

**M1.B**

**[1]**

**M2.A**

**[1]**

**M3.B**

**[1]**

**M4.A**

**[1]**

**M5.C**

**[1]**

**M6.C**

**[1]**

**M7.B**

**[1]**

**M8.A**

**[1]**

**M9.B**

**[1]**

**M10.C**

**[1]**

**M11.A**

**[1]**

**M12.B**

**[1]**

**M13. D**

**[1]**

**M14. C**

**[1]**

**M15.** B [1]

**M16.** C [1]

**M17.** D [1]

**M18.** B [1]

**M19.** A [1]

**M20.**      B **[1]**

**M21.**      B **[1]**

**M22.**      A **[1]**

**M23.**      C **[1]**

**M24.**      B **[1]**

**M25.** (a) (i)  $h (= ct) (= 3.0 \times 10^8 \times 68 \times 10^{-3}) = 2.0(4) \times 10^7 \text{ m (1)}$

(ii)  $g = \frac{GM}{r^2} \text{ (1)}$   
 $r (= 6.4 \times 10^6 + 2.04 \times 10^7) = 2.68 \times 10^7 \text{ (m) (1)}$   
 (allow C.E. for value of  $h$  from (i) for first two marks, but not 3rd)

$$g = \frac{6.67 \times 10^{-11} \times 6.0 \times 10^{24}}{(2.68 \times 10^7)^2} \text{ (1) } (= 0.56 \text{ N kg}^{-1})$$

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(b) (i)  $g = \frac{v^2}{r} \text{ (1)}$

$$v = [0.56 \times (2.68 \times 10^7)]^{1/2} \text{ (1)}$$

$$= 3.9 \times 10^3 \text{ m s}^{-1} \text{ (1) } (3.87 \times 10^3 \text{ m s}^{-1})$$

(allow C.E. for value of  $r$  from a(ii))

[or  $v^2 = \frac{GM}{r} = \text{(1)}$

$$v = \left( \frac{6.67 \times 10^{-11} \times 6 \times 10^{24}}{2.68 \times 10^7} \right)^{1/2} \text{ (1)}$$

$$= 3.9 \times 10^3 \text{ m s}^{-1} \text{ (1)}$$

(ii)  $T \left( = \frac{2\pi r}{v} \right) = \frac{2\pi \times 2.68 \times 10^7}{3.87 \times 10^3} \text{ (1)}$

$$= 4.3(5) \times 10^4 \text{ s (1) } (12.(1) \text{ hours})$$

(use of  $v = 3.9 \times 10^3$  gives  $T = 4.3(1) \times 10^4 \text{ s} = 12.0 \text{ hours}$ )

(allow C.E. for value of  $v$  from (i))

[alternative for (b):

(i)  $v \left( \frac{2\pi r}{T} \right) = \frac{2\pi \times 2.68 \times 10^7}{4.36 \times 10^4} \text{ (1)}$

$$= 3.8(6) \times 10^3 \text{ m s}^{-1} \text{ (1)}$$

(allow C.E. for value of  $r$  from (a)(ii) and value of  $T$ )

$$(ii) \quad T^2 = \left( \frac{4\pi^2}{GM} \right) r^3 \quad (1)$$

$$\left( = \frac{4\pi^2}{6.67 \times 10^{-11} \times 6.0 \times 10^{24}} \times (2.68 \times 10^7)^3 \right) = (1.90 \times 10^9 \text{ s}^2) \quad (1)$$

$$T = 4.3(6) \times 10^4 \text{ s} \quad (1)$$

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[9]

M26. C

[1]

M27. C

[1]

M28. C

[1]

**M29.D**

**[1]**