of 500 g/min. What must the minimum horse power of the pump be?

Q.6: A horse pulls a cart horizontally with a force of 40 lb at an angle 30° above the horizontal and moves along at a speed of 6.0 miles/hr. (a) How much work does the horse do in 10 minutes? (b) What is the power out put of the horse?

Q.7: A body of mass 'm' accelerates uniformly from rest to a speed V_f in time t_f. Show that the work done on the body as a function of time 't', in terms of V_f and t_f, is

$$\frac{1}{2} m \frac{V_f^2}{t_f^2} t^2$$

Q.8: A rocket of mass 0.200 kg is launched from rest. It reaches a point p lying at a height 30.0 m above the surface of the earth from the starting point. In the process + 425 J of work is done on the rocket by the burning chemical propellant. Ignoring air-resistance and the amount of mass lost due to the burning propellant, find the speed V_f of the rocket at the point P.

"WAVE MOTION & SOUND"

Q.1: An object is connected to one end of a horizontal spring whose other end is fixed. The object is pulled to the right (in the positive x-direction) by an externally applied force of magnitude 20 N causing the spring to stretch through a displacement of 1 cm (a) Determine the value of force constant if, the mass of the object is 4 kg (b) Determine the period of oscillation when the applied force is suddenly removed.

Q.2: A body hanging from a spring is set into motion and the period of oscillation is found to be 0.50 s. After the body has come to rest, it is removed. How much shorter will the spring be when it comes to rest?

Q.3: A pipe has a length of 2.46 m. (a) Determine the frequencies of the fundamental mode and the first two overtones if the pipe is open at both ends. Take $\upsilon = 344$ m/s as the speed of sound in air. (b) What are the frequencies determined in (a) if the pipe is closed at one end? (c) For the case of open pipe, how many harmonics are present in the normal human being hearing range (20 to 20000 Hz)?

Q.4: A standing wave is established in a 120 cm long string fixed at both ends. The string vibrates in four segments when driven at 120 Hz (a) Determine the wavelength (b) What is the fundamental frequency?

Q.5: Calculate the speed of sound in air at atmospheric pressure $p = 1.01 \times 10^5 N/m^2$, taking $\gamma = 1.40$ and $\rho = 1.2 kg/m^3$.

Q.6: A sound wave propagating in air has a frequency of 4000 Hz. Calculate the percent change in wave length when the wave front, initially in a region where $T = 27^oC$, enters a region where the air temperature decreases to 10^oC.

Q.7: The frequency of the second harmonic of an open pipe (open at both ends) is equal to the frequency of the second harmonic of a closed pipe (open at one end). (a) Find the ratio of the length of the closed pipe to the length of the open pipe.(b) If the fundamental frequency of the open pipe is 256 Hz, what is the length of pipe? (Use $\upsilon = 340$ m/s).

Q.8: A 256 Hz tuning fork produces four beats per second when sounded with another fork of unknown frequency. What are two possible values for the unknown frequency?

Q.9: An ambulance travels down a highway at a speed of 75 mi/h. Its siren emits sound at a frequency heard by a person in a car traveling at 55 mi/h in the opposite direction as the car approaches the ambulance and as the car moves away from the ambulance.

Q.10: A car has siren sounding a 2 kHz tone. What frequency will be detected as stationary observer as the car approaches him at 80 km/h? Speed of sound = 1200 km/h.

"NATURE OF LIGHT"

Q.1: How many fringes will pass a reference point if the mirror of a Michelson's interferometer is moved by 0.08 mm. The wavelength of light used is 5800 A^o.

Q.2: In a double slit experiment the separation of the slits is 1.9 mm and the fringe spacing is 0.31mm at a distance of 1 metre from the slits. Find the wavelength of light?

Q.3: Interference fringes were produced by two slits 0.25 mm apart on a screen 150 mm from the slits. If eight fringes occupy 2.62 mm. What is the wavelength of the light producing the fringes?

Q.4: Green light of a wavelength 5400 A is diffracted by grating having 2000 line/cm.
(a) Compute the angular deviation of the third order image. (b) Is a 10th order image possible?

Q.5: Light of a wavelength $6x10^{-7}$ m falls normally on a diffraction grating with 400 lines per mm. At what angle to the normal are the 1st, 2nd and 3rd order spectra produced?

Q.6: If a diffraction grating produced a 1st order spectrum of light of wavelength $6x10^{-7}$ m at an angle of 20° from the normal. What is its spacing and also calculate the number of lines per mm?

Q.7: Newton's rings are formed between a lens and a flat glass surface of wavelength $5.88x10^{-7}$ m. If the light passes through the gab at 30° to the vertical and the fifth dark ring is of diameter 9 mm. What is the radius of the curvature of the lens?

Q.8: How far apart are the diffracting planes in a NaCl crystal for which X-rays of wavelength 1.54 A^o make a glancing angle of 15°-54 in the 1st order?

Q.9: A parallel beam of X-rays is diffracted by rocksalt crystal the 1st order maximum being obtained when the glancing angle of incidence is 6 degree and 5 minutes. The distance between the atomic planes of the crystal is $2.8x10^{-10}$ m. Calculate the wavelength of the radiation.

"GEOMETRICAL OPTICS"

Q.1: An object 4 cm tall is placed near the axis of a thin converging lens. If the focal length of the lens is 25 cm, where will the image be formed and what will be the size of the image? Sketch the principal ray diagram.

Q.2: A convex lens has a focal length of 10 cm. Determine the image distances when an object is placed at the following distances from the lens. 20 cm, 20 cm, 15 cm, 10 cm and 5 cm

Q.3: Two converging lenses of focal lengths 40 cm and 50 cm are placed in contact. What is the focal length of this lens combination? What is the power of the combination in diopters?

Q.4: A converging lens of focal length 20 cm is placed in front of a converging lens of focal length 4 cm. What is the distance between the lenses if parallel rays entering the first lens leave the second lens as parallel rays?

Q.5: A parallel light beam is diverged by a concave lens of focal length -12.5 cm and then made parallel once more by a convex lens of focal length 50 cm. How far are the two lenses apart.

Q.6: Two lenses are in contact, a converging one of focal length 30 cm and a diverging one of focal length -10cm. What is the focal length and power of the combination?

Q.7: Moon light passes through a converging lens of focal length 19 cm, which is 20.5 cm from a second converging lens of focal length 2 cm. Where is the image of the moon produced by the lens combination?

Q.8: Find the distance at which an object should be placed in front of a convex lens of focal length 10 cm to obtain an image of double its size?

Q.9: A compound microscope has a 12 mm focal length objective and a 75 mm focal length eye piece, and the two lenses are mounted 200 mm apart. If the final image is 225 mm from the eye piece, what is the magnification produced?

Q.10: An astronomical telescope of angular magnification 1000 has an objective of 15 m focal length. What is the focal length of the eye piece?

Q.11: A Galilean telescope has an objective of 120 mm focal length and an eye piece of 50 mm focal length. If the image seen by the eye is 300 mm from the eye piece, what is angular magnification?

Q.12: A compound microscope has an objective with a focal length of 10 mm and a tube 100 mm long. An image is produced 250 mm from the eye piece when the object is 12 mm from the objective. What is the angular magnification?

Q.13: A converging lens of 4 dioptres is combined with a diverging lens of -2 dioptres. Find the power and focal length of the combination?

Q.14: A convex lens forms image of an object on a fixed screen 20 cm from the lens. On moving the lens 60 cm towards the object, the image is again formed on the screen. What is the focal length of the lens?

Q.15: Two converging lenses are 25 cm part. Focal length of each is 10 cm. An object is placed in front of one lens at 50 cm. Find the distance between the object and the final image?