

|          |                                                                                                                        |
|----------|------------------------------------------------------------------------------------------------------------------------|
| 1(a)     | work done per unit mass                                                                                                |
|          | work (done in) moving mass from infinity (to the point)                                                                |
| 1(b)(i)  | evidence of addition of $3.4 \times 10^6$ to $1.7 \times 10^6$ <b>or</b> $6.8 \times 10^6$                             |
|          | $GM \times 122 / (5.1 \times 10^6)$ <b>or</b> $GM \times 122 / (10.2 \times 10^6)$                                     |
|          | $6.67 \times 10^{-11} \times M \times 122 \times [(5.1 \times 10^6)^{-1} - (10.2 \times 10^6)^{-1}] = 5.1 \times 10^8$ |
|          | leading to $M = 6.4 \times 10^{23}$ kg                                                                                 |
| 1(b)(ii) | $\phi = (-) (6.67 \times 10^{-11} \times 6.4 \times 10^{23}) / (3.4 \times 10^6)$                                      |
|          | $= -1.3 \times 10^7 \text{ J kg}^{-1}$                                                                                 |
| 1(c)(i)  | Mars takes (just under) 25 hours to rotate once on its axis                                                            |
| 1(c)(ii) | orbit is equatorial<br><b>or</b><br>orbit is in same direction as direction of rotation of Mars                        |