Answer

FORM 4

CHAPTER 3

Paper 1

1 C	2 D	3 A	4 B	5 C
6 A	7 D	8 C	9 A	10 B

Paper 2

Structured question

1. (a) (i) $1.98 \times 10^{20}\,\text{N}$
   (ii) $3.46 \times 10^8\,\text{m}$
   (iii) Newton's Universal Law of Gravitation

   (b) (i) $\rho = \dfrac{3g}{4\pi Gr}$
   (ii) $3\,332.36\,\text{kg m}^{-3}$

2. (a) (i) $a = \dfrac{v^2}{R}$
   (ii) $F = \dfrac{mv^2}{R}$
   $\quad = \dfrac{m}{R}\left(\dfrac{2\pi R}{T}\right)^2$
   $\quad = \dfrac{4\,m\pi^2 R}{T^2}$

   (b) (i) Towards the centre of the circle
   (ii) $3\,395.06\,\text{N}$
   (iii) Road surface friction

3. (a) $v = \sqrt{\dfrac{GM}{R+h}}$

   (b) $\dfrac{1}{2}mv^2_{\text{escape}} = \dfrac{GMm}{R}$
   $\quad v_{\text{escape}} = \sqrt{\dfrac{2GM}{R}}$

   (c) There is no other gravitational force than the Earth's gravitational force

   (d) (i) $\dfrac{mv^2}{r} = G\dfrac{Mm}{r^2}$
   $\quad M = \dfrac{v^2 r}{G}$ ——①
   $\quad v = \dfrac{2\pi R}{T}$ ——②
   ② → ①:
   $\quad M = \left(\dfrac{2\pi r}{T}\right)^2 \dfrac{r}{G}$
   $\quad M = \dfrac{4\pi^2}{G}\left(\dfrac{r^3}{T^2}\right)$

   (ii) $m = \dfrac{4\pi^2}{G}\left(\dfrac{r^3}{T^2}\right)$
   $\quad = \dfrac{4\pi^2}{6.67 \times 10^{-11}}\left(\dfrac{(50\,000 \times 10^3)^3}{(8 \times 60 \times 60)^2}\right)$
   $\quad = 8.92 \times 10^{25}\,\text{kg}$