Revision : 2015 | Course code : 1003

Course Title : ENGINEERING PHYSICS I

| Q. No. | Scoring Indicators | Split up score | Sub Total | Total |
|---|---|---|---|---|
| I. | PART – A | | | |
| 1. | Definition of scalar quantities with eg. | 1 | 2 | 2 |
| | Definition of vector quantities with eg. | 1 | | |
| 2. | Statement of 2nd law | 2 | 2 | 2 |
| 3. | Definition of stress | 1 | | |
| | Definition of strain | 1 | 2 | 2 |
| 4. | Definition of flow rate | 2 | 2 | 2 |
| 5. | Transverse wave | 1 | | |
| | Longitudinal wave | 1 | 2 | 2 |
| | PART – B | | | |
| II 1. | $S_n = u + a(n - 1/2)$ | 1 | | |
| | $50 = u + 2.5a$ | 1 | | |
| | $60 = u + 4.5a$ | 1 | 6 | 6 |
| | Solving, $a = 5\ m/s^2$ | 1 | | |
| | $u = 37.5\ m/s$ | 1 | | |
| | $S_7 = 70\ m$ | 1 | | |
| 2. | Statement | 1 | | |
| | Diagram | 1 | | |
| | $F_{12} = m_2\left(\frac{V_2 - u_2}{t}\right)$ | ½ | | |
| | $F_{21} = m_1\left(\frac{V_1 - u_1}{t}\right)$ | ½ | | |

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Course Title : ENGINEERING PHYSICS I

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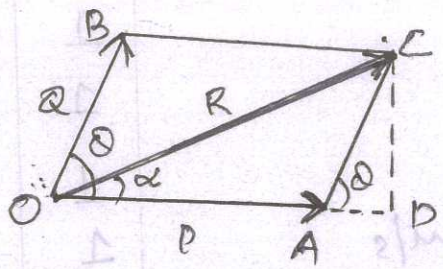
|---|---|---|---|---|
| | According to III law, $F_{12} = -F_{21}$ | 1 | | |
| | $m_2\frac{(v_2-u_2)}{t} = -m_1\frac{(v_1-u_1)}{t}$ | 1 | | |
| | $m_1u_1+m_2u_2 = m_1v_1+m_2v_2$ | 1 | 6 | 6 |
| 3. | $F = ma$ | 1 | | |
| | $a = \frac{v-u}{t}$ | 1 | | |
| | $= \frac{30-0}{60} = 0.5\ m/s^2$ | 2 | 6 | 6 |
| | $F = 100 \times 0.5$ | 1 | | |
| | $= 50\ N$ | 1 | | |
| 4. |   | 1 | | |
| | Applying pythagoras theorem | | | |
| | $OC^2 = OD^2 + CD^2$ | 1 | | |
| | $R = \sqrt{P^2+Q^2+2PQ\cos\theta}$ | 2 | 6 | 6 |
| | $\tan\alpha = \frac{Q\sin\theta}{P+Q\cos\theta}$ | 2 | | |

Revision : 2015 | Course code : 1003

Course Title : ENGINEERING PHYSICS I

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|---|---|---|---|---|
| 5. | Young's modulus (definition) | 1 | | |
| | $Y = \frac{FL}{Al}$ | 1 | | |
| | Bulk modulus (definition) | 1 | 6 | 6 |
| | $K = \frac{PV}{v}$ | 1 | | |
| | Rigidity modulus (definition) | 1 | | |
| | $n = \frac{F}{A\theta}$ | 1 | | |
| 6. | Statement | 1 | | |
| | Diagram | 1 | | |
| | Loss in pressure energy $= \frac{mP_1}{\rho} - \frac{mP_2}{\rho}$ | | | |
| | Loss in potential energy $= mgh_1 - mgh_2$ | 2 | | |
| | Gain in kinetic energy $= \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2$ | | | |
| | According law of conservation of energy, total loss in energy is equal to total gain in energy | 1 | 6 | 6 |
| | ie $\left(\frac{mP_1}{\rho} - \frac{mP_2}{\rho}\right) + (mgh_1 - mgh_2) = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2$ | | | |
| | $\therefore \frac{P_1}{\rho} + gh_1 + \frac{1}{2}v_1^2 = \frac{P_2}{\rho} + gh_2 + \frac{1}{2}v_2^2$ | 1 | | |

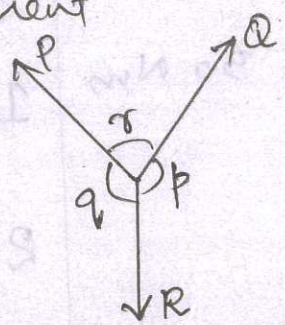
Revision : 2015 Course code : 1003

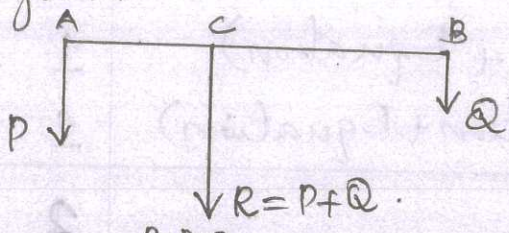
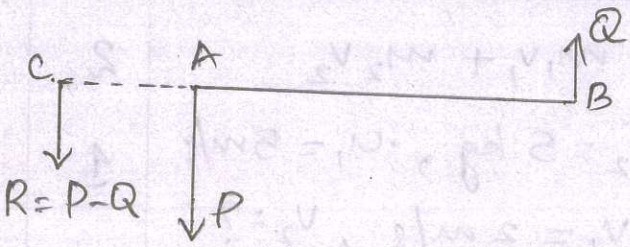
Course Title : ENGINEERING PHYSICS I

| Q. No. | Scoring Indicators | Split up score | Sub Total | Total |
|---|---|---|---|---|
| 7. | Six applications | 6×1 | 6 | 6 |
| | PART-C | | | |
| III a. | Seven fundamental quantities and two supplementary quantities | 1½ | 3 | |
| | SI units of fundamental and supplementary quantities | 1½ | | |
| b. | Distance (Definition) | 1 | 6 | 15 |
| | Displacement (Definition) | 1 | | |
| | $S_n = S_1 - S_2$ — ① | 1 | | |
| | $S_1 = un + \frac{1}{2}an^2$ | ½ | | |
| | $S_2 = u(n-1) + \frac{1}{2}a(n-1)^2$ | ½ | | |
| | ① $\Rightarrow S_n = u + a(n - \frac{1}{2})$ | 2 | | |
| c. | Recoil velocity, $V = \frac{mv}{M}$ | 3 | 6 | |
| | $= \frac{5 \times 100}{1000}$ | 3 | | |
| | $= 0.5$ m/s | | | |

Revision : 2015 | Course code : 1003

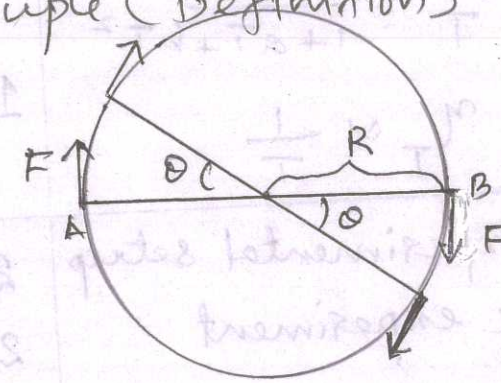
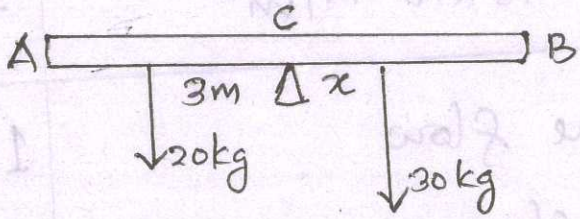
Course Title : ENGINEERING PHYSICS I

| Q. No. | Scoring Indicators | Split up score | Sub Total | Total |
|---|---|---|---|---|
| IV a) | Inertia (Definition) | 1 | | |
| | Force (Definition + Equation) | 1 | 3 | |
| | Momentum (Definition + Equation) | 1 | | |
| b) | Statement | 1 | | |
| | Principle of rocket propulsion (Explanation) | 2 | 6 | 15 |
| | Principle of recoil of gun (explanation) | 2 | | |
| c) | $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ | 2 | | |
| | $m_1 = 10\ kg$, $m_2 = 5\ kg$, $u_1 = 5\ m/s$ | 1 | | |
| | $u_2 = -2\ m/s$ $v_1 = 2\ m/s$, $v_2 = ?$ | | 6 | |
| | $10 \times 2 - 5 \times 2 = 10 \times 2 + 5 \times v_2$ | 2 | | |
| | $v_2 = 4\ m/s$ | 1 | | |
| V a) | Statement | 1 | | |
| |   | 1 | 3 | |
| | $P \propto \sin p$ $Q \propto \sin q$ $R \propto \sin r$ | 1 | | |
| | $\frac{P}{\sin p} = \frac{Q}{\sin q} = \frac{R}{\sin r}$ | | | |

| Q. No. | Scoring Indicators | Split up score | Sub Total | Total |
|---|---|---|---|---|
| b) | Like parallel forces (Definition) | 1 | | |
| | Diagram   | 1 | | |
| | Resultant, $R=P+Q$ acts at the point C such that $P \times AC = Q \times BC$ | 1 | | |
| | Unlike parallel forces (Definition) | 1 | 6 | |
| |   | 1 | | 15 |
| | Resultant $R=P-Q$ acts at a point C such that $P \times AC = Q \times BC$ | 1 | | |
| c) | $P = 2\pi NC$ | 2 | | |
| | $N = \frac{1200}{60} = 20$ , $C = 50$ Nm | 1 | | |
| | $P = 2\pi NC$ | | | |
| | $= 2\pi \times 20 \times 50$. | 2 | 6 | |
| | $= 6.28$ kW | 1 | | |

Revision : 2015 | Course code : 1003

Course Title : ENGINEERING PHYSICS I

| Q. No. | Scoring Indicators | Split up score | Sub Total | Total |
|---|---|---|---|---|
| VI | | | | |
| a) | Triangle method (Statement)<br>Diagram | 2<br>1 | 3 | |
| b) | Couple (Definition) | 1 | | |
| |  | 1 | | |
| | Moment of couple, C = F × AB<br>= F × 2R = 2FR | 1 | 6 | 15 |
| | Total work done = F × 2πR + F × 2πR<br>= 4πFR<br>= 2π × 2FR = 2πC | 2 | | |
| | If there are N rotations per second<br>Work done in 1s = 2πNC | 1 | | |
| c) |  | 3 | | |
| | 3 × 20 = x × 30 | 2 | 6 | |
| | x = 2 m | 1 | | |

Revision : 2015

Course Title : ENGINEERING PHYSICS I — Course code : 1003

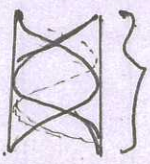
| Q. No. | Scoring Indicators | Split up score | Sub Total | Total |
|---|---|---|---|---|
| VII a) | for gases, $\eta_T = \frac{\eta_0 A\sqrt{T}}{1+B/T}$ ie $\eta_T \propto T^{\frac{1}{2}}$ | 1½ | 3 | 15 |
| | for liquids, $\eta_T = \frac{\eta_0}{1+aT+bT^2}$ ie $\eta_T \propto \frac{1}{T}$ | 1½ | | |
| b) | Diagram – Experimental setup | 2 | 6 | |
| | Description of experiment | 2 | | |
| | Equation $Y = \frac{mgL}{\pi r^2 l} = \frac{gL}{\pi r^2}\left(\frac{m}{l}\right)$ | 2 | | |
| c) | $Y = \frac{mgL}{\pi r^2 l}$ | 2 | 6 | |
| | $= \frac{4 \times 9.8 \times 3}{\pi \times (0.5\times10^{-3})^2 \times 10^{-3}}$ | 3 | | |
| | $= 14.98 \times 10^{10}\ N/m^2$ | 1 | | |
| VIII a) | Streamline flow | 1½ | 3 | |
| | Turbulent flow | 1½ | | |

Revision : 2015

Course Title : ENGINEERING PHYSICS I

Course code : 1003

| Q. No. | Scoring Indicators | Split up score | Sub Total | Total |
|---|---|---|---|---|
| b) | Terminal velocity (Definition) | 1 | | |
| | Downward force, $mg = \frac{4}{3}\pi r^3 \rho g$ | 1 | | |
| | upward forces : | | | |
| | 1) Upthrust $= \frac{4}{3}\pi r^3 d g$ | 1 | | |
| | 2) Viscous force $= 6\pi\eta r v$ | 1 | | |
| | $\frac{4}{3}\pi r^3 \rho g = \frac{4}{3}\pi r^3 d g + 6\pi\eta r v$ | 1 | 6 | |
| | $\eta = \frac{2(\rho - d) r^2}{9v}$ | | | |
| | $v = \frac{2(\rho - d) r^2}{9\eta}$ | 1 | | |
| c) | $a_1 v_1 = a_2 v_2$ | 2 | | |
| | $\pi r_1^2 v_1 = \pi r_2^2 v_2$ | 1 | | |
| | $\pi (75 \times 10^{-3})^2 \times 3 = \pi \times (25 \times 10^{-3})^2 \times v_2$ | 2 | 6 | |
| | $v_2 = 27$ m/s | 1 | | |
| IX a) | Wavelength | 1 | | |
| | Frequency | 1 | | |
| | $v = f\lambda$ | 1 | | |

| Q. No. | Scoring Indicators | Split up score | Sub Total | Total |
|---|---|---|---|---|
| b) | Figure | 1 | | |
| | Description of experimental set up | 2 | | |
| | $\lambda/4 = l_1 + e$ | 1 | 6 | |
| | $3\lambda/4 = l_2 + e$ | 1 | | |
| | $\therefore v = 2f(l_2 - l_1)$ | 1 | | 15 |
| c) | $V_t = V_0\sqrt{\frac{273+t}{273}}$ | 2 | | |
| | $V_t = 2V_0$ | 1 | | |
| | $2V_0 = V_0\sqrt{\frac{273+t}{273}}$ | 1 | 6 | |
| | Solving, $t = 819^\circ C$ | 2 | | |
| X a) | Simple harmonic motion (Definition) | 2 | | |
| | $\frac{d^2x}{dt^2} + \omega^2 x = 0$ | 1 | 3 | |
| b) |  $L = \lambda/2$ $\therefore \lambda = 2L$ $f = \frac{v}{\lambda} = \frac{v}{2L}$ | 1+1 | | |
| |  $L = \lambda$ $\lambda = L$ $f = \frac{v}{\lambda} = \frac{2v}{2L} = 2f$ | 1+1 | | |

| Q. No. | Scoring Indicators | Split up score | Sub Total | Total |
|---|---|---|---|---|
| |  $L = \frac{3\lambda}{2}$ $\lambda = \frac{2L}{3}$ $f = \frac{V}{\lambda} = \frac{3V}{2} = 3f$ | 1+1 | 6 | |
| c) | a) $f = \frac{V}{4l}$ | 1 | | 15 |
| | $= \frac{345}{4 \times 0.45} = 191.67$ Hz | 2 | 6 | |
| | b) $f = \frac{V}{2l}$ | 1 | | |
| | $= \frac{345}{2 \times 0.45} = 383.33$ Hz | 2 | | |