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|---|---|
| 1(a) | $D-350=900\times 0.25$ |
| | $D = 575$ N |
| | |
| 1(b) | $P=575\times 15$ |
| | $P=8625$ W or 8.625 kW |
| | |

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|---|---|
| 2(a) | $3\times 4=3\times(-1)+5\times v$<br>**or** $3\times 4=3\times 1+5v$ |
| | $v=3\text{ m s}^{-1}$ |
| | $v=1.8\text{ m s}^{-1}$ |
| | |
| 2(b) | KE = $\frac{1}{2}\times 3\times 4^2\ (=24)$ **or** KE = $\frac{1}{2}\times 3\times 1^2+\frac{1}{2}\times 5\times 1.8^2\ (=9.6)$<br>**or** KE = $\frac{1}{2}\times 3\times 1^2+\frac{1}{2}\times 5\times 3^2\ (=24)$ |
| | $\lambda=14.4$ ONLY |
| | |





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| 3 | For attempt to resolve in any direction to form an equation or expression |
| | Vertically: $(Y=)\ \pm(45+28\sin 35-72\sin 50-35\sin 60)$ |
| | Horizontally: $(X=)\ \pm(28\cos 35+72\cos 50-35\cos 60)$ |
| | $R=\sqrt{(\textit{their}\ 24.4059...)^2+(\textit{their}\ 51.7169...)^2}$ |
| | $\theta=\tan^{-1}\left(\frac{\textit{their}\ 24.4059...}{\textit{their}\ 51.7169...}\right)\left[=\tan^{-1}0.4719...\right]$<br>OR $\alpha=\tan^{-1}\left(\frac{\textit{their}\ 51.7169...}{\textit{their}\ 24.4059...}\right)\left[=\tan^{-1}2.1190...\right]$ |
| 3 | $R=57.2$ N<br>Direction is $25.3^\circ$ below the positive *x*-direction<br>or bearing $115^\circ$ |
| | |

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| 4 | PE lost by $A$: $\pm mg \times 0.75$ |
| | PE gained by $B$: $\pm 3g \times 0.75 \times 0.6 [= \pm 13.5]$ |
| | KE gained by $A$ **and** $B$: $\pm\left(\frac{1}{2} \times 3 \times 2^2 + \frac{1}{2} \times m \times 2^2\right)[= \pm(6+2m)]$ |
| | Work done against resistance = $\pm\frac{10}{3} \times 0.75 [= \pm 2.5]$ |
| | $\frac{1}{2} \times 3 \times 2^2 + \frac{1}{2} \times m \times 2^2 = 0.75mg - 13.5 - 2.5$ |
| | $m = 4$ |
| | **Special case for use of N2L max 3 marks** |
| | $2^2 = 0^2 + 2 \times a \times 0.75 \Rightarrow a = \frac{8}{3}$ |
| | $mg - T = ma$ **and** $T - 3g \times 0.6 - \frac{10}{3} = 3a$<br><br>OR $mg - 3g \times 0.6 - \frac{10}{3} = (m+3)a$ |
| | $m = 4$ |
| | |





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| 7(a) | $v = \frac{1}{3}(2t^2 - 11t + 12) \Rightarrow \frac{dv}{dt} = \frac{1}{3}(4t - 11)$ |
| | $\frac{1}{3}(4 \times 2 - 11) = -1 \text{ m s}^{-2}$ |
| | |
| 7(b) | Attempt to integrate |
| | $s = \frac{1}{3}\left(\frac{2t^3}{3} - \frac{11t^2}{2} + 12t\right)(+c)$ |
| | [$P$ changes direction when] $t = 1.5$ |
| | Attempt to evaluate their $\frac{1}{3}\left(\frac{2t^3}{3} - \frac{11t^2}{2} + 12t\right)$ for $t = 0$ to $t = 1.5$ **and** $t = 1.5$ to $t = 3$ |
| | Total distance is $[2.625 + \lvert -1.125 \rvert =]$ 3.75 m |
| | |

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| 7(c) | Attempt to evaluate their $s$ for $t = 0$ to $t = 4$ |
| | $\int_0^4 v\,\mathrm{d}t = \frac{8}{9} > 0$ so, no $P$ does not return to $O$ |
| | |





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| 7(a) | For attempt to resolve in any direction to form an expression or equation |
| | $[X =] \pm(30\cos 30 + 15\cos 45 - 20\cos 20)$ <br> OR $[S\cos\alpha =] \pm(30\cos 30 + 15\cos 45 - 20\cos 20)$ |
| | $[Y =] \pm(25 + 15\sin 45 - 20\sin 20 - 30\sin 30)$ <br> OR $[S\sin\alpha =] \pm(25 + 15\sin 45 - 20\sin 20 - 30\sin 30)$ |
| | $S = \sqrt{(\textit{their}\,17.7935\ldots)^2 + (\textit{their}\,13.76661\ldots)^2}$ <br> OR $S = \frac{\textit{their}\,17.7935\ldots}{\cos(\textit{their}\,37.7278\ldots)}$ OR $S = \frac{\textit{their}\,13.76661\ldots}{\sin(\textit{their}\,37.7278\ldots)}$ |
| | $\alpha = \tan^{-1}\left(\frac{\textit{their}\,13.7661\ldots}{\textit{their}\,17.7935\ldots}\right)$ <br> OR $\alpha = \cos^{-1}\left(\frac{\textit{their}\,17.7935\ldots}{\textit{their}\,22.4970\ldots}\right)$ OR $\alpha = \sin^{-1}\left(\frac{\textit{their}\,13.7661\ldots}{\textit{their}\,22.4970\ldots}\right)$ |
| | $[S =]$ 22.5 $[\alpha =]37.7$ |
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| 7(b) | $(their\,17.7935\ldots) - F = 0.6a$<br>OR $30\cos 30 + 15\cos 45 - 20\cos 20 - F = 0.6a$<br><br>OR $(their\,S)\cos(their\,\alpha) - F = 0.6a$ $[17.8025 - F = 0.6a]$ |
| | $2 = 0 + \frac{1}{2}a \times 3^2$ $\left[a = \frac{4}{9}\right]$ |
| | $R = their(13.7661\ldots) + 0.6g$ $[= 19.7661\ldots]$<br>OR $R = 25 + 15\sin 45 - 20\sin 20 - 30\sin 30 + 0.6g$<br><br>OR $R = (their\,S)\sin(their\,\alpha) + 0.6g$ $[R = 13.759 + 0.6g]$ |
| | $(their\,17.7935)\ldots - \mu \times 19.7661 = 0.6 \times \left(their\,\frac{4}{9}\right)$ |
| | $\mu = 0.887$ |





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| 7(b) | **Alternative scheme for using energy** |
| | $\frac{1}{2} \times 0.6 \times v^2 = (their\,17.7935) \times 2 - F \times 2$<br><br>OR $\frac{1}{2} \times 0.6 \times v^2 = (30\cos 30 + 15\cos 45 - 20\cos 20) \times 2 - F \times 2$<br><br>OR $\frac{1}{2} \times 0.6 \times v^2 = (their\,S)\cos(their\,\alpha) \times 2 - F \times 2$ |
| | $2 = \frac{1}{2}(0 + v) \times 3$ $\left[v = \frac{4}{3}\right]$ |
| | $R = their(13.7661\ldots) + 0.6g$ $[= 19.7661\ldots]$<br>OR $R = 25 + 15\sin 45 - 20\sin 20 - 30\sin 30 + 0.6g$<br><br>OR $R = (their\,S)\sin(their\,\alpha) + 0.6g$ $[R = 13.759 + 0.6g]$ |
| | $\frac{1}{2} \times 0.6 \times \left(their\,\frac{4}{3}\right)^2 = (their\,17.7935) \times 2 - 19.7661 \times \mu \times 2$ |
| | $\mu = 0.887$ |
| | |