Q. 1. 1. b – 1 sec  
2. b – throughout increases  
3. d – 8 % (I α MR^2 & M α R^2, i.e., I α R^2)  
4. b – (An)^2  
5. d - centrifugal force > gravitational force  
6. c – 2.5 cm  
7. a – Should be concave

Q. 2. 1. Formula 1 mark
Dimensions \( \left( \text{M}^{-1} \text{L}^3 \text{T}^{-2} \right) \) 1 mark
2. P. E. = \(-\frac{G M m}{R}\) \(\frac{1}{2}\) mark
Substitution \(\frac{1}{2}\) mark, 
answer \(-2.001 \times 10^{11}\) J 1 mark (1/2 mark for negative sign and for unit)
3. \(MK^2 = I = \left(\frac{7}{5}\right) MR^2\) 1 mark
\(K = \sqrt{\frac{14}{15}} R\) 1 mark
4. \(\frac{1}{2}\) mark each
5. 1 mark each (1/2 mark for proper symbols on axes)
6. As per answer (Any method, exact or approximate)
7. \(T = \frac{\int \text{f}}{2(2\pi r)}\) \(\frac{1}{2}\) mark
Substitution \(\frac{1}{2}\) mark
Answer 50 dynes/cm 1 mark
8. 1 mark each
Q. 3.  1. Figure is not essential. Meanings of symbols must be mentioned. Step wise marks.

2. Figure ½ mark. Stepwise 2.5 marks, starting with equation of source particle and then introducing negative phase difference.

3. \( N' = N \left[ \frac{v_1 + v_2}{v_1 - v_2} \right] \) ½ mark

\( v_0 = v_2 = v_{\text{train}} = 10 \text{ m/s} \) ½ mark

\( N' = 700 \text{ Hz} \) 1 mark

\( f_{\text{beats}} = 40 \text{ Hz} \) ½ marks

Beats not audible or not detectable ½ mark

4. Correct number of oscillations, per day = \( \frac{86400}{2} = 43200 \) ½ mark

Actual number of oscillations performed, per day \( \frac{86400}{1.98} = 43640 \) 1 mark

Number of oscillations gained, per day = \( 43640 - 43200 = 440 \) ½ mark

Time gained, per day = \( 440 \times 2 = 880 \text{ s} \) 1 mark

Q. 4. A. Step wise marks (4)

B) \( P. V^' = \text{constant} \) ½ mark

\( Y = \frac{7}{5} = 1.4 \) ½ mark

Calculation 1 mark

Answer = 2.639 atm 1 mark

Q. 4. OR. A. Figure with directions of vectors ½ mark

Remaining 2.5 marks stepwise.

B. \( I_1 n_1 - I_2 n_2 = (I_1 + I_2)n \) 1 mark

Answer = 5 rpm, in the sense of rotation of second wheel. 1 mark

Q. 5. 1. D – frequency

2. D – 1.732

3. A – \( (M^{-1} L^{-2} T^4 I^2) \)
Q. 6. 1. Number of waves \( \frac{d_g}{\lambda_g} = \frac{12 \ \mu m}{\lambda_u} \) 1 mark

Answer \( d_g = 8 \ \mu m \) 1 mark

2. Definition 1 mark

Gyromagnetic ratio = \( \frac{e}{2m_e} = 8.8 \times 10^{10} \frac{C}{kg} \) 1 mark

3. Each point, 1 mark.

4. Figure, 1 mark

Labelling, 1 mark.

5. \( 1 + \frac{1}{2} + \frac{1}{2} \) mark

6. Formula \( \frac{1}{2} \) mark, substitution 1 mark, answer \( 2 \times 10^{-4} \) A (0.2 mA) \( \frac{1}{2} \) mark.

7. \( d\theta = 1.22 \frac{\lambda}{D} = 3.66 \times 10^{-7} \) radian.

Formula \( \frac{1}{2} \) mark, substitution 1 mark, answer \( \frac{1}{2} \) mark.

8. Formula \( \frac{1}{2} \) mark, substitution 1 mark, answer \( \frac{1}{\sqrt{2}} = 0.7071 \) g \( \frac{1}{2} \) mark.

Q. 7. 1. Limitations of Rutherford theory: \( \frac{1}{2} \) mark each.

How those are overcome in Bohr’s theory (in postulate II and III): 1 mark each.

2. Any method, answer 2.016 V (\( E = 6.216 \) eV, \( \phi = 4.2 \) V, i.e., answer 2.016 V)

3. \( C = \frac{1}{4\pi^2 \int_0^L f^2} = \frac{1}{1000\pi^2} = 1.012 \times 10^{-4} \) F 2 marks

\( I = \frac{V}{R} = 3 \) A 1 mark

4. Diagram 1 mark 1 mark

Explanation of amplitude modulation 1 mark
Q. 8. I. Voltage across 3μF capacitor is $2 \times \frac{5}{3} = \frac{10}{3}$ volts  
\[ \therefore Q = CV = 10 \mu C \]
2 marks

II. 'r' by potentiometer, figure  
1 mark

Description and formula  
3 marks

Q. 8. OR. A. Figures  
½ mark, each

Description,  
1½ mark each.

B. Voltage rating is unchanged during shunting  
\[ \therefore V = 5 \text{ V} \]
1 mark

\[ S = G, \therefore \text{Current range is doubled,} \therefore I = 200 \mu \text{A.} \]
2 marks.