Year 12 Physics Assessment Task

I.D. Number: _____

Practical and Processes

Teacher: ☐ Mr Coombes ☐ Mr Pitt ☐ Mr Robson

TOTAL MARKS _____/ 30

Task Weighting: 15%

Time Allowed: 45 minutes

- Attempt all questions
- Show all working
- You will require a stopwatch to carry out part of this task. 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

$g = 9.8 \text{ m s}^{-2}$

The kinetic energy of an object of mass m, moving with a velocity v is calculated using the equation $E_k = ½ mv^2$

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

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

$$F = mg$$

$$v_x^2 = u_x^2$$

$$v = u + at$$

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

$$\Delta x = u_x t$$

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

Question 1

This question refers to the pendulum shown in the following photographs and the movie titled "Pendulum B1" that will be shown during the task.

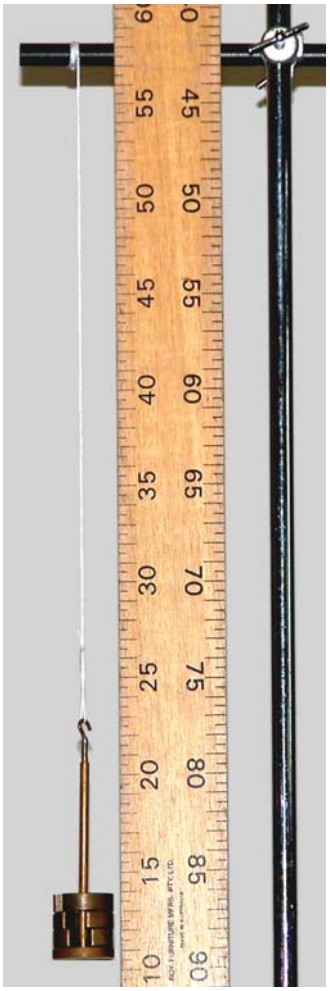

Figure (A)

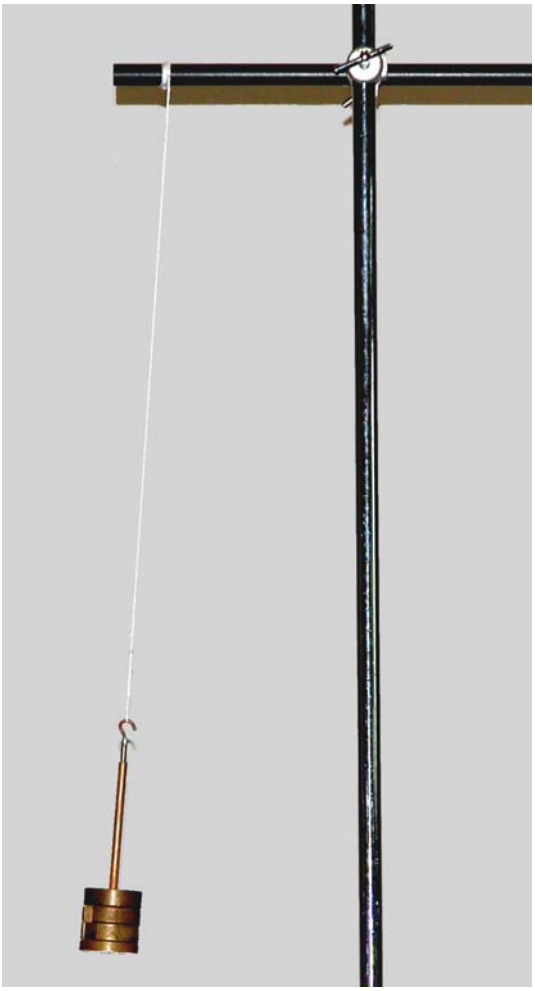

Figure (B)

(a) Measure the length of the pendulum using the scale in photograph (Figure A). The numbers on the scale indicate centimetres. Clearly show the process that you used to determine this length, using appropriate markings on the diagram and showing any working that you carried out. (2M)

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(b) Using the length that you have measured, predict the period of this pendulum. (2M)

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(c) Figure (B) shows the pendulum at one extreme of its swing. Identify a significant variable, evident in this photograph, which does not affect the period of the pendulum. (1M)

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(d) Watch the movie titled “Pendulum B1”, showing this pendulum in action and determine the period of the pendulum. Show your measurements and calculations clearly in your answer. (3M)

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(e) Compare the predicted period with the calculated period. (2M)

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(f) Provide an explanation for the difference between the predicted period and the measured period. (2M)

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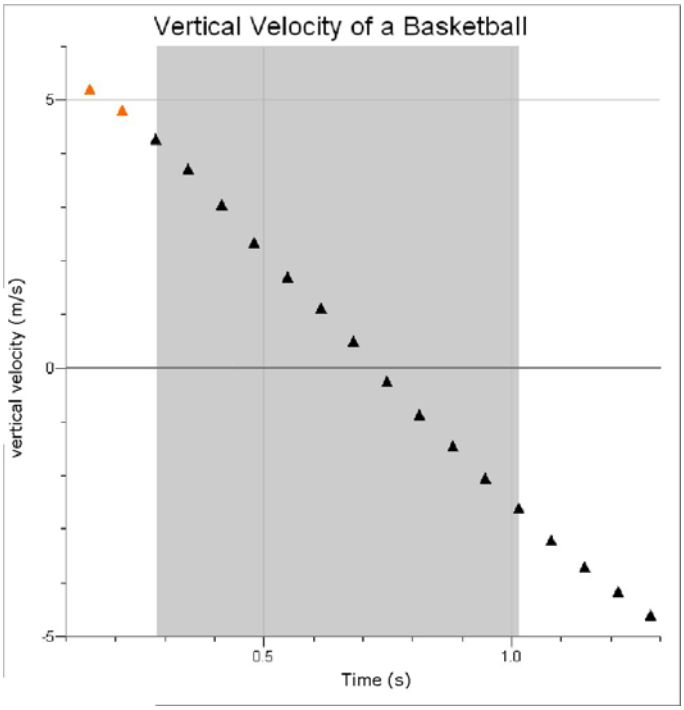
Question 2

The graph below was produced using Logger Pro® to analyse a movie of a basketball being thrown in a curved trajectory between two students. The origin was set at the top of the flight.



(a) Draw a line of best fit for the highlighted section of this data. [1M]

(b) Outline the physical behaviour of the projectile that is consistent with this graph. [1M]

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(c) Using the graph and any relevant equations, calculate the acceleration of the ball. [3M]

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(d) Assess the statement: "*At t = 0.7 s, the velocity of the basketball is zero*" [3M]

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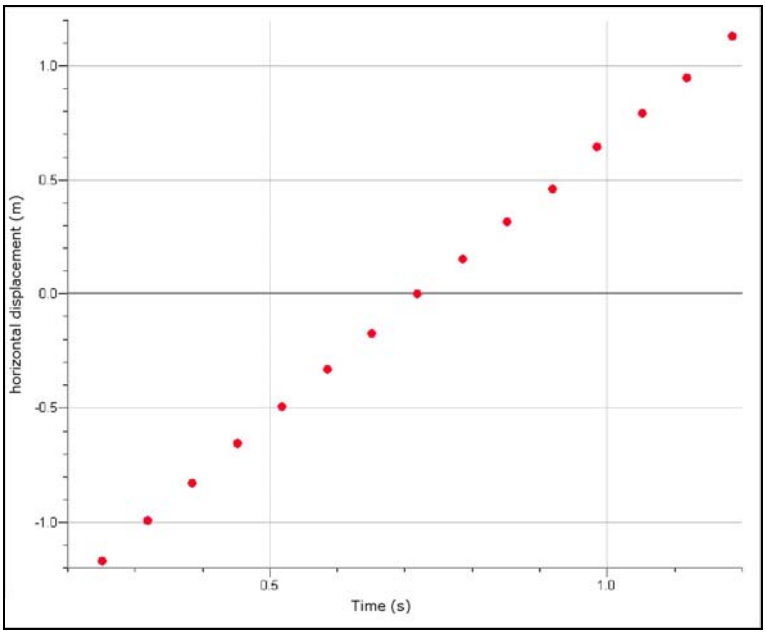
Question 3

The graph below was produced using Logger Pro® to analyse a movie of a basketball thrown in a curved trajectory between two students.



(a) The initial vertical velocity was calculated to be 4 m s^{-1}.
Calculate the initial velocity of the projectile. [4M]

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(b) Predict how the initial velocity calculated in (a) would have been different if the scale used in the video had been incorrectly placed further away from the plane in which the ball was moving and justify your prediction. [2M]

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Question 4

Write down the equation/s that you would need to use to calculate the work done when the space shuttle is launched from the Earth's surface into orbit around the Earth. [2M]

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Question 5

The following equation can be considered to be a model.

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

Outline how your investigation to calculate the acceleration due to gravity using the pendulum validated this model. [2M]

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End of this task

Marking Criteria

1 a Criteria	Marks
Correctly determines the length of the pendulum to be between 0.45 and 0.46 m and clearly indicates on the diagram that the length was measured to the centre of mass	2
Correctly determines the length of the pendulum to be between 0.45 and 0.46 m	1

1 b Criteria	Marks
Substitutes appropriate values into the formula to obtain a correct period value including units (T = 1.35 s for a length of 0.45 m)	2
Substitutes appropriate values into the formula to obtain a correct length value but omits units or units incorrect	1.5
Substitutes appropriately but does not calculate a correct value	1

1c Criteria	Marks
Correctly identifies mass or angle of swing	1

1d Criteria	Marks
Measurement of period taken over multiple oscillations and At least 3 separate measurements made and The answer is calculated in the correct range of 1.33-1.39s	3
Correct method omitting one or more of the steps above	1-3

1e Criteria	Marks
A quantitative comparison that is significant. e.g. the calculated period is 3% greater than the predicted period	2
A qualitative comparison. e.g. the calculated period is greater than the predicted period.	1

1f Criteria	Marks
Answer identifies a significant reason and links the reason to the difference between the values. e.g. The predicted period relied on the measurement of the length which may have been estimated as being larger than it actually is. This would cause the measurement of the predicted period to larger than it actually should.	2
Answer identifies a significant reason for the difference.	1

2a Criteria	Marks
Rules a straight line through the points in the shaded region showing points evenly distributed on both sides of the line along its length	1

2b Criteria	Marks
States that he projectile is accelerating downward at a constant rate OR Gives a clear account of the vertical motion slowing down uniformly as the projectile moves to its highest point and states that the vertical speed increases uniformly as it comes down.	1

2c Criteria	Marks
Calculates acceleration accurately (-9.6 m s^{-2}) using two widely-spaced points on the graph and the relationship accel = $\Delta v/\Delta t$. The answer must be accurate, have the correct sign (or state that the direction of the acceleration is downward) and have the correct unit.	3
Has the correct unit for acceleration in the answer (m s^{-2}) and shows the correct method of using the gradient of the graph BUT has poor accuracy OR Has an accurate answer with correct unit but omits direction or negative gradient.	2
States that the speed or velocity is equal to the gradient of the graph OR has the correct units for the acceleration (m s^{-2})	1

2d Criteria	Marks
States that at the highest point, the vertical component of the velocity is zero AND states that at that point the horizontal component of the velocity is non-zero [because the question states that the trajectory is curved] AND concludes therefore that the statement is false.	3
Concludes that the statement is false AND states that the horizontal velocity component is non-zero OR Concludes that the statement is false because the at 0.7 s the line of best fit does not correspond exactly to a vertical velocity of zero.	2
States that at the highest point, the vertical component of the velocity is zero ZERO marks for concluding that the statement is TRUE	1

3a Criteria	Marks
Correct calculation of initial horizontal velocity (gradient = 2.5 ms^{-1}) and correct calculation of the initial velocity from horizontal and vertical components including angle (u=4.7ms^{-1} 58^0 above the horizontal)	4
Correct calculation of initial velocity excluding angle	3
Correct calculation of initial horizontal velocity (gradient)	1

4 Criteria	Marks
Correct formulas identified without additional incorrect formulas. $E_p = -G\frac{m_1 m_2}{r}$ $E_k = \frac{1}{2}mv^2$	2
Identifies one of the above formulas [zero marks awarded for one correct and one incorrect equation]	1

5 Criteria	Marks
Two appropriate results that validated the model. e.g. That the g calculated was comparable to a known value That the line of best fit proved that length was directly proportional to the period squared.	2
One of the above	1