Year 12 Physics Assessment Task ID Number: _____

Practical and Processes

Teacher: ☐ **Mr Coombes** ☐ **Mr Pitt** ☐ **Mr Trotter** **TOTAL MARKS _____/ 30**

Task Weighting: 15% **Time allowed: 45 minutes**

- Attempt all questions
- Show **all** working
- For question 1, watch the movie on the screen. You will require a stopwatch to carry out question 1. This may be shared between two students. Check that the stopwatch is working before the task commences and notify your teacher if there is a problem.

Data and Equations

g = 9.8 m s^{-2}

Mass of Earth = 6 x 10^{24} kg

Radius of Earth = 6400 km

Universal Gravitational Constant

G = 6.67 x 10^{-11} N m^2 kg^{-2}

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$E_p = -G\frac{m_1 m_2}{r}$$

F=mg

$$v_x^2 = u_x^2$$

$$v = u + at$$

$$v_y^2 = u_y^2 + 2a_y\Delta y$$

$$\Delta x = u_x t$$

$$\Delta y = u_y t + \frac{1}{2}a_y t^2$$

Question 1

Determine the period of the pendulum in the movie and outline how you ensured that your measurement was valid. 3M

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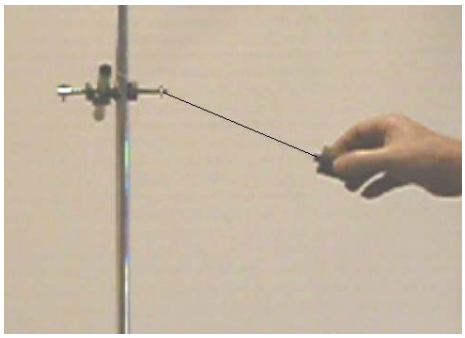
Question 2

This image shows the position from which the mass of a simple pendulum was released in an investigation carried out by students using a pendulum to determine the acceleration due to gravity using the equation beside the image.



$$T = 2\pi\sqrt{\frac{l}{g}}$$

(a) Assess the appropriateness of releasing the mass from the position shown. 2M

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(b) The period of a simple pendulum can be modelled using this equation:

$$T = 2\pi\sqrt{\frac{l}{g}}$$

How has this model been validated? 3M

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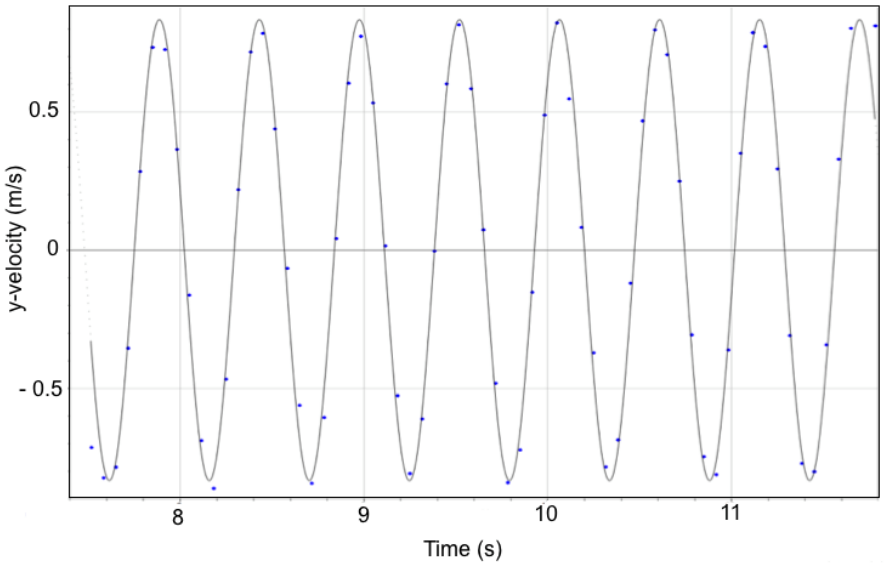
The following graph shows the velocity in the vertical direction of the pendulum shown in the photograph (figure 1).



(c) Use this graph to determine the period of the pendulum. 3M

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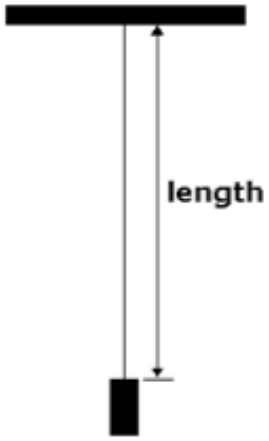
(d) A student measured the length of a pendulum used to investigate acceleration due to gravity, "g", as shown in this diagram.



Explain the effect that this measurement would have had on the final value of "g" that the student obtained. 3M

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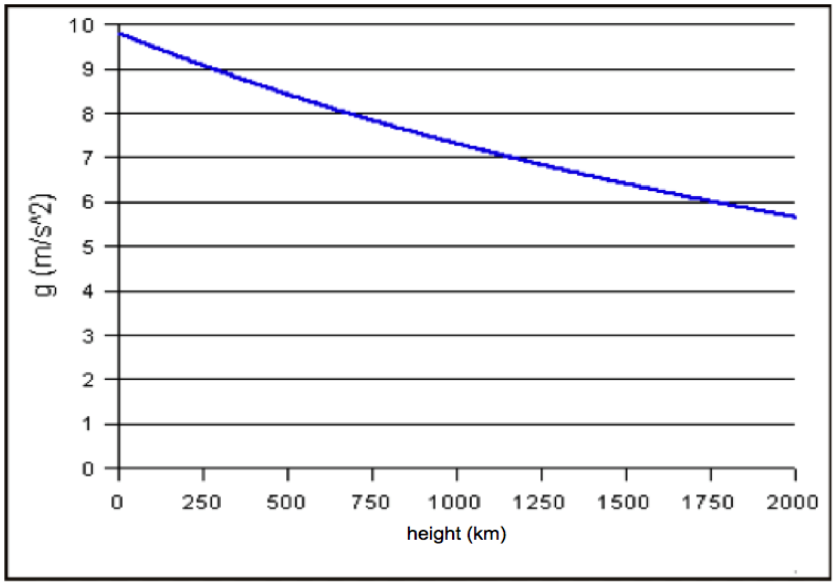
Question 3

This graph shows the relationship on Earth between height above sea level and the acceleration due to gravity.



(a) Qualitatively describe the relationship between "g" and the height of the satellite above the Earth. 2M

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(b) The force of gravity acting on an object having a mass m on the surface of a planet of mass M is given by the expression, where r is distance from the centre of the planet.

$$F = \frac{GMm}{r^2}$$

The following table shows some data about the planets. The mass of the Earth is 6.0×10^{24} kg.

	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
Mean Distance from the Sun (AU)	0.3871	0.7233	1	1.524	5.203	9.539	19.19	30.06
Sidereal period of orbit (years)	0.24	0.62	1	1.88	11.86	29.46	84.01	164.79
Equatorial Radius (km)	2439	6052	6378	3397	71490	60268	25559	25269
Polar Radius (km)	same	same	6357	3380	66854	54360	24973	24340
Mass of planet (Earth=1)	0.06	0.82	1	0.11	317.89	95.18	14.53	17.14

Calculate the acceleration due to gravity on Mercury. 2M

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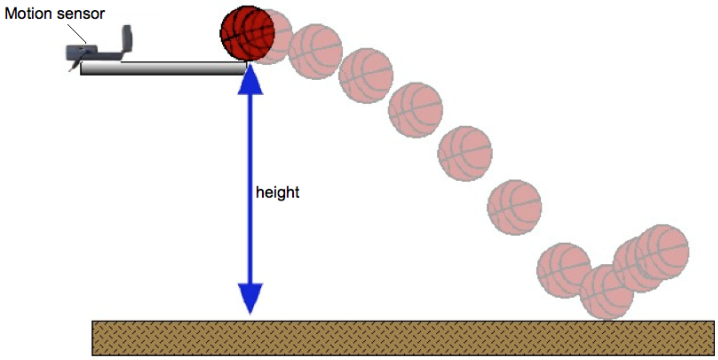
Question 4

A ball was rolled at different speeds off the edge of a table 0.86 m high.

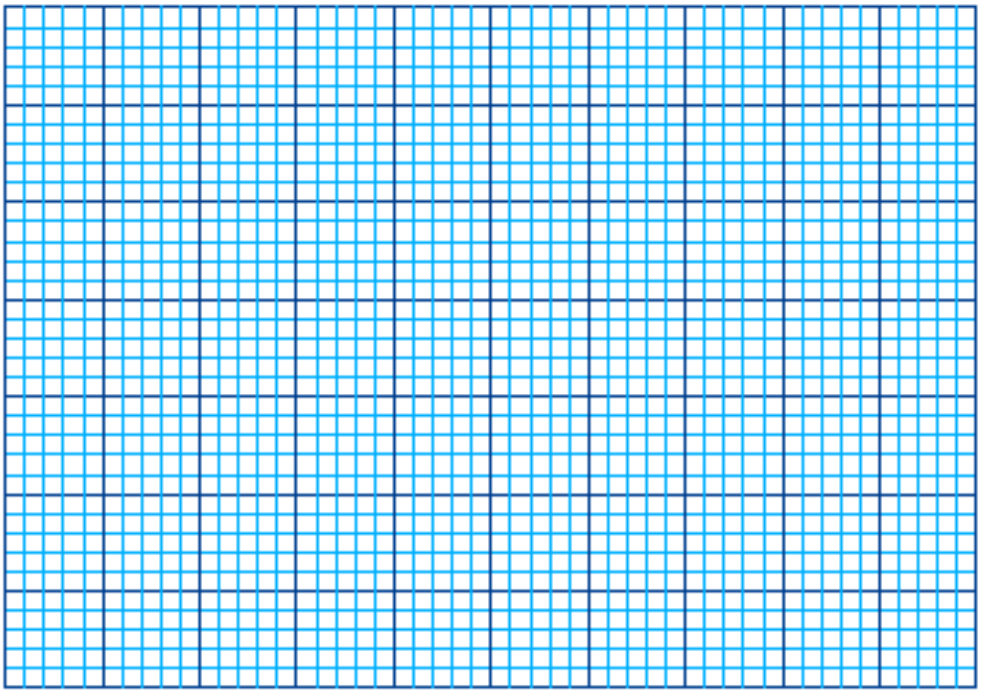


The horizontal distance travelled from the edge of the table was marked on the floor and measured with a metre rule.

The horizontal speed as the ball left the table was measured with an electronic data logger using a motion sensor.

Initial Horizontal Speed (m/s)	2.1	2.8	3.5	4.5	4.7	5.6	7.5
Range (m)	0.9	1.1	1.6	1.9	2.1	2.6	3.2

(a) Graph this data, placing the independent variable on the horizontal axis. 3M



(b) Calculate the gradient of this graph and explain its significance.

3M

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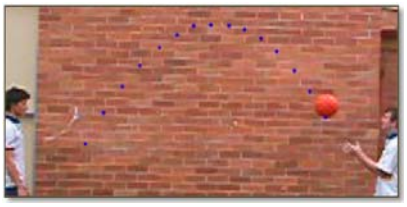
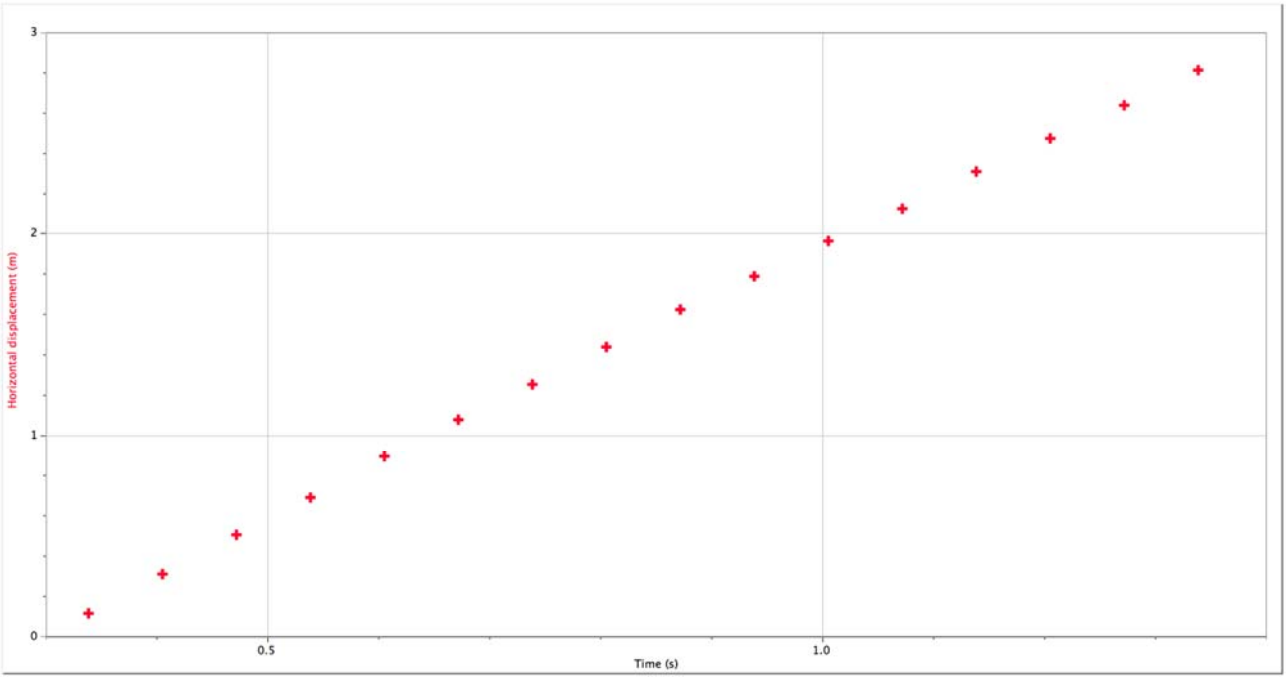
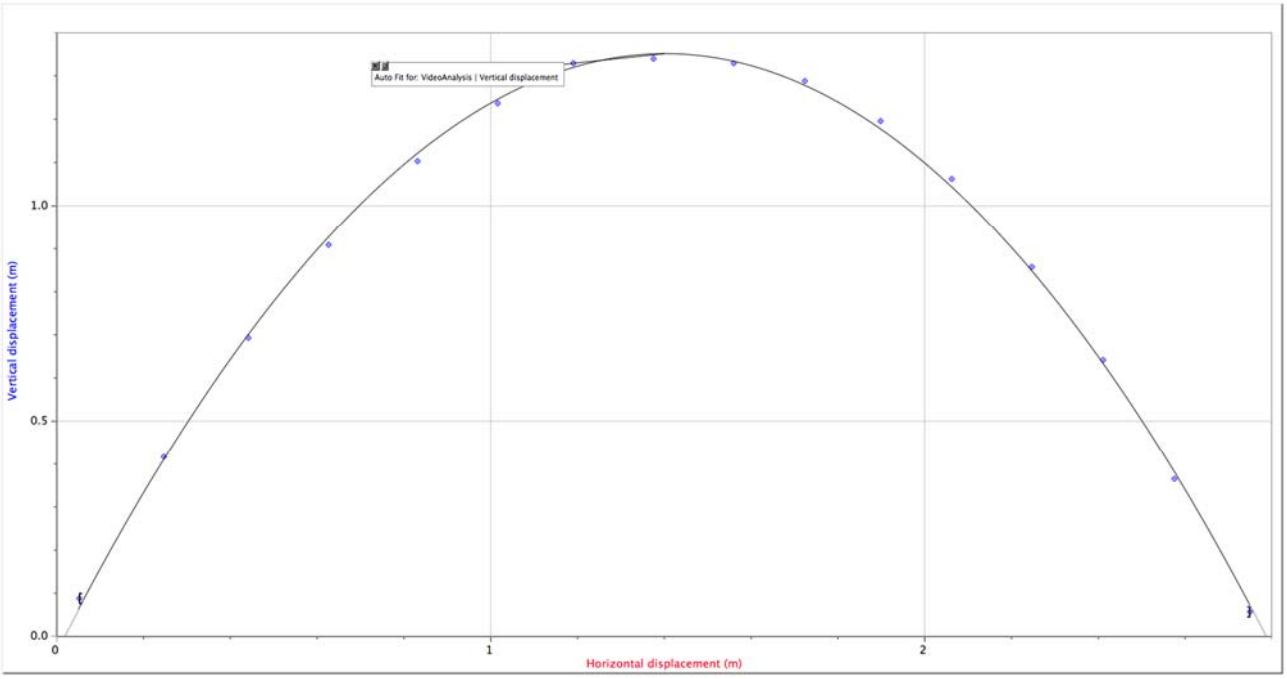
Question 5

The photo shows the path of a ball thrown by the person on the left to the person on the right.



The two graphs shows data collected from the analysis of a movie taken of the ball's motion.





(a) What maximum height did the projectile reach? Clearly show this on the appropriate graph. (2M)

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(b) What was the initial horizontal velocity of the projectile? (2M)

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(c) What was the initial vertical velocity of the projectile? (2M)

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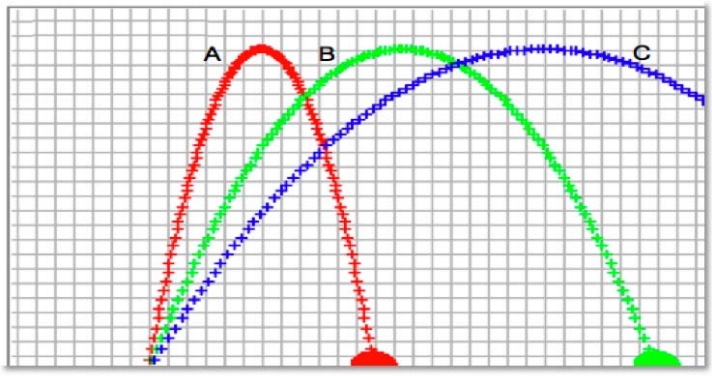
Question 6 [This was not included on the day – the image did not print – now fixed]

The following image shows the trajectories of three projectiles, A, B and C.



Compare the initial velocities of the projectiles A and B. 3M

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END OF EXAM

Criteria Q1	Mark
Records at least two attempts to make independent measurements (e.g. a table) AND States a value of 7.0 s (± 0.5 s) for the period AND Makes a statement that demonstrates a clear understanding of experimental validity (e.g. By measuring the time for 3 oscillations and dividing by 3 to obtain the period – it is not necessary to explain why the procedure is valid)	3
Records at least two attempts to make independent measurements (e.g. a table) OR states a value of 7.0 s (± 0.5 s) for the period AND Makes a statement that demonstrates a clear understanding of experimental validity	2
Answer has one correct component (from the 3 above)	1

"The measurement's validity was ensured by measuring the time for three oscillations and dividing by 3. This reduces the significance of human reaction time and errors made in judging the beginning and end points of the timed oscillations, compared to that which would be made if a single oscillation were timed. This process reduces the likely percentage error in the measurement, increasing the validity of the value for the period.

Criteria Q2a	Mark
States that the release position is not appropriate and provides a reason that demonstrates a **substantive** understanding of physics – it is NOT sufficient to say simply that this method would produce incorrect results	2
States that the release position is not appropriate and provides a reason that demonstrates an **elementary** understanding of physics – one mark is lost in this question for ANY statement made that demonstrates a poor understanding of physics	1

Criteria Q2b	Mark
Outlines **three*** ways in which the specific model can be validated reflecting a **substantive** understanding of the process of validation	3
Outlines **two** ways in which models can be validated OR three ways, but demonstrating only an elementary understanding of validation	2
Outlines **one** way in which models can be validated	1

* the model must be consistent with existing observations of the phenomenon it describes; controlled experiments designed to test the model must produce results consistent with the model; the model can be used to make predictions which can be observed/measured and seen to be consistent with the model

Criteria Q2c	Mark
Applies the relationship Period, T = time for n oscillations/n AND Substitutes a value of n >3 AND Recognises that 2 cycles of the graph is ONE oscillation of the pendulum (period is 1.1 s)	3
Applies the relationship Period, T = time for n oscillations/n AND Substitutes a value of n >3	2
Measures the time for n oscillations accurately OR writes the formula T = time/number of cycles	1

Criteria Q2d	Mark
Provides a clear reasoning that if the measured length "l" is too short, then the calculated value of "g" will be too small, supported by reference to the equation which demonstrates an understanding that $g \propto l$ *	3
States that since "l" is too small, "g" will be too small	2
Makes a correct and relevant statement about the pendulum's motion	1

* Rearranging

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$g = 4\pi^2\frac{l}{T^2} \quad \text{showing "g"} \propto \text{"l"}$$

Criteria Q3a	Mark
As height increases "g" decreases at a decreasing rate.	2
As height increases, "g" decreases. OR Correct answer with an incorrect statement, such as, quantities are inversely proportional or directly proportional (both incorrect).	1

Criteria Q3b	Mark
Equates given equation to F=ma to derive equation for acceleration due to gravity AND Correctly substitutes all quantities into formula (including converting units for radius). OR Uses ratios of Earth's and Mercury's radii and masses to find proportion of Earth's acceleration due to gravity on Mercury. (4.04 m s^{-2})	2
Makes one mistake in calculating the acceleration due to gravity OR Only completes one of the previous steps.	1

Criteria Q4a	Mark
Labels axes correctly with units and puts initial horizontal speed on the x-axis. AND Uses an appropriate scale on both axes. AND Accurately plots points and draws a straight line of best fit with at least one point on each side of the line.	3
Two of the above	2
One of the above	1

Criteria Q4b	Mark
Chooses appropriate points from line of best fit to calculate the gradient and substitutes these into the correct equation. (Marks not awarded for points from the table, which were not on the line of best fit). AND Gives the correct value for the gradient (0.44 s) AND States that the significance of the gradient is that it is the tame taken for the projectile to hit the ground. (Marks not awarded for simply "time taken")	3
Two of the above	2
One of the above	1

Criteria Q5a	Mark
Maximum height clearly labelled on the graph. AND Correct value given for maximum height (1.34 m – some variation allowed)	2
One of the above	1

Criteria Q5b	Mark
Use of gradient to find horizontal velocity of projectile. AND Correct calculation of gradient (2.73 $m.s^{-1}$)	2
Attempt to use gradient to find horizontal velocity but make small mistake, such as not realising the x-axis scale doesn't start at 0.	1

Criteria Q5c	Mark
Correct formula selected ($v_y^2 = u_y^2 + 2a_y\Delta y$) and one correct substitution into the formula. AND Correct answer (5.13 $m.s^{-1}$) given with correct units.	2
Correct formula selected ($v_y^2 = u_y^2 + 2a_y\Delta y$) and one correct substitution into the formula. OR One small mistake in calculation	1

Consider these graphs in relation to question 2(c)