See back cover for an English translation of this cover.

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L3–PHYSMR

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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Te Mātai Ahupūngao, Kaupae 3, 2024

TE PUKAPUKA RAUEMI

Tirohia tēnei pukapuka hei whakaoti i ngā tūmahi kei ō Pukapuka mō ngā Tūmahi me ngā Tuhinga.

Tirohia kia kitea ai e tika ana te raupapatanga o ngā whārangi 2–5 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

E ĀHEI ANA TŌ PUPURI KI TĒNEI PUKAPUKA HEI TE MUTUNGA O TE WHAKAMĀTAUTAU.

Ka whaitake pea ki a koe ngā raraunga me ngā tikanga tātai e whai ake nei.

91523 Te whakaatu māramatanga ki ngā pūnaha ngaru

$$d\sin\theta = n\lambda \qquad n\lambda = \frac{dx}{L} \qquad f' = f\frac{v_{\mathrm{W}}}{v_{\mathrm{W}} \pm v_{\mathrm{S}}} \qquad v = f\lambda \qquad f = \frac{1}{T}$$

91524 Te whakaatu māramatanga ki ngā pūnaha pūhanga

$$F = ma \qquad p = mv \qquad \Delta p = F\Delta t \qquad \Delta E_{\mathrm{p}} = mg\Delta h$$

$$W = Fd \qquad E_{\mathrm{K(LIN)}} = \frac{1}{2}mv^2 \qquad x_{\mathrm{COM}} = \frac{m_1x_1 + m_2x_2}{m_1 + m_2}$$

$$d = r\theta \qquad v = r\omega \qquad a = r\alpha \qquad \omega = \frac{\Delta\theta}{\Delta t}$$

$$\alpha = \frac{\Delta\omega}{\Delta t} \qquad \omega = 2\pi f \qquad f = \frac{1}{T} \qquad E_{\mathrm{K(ROT)}} = \frac{1}{2}I\omega^2$$

$$\omega_{\mathrm{f}} = \omega_{\mathrm{i}} + \alpha t \qquad \theta = \frac{\omega_{\mathrm{f}} + \omega_{\mathrm{i}}}{2}t \qquad \omega_{\mathrm{f}}{}^2 = \omega_{\mathrm{i}}{}^2 + 2\alpha\theta \qquad \theta = \omega_{\mathrm{i}}t + \frac{1}{2}\alpha t^2$$

$$\tau = I\alpha \qquad \tau = Fr \qquad L = mvr \qquad \theta = \omega_{\mathrm{f}}t - \frac{1}{2}\alpha t^2$$

$$F_{\mathrm{g}} = \frac{\mathrm{G}Mm}{r^2} \qquad F_{\mathrm{c}} = \frac{mv^2}{r} \qquad L = I\omega$$

$$F = -ky \qquad E_{\mathrm{p}} = \frac{1}{2}ky^2 \qquad T = 2\pi\sqrt{\frac{l}{g}} \qquad T = 2\pi\sqrt{\frac{m}{k}}$$

$$y = A\sin\omega t \qquad v = A\omega\cos\omega t \qquad a = -A\omega^2\sin\omega t \qquad a = -\omega^2 y$$

$$y = A\cos\omega t \qquad v = -A\omega\sin\omega t \qquad a = -A\omega^2\cos\omega t$$

You may find the following formulae and data useful.

91523 Demonstrate understanding of wave systems

$d\sin\theta = n\lambda$ $\quad n\lambda = \dfrac{dx}{L}$ $\quad f' = f\dfrac{v_{\mathrm{W}}}{v_{\mathrm{W}} \pm v_{\mathrm{S}}}$ $\quad v = f\lambda$ $\quad f = \dfrac{1}{T}$

91524 Demonstrate understanding of mechanical systems

$F = ma$ $\quad p = mv$ $\quad \Delta p = F\Delta t$ $\quad \Delta E_{\mathrm{p}} = mg\Delta h$

$W = Fd$ $\quad E_{\mathrm{K(LIN)}} = \dfrac{1}{2}mv^2$ $\quad x_{\mathrm{COM}} = \dfrac{m_1x_1 + m_2x_2}{m_1 + m_2}$

$d = r\theta$ $\quad v = r\omega$ $\quad a = r\alpha$ $\quad \omega = \dfrac{\Delta\theta}{\Delta t}$

$\alpha = \dfrac{\Delta\omega}{\Delta t}$ $\quad \omega = 2\pi f$ $\quad f = \dfrac{1}{T}$ $\quad E_{\mathrm{K(ROT)}} = \dfrac{1}{2}I\omega^2$

$\omega_{\mathrm{f}} = \omega_{\mathrm{i}} + \alpha t$ $\quad \theta = \dfrac{\omega_{\mathrm{f}} + \omega_{\mathrm{i}}}{2}t$ $\quad \omega_{\mathrm{f}}{}^2 = \omega_{\mathrm{i}}{}^2 + 2\alpha\theta$ $\quad \theta = \omega_{\mathrm{i}}t + \dfrac{1}{2}\alpha t^2$

$\tau = I\alpha$ $\quad \tau = Fr$ $\quad L = mvr$ $\quad \theta = \omega_{\mathrm{f}}t - \dfrac{1}{2}\alpha t^2$

$F_{\mathrm{g}} = \dfrac{\mathrm{G}Mm}{r^2}$ $\quad F_{\mathrm{c}} = \dfrac{mv^2}{r}$ $\quad L = I\omega$

$F = -ky$ $\quad E_{\mathrm{p}} = \dfrac{1}{2}ky^2$ $\quad T = 2\pi\sqrt{\dfrac{l}{g}}$ $\quad T = 2\pi\sqrt{\dfrac{m}{k}}$

$y = A\sin\omega t$ $\quad v = A\omega\cos\omega t$ $\quad a = -A\omega^2\sin\omega t$ $\quad a = -\omega^2 y$

$y = A\cos\omega t$ $\quad v = -A\omega\sin\omega t$ $\quad a = -A\omega^2\cos\omega t$

91526 Te whakaatu māramatanga ki ngā pūnaha hiko

$$V = Ed \qquad \Delta E = Vq \qquad E = \frac{1}{2}QV \qquad Q = CV$$

$$C = \frac{\varepsilon_o \varepsilon_r A}{d} \qquad C_{\mathrm{T}} = C_1 + C_2 + \ldots \qquad \frac{1}{C_{\mathrm{T}}} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots \qquad \tau = RC$$

$$R_{\mathrm{T}} = R_1 + R_2 + \ldots \qquad \frac{1}{R_{\mathrm{T}}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \qquad V = IR \qquad P = VI$$

$$\phi = BA \qquad \varepsilon = -L\frac{\Delta I}{\Delta t} \qquad \varepsilon = -\frac{\Delta \phi}{\Delta t} \qquad f_0 = \frac{1}{2\pi\sqrt{LC}}$$

$$\frac{N_{\mathrm{p}}}{N_{\mathrm{s}}} = \frac{V_{\mathrm{p}}}{V_{\mathrm{s}}} \qquad E = \frac{1}{2}LI^2 \qquad \tau = \frac{L}{R} \qquad I = I_{\mathrm{MAX}} \sin \omega t$$

$$V = V_{\mathrm{MAX}} \sin \omega t \qquad I_{\mathrm{MAX}} = \sqrt{2}\, I_{\mathrm{rms}} \qquad V_{\mathrm{MAX}} = \sqrt{2}\, V_{\mathrm{rms}} \qquad X_C = \frac{1}{\omega C}$$

$$X_L = \omega L \qquad V = IZ \qquad \omega = 2\pi f \qquad f = \frac{1}{T}$$

Ngā raraunga whaitake

Te tere o te aho, $c = 3.00 \times 10^8$ m s^{-1}

Te whana kei te irahiko, $q = -1.60 \times 10^{-19}$ C

Te whakaterenga nā te tō ā-papa o Papatūānuku, $g = 9.81$ m s^{-2}

Te taupūmau o te korekore, $\varepsilon_0 = 8.85 \times 10^{-12}$ F m^{-1}

Te Taupūmau o te Tō Whakaroto, $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}

91526 Demonstrate understanding of electrical systems

$$V = Ed \qquad \Delta E = Vq \qquad E = \frac{1}{2}QV \qquad Q = CV$$

$$C = \frac{\varepsilon_o \varepsilon_r A}{d} \qquad C_{\text{T}} = C_1 + C_2 + \ldots \qquad \frac{1}{C_{\text{T}}} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots \qquad \tau = RC$$

$$R_{\text{T}} = R_1 + R_2 + \ldots \qquad \frac{1}{R_{\text{T}}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \qquad V = IR \qquad P = VI$$

$$\phi = BA \qquad \varepsilon = -L\frac{\Delta I}{\Delta t} \qquad \varepsilon = -\frac{\Delta \phi}{\Delta t} \qquad f_0 = \frac{1}{2\pi\sqrt{LC}}$$

$$\frac{N_{\text{p}}}{N_{\text{s}}} = \frac{V_{\text{p}}}{V_{\text{s}}} \qquad E = \frac{1}{2}LI^2 \qquad \tau = \frac{L}{R} \qquad I = I_{\text{MAX}} \sin \omega t$$

$$V = V_{\text{MAX}} \sin \omega t \qquad I_{\text{MAX}} = \sqrt{2}\, I_{\text{rms}} \qquad V_{\text{MAX}} = \sqrt{2}\, V_{\text{rms}} \qquad X_C = \frac{1}{\omega C}$$

$$X_L = \omega L \qquad V = IZ \qquad \omega = 2\pi f \qquad f = \frac{1}{T}$$

Useful data

Speed of light, $c = 3.00 \times 10^8$ m s^{-1}

Charge on an electron, $q = -1.60 \times 10^{-19}$ C

Acceleration due to gravity on Earth, $g = 9.81$ m s^{-2}

Permittivity of free space, $\varepsilon_0 = 8.85 \times 10^{-12}$ F m^{-1}

Universal Gravitational Constant, $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}

English translation of the wording on the front cover

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Level 3 Physics 2024

RESOURCE BOOKLET

Refer to this booklet to answer the questions in your Question and Answer Booklets.

Check that this booklet has pages 2–5 in the correct order and that neither of them is blank.

YOU MAY KEEP THIS BOOKLET AT THE END OF THE EXAMINATION.