

ISC Class 12 Physics Specimen Paper 2

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Maximum Marks: 70 | Time Allowed: Three hours | Reading Time: 15 minutes

Paper 1 (Theory) carries 70 marks. All four Sections are compulsory.

General Instructions

Write your answers on the separate answer paper provided. The first 15 minutes are for reading the paper, and you may not write during that time. All four Sections are compulsory, and you must attempt every question. Marks for each question, or part of a question, are shown in brackets. All working for numerical questions must be shown on the same sheet as the answer, and the final answer must carry its unit. Every physical constant you need is given inside the question that needs it. Circuit diagrams and ray diagrams are not printed in this paper, and where a question describes an arrangement you are expected to draw it yourself in pencil and label it. This paper carries 70 of the 100 marks for the subject, the remaining 30 being for the practical work and the project.

SECTION A (16 Marks)

Attempt all parts of Question 1.

Question 1 [16]

Each part carries 1 mark. For the parts that offer four choices, write only the option you choose. For the rest, answer in a single sentence.

- (i) A charge of $2\ \mu\text{C}$ is carried from one point to another between which the potential difference is 50 V. The work done is:
(a) $1 \times 10^{-4}\ \text{J}$ (b) 100 J (c) 25 J (d) $4 \times 10^{-8}\ \text{J}$
- (ii) State what happens to the capacitance of a parallel plate air capacitor when a slab of dielectric constant 5 is slid in so that it fills the space between the plates.
- (iii) Four resistances, each of 4 ohm, are joined in parallel. The resistance of the combination is:
(a) 16 ohm (b) 4 ohm (c) 2 ohm (d) 1 ohm
- (iv) A uniform wire is drawn out so that its length is doubled, the volume staying the same. Its resistance becomes:
(a) half (b) twice (c) four times (d) unchanged
- (v) Define the term current sensitivity of a moving coil galvanometer.
- (vi) At a place where the angle of dip is 60 degrees, a freely suspended magnetic needle will set itself:
(a) horizontally (b) vertically
(c) at 60 degrees to the horizontal (d) at 30 degrees to the horizontal
- (vii) A transformer has 100 turns in its primary and 500 turns in its secondary. If the primary current is 5 A and the transformer is taken to be ideal, the secondary current is:
(a) 25 A (b) 1 A (c) 5 A (d) 0.2 A
- (viii) State the phase difference between the current and the applied voltage in a circuit containing a pure inductor alone.
- (ix) The member of the electromagnetic spectrum used in a microwave oven is produced by:
(a) a klystron valve (b) a hot filament
(c) nuclear decay (d) an electric spark across a gap
- (x) Name the phenomenon that explains why the sky looks blue on a clear day.

- (xi) A magnifying glass of focal length 5 cm is used by an eye whose least distance of distinct vision is 25 cm, the image being formed at the near point. The magnifying power is:
(a) 5 (b) 6 (c) 4 (d) 1.2
- (xii) State the change, if any, in the wavelength of light when it passes from air into water.
- (xiii) The energy of a photon of light of wavelength 600 nm, taking $h = 6.63 \times 10^{-34} \text{ J s}$ and $c = 3 \times 10^8 \text{ m s}^{-1}$, is:
(a) $3.3 \times 10^{-19} \text{ J}$ (b) $3.3 \times 10^{-20} \text{ J}$
(c) $1.1 \times 10^{-19} \text{ J}$ (d) $6.6 \times 10^{-19} \text{ J}$
- (xiv) The series of the hydrogen spectrum that lies wholly in the ultraviolet region is the:
(a) Balmer series (b) Paschen series
(c) Lyman series (d) Brackett series
- (xv) State the effect on the conductivity of a pure semiconductor when its temperature is raised.
- (xvi) In an amplitude modulated wave, the quantity that is varied in step with the audio signal is the:
(a) frequency of the carrier (b) phase of the carrier
(c) speed of the carrier (d) amplitude of the carrier

SECTION B (14 Marks)

Attempt all parts of Question 2.

Question 2 [14]

- (i) Two point charges of $+4 \mu\text{C}$ and $-4 \mu\text{C}$ are held 10 cm apart. Calculate the electric dipole moment of the pair and state its direction. [2]
- (ii) Define the specific resistance of a material and state the two factors on which it depends. [2]
- (iii) A proton carrying a charge of $1.6 \times 10^{-19} \text{ C}$ enters a magnetic field of 0.5 T at right angles to the field with a speed of $2 \times 10^6 \text{ m s}^{-1}$. Calculate the force acting on it and name the shape of the path it follows. [2]
- (iv) State Lenz's law and explain how it follows from the principle of conservation of energy. [2]
- (v) A diverging lens has a focal length of 25 cm. Calculate its power, and state the nature of the image it forms of a real object placed anywhere in front of it. [2]
- (vi) The half life of a radioactive sample is 10 days. Calculate the fraction of the sample left undecayed after 40 days, and calculate the decay constant of the sample. [2]
- (vii) Explain the terms doping and depletion layer as they are used in semiconductor physics. [2]

SECTION C (15 Marks)

Attempt all parts of Question 3.

Question 3 [15]

- (i) A $4 \mu\text{F}$ capacitor and a $12 \mu\text{F}$ capacitor are joined in series across a 200 V supply. Calculate the capacitance of the combination, the charge on each capacitor and the potential difference across the $4 \mu\text{F}$ capacitor. [3]
- (ii) A galvanometer of resistance 50 ohm gives a full scale deflection for a current of 2 mA. Calculate the resistance that must be joined in series with it to turn it into a voltmeter reading up to 10 V, and calculate the shunt that must be joined across it to turn it into an ammeter reading up to 1 A. [3]
- (iii) A capacitor of $20 \mu\text{F}$ is joined across a 220 V, 50 Hz a.c. supply. Calculate the reactance of the capacitor and the root mean square current in the circuit, and state the phase relation between the current and the applied voltage. Take $\pi = 3.14$. [3]

- (iv) An astronomical telescope has an objective of focal length 120 cm and an eyepiece of focal length 4 cm. Calculate its magnifying power and the length of the telescope tube when the final image is formed at infinity, and state why the objective of such a telescope is made of large aperture. [3]
- (v) Light of wavelength 400 nm falls on a metal surface whose work function is 2.0 eV. Calculate the energy of the incident photon in electron volts, the maximum kinetic energy of the photoelectrons and the stopping potential. Take $h = 6.63 \times 10^{-34}$ J s, $c = 3 \times 10^8$ m s⁻¹ and 1 eV = 1.6×10^{-19} J. [3]

SECTION D (25 Marks)

Attempt all five questions from this Section. Each question carries 5 marks.

Question 4 [5]

- (a) State Biot and Savart's law. Using it, derive an expression for the magnetic flux density at the centre of a circular coil of N turns, radius r, carrying a current I. [3]
- (b) A circular coil of 20 turns and radius 5 cm carries a current of 4 A. Calculate the magnetic flux density at its centre. Take $\mu_0 = 4\pi \times 10^{-7}$ T m A⁻¹ and $\pi = 3.14$. [2]

Question 5 [5]

- (a) Describe the construction and the working of a step down transformer, and explain why its core is laminated and why it cannot be used with a direct current supply. [3]
- (b) An ideal transformer is used to run a lamp rated 11 V, 4 A from a 220 V a.c. supply. Calculate the ratio of the number of turns in the primary to the number in the secondary, and calculate the current drawn from the supply. [2]

Question 6 [5]

- (a) Define the refractive index of a medium and the critical angle for a pair of media. Derive the relation connecting the two, and state the two conditions that must be satisfied for total internal reflection to take place. [3]
- (b) A ray of light travels through a certain transparent medium at a speed of 2×10^8 m s⁻¹. Taking the speed of light in air as 3×10^8 m s⁻¹, calculate the refractive index of the medium and its critical angle with respect to air. [2]

Question 7 [5]

- (a) State the three postulates of Bohr's theory of the hydrogen atom, and explain how the theory accounts for the appearance of a line spectrum rather than a continuous one. [3]
- (b) An electron in a hydrogen atom falls from the third energy level to the first. Taking the energy of the nth level as $-13.6/n^2$ eV, $h = 6.63 \times 10^{-34}$ J s, $c = 3 \times 10^8$ m s⁻¹ and 1 eV = 1.6×10^{-19} J, calculate the energy of the photon emitted and its wavelength. [2]

Question 8 [5]

- (a) Draw, from this description, the circuit of a common emitter n-p-n transistor amplifier in which the emitter is earthed, the base receives the input signal through a resistance and the output is taken across a load resistance in the collector branch. Explain how the amplifier works, and state why the output signal is out of phase with the input by 180 degrees. [3]
- (b) A common emitter amplifier has a current gain of 100, an input resistance of 1000 ohm and a load resistance of 2000 ohm. Calculate its voltage gain, and name one other kind of gain used to describe an amplifier. [2]

ANSWER KEY AND MARKING SCHEME

Full working is given for every numerical, and every answer is quoted to three significant figures unless the figures work out exactly. Marks shown in italics are the step marks an examiner would award. Accept any correct alternative method that reaches the same answer, and accept a correctly labelled diagram drawn in any reasonable style.

Question 1 [16]

- (i) (a) 1×10^{-4} J. $W = qV = 2 \times 10^{-6} \times 50 = 1 \times 10^{-4}$ J.
- (ii) The capacitance becomes five times as great, since $C = K\epsilon_0 A/d$ and K is 5 for the slab.
- (iii) (d) 1 ohm. $1/R = 4 \times (1/4) = 1$, so $R = 1$ ohm.
- (iv) (c) four times. Doubling the length at constant volume halves the area of cross section, and $R = \rho l/A$, so the resistance rises by a factor of $2 \times 2 = 4$.
- (v) Current sensitivity is the deflection produced in the galvanometer per unit current passed through its coil, and it is measured in divisions per ampere.
- (vi) (c) at 60 degrees to the horizontal. The angle of dip is by definition the angle the needle makes with the horizontal when it is free to turn in the vertical plane of the magnetic meridian.
- (vii) (b) 1 A. For an ideal transformer $I_s/I_p = N_p/N_s$, so $I_s = 5 \times 100/500 = 1$ A.
- (viii) The current lags behind the applied voltage by 90 degrees, that is by $\pi/2$ radians.
- (ix) (a) a klystron valve. A magnetron or a gunn diode would also be accepted.
- (x) The scattering of light, as described by Rayleigh, in which the shorter blue wavelengths are scattered far more strongly by the molecules of the air than the longer red ones.
- (xi) (b) 6. For the image at the near point $M = 1 + D/f = 1 + 25/5 = 6$.
- (xii) The wavelength becomes shorter, since the frequency is unchanged while the speed falls, and in water it becomes about three quarters of its value in air.
- (xiii) (a) 3.3×10^{-19} J. $E = hc/\lambda = (6.63 \times 10^{-34} \times 3 \times 10^8)/(600 \times 10^{-9}) = 3.32 \times 10^{-19}$ J.
- (xiv) (c) Lyman series, which is made up of the transitions ending on the $n = 1$ level.
- (xv) The conductivity rises, because the extra thermal energy breaks more covalent bonds and so creates more free electrons and holes.
- (xvi) (d) amplitude of the carrier.

1 mark for each correct part. No mark is deducted for a wrong option, and a one-line answer that carries the correct physics gains the mark even if it is loosely worded.

Question 2 [14]

- (i) $p = q \times 2a = 4 \times 10^{-6} \times 0.10 = 4 \times 10^{-7}$ C m. The dipole moment is directed along the line joining the charges, from the negative charge towards the positive charge.
Answer 4×10^{-7} C m 1. Direction from $-q$ to $+q$ 1.
- (ii) The specific resistance, or resistivity, of a material is the resistance of a specimen of that material of unit length and unit area of cross section, so that from $R = \rho l/A$ it follows that $\rho = RA/l$. It depends on the nature of the material, that is on the number of free charge carriers it holds and on how often they collide, and on the temperature of the material. It does not depend on the length or the area of cross section of the specimen.
Definition, with $\rho = RA/l$ or an equivalent statement 1. Nature of the material and temperature 1.
- (iii) $F = qvB \sin \theta$ with $\theta = 90$ degrees, so $F = 1.6 \times 10^{-19} \times 2 \times 10^6 \times 0.5 = 1.6 \times 10^{-13}$ N. Since the force is always at right angles to the velocity and is constant in magnitude, it acts as a centripetal force and the proton travels in a circle.
Answer 1.6×10^{-13} N 1. Circular path 1.
- (iv) Lenz's law states that the direction of an induced current is always such that it opposes the change that produced it. It follows from the conservation of energy, because if the induced current helped the change instead of opposing it, the change would grow of its own accord and the current, and so the electrical energy, would go on rising without any work being done. In fact the opposition means that work has to be done against

the magnetic force to keep the change going, and it is that mechanical work which appears as the electrical energy of the induced current.

Statement of the law 1. Energy argument, work must be done against the opposition 1.

- (v) For a diverging lens f is negative, so $f = -25 \text{ cm} = -0.25 \text{ m}$. $P = 1/f = 1/(-0.25) = -4 \text{ D}$. For any real object placed anywhere in front of a diverging lens the image is virtual, erect and smaller than the object, and it lies on the same side of the lens as the object, between the lens and its focus.

Power -4 D 1. Virtual, erect and diminished 1.

- (vi) 40 days is four half lives, so the fraction left is $(1/2)^4 = 1/16$, that is 0.0625 or 6.25 per cent of the original sample. Decay constant $\lambda = 0.693/T_{1/2} = 0.693/10 = 0.0693 \text{ per day}$, which is $8.02 \times 10^{-7} \text{ s}^{-1}$.

Fraction 1/16 1. Decay constant 0.0693 per day 1.

- (vii) Doping is the deliberate addition of a very small, controlled quantity of a suitable impurity to a pure semiconductor crystal in order to raise its conductivity, a pentavalent impurity giving an n type crystal and a trivalent one a p type crystal. The depletion layer is the thin region on either side of a p-n junction from which the mobile charge carriers have disappeared, the electrons that crossed over having filled the holes nearby. It is left holding only the fixed ionised impurity atoms, so it carries an internal potential difference called the barrier potential and acts as a poor conductor.

Doping with the effect of the impurity 1. Depletion layer with the barrier potential 1.

Question 3 [15]

- (i) In series $1/C = 1/4 + 1/12 = (3 + 1)/12 = 4/12$, so $C = 3 \mu\text{F}$. Capacitors in series carry the same charge, $Q = CV = 3 \times 10^{-6} \times 200 = 6 \times 10^{-4} \text{ C}$, that is 600 μC on each. Potential difference across the $4 \mu\text{F}$ capacitor $V_1 = Q/C_1 = 600/4 = 150 \text{ V}$. As a check, the $12 \mu\text{F}$ capacitor carries $600/12 = 50 \text{ V}$, and $150 + 50 = 200 \text{ V}$.

Capacitance 3 μF 1. Charge 600 μC on each 1. Potential difference 150 V 1.

- (ii) For the voltmeter the full scale current must flow when 10 V is applied across the galvanometer and the series resistance together, so $R = V/I_g - G = 10/(2 \times 10^{-3}) - 50 = 5000 - 50 = 4950 \text{ ohm}$, joined in series. For the ammeter the shunt must carry the rest of the current while the same potential difference stands across both, so $I_g G = (I - I_g)S$, giving $S = I_g G/(I - I_g) = (2 \times 10^{-3} \times 50)/(1 - 2 \times 10^{-3}) = 0.1/0.998 = 0.100 \text{ ohm}$, joined in parallel.

Correct formula for the series resistance 1. Series resistance 4950 ohm 1. Shunt 0.100 ohm 1.

- (iii) $X_C = 1/(2\pi fC) = 1/(2 \times 3.14 \times 50 \times 20 \times 10^{-6}) = 1/(6.28 \times 10^{-3}) = 159 \text{ ohm}$. $I_{\text{rms}} = V_{\text{rms}}/X_C = 220/159 = 1.38 \text{ A}$. In a purely capacitive circuit the current leads the applied voltage by 90 degrees, since the capacitor must be charged before a potential difference can appear across it.

Reactance 159 ohm 1. Current 1.38 A 1. Current leads the voltage by 90 degrees 1.

- (iv) For the final image at infinity the magnifying power is $M = f_o/f_e = 120/4 = 30$. The tube length is $L = f_o + f_e = 120 + 4 = 124 \text{ cm}$. The objective is made of large aperture so that it gathers as much light as possible from a faint and distant object, which gives a brighter image, and because a wider objective also improves the resolving power of the telescope.

Magnifying power 30 1. Tube length 124 cm 1. Large aperture for brightness, or for resolving power 1.

- (v) $E = hc/\lambda = (6.63 \times 10^{-34} \times 3 \times 10^8)/(400 \times 10^{-9}) = 4.97 \times 10^{-19} \text{ J}$. In electron volts, $E = 4.9725 \times 10^{-19}/1.6 \times 10^{-19} = 3.11 \text{ eV}$. By Einstein's photoelectric equation, the maximum kinetic energy $K_{\text{max}} = E - W_0 = 3.11 - 2.0 = 1.11 \text{ eV}$, which is $1.77 \times 10^{-19} \text{ J}$. The stopping potential V_0 is given by $eV_0 = K_{\text{max}}$, so $V_0 = 1.11 \text{ V}$.

Photon energy 3.11 eV 1. Maximum kinetic energy 1.11 eV 1. Stopping potential 1.11 V 1.

Question 4 [5]

- (a) Biot and Savart's law states that the magnetic flux density dB at a point P due to a small element of length dl of a conductor carrying a current I is directly proportional to the current, to the length of the element and to the sine of the angle θ between the element and the line joining it to P, and inversely proportional to the square of the distance r of P from the element. In SI units $\text{dB} = (\mu_0/4\pi) \times I dl \sin \theta/r^2$, the direction of dB being at right angles to the plane containing the element and the line to P. For a circular coil of one turn and radius r , take the centre O as the point P. Every element of the coil is at the same distance r from O, and the line from any

element to the centre lies along the radius, which is at right angles to the element itself, so $\theta = 90$ degrees and $\sin \theta = 1$ everywhere. Hence $dB = (\mu_0/4\pi) \times I dl/r^2$. The contributions from all the elements point the same way along the axis, at right angles to the plane of the coil, so they add as scalars. Integrating round the coil, $B = (\mu_0 I/4\pi r^2) \times \oint dl = (\mu_0 I/4\pi r^2) \times 2\pi r = \mu_0 I/2r$. For N turns wound closely together each turn gives the same contribution, so $B = \mu_0 NI/2r$.

Statement of the law with the expression for dB 1. Recognition that $\theta = 90$ degrees for every element and that the contributions are parallel 1. Integration to give $B = \mu_0 NI/2r$ 1.

- (b) $B = \mu_0 NI/2r = (4 \times 3.14 \times 10^{-7} \times 20 \times 4)/(2 \times 0.05) = (1.0048 \times 10^{-4})/(0.1) = 1.00 \times 10^{-3}$ T. The field is directed along the axis of the coil, at right angles to its plane.

Correct substitution with r in metres 1. Answer 1.00×10^{-3} T 1.

Question 5 [5]

- (a) A transformer is built from two coils of insulated copper wire, the primary and the secondary, wound on a common closed core of soft iron made up of thin sheets. In a step down transformer the secondary has fewer turns than the primary, so it delivers a smaller voltage at a larger current. When alternating current is passed through the primary, the current in it changes continuously and sets up a changing magnetic flux in the core. The core carries almost the whole of this flux round to the secondary, where the changing flux links the secondary turns and induces an alternating emf in them. Since the same flux links each turn of both coils, $E_s/E_p = N_s/N_p$, and for an ideal transformer, in which no power is lost, $E_p I_p = E_s I_s$. The core is laminated, the sheets being insulated from one another by varnish, because the changing flux would otherwise drive large eddy currents through the solid body of the iron and waste energy as heat. The thin insulated sheets break up the paths available to those currents and so cut the loss down sharply. A transformer cannot be worked from a direct current supply because a steady current sets up a steady flux, and with no change of flux there is no induced emf in the secondary at all.

Construction and working with the turns relation 1. Lamination to cut down eddy currents 1. No output on d.c. because the flux does not change 1.

- (b) For an ideal transformer $N_p/N_s = V_p/V_s = 220/11 = 20$, so the ratio is 20 to 1. Taking the output power as equal to the input power, $V_p I_p = V_s I_s$, so $I_p = (11 \times 4)/220 = 44/220 = 0.2$ A.

Turns ratio 20 to 1 1. Primary current 0.2 A 1.

Question 6 [5]

- (a) The refractive index of a medium is the ratio of the speed of light in free space to the speed of light in that medium, $\mu = c/v$, and it is equal to the ratio of the sine of the angle of incidence in free space to the sine of the angle of refraction in the medium. The critical angle for a pair of media is the angle of incidence in the denser medium for which the angle of refraction in the rarer medium is exactly 90 degrees. To connect the two, apply Snell's law at the boundary when the ray travels from the denser medium into the rarer one at the critical angle C . Then $\mu_{\text{denser}} \sin C = \mu_{\text{rarer}} \sin 90$ degrees, so $\mu_{\text{denser}} \sin C = \mu_{\text{rarer}}$ and $\sin C = \mu_{\text{rarer}}/\mu_{\text{denser}}$. When the rarer medium is air, taken as having a refractive index of 1, this reduces to $\sin C = 1/\mu$, that is $\mu = 1/\sin C$. Total internal reflection requires two conditions. First, the light must be travelling from the optically denser medium towards the rarer one. Second, the angle of incidence in the denser medium must be greater than the critical angle for that pair of media.

Both definitions 1. Derivation of $\sin C = 1/\mu$ by Snell's law at 90 degrees refraction 1. Both conditions 1.

- (b) $\mu = c/v = 3 \times 10^8/2 \times 10^8 = 1.5$. Then $\sin C = 1/\mu = 1/1.5 = 0.667$, so $C = 41.8$ degrees.

Refractive index 1.5 1. Critical angle 41.8 degrees 1.

Question 7 [5]

- (a) First postulate: an electron in a hydrogen atom can move round the nucleus only in certain allowed circular orbits, called stationary orbits, and while it is in such an orbit it does not radiate energy, even though it is accelerating. The necessary centripetal force is supplied by the electrostatic attraction of the nucleus. Second postulate: the allowed orbits are those for which the angular momentum of the electron is an integral multiple of $h/2\pi$, so that $mvr = nh/2\pi$, where n is a whole number called the principal quantum number. Third postulate: the atom radiates or absorbs energy only when the electron jumps from one allowed orbit to another, and the

energy of the photon involved is exactly the difference between the energies of the two orbits, $h\nu = E_2 - E_1$. The theory accounts for a line spectrum because the orbits, and so the energies of the atom, form a discrete set rather than a continuous range. Only certain definite energy differences are therefore possible, so only photons of certain definite frequencies can be emitted, and each of them shows in the spectrum as a sharp line. A continuous spectrum would need the atom to be able to take up energy of any value at all, which the quantisation of the orbits forbids.

First postulate, stationary non radiating orbits 1. Second and third postulates, quantised angular momentum and the frequency condition 1. Line spectrum explained from discrete energy levels 1.

- (b) $E_3 = -13.6/9 = -1.511$ eV and $E_1 = -13.6/1 = -13.6$ eV. Energy of the photon $= E_3 - E_1 = -1.511 - (-13.6) = 12.1$ eV, which is $12.089 \times 1.6 \times 10^{-19} = 1.934 \times 10^{-18}$ J. Wavelength $\lambda = hc/E = (6.63 \times 10^{-34} \times 3 \times 10^8)/(1.934 \times 10^{-18}) = 1.03 \times 10^{-7}$ m, that is about 103 nm, which lies in the ultraviolet and belongs to the Lyman series.

Photon energy 12.1 eV 1. Wavelength 1.03×10^{-7} m 1.

Question 8 [5]

- (a) The circuit should show the n-p-n transistor with its emitter joined to the common earthed line. The input signal is fed between the base and the emitter through a resistance, with a battery in the base circuit that keeps the base positive with respect to the emitter so that the base emitter junction stays forward biased. The collector is joined through the load resistance to the positive terminal of a second battery whose negative terminal goes to the earthed line, so that the base collector junction is reverse biased. The output is taken between the collector and the earthed line. In working, the input signal adds to and subtracts from the steady forward bias of the base emitter junction, so the small base current rises and falls in step with the signal. Because the collector current is β times the base current, a large change in collector current follows the small change in base current, and this change passes through the load resistance and produces a far larger change of voltage across it, which is the amplified output. The output is 180 degrees out of phase with the input because the collector voltage is $V_C = V_{CC} - I_C R_L$. When the signal makes the base current rise, the collector current rises too, the drop across the load resistance grows and so the collector voltage falls. A rising input therefore gives a falling output, which is a phase difference of 180 degrees.

Correct circuit with the emitter earthed, the base emitter junction forward biased and the base collector junction reverse biased 1. Working, small base current change giving a large collector current change across the load 1. Phase reversal explained from $V_C = V_{CC} - I_C R_L$ 1.

- (b) Voltage gain $A_V = \beta \times R_L / R_{in} = 100 \times 2000/1000 = 200$. Another gain used to describe an amplifier is the power gain, which is the product of the current gain and the voltage gain and would here be $100 \times 200 = 2 \times 10^4$.

Voltage gain 200 1. Power gain named 1.