Marking Scheme
Strictly Confidential
(For Internal and Restricted use only)
Senior School Certificate Examination, 2024
SUBJECT NAME PHYSICS [PAPER CODE 55/(B)/S]

General Instructions: -

1	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully.
2	**"Evaluation policy is a confidential policy as it is related to the confidentiality of the examinations conducted, Evaluation done and several other aspects. Its' leakage to public in any manner could lead to derailment of the examination system and affect the life and future of millions of candidates. Sharing this policy/document to anyone, publishing in any magazine and printing in News Paper/Website etc may invite action under various rules of the Board and IPC."**
3	Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and due marks be awarded to them. In class-X, while evaluating two competency-based questions, please try to understand given answer and even if reply is not from marking scheme but correct competency is enumerated by the candidate, due marks should be awarded.**
4	The Marking scheme carries only suggested value points for the answers These are in the nature of Guidelines only and do not constitute the complete answer. The students can have their own expression and if the expression is correct, the due marks should be awarded accordingly.
5	The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. If there is any variation, the same should be zero after delibration and discussion. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
6	Evaluators will mark(√) wherever answer is correct. For wrong answer CROSS 'X" be marked. Evaluators will not put right **(✓)**while evaluating which gives an impression that answer is correct and no marks are awarded. **This is most common mistake which evaluators are committing.**
7	If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled. This may be followed strictly.
8	If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.
9	If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note **"Extra Question"**.
10	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.

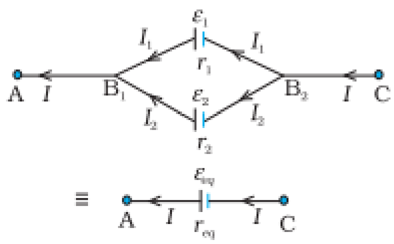
11	A full scale of marks 0-70 (example 0 to 80/70/60/50/40/30 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.
12	Every examiner has to necessarily do evaluation work for full working hours i.e., 8 hours every day and evaluate 20 answer books per day in main subjects and 25 answer books per day in other subjects (Details are given in Spot Guidelines).This is in view of the reduced syllabus and number of questions in question paper.
13	Ensure that you do not make the following common types of errors committed by the Examiner in the past:- ● Leaving answer or part thereof unassessed in an answer book. ● Giving more marks for an answer than assigned to it. ● Wrong totaling of marks awarded on an answer. ● Wrong transfer of marks from the inside pages of the answer book to the title page. ● Wrong question wise totaling on the title page. ● Wrong totaling of marks of the two columns on the title page. ● Wrong grand total. ● Marks in words and figures not tallying/not same. ● Wrong transfer of marks from the answer book to online award list. ● Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.) ● Half or a part of answer marked correct and the rest as wrong, but no marks awarded.
14	While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as cross (X) and awarded zero (0)Marks.
15	Any un assessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
16	The Examiners should acquaint themselves with the guidelines given in the "**Guidelines for spot Evaluation**" before starting the actual evaluation.
17	Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.
18	The candidates are entitled to obtain photocopy of the Answer Book on request on payment of the prescribed processing fee. All Examiners/Additional Head Examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

MARKING SCHEME: PHYSICS (042)			
Code: 55/(B)/S			
Q. No.	**VALUE POINTS/EXPECTED ANSWERS**	**Marks**	**Total Marks**
	SECTION A		
1.	(D) $-\frac{1}{4\pi\varepsilon_0}\left(\frac{10q^2}{a}\right)$		1
2.	(B) Doubled		1
3.	(D)1.6 J		1
4.	(B) $[MLT^{-2} A^{-2}]$		1
5.	(A) become four times		1
6.	(B) first anticlockwise and then clockwise		1
7.	(A) properties of the medium		1
8.	(C) Zero		1
9.	(C) $\sqrt{\frac{M}{m}}$		1
10.	(C) 3		1
11.	(B) holes, electrons		1
12.	(B) continuous with ripple		1
13.	(A) Both Assertion (A) and Reason (R) are true and (A) Reason (R) is the correct explanation of the Assertion (A).		1
14.	(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).		1
15.	(D) Assertion (A) is false and Reason (R) is also false.		1
16.	(A) (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).		1
	SECTION B		
17.	Finding the ratio of drift velocities 2 For the first wire $v_d = \frac{I}{enA}$ $v_d = \frac{I}{en\pi r^2}$ ----------------------------(1)	½	

	For the second wire $v'_d = \frac{2I}{\pi en\left(\frac{r^2}{4}\right)} = \frac{8I}{\pi enr^2}$ ---------(2) From eq (1) and (2) $\frac{v'_d}{v_d} = \frac{8}{1}$	½ 1	2
18.	(a) Explanation 1 Relation between real and apparent depth (Expression only) 1 It is due to refraction of light. Light coming out of the water surface deviates away from normal and as a result appear to come from a point above the bottom of water tank. Relation between real depth, apparent depth and refractive index of water. $\text{Refractive index} = \frac{\text{Real depth}}{\text{Apparent depth}}$ Alternatively- $\mu_w = \frac{R_d}{A_d}$ OR (b) • Defining optical fibres ½ • How light travels through an optical fibre ½ • Two applications 1 Optical fibres are composite glass/ quartz fibres consisting of a core & a cladding used to transmit audio and video signals through long distances. When a signal in the form of light is directed at one end of the fibre at a suitable angle, it undergoes repeated total internal reflections along the length of the fibre and finally comes out at the other end. Two applications of optical fibres- (1) For communication (2) For decorative purpose (3) For examining internal organs (Any two)	1 1 ½ ½ 1	2

19.	**Calculating the wavelength** 2 Distance of nth maxima from centre of screen $x_{nth} = \frac{(2n+1)\lambda D}{2a}$ For n=1 $x = \frac{3\lambda D}{2a}$ $\lambda = \frac{2ax}{3D}$ $\lambda = \frac{2\times 0.2\times 10^{-3}\times 3\times 10^{-3}}{3\times 1.5}$ $\lambda = 2.67\times 10^{-7} m$	½ ½ ½ ½	2
20.	• Bohr's postulates ½ + ½ +½ • Expression of radius of nth orbit of electron ½ (i) Bohr's first postulate states that an electron in an atom revolve in certain stable orbits without the emission of radiant energy. (ii) Bohr's second postulate states that the electron revolves around the nucleus only in those orbits for which the angular momentum is some integral multiple of h/2π where h is the Planck's constant (= 6.6 x10^{-34} J s).Thus the angular momentum (L) of the orbiting electron is quantized. That is L = nh/2π (iii) Bohr's third postulate states that an electron might make a transition from one of its specified non-radiating orbits to another of lower energy. When it does so, a photon is emitted having energy equal to the energy difference between the initial and final states. Radius of n^{th} orbit of electron, $r_n = \frac{n^2h^2\varepsilon_o}{\pi me^2}$	½ ½ ½ ½	2
21.	Explanation of Formation of potential barrier 1 Effect on height of barrier when p-n junction is- (i) Forward biased ½ (ii) Reverse biased ½ Due to the positive space- charge region on the n-side of the junction & negative space – charge region on the p- side of the junction a potential difference is developed across the junction of the two regions, which is	1	

	called potential barrier. (a) Barrier height reduces on forward biasing (b) Barrier height increases on reverse biasing	½ ½	2
	SECTION C		
22	(a) • Definition of mobility 1 • Change in mobility when (i) Temperature of conductor is decreased 1 (ii) Applied voltage is doubled 1 Mobility of free electrons in a conductor is defined as the magnitude of the drift velocity per unit electric field. Alternatively:- $\mu = \frac{\lvert\vec{v}_d\rvert}{E}$ (i) When the temperature of the conductor is decreased at constant potential difference the mobility will increase. (ii) When the applied potential difference is doubled at a constant temperature the mobility will be unchanged. Alternatively:- (i) $\mu = \frac{e\tau}{m}$ As temperature decreases τ will increase and μ will also increase. (ii) $\mu = \frac{e\tau}{m}$ As μ is independent of applied voltage hence μ remains unchanged. OR (b) Obtaining expression for equivalent emf 2 Equivalent resistance 1	 1 1 1	

	 When two cells are connected in parallel the total current $I=I_1+I_2$ --------------(1) $I=\frac{\varepsilon_1-V}{r_1}+\frac{\varepsilon_2-V}{r_2}$ $I=\left(\frac{\varepsilon_1}{r_1}+\frac{\varepsilon_2}{r_2}\right)-V\left(\frac{1}{r_1}+\frac{1}{r_2}\right)$ $V=\frac{\varepsilon_1 r_2+\varepsilon_2 r_1}{r_1+r_2}-I\left(\frac{r_1 r_2}{r_1+r_2}\right)$ Hence $\varepsilon_{eq}=\frac{\varepsilon_1 r_2+\varepsilon_2 r_1}{r_1+r_2}$ $r_{eq}=\frac{r_1 r_2}{r_1+r_2}$	½ ½ ½ ½ ½ ½	3
23.	(a) Definition of coefficient of self induction 1 (b) Calculation of self inductance 2 (a) Coefficient of self – induction – It is the flux linked with a coil when the current flowing through the coil is unity. Alternatively- Coefficient of self – induction – It is the self induced emf in a coil when the current in the coil changes at the rate of 1 A/S (b) Coefficient of self induction (L) $L=\frac{N^2\mu_0 A}{l}$ $L=\frac{(1500)^2\times 4\pi\times 10^{-7}\times 24\times 10^{-4}}{12\times 10^{-2}}$ $L=18\pi\times 10^{-3}H$ $=5.65\times 10^{-2}$ H	1 ½ ½ 1	3

24	Finding the (a) maximum current 1 (b) flux through the coil when current is zero 1 (c) flux through the coil when current is maximum 1 (a) Induced $Emf\,(\varepsilon) = N\frac{-d\phi_B}{dt} = -NBA\frac{d}{dt}(\cos\omega t)$ Induced $emf\,(\varepsilon) = NBA\,\omega\, sin\omega\, t$ $Current(\text{I}) = \frac{\varepsilon}{R} = \frac{NBA\omega Sin\omega t}{R}$ Max current $(I_{\max}) = \frac{NBA\omega}{R}$ (b) Flux through the coil $\phi_B = NBACos\omega t$ When current is zero, $\omega t = 0^0$ $\phi_B = NBA$ (c) When current is maximum, $\omega t = 90^0$ $\phi_B = 0$	 1 1 1	 3
25	Explanation of polarization of dielectric 1 Effect of dielectric on capacitance 1 Definition of dielectric constant 1 When a dielectric medium is filled inside a charged capacitor, it will develop a net dipole moment. The capacitance of a capacitor increases due to filling a dielectric medium because the electric field decreases. Alternatively- $C = \frac{A\varepsilon_0}{d}$ $C_m = \frac{A\varepsilon}{d} = \frac{KA\varepsilon_0}{d}$ $C_m = KC$ Dielectric constant of a medium :- It is the ratio of the permittivity of a medium to the permittivity of free space. (Note- Any other relevant definition)	 1 1 1	 3

26.	Finding new power of the lens 2 ½ Nature of the new lens ½ According to Lens- Makers formula: $\frac{1}{f}=(\mu-1)(\frac{1}{R_1}-\frac{1}{R_2})$ For biconvex lens $\frac{1}{0.6}=(1.5-1)(\frac{1}{R_1}-\frac{1}{R_2})---------(1)$ When immersed in medium:- $\frac{1}{f}=(\frac{1.5}{2}-1)(\frac{1}{R_1}-\frac{1}{R_2})---------(2)$ On solving equation (1) and (2):- $\frac{1}{f}=-\frac{5}{6}m$ $P=-\frac{5}{6}D$ Nature of lens will be concave or diverging.	½ ½ ½ 1 ½	3
27.	Calculating (a)Work function of the metal 1½ (b)The value of the function of the metal 1½ Work Function $(\phi_o)=h\nu_0$ $=6.63\times10^{-34}\times4\times10^{14}$ $=2.65\times10^{-19}$J From the Photoelectric equation:- $eV_o=h\nu-h\nu_0$ $1.6\times10^{-19}\times4.98=6.63\times10^{-34}[\nu-4\times10^{14}]$ On solving:- $\nu=1.6\times10^{15}$ Hz	½ 1 ½ 1	3

28.	(a) Explanation of formation of valence and conduction band 1 ½ (b) Differences between energy bands of (i) A metal ½ + ½ + ½ (ii) An insulator (iii) A semiconductor		
	(a) When the atoms come together to form a crystal, the filled energy levels having valence electrons come together to form the valence band and unfilled energy levels come together to form the conductor band above the energy gap.	1 ½	
	(b) (i) In case of metals the conduction band and valence band overlap.	½	
	(ii) In case of of insulators, a large band gap $E_g > 3eV$ exists between the conduction and valence bands.	½	
	(iii) In case of of semiconductors, a finite but small band gap $E_g < 3eV$ exists between the conduction and valence bands.	½	3
	SECTION - D		
29.	(i) (C) Spherical with charge at its centre	1	
	(ii) (A) Planes parallel to the XY plane	1	
	(iii) (C) Equipotential surfaces always enclose some volume	1	
	(iv) (a) (D) 0^0 OR (b) (B) move from A to B	1	4
30.	(i) (B) Balmer	1	
	(ii) (D) Pascher	1	
	(iii) (B) n = 1 to n = 3	1	
	(iv) (a) (A) 1:4 OR (b) (C) becomes smaller for higher levels	1	4
	SECTION - E		
31.	(i)Defining electric field 1 SI units ½ Deriving expression for electric field 1 Reason for test charge to be small ½ (ii) Finding the force on electron & α-particle ½+½ Acceleration of electron & α-particle ½+½		
	(i) Electric field due to a change Q at a point in space may be defined as the force that a unit positive charge would experience if placed at that point. S I unit is N/C	1	

Alternatively-
SI unit is V/m ½

The force between a source charge Q and test charge q will be

$$\vec{F} = \frac{Qq}{4\pi\varepsilon_0 r^2}\hat{r}$$

The electric field due to the source charge

$$\vec{E} = \lim_{q\to 0}\left(\frac{\vec{F}}{q}\right)$$

$$\vec{E} = \frac{Q}{4\pi\varepsilon_0 r^2}\hat{r}$$ 1

- The test charge should be as small as possible so that the source charge remains at its original location. ½

(ii) Electric field $(\vec{E}) = E_1\hat{i} + E_2\hat{j}$ (Given)

Force experienced by the electron $\vec{F}_e = -e\vec{E} = -e\left[E_1\hat{i} + E_2\hat{j}\right]$ ½

Acceleration of the electron $\vec{a}_e = -\frac{\vec{F}_e}{m_e} = -\frac{e}{m_e}\left[E_1\hat{i} + E_2\hat{j}\right]$ ½

Force experienced by an alpha particle ½

$\vec{F}_\alpha = 2e\vec{E} = 2e\left[E_1\hat{i} + E_2\hat{j}\right]$

Acceleration of the alpha-particle

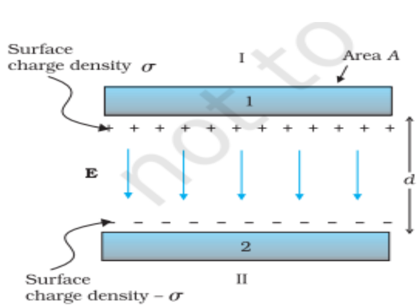
$\vec{a}_\alpha = \frac{2e}{m_\alpha}\left[E_1\hat{i} + E_2\hat{j}\right]$ ½

OR

(b)

(i) Obtaining expression for capacitance	2
(ii) Expressions for	
(1) Potential difference between the plates	1
(2) Capacitance of the capacitor	1
(3) Energy stored in the capacitor	1

(i)



	Electric field in between the plates of the capacitor $E=\frac{\sigma}{\varepsilon_0}=\frac{Q}{\varepsilon_0 A}-----------(1)$ The potential difference between the plates of the capacitor V=Ed The capacitance of the parallel plate capacitor $C=\frac{Q}{V}$ $C=\frac{\varepsilon_0 A}{d}$ (ii) (1) Potential difference when dielectric of constant K is filled $=\frac{\sigma \mathrm{d}}{\varepsilon_0 \mathrm{K}}$ Alternatively:- $\mathrm{V'}=\frac{\mathrm{V}}{\mathrm{K}}$ (2) Capacitance of the capacitor formed $=\frac{KA\varepsilon_0}{d}$ $C'=KC$ (3) Energy stored in the capacitor $=\frac{U}{K}$	½ ½ 1 1 1 1	5
32.	(a) (i)Discussing the motion of charged particle when it is moving (1) at an angle θ with field direction 1 (2) Perpendicular to the field direction 1 (3) Parallel to the field direction 1 (ii) Calculating (1) The speed of electron 1 (2) Potential difference 1 (i) The force on a charge particle of mass m and charge q moving in a uniform magnetic field $\vec{B}$ velocity $\vec{v}$ $\vec{F}=q(\vec{v}\times\vec{B})$ (1) The particle follows a helical path. As the component of velocity parallel to magnetic field tends to move the particle along linear path while the component perpendicular to magnetic field tends to move the particle in circular path. Hence, the particle follows a helical path. (2) The particle follows a circular path. As total magnetic force $(F=qvB)$ (3) The particle moves in a straight line. As force on particle will be zero.	 1 1 1	

(ii)

(1) Speed of the electron $v = \frac{qBr}{m}$ ½

$$v = \frac{1.6\times10^{-19}\times2\times10^{-3}\times18.2\times10^{-2}}{9.1\times10^{-31}}$$

$v = 6.4\times10^{7}$ m/s ½

(2) Accelerating Potential Difference

$$V = \frac{mv^2}{2e}$$ ½

$$V = \frac{9.1\times10^{-31}\times(6.4\times10^{7})^2}{2\times1.6\times10^{-19}}$$

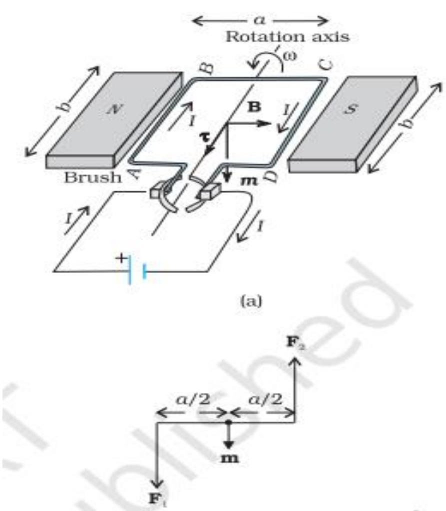
=11.65 kV ½

OR

(b)

(i) Deducing expression for Torque experienced by the coil	3
(ii) Calculating	
(1) The magnetic field	1
(2) The magnetic dipole moment	1

(i)



The field exerts no force on the two arms AD and BC of the coil.

The force on arm AB= F_1 = IbB ½

The force on arm CD=F_2=IbB ½

	The torque on the coil due to the pair of forces F_1 & F_2 tends to rotate the coil. Torque acting on the coil, $\tau = F_1 \frac{a}{2} + F_2 \frac{a}{2}$ $= IbB\frac{a}{2} + IbB\frac{a}{2}$ $\tau = IAB$ (ii) (1) Torque $\tau = IAB$ $B = \frac{\tau}{IA}$ $= \frac{8\times10^{-8}}{1.6\times10^{-6}\times0.08}$ $B = 0.62T$ (2) Magnetic dipole moment (m)=IA $m = 1.6\times10^{-6}\times0.08$ $m = 1.28\times10^{-7}\,Am^2$	½ ½ 1 ½ ½ ½ ½	5
33.	(a) (i) Relation between u, v and R — ½ Deriving lens maker formula — 1½ (ii) (1) Calculating focal length — 1 (2) Finding position and size of image — 2 (i) For a convex spherical surface, for light going from optically rarer to optically denser medium- $\frac{n_1}{-u} + \frac{n_2}{v} = \frac{n_2 - n_1}{R}$ For the refraction through the first convex surface (light going from rarer to denser medium) , the relation will be $\frac{n_1}{-u} + \frac{n_2}{v_1} = \frac{n_2 - n_1}{R_1}$ ------------- (1) For the refraction through the second convex surface (light going from denser to rarer medium) , the relation will be	 ½ ½	

$$\frac{-n_2}{v_1} + \frac{n_1}{v} = \frac{n_1 - n_2}{R_2} \quad ------------- \quad (2)$$

Adding equation (1) and (2) ½

$$\frac{n_1}{v} - \frac{n_1}{u} = (n_2 - n_1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \quad --------- (3)$$

From lens formula

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

Using equation (3) and (4)

$$\frac{1}{f} = (n_{21} - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$ ½

(ii)

(1) $P_1 = +25D \Rightarrow f_1 = 4\,cm$

$P_2 = -5D \Rightarrow f_2 = -20\,cm$

$$f = \frac{f_1 f_2}{f_1 + f_2} = \frac{4 \times (-20)}{-16}$$

$f = 5$ cm 1

(2) From lens formula

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$ ½

$$\frac{1}{v} = \frac{5-1}{25}$$

on solving

$$v = \frac{25}{4}\ cm$$ 1

Magnification $m = \frac{I}{O} = \frac{v}{u}$

$$I = \frac{v}{u} \times O = \frac{25}{4 \times (-25)} \times 4$$ ½

$I = -1$ cm

OR

(b)

(i) Giving reason:-

(1) For large focal length large aperture of objective lens 1

(2) Two sodium lamps cannot emit coherent lights 1

(3) For resultant intensity to vary between zero and four times the intensity 1

(ii) Calculating the wavelength of the light used 2

	(i) (1) The objective lens of a telescope should have large focal length and large aperture so that it is able to gather more light and hence has better resolving power. (2) Two sodium lamps which are independent cannot emit coherent lights as two independent sources cannot produce waves which have no phase difference or have constant phase difference between them. (3) The resultant intensity $I = 4I_o \cos^2 \frac{\phi}{2}$ I is maximum for $\phi = 0, 2\pi, 4\pi ----$ => $I_{max} = 4I_o$ I is minimum for $\phi = \pi, 3\pi, ----$ => $I_{min} = 0$ (ii) Fringe width $(\beta) = \frac{\lambda D}{d}$ ----------(1) When screen is moved 20 cm towards the slit; fringe width $(\beta') = \frac{\lambda(D-20)}{d}$ ------(2) Subtracting equation (1) and (2) $(\beta - \beta') = \frac{\lambda \times 20 \times 10^{-2}}{d}$ On solving $\lambda = 6 \times 10^{-7} m = 600 nm$	1 1 1 ½ ½ 1	5