

2021年度 東北医科薬科大学 物理 解答速報(1月23日実施分) 医学部

解答番号	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
答	3	1	6	3	3	5	3	6	4	2	4	2	2	5	6
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	5	6	2	1	1	2	7	2	4	2	7	1	3	4	8
	31	32	33	34											
	2	2	7	5											

講評

概ね易化。I IIIの後半はやや難か。6割から7割の得点者が多そうであるから、合格には7割5分は欲しい。

解説

[I]

問1

$$1. \text{ 台 : } MA = F - T \quad \text{小物体 : } mA = T \quad \textcircled{2}$$

問2

$$2. \quad 1. \text{ より } A = \frac{F}{M+m} \text{ (左向き)} \quad \textcircled{1}$$

問3

$$3. \quad MA = F - T - N \quad \textcircled{6}$$

問4

$$4. \quad ma = T - mA \quad \textcircled{3}$$

問5

$$5. \quad \text{おもりの鉛直方向 : } m'a = m'g - T$$

$$\text{おもりの水平方向 : } 0 = N - m'A \quad \textcircled{3}$$

問6

6. 3.4.5. より T, N, A を消去して、

$$a' = \frac{m'}{m}g - \frac{M+m'}{M+m+m'}a - \frac{1}{M+m+m'}F < \frac{m'}{m}g - \frac{1}{M+m+m'}F < 0$$

$$F > \frac{m'}{m}(M + m + m')g \quad \textcircled{5}$$

問 7

$$\begin{aligned} 7. \quad MA &= Mg \sin \theta + N' \sin \theta + N' \sin \theta + T \sin \theta - N \cos \theta - T \cos \theta \\ &= (Mg + N' + T) \sin \theta - (N + T) \cos \theta \quad \textcircled{3} \end{aligned}$$

問 8

$$8. \quad \text{小物体の鉛直方向} : 0 = mg - N' - mA \sin \theta$$

$$\text{小物体の鉛直方向} : ma = T - mA \cos \theta \quad \textcircled{6}$$

問 9

$$\text{おもりの鉛直方向} : m'a' = m'g - T - m'A \sin \theta$$

$$\text{おもりの水平方向} : 0 = N - m'A \cos \theta \quad \textcircled{4}$$

問 10

$$10. \quad \text{斜面方向} : (M + m + m')a = (M + m + m')g \sin \theta \quad \therefore a = g \sin \theta \quad \textcircled{2}$$

問 11

$$11. \quad 8.9.10. \text{より } a = a' = 0 \quad A = g \sin \theta \text{ とすると、}$$

$$0 = T - mg \sin \theta \cos \theta$$

$$0 = m'g - T - m'A \sin^2 \theta$$

辺々加えて

$$0 = m'g - mg \sin \theta \cos \theta - m'g \sin^2 \theta$$

$$0 = m' - m \cdot \frac{\tan \theta}{1 + \tan^2 \theta} - m' \cdot \frac{\tan^2 \theta}{1 + \tan^2 \theta} \quad \therefore \tan \theta = \frac{m'}{m} \quad \textcircled{4}$$

[II]

$$\text{問 1} \quad 12. \quad \frac{V}{R_1} \quad \textcircled{2} \quad 13. \quad \frac{V^2}{R_1} \quad \textcircled{2}$$

$$\text{問 2} \quad 14. \quad \frac{\left(\frac{R_1}{R_1 + R_2}V\right)^2}{R_1} = \frac{R_1 V^2}{(R_1 + R_3)^2} \quad \textcircled{5} \quad 15. \quad \frac{\left(\frac{R_2}{R_1 + R_2}V\right)^2}{R_3} = \frac{R_2 V^2}{(R_1 + R_3)^2} \quad \textcircled{6}$$

$$\text{問 3} \quad 16. \quad C \left(\frac{R_2}{R_1 + R_2}V\right) = \frac{CR_2 V}{R_1 + R_2} \quad \textcircled{5} \quad \text{問 4} \quad \frac{1}{2}C \left(\frac{R_2}{R_1 + R_2}V\right)^2 = \frac{CR_2^2 V^2}{2(R_1 + R_2)^2} \quad \textcircled{6}$$

$$\text{問 5} \quad 18. \quad \frac{V^2}{R_1} \quad \textcircled{2} \quad 19. \quad 0 \quad \textcircled{1} \quad \text{問 6.} \quad 0 \quad \textcircled{1}$$

$$\text{問 7} \quad 21. \quad \frac{1}{2}L \left(\frac{V}{R_1}\right)^3 = \frac{LV^2}{2R_1^2} \quad \textcircled{2}$$

問 8 22. $\frac{Q^2}{2C} \leq \frac{LV^2}{2R_1^2} \quad \therefore Q \leq \sqrt{LC} \frac{V}{R_1} \quad \textcircled{7}$

[Ⅲ]

問 1 23. 2 24. $f_1 = \frac{1}{0.2} = 5\text{Hz} \quad v_1 = f_1 \lambda = 5 \times 2 = \frac{10\text{m}}{\text{s}} \quad \textcircled{4}$

問 2 25. ② 問 3 26. $\frac{dy}{dt} = A_1 w_1 \cos\left\{w_1 \left(t - \frac{x}{v_1}\right)\right\} \quad \textcircled{7}$

問 4 27. $\Delta E = 2 \times \frac{1}{2} \Delta m \left[A_1 w_1 \cos\left\{w_1 \left(t - \frac{x}{v_1}\right)\right\} \right]^2 = \Delta m A_1^2 w_1^2 \cos^2\left\{w_1 \left(t - \frac{x}{v_1}\right)\right\} \quad \textcircled{1}$

問 5 28. $\Delta E = \rho_1 \Delta x A_1^2 w_1^2 \cos^2\left\{w_1 \left(t - \frac{x}{v_1}\right)\right\} \quad u_1 = \frac{\Delta E}{\Delta x} = \rho_1 \Delta x A_1^2 w_1^2 \cos^2\left\{w_1 \left(t - \frac{x}{v_1}\right)\right\}$

$$\overline{u_1} = \rho_1 A_1^2 w_1^2 \overline{\cos^2\left\{w_1 \left(t - \frac{x}{v_1}\right)\right\}} = \frac{1}{2} \rho_1 A_1^2 w_1^2 \left[1 - \overline{\cos\left\{2w_1 \left(t - \frac{x}{v_1}\right)\right\}} \right] = \frac{1}{2} \rho_1 A_1^2 w_1^2 \quad \textcircled{3}$$

問 6 29. ④ 30. ⑧ 問 7 31. ② 問 8 32. ② 33. ⑦ 問 9 34. ⑤