# MECHANICS 2 (A) TEST PAPER 6 : ANSWERS AND MARK SCHEME

1. (a) $5\,000\,000 \times (15\,000 \div 3600) = 2{\cdot}08 \times 10^7$ Ns or kg m s$^{-1}$ — M1 A1 A1
   (b) $P = 4000 \times (150 \div 36) = 16{\cdot}7$ kW — M1 A1 A1 — 6

2. (a) $[v - (-u/2)] / (-u - u) = -e$ $\quad v + \frac{1}{2}u = 2ue$ $\quad v = \frac{1}{2}u(4e - 1)$ — M1 A1 M1 A1
   (b) If $v > 0$ then $4e - 1 > 0$, so $\frac{1}{4} < e \leq 1$ — M1 A1 A1 — 7

3. (a) $v = 25$ $\quad$ K.E. $= \frac{1}{2} \times 1{\cdot}8 \times 25^2 = 562{\cdot}5$ J — B1 M1 A1
   (b) New K.E. $= \frac{1}{2} \times 1{\cdot}8 \times 12{\cdot}5^2 = 140{\cdot}6$ J — M1 A1 A1
   Work done = change in K.E. = 422 J — M1 A1 — 8

4. (a) P.E. lost = K.E. gained $= 19 - \frac{1}{2} \times 0{\cdot}5 \times 4^2 = 15$ J — M1 A1 A1
   (b) $0{\cdot}5gh = 15$ $\quad h = \frac{30}{g}$ $\quad d = h \div \sin\alpha = \frac{75}{g} = 7{\cdot}65$ m — M1 A1 M1 A1
   (c) Modelled block as particle; ignored air resistance — B1 B1 — 9

5. (a) Diagram showing weight, tension, two components of reaction or single reaction force at $X$ — B4
   (b) M($X$) : $2mg\,a\cos\theta = mg\,a\sin\theta$ $\quad \tan\theta = 2$ $\quad \theta = 63{\cdot}4°$ — M1 A1 A1 M1 A1 — 9

6. (a) (i) $132(11) + 84(3) = 216\bar{x}$ $\quad \bar{x} = 7{\cdot}89$ — M1 A1 A1
   (ii) $132(3) + 84(13) = 216\bar{y}$ $\quad \bar{y} = 6{\cdot}89$ — M1 A1 A1
   (b) $\tan\alpha = 0{\cdot}89 \div 1{\cdot}89 = 0{\cdot}471$ $\quad \alpha = 25{\cdot}2°$ — M1 A1 M1 A1 — 10

7. (a) $v = 3t^2 - 14t + 8 = (3t - 2)(t - 4)$ $\quad v = 0 : t = \frac{2}{3},\ t = 4$ — M1 A1 M1 A1
   $P$ is turning round (changing direction) — A1
   (b) $s(3) = -12$, $s(4) = -16$, $s(5) = -10$, so dist = 4 + 6 = 10 m — M1 A1 A1
   (c) $a = 6t - 14$ $\quad a = -2$ when $t = 2$ — M1 A1
   Negative acceleration acting on negative velocity, so speeding up — B1 — 11

8. (a) 12·5 ms$^{-1}$ (7, 24, 25 Δ) — M1 A1
   (b) $x = 3{\cdot}5t$, $y = 12t - \frac{1}{2}gt^2 = 12t - 4{\cdot}9t^2$, — B1 M1 A1
   hence $\mathbf{r} = 3{\cdot}5t\,\mathbf{i} + (12t - 4{\cdot}9t^2)\mathbf{j}$ — A1
   (c) When $y = 4{\cdot}4$, $4{\cdot}9t^2 - 12t + 4{\cdot}4 = 0$ $\quad t = (12 \pm 7{\cdot}6)/9{\cdot}8$ — M1 A1
   $t = 0{\cdot}449$ or $t = 2$ $\quad x = 1{\cdot}57$ m, $x = 7$ m — M1 A1 A1
   (d) $\mathbf{v} = 3{\cdot}5t\,\mathbf{i} + (12 - 3t^2)\mathbf{j}$ $\quad$ When $y$-component of $\mathbf{v}$ is 0, $t = 2$ — B1 M1 A1
   Then $\mathbf{r} = 7\mathbf{i} + 16\mathbf{j}$ — A1 — 15