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

Mark Schemes

Q1.

(a) An object that produces a rapid increase in brightness ✓
Allow lowering in value of absolute magnitude
1

(b) Extremely dense ✓
Ignore descriptions of Neutron star surface
1

Made up of neutrons ✓
Ignore refs to spinning or producing radio waves
1

(c) Use of $Rs = 2GM / c^2$

To give

$Rs = 2 \times 6.67 \times 10^{-11} \times 2 \times 2 \times 10^{30} / (3 \times 10^8)^2$ ✓
First mark is for substitution
1

$= 5.9 \times 10^3$ m ✓
Second mark for answer
1

(d) Collapsing star can produce gamma ray bursts with energy similar to total output of Sun ✓
First mark is for gamma ray burst and an idea of the amount of energy
1

Highly collimated – if in direction of Earth, could cause mass extinction event ✓
Second mark is for consequence.
1

[7]

Q2.

(a) Both t_m values correct: 0.404, 0.429
AND
Both t_m^2 values correct: 0.163, 0.184 ✔
Exact values required for the mark.
1

(b) Both plotted points to nearest mm ✔
Best line of fit to points ✔

The line should be a straight line with approximately an equal number of points on either side of the line.

2

(c) Large triangle drawn (at least 8 cm × 8 cm) ✔
Correct values read from graph ✔
Gradient value in range 0.190 to 0.222 ✔

Allow 2 or 3 sf for gradient

3

(d) g = 9.71 (ms^{-2}) or correct value from gradient value in **(c)** ✔.

(The answer must be in the range 9.0 to 10.5 (ms^{-2})).

Allow 2 or 3 sf.

Unit not required

1

(e) $$\%\ difference = \frac{(9.81-9.71)}{9.81} \times 100 = 1.02$$

OR correct computation using value from **(d)** ✔

If the candidate's value is exactly 9.81, then a statement that there is no (or zero) percentage difference is acceptable.

No sf penalty.

NB. Allow an answer from a calculation with either the candidate's value or the accepted value as the denominator in the equation.

1

(f) 0.001 s✔ (half the spread)
(Must have unit).

1

(g) $g = 2s/t_m^2$ ✔
$= 2 \times 0.300/0.245^2$ ✔
$= 10.0$ (or 10.00) ms^{-2} ✔

Unit required and 3 or 4sf for the last mark.

3

(h) % uncertainty in s = 0.33 **and**
% uncertainty in t_m = 0.41 ✔

*Allow ecf from part **(f)**.*

% uncertainty in g
= 0.33 + (2 × 0.41) = 1.15 ✔

Allow ecf at each stage of calculation.

Uncertainty in g
= 10.0 × 1.15/100 = 0.12 m s^{-2} or 0.1 m s^{-2} ✔

*Allow ecf from part **(g)**.*

(allow 1 or 2 sf only)
(Must have unit for 3rd mark).

3

(i) (a) Use spherical objects of different mass **and** determine mass with balance ✔

Annotate the script with the appropriate letter at the point where the mark has been achieved.

(b) Would need **same diameter** spherical objects for fair comparison (same air resistance etc) ✔

(c) Time spherical object falling through same height **and** compare times

*Alternative for **(c)**:*
i.e. repeat whole of experiment, plot extracted values of g against mass. Horizontal line expected, concluding acceleration same for different masses.

3

[18]