Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Mark Schemes

Q1.

(a) (i) Use of $F = GMm/r^2$

C1

Allow 1 for
-correct formula quoted but forgetting square in substitution

Correct substitution of data

M1

-missing m in substitution

491 (490)N

A1

-substutution with incorrect powers of 10
Condone 492 N,

(ii) Up and down vectors shown (arrows at end) with labels

B1

allow W, mg (not gravity); R
allow if slightly out of line / two vectors shown at feet

up and down arrows of equal lengths

B1

condone if colinear but not shown acting on body
In relation to surface W ≤ R (by eye) to allow for weight vector starting in middle of the body
Must be colinear unless two arrows shown in which case R vectors ½ W vector(by eye)

(b) (i) Speed = $2\pi r / T$

B1

Max 2 if not easy to follow

$2\pi 6370000 / (24 \times 60 \times 60)$

B1

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463 m s^{-1}

B1

Must be 3sf or more

(ii) Use of $F = mv^2/r$

C1

Allow 1 for use of $F = mr\omega^2$ with $\omega = 460$

1.7 (1.66 – 1.68) N

A1

(iii) Correct direction shown
(Perpendicular to and toward the axis of rotation)
NB – not towards the centre of the earth

B1

(c) Force on scales decreases / apparent weight decreases
Appreciates scale reading = reaction force

C1

The reading would become 489 (489.3)N or reduced by 1.7 N)

A1

Some of the gravitational force provides the necessary centripetal force

B1

or $R = mg - mv^2/r$

[14]

Q2.

(a) zero potential at infinity (a long way away)

B1

energy input needed to move to infinity (from the point)
work done by the field moving object from infinity
potential energy falls as object moves from infinity

B1

2

(b) Any pair of coordinates read correctly

C1

±1/2 square

Use of $E_p \text{ or } V = (-)\frac{GM}{r}$

C1

Rearrange for M

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6.4 (±0.5) × 10^{23} kg

A1

3

(c) Reads correct potential at surface of Mars = −12.6 (MJ)

C1

or reads radius of mars correctly (3.5 × 10^{6})

equates to ½ v^2 (condone power of 10 in MJ)

C1

use of v = √(2GM/r) with wrong radius

5000 ± *20* m s^{-1} (condone 1sf e.g. 5 km s^{-1})

A1

e.c.f. value of M from (b) may be outside range for other method 6.2 × 10^{-9}x √their M

3

(d) Attempts 1 calculation of *Vr*

B1

Many values give 4.2.... so allow mark is for reading and using correct coordinates but allow minor differences in readings
Ignore powers of 10 but consistent

Two correct calculation of *Vr*

B1

Three correct calculations with conclusion

B1

3

[11]

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