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Physics Exam
Category B Practice Paper

October 14, 2018

Rules and Regulations

Marking Scheme

1. The question paper is divided in two parts: Objective and Subjective.
2. Each objective question is worth **2 point** and there is no negative marking.
3. You are not required to show your work for the objective part of the paper.
4. Each subjective problem is worth **10 points**.
5. For getting full credit in the subjective questions you need to give the detailed solutions. However, credit will also be awarded for partially correct solutions.
6. There is no negative marking in the subjective section as well.
7. **The subjective part will be graded only if you score above a certain cut-off (which will be decide later) in the objective section of the paper. However, for the final score, your total score (subjective + objective) will be taken into consideration.**

Miscellaneous

1. Any form of plagiarism will lead to disqualification
2. For solving the problems, you are allowed to use the Internet and books as resources.
3. Write the answer clearly, in a legible way. Write formal proofs wherever necessary. Be clear with your reasoning.
4. You are not allowed to post/discuss the problems in any online forum within the exam time.

Objective Questions

For **Problems 1-10**, each problem has **four** options, namely **(a), (b), (c), (d)**, of which ***only one*** is correct, **2 point** will be awarded for correctly answering a problem, **NO** negative marks shall be awarded for wrong answers/unattempted problems .

Problem 1. *A rope whose mass is not negligible supports a block of mass* 10 *times that of rope. A pulse is generated in string near lower end, the pulse moves up with acceleration:*

(a) g

(b) $\frac{g}{10}$

(c) $\frac{g}{5}$

(d) $\frac{g}{2}$

Problem 2. *Four particles each of mass m are located at equal distances from each other. If the separation between any two particles is d then their gravitational potential energy is:*

(a) $\frac{-6Gm^2}{d}$

(b) $\frac{-Gm^2}{6d}$

(c) $\frac{-Gm^2}{8d}$

(d) $\frac{-4Gm^2}{d}$

Problem 3. *An electron beam travelling at* 10^7 *m/s strikes a metal target and absorbed by it. If the mass of target is* 0.5 *gm and its specific heat is* 100 *cal/kg* ^oC*, find the rate at which its temperature rises. Given the electron beam current is* $0.048A$ *and no heat losses by target in form of conduction or radiation.*

(a) $30^\circ C/sec$

(b) $55^\circ C/sec$

(c) $60^\circ C/sec$

(d) $65^\circ C/sec$

Problem 4. *A circular loop of radius R carries a current I. Another circular loop of radius $r(<< R)$ carries a current i and is placed at the centre of the larger loop. The planes of the two circles are at right angle to each other. The torque acting on the smaller loop is:*

(a) $\frac{2\mu_0 \pi i I r^2}{R}$

(b) $\frac{\mu_0 i I r^2}{2\pi R}$

(c) $\frac{\mu_0 \pi i I r^2}{2R}$

(d) $\frac{\mu_0 i I r}{2\pi R}$

Problem 5. *In a hydrogen like atom an electron is moving in an orbit having quantum number m. Its frequency of revolution is $13.2 \times 10^{15} Hz$. Energy required to remove this electron from the given orbit is $54.4 eV$. In a time of 7 nano second the electron jumps back to orbit having quantum number $\frac{m}{2}$. If τ is the average torque acted on the electron during the above process, then τ is:*

(a) $2.5 \times 10^{23} Nm$

(b) $2.5 \times 10^{24} Nm$

(c) $1.5 \times 10^{23} Nm$

(d) $1.5 \times 10^{24} Nm$

Problem 6. *When a surface is irradiates with light of wavelength $4950 \mathring{A}$, a photocurrent appears which vanishes if a retarding potential greater than $0.6 V$ is applied across the phototube. When a second source of light is used. It is found that the retarding potential is changed to $1.1 V$. The wavelength of the second source is:*

(a) $5150 \mathring{A}$

(b) $4125 \mathring{A}$

(c) $6150 \mathring{A}$

(d) $4500 \mathring{A}$

Problem 7. *A thin film of uniform thickness has refractive index $\sqrt{2}$. This film is illuminated by white light incident at an angle 30°. The transmitted light is found to have a*

maximum value of intensity for a wavelength $5000\mathring{A}$*. The minimum thickness of the film is:*

(*a*) 123.6 *nm*

(*b*) 188.9 *nm*

(*c*) 223.6 *nm*

(*d*) 288.9 *nm*

Problem 8. *A hydrogen atom in excited state n reaches the ground state by emitting three photons of frequency in ratio* $5 : 72 : 243$*. If wavelength corresponding to one of the transition belongs to visible region, then the value of n is:*

(*a*) 9

(*b*) 12

(*c*) 15

(*d*) 18

Problem 9. *Two identical particles A and B each having charge q when released with initial separation* $1m$ *between them, their separation becomes double in time t. How long will it take to double the separation, if charge of particle A is made* $2q$*, charge of particle B is made* $3q$ *and they are released with initial separation* $6m$*?*

(*a*) t

(*b*) $\frac{t}{6}$

(*c*) $6t$

(*d*) $\sqrt{6}t$

Problem 10. *A Particle of mass* m_1 *collides elastically with a stationary particle of mass* $m_2(m_1 > m_2)$*. Find the maximum angle through which the striking particle may deviate as a result of collision.*

(*a*) $\arccos \frac{m_2}{m_1}$

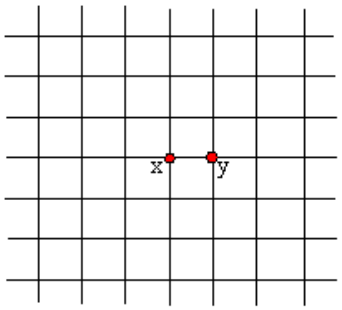
(*b*) $\arcsin \frac{m_2}{m_1}$

(*c*) 90°

(*d*) 180°

Subjective Problems

Problem 1. *Figure shows an infinite wire grid with square cells. The resistance of each wire between neighbouring junctions is R. Find the equivalent resistance of the grid across*



two points X and Y.

Problem 2. *A point like radioactive sample of decay constant λ initially at a distance d_0 from a radiation counter starts moving towards the counter. If the count number recorded by the counter remains constant with time, express the distance d between the radioactive sample and the counter as function of time and its initial speed.*

Problem 3. *Find the efficiency of a cycle consisting of two isobaric and two adiabatic lines, if the pressure changes n times withing the cycle. The working substance is an ideal gas whose adiabatic exponent is equal to γ.*