Question 1, test 1, Phys 1131 — Mark

a) $a = \frac{F}{m} = \frac{g}{3} = 3$ — 2

$v = v_0 + at = 2 + 3t$ — 2

$x = x_0 + v_0 t + \frac{at^2}{2} = 1 + 2t + \frac{3t^2}{2}$ — 2

b) $a = \frac{F}{m} = \frac{gt}{3} = 3t$ — 2

$v = \int a\,dt = \int 3t\,dt = 3\frac{t^2}{2} + v_0$

$v = 2 + \frac{3t^2}{2}$ — 2

$x = \int v\,dt = 2t + \frac{3}{2}\frac{t^3}{3} + x_0 = 1 + \frac{t^3}{3} + 2t$ — 2

c) $\underset{\sim}{v} = \frac{d\underset{\sim}{r}}{dt} = \underset{\sim}{K} \cdot \frac{de^{-2t}}{dt} = -2e^{-2t} \cdot \underset{\sim}{K}$ — 2

$\underset{\sim}{a} = \frac{d\underset{\sim}{v}}{dt} = -2 \cdot (-2e^{-2t})\underset{\sim}{K} = 4e^{-2t}\underset{\sim}{K}$ — 2

$\underset{\sim}{F} = m\,\underset{\sim}{a} = 12e^{-2t}\underset{\sim}{K}$ — 2

Directions of $\underset{\sim}{a}$, $\underset{\sim}{F}$ are along z-axis ($\underset{\sim}{v}$ is in opposite direction to z) — 4

Magnitude

$v = 2e^{-2t}$ $\frac{m}{s}$ — 1

$a = 4e^{-2t}$ $\frac{m}{s^2}$ — 1

$F = 12e^{-2t}$ N — 1

Problem 2, test 1, Phys 1131 — Mark

$m = 0.01\ kg$, $m + M = 0.1\ kg$

$v = 1000\ \frac{m}{s}$

a) Kinetic energy of the bullet

$$E_{bul} = \frac{mv^2}{2} = 0.01 \cdot \frac{(1000)^2}{2} = 0.5 \cdot 10^4\ J$$

5

b) Speed of the block

$$mv = (M+m)V$$

$$V = \frac{m}{M+m} v = \frac{1}{10} \cdot 1000 = 100\ \frac{m}{s}$$

5

c) Kinetic energy of the block

$$E_{bl} = (M+m)\frac{V^2}{2} = 0.1 \cdot \frac{(100)^2}{2} = 0.5 \cdot 10^3\ J$$

5

d) height

$$(M+m) g h = E_{bl}$$

$$h = \frac{E_{bl}}{g(M+m)} = \frac{0.5 \cdot 10^3}{9.8 \cdot 0.1} = 0.51 \cdot 10^3\ m$$

5

e) distance

$$F_{fr} \cdot X = \mu_K (M+m) g X = E_{bl}$$

$$X = \frac{E_{bl}}{\mu_K (M+m) g} = \frac{0.5 \cdot 10^3}{0.1 \cdot 0.1 \cdot 9.8} = 0.51 \cdot 10^4\ m$$

5

Problem 3, test 1, Phys 1131

Mark

a) $I = \int_0^L x^2 dx \cdot \frac{M}{L} = \frac{L^3}{3}\frac{M}{L} = \frac{ML^2}{3}$ — 8

b) $T = 2\pi\sqrt{\frac{ML^2}{3MgL}} = 2\pi\sqrt{\frac{L}{3g}}$ — 5

c) $I = 2\int_0^{L/2} x^2 dx \ \frac{M}{L} = \frac{L^3}{3\cdot 8}\cdot 2\frac{M}{L} = \frac{ML^2}{12}$ — 8

d) $T = 2\pi\sqrt{\frac{L}{12g}}$ — 4

Problem 4, test 1, Phys 1131 Mark

a) $\frac{mv^2}{r} = \frac{GM_r m}{r^2}$ 10

b) $M_r = \frac{v^2 r}{G}$ 5

c) $M_R = \frac{v_2^2 R}{G}$ 5

5

$M_R - M_r = \frac{v_2^2 R}{G} - \frac{v^2 r}{G}$