Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 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

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) (i) $mg = ke$ **(1)**

$k = \left(\frac{0.25 \times 9.81}{40 \times 10^{-3}}\right)$ = 61(.3) N m^{-1} **(1)**

$T\left(= 2\pi\sqrt{\frac{m}{k}}\right) = 2\pi\sqrt{\frac{0.69}{61.3}}$ **(1)** (= 0.667 s)

(ii) $f\left(= \frac{1}{T}\right) = \frac{1}{0.667}$ **(1)**(= 1.50 Hz)

4

(b) (i) forced vibrations (at 0.2 Hz) **(1)**
amplitude less than resonance (≈ 30 mm) **(1)**
(almost) in phase with driver **(1)**

(ii) resonance [or oscillates at 1.5 Hz] **(1)**
amplitude very large (> 30 mm) **(1)**
oscillations may appear violent **(1)**
phase difference is 90º **(1)**

(iii) forced vibrations (at 10 Hz) **(1)**
small amplitude **(1)**
out of phase with driver [or phase lag of (almost) π on driver] **(1)**

Max 6

[10]