

HSC Course

2009

Year 12 Half Yearly Assessment Task

Exam / Practical and Processes

Total marks 50

General Instructions

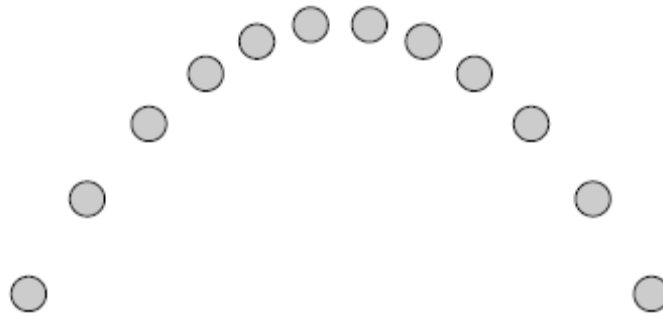
- Reading time – 5 minutes
- Working time – 1.5 hours

- There are 14 questions in this paper
- Attempt all questions
- Write using blue or black pen
- Draw diagrams using pencil
- Approved calculators may be used
- Write your I.D. number on each answer sheet

Teachers: Mr Coombes, Mr Robson, Mr Pitt

Task Weighting: 30 %

5. A ball thrown traces the path shown below.



Assess the statement “At the highest point in its trajectory, the velocity of the ball is constant”. 2M

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6. The Starship Enterprise is travelling with a speed of $0.65c$ with respect to the Earth when Captain Kirk measures a time interval of 22.0 hours between two events occurring on Earth. Calculate the time interval he would measure if the Enterprise had a speed of $0.85c$ relative to the Earth 3M

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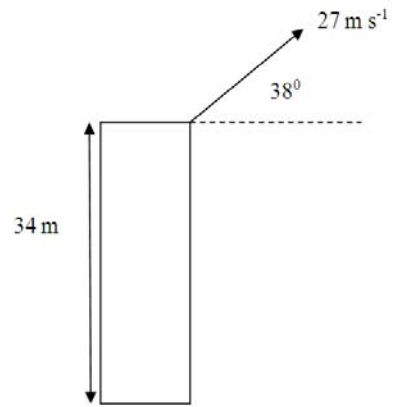
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7. A small, heavy projectile was launched upward from the edge of a building at 38° to the horizontal with an initial speed of 27 m s^{-1} . The height of the building was 34 m. The projectile landed on the ground away from, but level with, the base of the building.



(a) Calculate how long the projectile was in the air?

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2M

(b) How far away from the base of the building did the projectile land?

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2M

[questions continue on next page]

8. Recount a first-hand investigation that you carried out to investigate the motor effect and state the conclusion you made from this investigation.

3M

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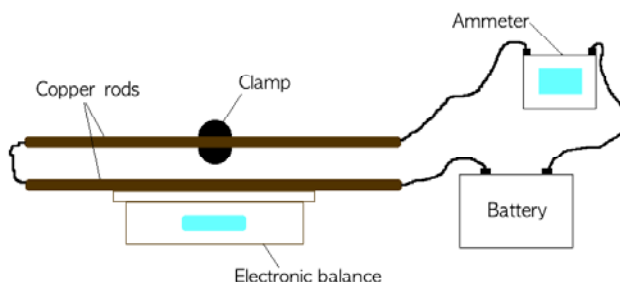
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13. Two copper rods were connected in a circuit with an ammeter and a battery as shown in the diagram. The upper rod was clamped so that it could not move. The lower rod was resting on an electronic balance.



The distance between the two copper rods was 0.01 m. With a current flowing in the wires, the reading on the balance was 24.215 g. When the battery was disconnected, the reading on the electronic balance changed by 0.015 g.

- (a) What was the force produced between the two wires when the current was flowing?

2M

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- (b) Calculate the current in the wires.

2M

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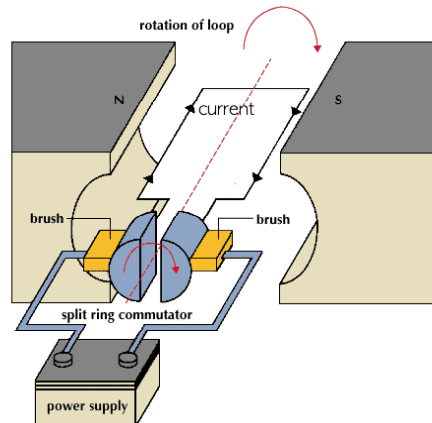
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14. The rectangular coil in the motor below has 50 turns and the coil's size is 4 cm x 6 cm. The current in the coil is 2 amperes.



(a) Outline the purpose of the component of the motor called the split-ring commutator. 2M

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(b) Explain how a torque is produced on the coil in this motor. 3M

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(c) Calculate the torque on the coil when it has rotated 30° from the position shown. 2M

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END OF TASK

Marking Criteria

Q1	Criteria	Marks
	Outlines two of Werner von Braun's contributions (must be specific – not generalisations)	2
	Outlines one of Werner von Braun's contributions	1

Q2	Criteria	Marks
	States that the linear velocity due to Earth's rotation is a maximum at the equator AND that this component adds to a rocket's velocity during launch AND Reasons that this strategy reduces fuel needed and hence mass of launch vehicle and cost of launch	2
	States that launch from near the equator assists launch by adding to the velocity of the rocket due to rotation of the Earth on its axis	1

Q3a	Criteria	Marks
	Identifies the force as frictional (centripetal also accepted)	1

Q3b	Criteria	Marks
	Identifies the correct formula to use for the calculation ($F=mv^2/r$) AND calculates the linear velocity of the car. (31.4 m s ⁻¹)	3
	Identifies the correct formula to use for the calculation	2
	Calculates the linear velocity of the car	1

Q4	Criteria	Marks
	Well-expressed answer using appropriate physics language which includes An assessment that the conclusion is invalid Reasons that the method of measuring has produced a value that is too long and therefore invalid (or refers to centre of mass and its relevance to a simple pendulum) Reasons that the method used to determine the period is subject to significant error (see sample answer)	3
	Poorly expressed answer that identifies both length and period errors/uncertainty and makes the correct assessment OR Well-expressed answer that identifies the invalid length measurement and outlines its cause (how the error was made) or effect (increased value of "g").	2
	Makes a correct assessment OR Outlines the incorrect length measurement OR Outlines the poor method of determining the period NB Correct assessment and reference only to measurement of period gets a maximum of one mark.	1

Q5a.	Criteria	Mark/s
	A judgement that the statement is incorrect and an appropriate justification. E.g. the ball is still accelerating due to gravity	2
	A judgement that the statement is incorrect but has a correct statement. E.g. the vertical velocity is zero at the top of the motion	1

Q6.	Criteria	Mark/s
	Correct answer of 31.7 hours	3
	Correct calculation of rest time = 16.7 hours	2
	Identifies the need to use the equation twice but has incorrect substitution.	1

Q7a.	Criteria	Mark/s
	Correct answer of 4.83 seconds	2
	One correct calculation. E.g. Maximum height of 48.1m.	1

Q7b.	Criteria	Mark/s
	Correct answer of 102.75m or correct use of equation with incorrect value from (a)	2
	Correct substitution with one error.	1

Q8.	Criteria	Mark/s
	A correct method which includes the use of a current carrying wire and a magnet. A correct observation A conclusion about the motor effect which is correctly stated.	3
	Two of the above	2
	One of the above	1

Q9a.	Criteria	Mark/s
	A correct description of the shape of the graph (NOT EXPONENTIAL) and an explanation of why the graph has this shape.	2
	Correct identification of the shape (as speed increases the mass increases at an increasing rate)	1

Q9b.	Criteria	Mark/s
	Answer thoroughly discusses one implication of mass dilation and makes reference to the graph.	3
	Answer thoroughly discusses one implication of mass dilation WITHOUT reference to the graph. OR answer outlines one implication of mass dilation with reference to the graph.	2
	Answer outlines one implication of mass dilation	1

Q10	Criteria	Marks
	States that the frame of reference is non-inertial and provides a clear, well-expressed reason (based on the apparent acceleration of the ball in the car frame of reference, implying that the car is accelerating)	2
	States that the frame of reference is non-inertial and provides an incomplete / less well expressed justification	1

Q11	Criteria	Marks
	Answer describes comprehensively the link between the chosen device to two specific advances in physics AND makes an assessment.	3
	Answer describes comprehensively the link between the chosen device to one specific advance in physics AND outlines a second AND makes an assessment.	2
	Answer describes comprehensively the link between the chosen device to one specific advance in physics OR outlines a two relevant advances in physics AND makes an assessment.	1

Marking Criteria

Q12a	Criteria	Marks
	Shows correct substitution and calculates the correct answer (0.9998c or $2.9999 \times 10^8 \text{ m s}^{-1}$)	2
	Correct substitution into formula	1
Q12b	Criteria	Marks
	Answer refers to at least one postulate of special relativity (constancy of velocity of light, no absolute inertial frame of reference) AND states at least one implication (mass dilation, time dilation, length contraction, $E = mc^2$) AND states that experiments can be used to test/validate scientific ideas (or reveal new results or ideas/directions of thinking) AND states that this process is an important part of the process of changing scientific thinking.	4
	States at least one implication (mass dilation, time dilation, length contraction, $E = mc^2$) AND States that experiments can be used to test/validate scientific ideas or reveal new results or ideas/directions of thinking AND states that this process is an important part of the process of changing scientific thinking.	3
	States at least one implication (mass dilation, time dilation, length contraction, $E = mc^2$) AND States that experiments can be used to test/validate scientific ideas or reveal new results or ideas/directions of thinking	2
	States at least one implication (mass dilation, time dilation, length contraction, $E = mc^2$) OR States that experiments can be used to test/validate scientific ideas or reveal new results or ideas/directions of thinking	1
Q13a	Criteria	Marks
	Converts the mass difference into a corresponding force in newtons ($0.015 \text{ gf} = 1.47 \times 10^{-4} \text{ N}$) AND States that the force is repulsive	2
	Substitutes correctly into the formula $F = mg$ OR States that the force is repulsive	1
Q13b	Criteria	Marks
	Shows the correct formula ($F/l = kI_1I_2/d$) and makes one correct substitution into that formula	2
	Shows the correct formula ($F/l = kI_1I_2/d$)	1
Q14a	Criteria	Marks
	Identifies that the commutator reverses the current in the coil each half a turn.	2
	Identifies that the commutator is responsible for changing the direction of the current in the coil.	1
Q14b	Criteria	Marks
	Answer identifies the direction of the forces acting on either side of the pictured motor AND Clearly relate the forces to a torque being produced	3
	Answer relates opposite forces on each side of a motor to a torque being produced	2
	Answer makes one correct statement related to the production of torque. Eg the sides of the motor experience a force due to the motor effect.	1
Q14c	Criteria	Marks
	Correct answer with units (either 0.21 Nm or 0.24 Nm)	2
	Correct answer with incorrect or missing units	1

Sample Answers

Sample answer Q2

The linear velocity of the Earth's surface due to its axial rotation is a maximum at the equator.

Satellites launched eastward from near the equator have this velocity component added to the velocity of the rocket produced by its engines.

Launching a rocket in this manner reduces the fuel required, hence the mass and cost of the rocket launch.

Sample answer 3b

Car's velocity $v = 2\pi r/T = 2\pi \times 100 / 20 = 31.4 \text{ m s}^{-1}$.

Centripetal force $F = mv^2/r$

Following shows a typical calculation – not required to get the marks in this question because the mass was omitted.

Taking mass to be 800 kg

$F = 800 \times 31.4^2 / 100 = 7895 \text{ N}$

Sample answer Q4

The conclusion is invalid because it is based on an invalid measurement of the length and a low-reliability of the method used to determine the period.

The length of a simple pendulum is from the point of support to the centre of mass. The student said the length was to the bottom of the mass and hence the length value is invalid and too large, which would produce a value of "g" that was too large.

The potential error due to human judgement in observing the pendulum and stopping the watch for the T/2 measurement made is significant compared to the period. This poor method is likely to compromise the accuracy of T, making the conclusion based on its use invalid.

Sample answer Q10

The car is a non-inertial frame of reference. If there is no net force acting on the ball, it must move at a constant velocity in the Earth frame of reference. It appears, from the increasing distances moved by the ball relative to the car however, that the ball is being accelerated. Since this is not possible without a net force, the car must be accelerating – in this situation, slowing down – making the ball appear to accelerate.

Sample answer Q11

Advances in physics were essential for the development of loudspeakers.

The development of the loudspeaker was dependent on the understanding between AC current and the sounds produced by the speaker because increasing the frequency of the current increases the pitch of the sound and increasing the magnitude of the current increases the loudness of the sound.

Loudspeaker development has also been impacted on by an understanding of magnetic materials resulting in the use of strong neodymium magnets, which has allowed smaller, more efficient speakers to be made.

Sample answer Q12b

Postulates of special relativity

The laws of physics are the same in any inertial frame, regardless of position or velocity

The speed of light c is a universal constant, the same in any inertial frame

Implications of special relativity

Time dilation, length contraction, $E=mc^2$ or mass dilation

Experiments are used to validate scientific ideas

Result of experiments lead to changes in scientific thinking

Sample answer Q13b

The laws of physics are the same in any inertial frame, regardless of position or velocity