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

Q1.

Antares is a red supergiant star in the constellation of Scorpio. It has a mass about 18 times that of the Sun.
Eventually the star will become a supernova, leaving behind a core that could form a neutron star or a black hole.

(a) State what is meant by a supernova.

_____

_____

(1)

(b) State the defining properties of a neutron star.

_____

_____

_____

(2)

(c) To become a black hole it is likely that the core would have to have a mass at least twice that of the Sun.

Calculate the Schwarzschild radius of a black hole with a mass twice that of the Sun.

radius = _____ m

(2)

(d) Some scientists are concerned about the consequences for the Earth of a supernova occurring in a nearby part of the galaxy.

Explain the cause of this concern.

_____

_____

(2)
(Total 7 marks)

Q2.

A student performs an experiment to find the acceleration due to gravity. The student measures the time t for a spherical object to fall freely through measured vertical distances s. The time is measured electronically. The results are shown in the table below.

s/**m**	t_1/s	t_2/s	t_3/s	**mean time** t_m/s	t_m^2/s^2
0.300	0.245	0.246	0.244	0.245	0.0600
0.400	0.285	0.286	0.286	0.286	0.0818
0.500	0.319	0.321	0.318	0.319	0.102
0.600	0.349	0.351	0.348	0.349	0.122
0.700	0.378	0.380	0.378	0.379	0.144
0.800	0.403	0.406	0.404		
0.900	0.428	0.428	0.430		

(a) Complete the table by entering the missing values for t_m and t_m^2

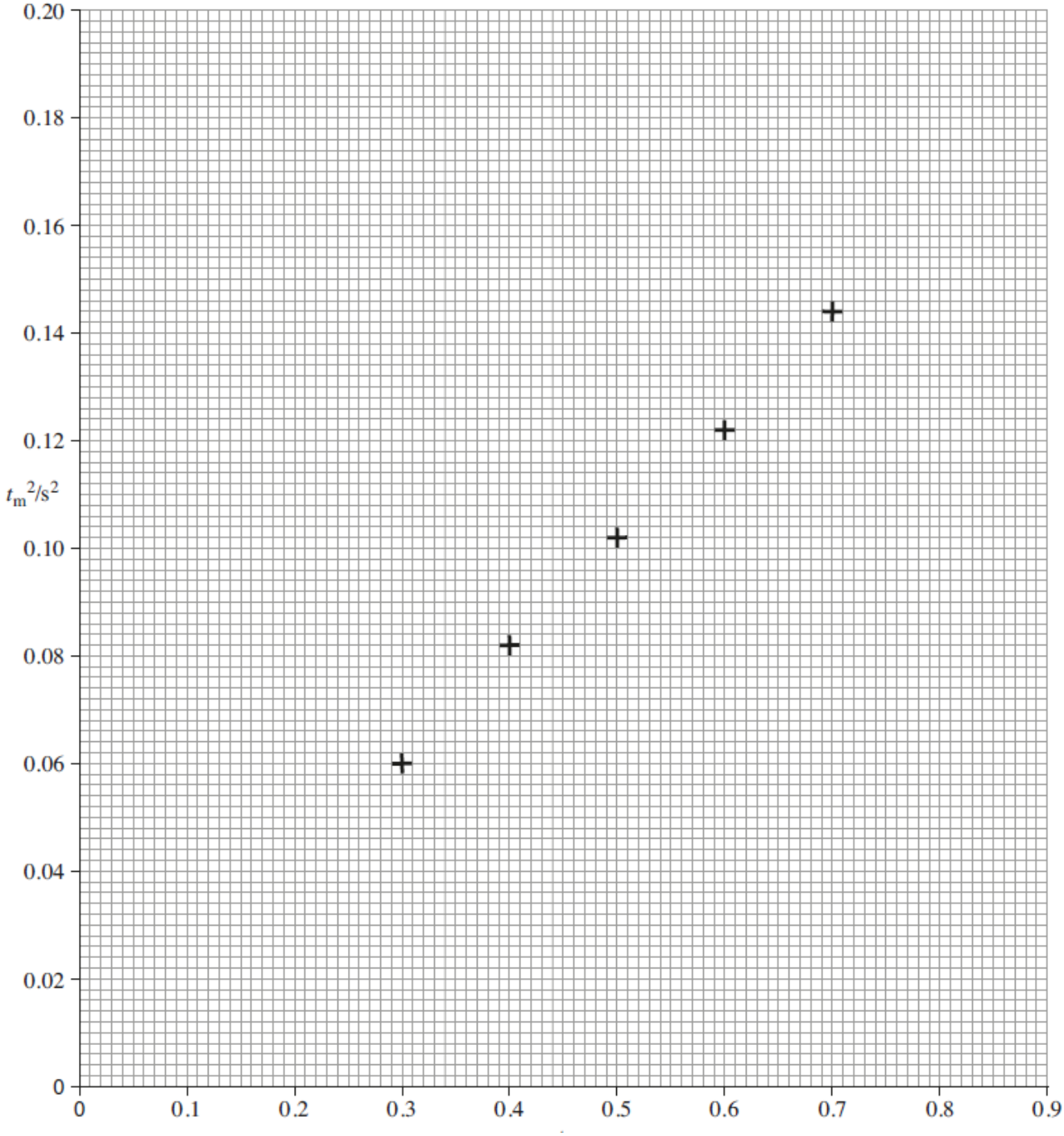
(1)

(b) Complete the graph below by plotting the remaining two points and draw a line of best fit.

(2)

(c) Determine the gradient of the graph.

(3)



(d) Theory suggests that the equation for the line is $t^2 = \frac{2s}{g}$ where g is the acceleration due to gravity.

Calculate a value for g using the above equation and the gradient of your graph above.

(1)

(e) Calculate the percentage difference between your value for g and the accepted value of 9.81 m s^{-2}.

(1)

(f) Calculate the uncertainty in the smallest value of t_m.

(1)

(g) Calculate the value of g which would be given from the smallest value of t_m and the corresponding value of s.

(3)

(h) The uncertainty in each value of s is ± 0.001 m.

Calculate the uncertainty in the value of g you calculated in part **(g)**.

You will need to use the uncertainty for t_m you calculated in part **(f)**.

(3)

(i) A student wishes to investigate the effect of changing the mass of the spherical object on the

acceleration of free fall.

Explain how you would modify the experiment seen at the start of this question.

(3)

(Total 18 marks)