**ANSWER KEY**

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HINTS & SOLUTIONS

PHYSICS

1. (b) 
   \( L \uparrow, z \uparrow, I \downarrow \) so brightness ↓

2. (c) 
   \[ \mu(mg \cos \theta) = mg \sin \theta \]
   \[ \mu = \tan \theta \]

3. (c) 
   Angle of contact between the surface and liquid \( 0 < 90^\circ \).

4. (b) 
   Frequency of microwave is less than visible light.
   Frequency of microwaves = Resonant frequency of \( H_2O \) molecules.

5. (c) 
   \[ w_{\text{net}} = \text{Area} \times \frac{1}{2} AC \cdot BC \]
   \[ = \frac{1}{2} \times 5 \times 10^{-3} \times 4 \times 10^5 \]
   \[ = -10^3 \text{J} \]

6. (c) 
   \[ R = \frac{\rho \ell}{A}, \ell' = 3\ell, \quad A' = \frac{A}{3} \]
   So, \( R' = 9R \)  
   \[ R_{\text{new}} = 9 R_{\text{old}} = 36 \]

7. (d) 
   \[ I = \frac{3v^2}{4g} \]
   \[ \frac{1}{2} I \omega^2 + 0 + \frac{1}{2} mv^2 = mg \times \frac{v^2}{g} \]
   \[ \frac{1}{2} I \omega^2 = mv^2 - \frac{1}{2} mv^2 = \frac{mv^2}{2}, \quad \frac{1}{2} I \frac{v^2}{R^2} = \frac{mv^2}{2} \]
   \[ I = mR^2 \text{ (Ring)} \]

8. (a) 
   \[ M = m \times \ell \quad M' = m \times r \sqrt{2} \]
   \[ \ell = \frac{\pi r}{2} \quad M' = \frac{2\sqrt{2}}{\pi} M \]
   So, \( m' = \frac{3}{\pi} M \)

9. (c) 
   \[ \tau = mg \frac{L}{4} = I \alpha = \left( \frac{mL^2}{12} + \frac{mL^2}{16} \right) \alpha \]
\[ \alpha = \frac{\text{mgL}}{4 \left( \frac{\text{mL}^2}{48} \times 7 \right)} = \frac{12 \text{ g}}{7 \text{ L}}, \quad \alpha = \frac{12 \text{ g}}{7 \text{ L}} \]

10. (d)

\[ \Delta V = \beta \frac{R_{\text{out}}}{R_{\text{in}}} \implies G = 25 \frac{R_{\text{out}}}{R_{1}} \quad \ldots \quad (i) \]

\[ g_m = \beta \frac{R_{\text{in}}}{R_1} \implies R_1 = \frac{g_m}{\beta} = 25 \times 0.03 \quad \ldots \quad (i) \]

\[ G' = 20 \frac{R_{\text{out}}}{25} \times 0.02 \quad \ldots \quad (ii) \]

\[ G' = \frac{2}{3} G = \frac{2}{3} \times 12 = 8 \]

11. (d)

\[ y = \frac{n\lambda D}{d}, \quad \left( n_1 + \frac{1}{2} \right) = \left( n_2 + \frac{1}{2} \right) \]

12. (d)

\[ 2 \times 6 = 12 \]

\[ 120^\circ \]

\[ 1 \times 12 = 12 \]

\[ 4 \text{ m} \]

\[ m = 3 \text{ kg} \]

13. (a)

\[ P = \frac{\Delta P}{P} \times 100 \% = 3 \frac{\Delta a}{a} \times 100 \% + 2 \]

\[ \frac{\Delta b}{b} 100 \% - \frac{\Delta c}{c} 100 \% - \frac{\Delta d}{d} \times 100 \% \]

\[ = 3.1 + 2.2 - 3 - 4 = 3 + 4 - 3 - 4 = 0 \% \]

14. (c)

\[ i = \frac{E}{r + R}, \quad 2.1 = \frac{2.1}{r + 0} \quad r = 1 \]

15. (c)

16. (a)

\[ P = \frac{E}{C} \quad \ldots \quad (i) \]
\[ \lambda_p = \frac{\hbar C}{E} \] ...(ii)
\[ \lambda_c^2 = \frac{\hbar}{\sqrt{2mE}}, \quad \lambda_e^2 = \frac{\hbar}{2mc} \lambda_p \]

17. (b)

value of x is \( \frac{1}{8} \)

\[ x_0 = \frac{x_0}{2^4} \Rightarrow t = 4T = 4 \times 20 = 80 \]

Alternate:

\[ X \rightarrow Y_0 \]
\[ t = 0 \quad N_0 \quad 0 \]
\[ t = t \quad N \quad N_0 - N \]

\[ \frac{N}{N_0 - N} = \frac{1}{15}, \quad \frac{N}{N_0} = \frac{1}{16} \]

\[ t = 4t, \quad 4 \times 20 = 80 \]

18. (a)

\[ V_1 > V_2 \]

as \( P = \text{constant} \Rightarrow V \propto T \)

19. (d)

\[ \frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} \]

\[ = (\mu_1 - 1) \left( \frac{1}{\infty} - \frac{1}{-R} \right) + (\mu_2 - 1) \left( \frac{1}{\infty} - \frac{1}{R} \right) \]

\[ = \frac{(\mu_1 - 1)}{R} \left( \frac{(\mu_2 - 1)}{R} \right) = \frac{1}{f} = \frac{\mu_1 - \mu_2}{R} = 0 \]

\[ f = \infty \]

20. (c)

\[ Y = A \sin (\omega t + kx + \phi) \]
\[ \omega = 2\pi f = \frac{2\pi}{\frac{\pi}{2}} = 2 \]
\[ k = \frac{2\pi}{\lambda} = \frac{2\pi}{2\pi} = 1 \]

\[ Y = 1 \sin (2t + x + \phi) \]

21. (d)
22. (a) 
\[ U_i = \frac{-GMm}{R}, \quad U_f = \frac{-GMm}{2R} \]
\[ \Delta U = \frac{-GMm}{2R} + \frac{GMm}{R} = \frac{mgR}{2} \]

23. (a) 
\[ E_0 = \frac{G \times 2}{1^2} - \frac{G \times 2}{2^2} - \frac{G \times 2}{4^2} - \frac{G \times 2}{8^2} \]
\[ = -2G \left[ 1 + \frac{1}{4} + \frac{1}{16} + \ldots \infty \right] = -2G \times \frac{1}{1 - \frac{1}{4}} = -\frac{8}{3}G \]

24. (b) 
\[ E = \frac{F}{q} = \frac{ma_e}{e} \quad (\text{east}) \]

For 3a0 towards east

We have to apply \( B = \frac{2ma_e}{ev_0} \) (upward)

25. (b)
\[ \theta = \frac{Y}{D} = \frac{n \lambda D}{dD}, \quad \text{so} \quad \frac{\lambda}{d} \]

26. (b)
27. (a)
28. (c)
29. (d)
30. (b)
31. (d)
32. (d)
33. (d)
34. (a)
35. (b)
36. (a)
37. (a)
38. (a)
BOTANY

91. \( \text{YYRr} = 2/16 + \text{YyRR} = 2/16 + \text{Yyrr} = 2/16 + \text{yyRr} = 2/16 = 8/16 \quad \therefore \quad 32/64 \)
\( \text{YYRR} = 1/16 + \text{YYrr} = 1/16 + \text{yyRR} = 1/16 + \text{yyrr} = 1/16 = 4/16 \quad \therefore \quad 16/64 \)

92. (d)
Pusa Gaurav is a variety of Brassica.

93. (a)
\( Glomus \) is a fungus-mycorrhiza.

94. (b)
Eyes on potato are scale leaves with axillary buds.
[C & D produce foliar buds.]

95. (b)
Leakage of Methyl-iso-cynate from Union carbide Pesticide plant, at Bhopal.

96. (c)
Jamun and date are 1-seeded berries. Grapes is a seedless berry. Cheeku and Areca are also berries. All the remaining fruits are with stony endosperm.

97. (b)
Anaphase of mitosis and Anaphase II of meiosis both involve haploidy of DNA, therefore separation of chromatids. In Anaphase I of meiosis separation of chromosomes occurs.

98. (d)
Brinjal (\text{Solanum melongen1}), and Belladona belong to family solanaceae.

99. (c)
Amphicribal is hadrocentric; present in fern rachis amphivasal is leptocentric.

100. (b)
Very fair is with one dominant gene, and there can be 6 out of 64, therefore approximately 10%.

101. (d)
Polysomes, i.e. many ribosomes on same mRNA molecular, therefore they produce identical polypeptide chains in rapid successions.

102. (a)
For DNA fingerprinting hair-follicle or root of hair is required. Largest human gene-dystrophin is with 2.4 million bases.

103. (d)
In eukaryotes, Monocistronic structural gene is interrupted by non-coding sequences- introns.

104. (a)
Chickenpox – ds DNA; Polio & HIV – ss RNA.

105. (a)
Guano deposits are excreta of marine birds, that are rich in phosphorous.

106. (b)
Carrot grass is Parthenium, pollen grains cause allergies.

107. (c)
Rice seedling infected by \text{Gibberella}; a fungus belonging Ascomycetes.
108. (d) Atlas-66 is a protein rich variety of wheat; Protina, Shakti & Rattan are lysine-rich maize varieties.

109. (b) *Ipomoeabatatas* i.e. sweet potato produces tuberous roots singly and not in cluster. It is adventitious root.

110. (c) Motor cells or bulliform cells lose water and bring about rolling of leaves in dry weather. These are present in monocot leaves.

111. (c) Typical, Mendelian di-hybrid test cross ratio is 1 : 1 : 1 : 1, as there is independent assortment. 1 : 1 ratio indicates linkage. The two genes are on the same chromosome and very close to each other.

112. (a) In lower organisms asexual reproduction is more common, algae produce motile spores and yeast reproduces by budding.

113. (b) Additional X-chromosome (44 + XXY = 47), results in Klinefelter’s syndrome that shows overall masculine development + breast development.

114. (d) In eukaryotes ribosomes are 80s and the two subunits are 40s and 60s.

115. (a)

116. (b) Insecta is class, the other three are orders.

117. (d) Lysosomes contain hydrolytic enzyme such as lipases, proteases, etc.

118. (a) 0.1% soln. of mercuric chloride is used as fungicide. It is sprayed on dried, pasted twigs.

119. (b) Nitrogenase is a Mo-Fe protein.

120. (a) *Navicula* & *Triceratium* are diatoms.

121. (b) The most primitive (ancient) bacteria – Archaebacteria are the oldest living fossils.

122. (d) Pineapple is a CAM plant; *Amaranthus* is a dicot showing Hatch and Slack pathway, *Oryza* is a C₃ plant.

123. (d) 

\[
2H_2O \rightarrow 4H^+ + 4e^- + O_2
\]

10 NADH₂ & 2 FADH₂ are formed per glucose molecule in respiration therefore 12 molecules of metabolic water are formed.

124. (c) Mitochondria are involved but ATP are not formed.

125. (c) Cell ‘x’ is fully turgid, so water will move from x \(\rightarrow\) y.

126. (d) Sexual reproduction is by somatogamy or spermatization and the basidiospores are formed by meiosis.
In beet and black-paper, perisperm is present.

128. (d)
129. (c)

Phylloids are not true leaves, stomata present at the apophysis.

130. (a)

All are ornithophilous flowers, they lack fragrance.

131. (d)
132. (b)
133. (a)
134. (d)
135. (c)

ZOOLOGY

136. Cyclostomes are jawless vertebrates
138. Pulse pressure = systolic pressure – diastolic pressure
141. Calcium is essential for muscular contraction
142. Lactose is broken down into glucose and galactose by lactase.
143. REN digests phosphodiester bonds formed between sugar and phosphate groups of nucleic acid
144. Epidemiology is study of spread of disease.
146. Primitive atmosphere was reducing
149. Lub is first heart sound produced due to closure of bicuspid and tricuspid valves i.e. AV valves
150. Rennin is a proteolytic enzyme and JG cells secrete Renin that controls blood pressure.
151. During menstrual cycle, myometrium is not regenerated, endometrium is repaired. When FSH and LH attain peak level, ovulation occurs causing formation of corpus luteum that results in increased secretion of progesterone.
155. Adenylic acid or AMP is a nucleotide Ađênine + ribose sugar + phosphate group
157. Use of calcium chloride produces pores on bacterial cell wall, thus facilitating uptake of rDNA.
163. Sympathetic nervous system disturbs the homeostasis of body.
167. Nasal cartilage is hyaline in nature.
168. Hydra – radial symmetry
   Tapeworm – bilateral symmetry
   Octopus – bilateral symmetry
   Sea urchin – spherical / radial symmetry
169. Renin is produced by JG cells that converts blood protein Angiotensinogen to angiotensin I.
170. Stapes being the smallest ear ossicle is in contact with fenestra ovalis so that max amplification is possible.
171. Pituitary can regulate only adrenal cortex through ACTH and not adrenal medulla which is under control of sympathetic nervous system.
172. Peptide hormones act through secondary messengers like cyclic AMP, IP₃, Ca²⁺ etc