

2IB Physics SL + HL. Test 29-5-2008 TM – *include working!*

MC-problems count 2 marks each. Total marks for SL+HL paper: 40+40 = 80.

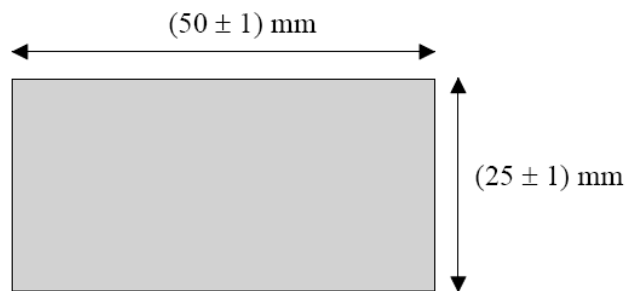
1. M02 S1: 1

The mass of an object is measured to be 4.652 kg and its volume 2.1 m^3 . If the density (mass per unit volume) is calculated from these values, to how many significant figures should it be expressed?

- A. 1
- B. 2
- C. 3
- D. 4

2. M02 S1: 2, H1: 1

The lengths of the sides of a rectangular plate are measured, and the diagram shows the measured values with their uncertainties.



Which of the following is the best estimate of the percentage uncertainty in the calculated **area** of the plate?

- A. $\pm 2\%$
- B. $\pm 4\%$
- C. $\pm 6\%$
- D. $\pm 8\%$

3. M02 H1: 8

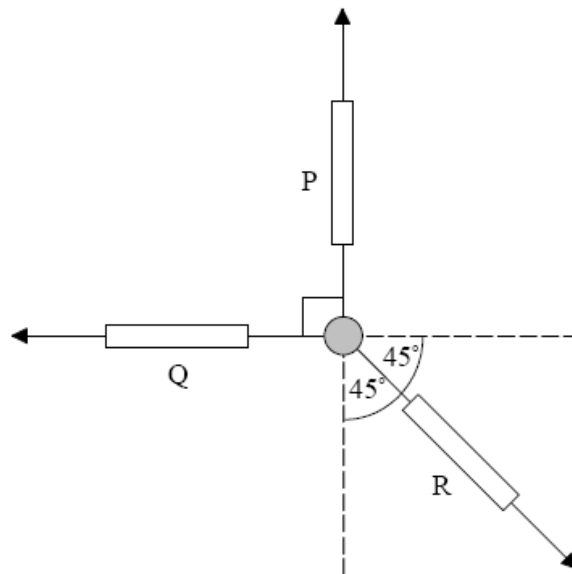
When an object undergoes simple harmonic motion, which of the following is true of the magnitude of the acceleration of the object?

- A. It is uniform throughout the motion.
- B. It is greatest at the end points of the motion.
- C. It is greatest at the midpoint of the motion.
- D. It is greatest at the midpoints and the endpoints.

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4. M02 S1: 4, H1: 3

A body on a smooth horizontal surface is attached to three spring scales P, Q and R as shown below. The body is in equilibrium with the scales pulling on it at the angles shown.



How do the **magnitudes** of the force readings F_P , F_Q and F_R on the scales compare?

- A. $F_P = F_Q = F_R$
- B. $F_R > F_P = F_Q$
- C. $F_R < F_P = F_Q$
- D. $F_P + F_Q = F_R$

5. M02 S1: 13

A copper block is placed in thermal contact with a iron block at a higher temperature. The blocks have the same mass, and energy exchange with the surroundings is negligible.

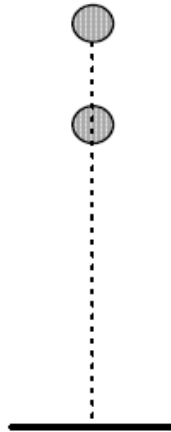
Which of the following will be true of the magnitudes of the **internal energy change** and **temperature change** of each block when thermal equilibrium is reached?

	Changes in internal energy	Changes in temperature
A.	equal	equal
B.	unequal	equal
C.	equal	unequal
D.	unequal	unequal

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6. M02 S1: 5, H1: 5

Two identical stones are dropped simultaneously from different heights. Air resistance is negligible.

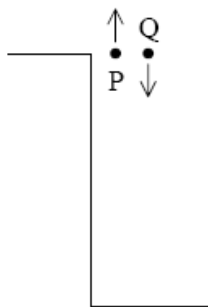


As the stones fall, the distance between them will

- A. increase continuously.
- B. decrease until they touch.
- C. remain the same.
- D. increase initially then remain the same.

7. M02 S1: 6

Two stones P and Q are thrown from the top of a building, P straight up and Q straight down at a **greater speed** than P, as indicated. Both stones eventually hit the ground.



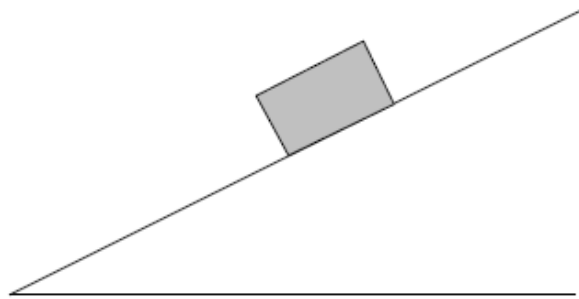
If air resistance is negligible, which of the following statements is true?

- A. Stone P hits the ground with the greater speed.
- B. Stone Q hits the ground with the greater speed.
- C. Both stones hit with the same speed.
- D. It depends on the height of the building which stone hits the ground with the greater speed.

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8. M02 H1: 4

A block is at rest on a rough incline as shown.

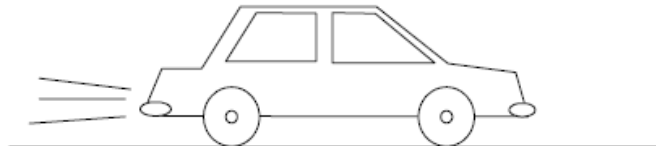


The frictional force acting on the block along the incline is

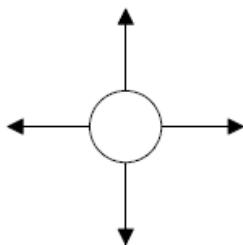
- A. zero.
- B. equal to the weight of the block.
- C. greater than the weight of the block.
- D. less than the weight of the block.

9. M02 S1: 8

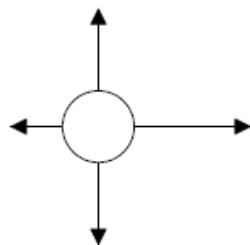
A car is travelling on a level highway at a constant velocity in a straight line. Air resistance is **not** negligible.



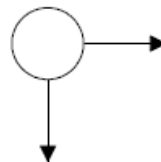
Which of the following is the correct free-body force diagram for the car?



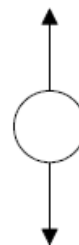
A.



B.



C.

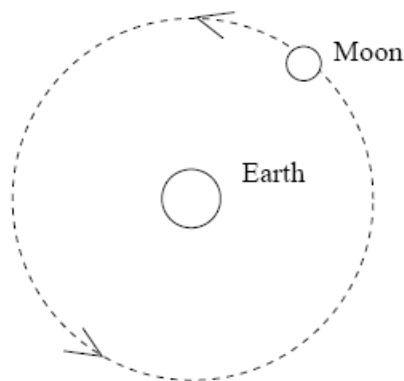


D.

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10. M02 S1: 9, H1: 10

The Moon orbits the Earth in a nearly circular orbit at constant speed as shown.

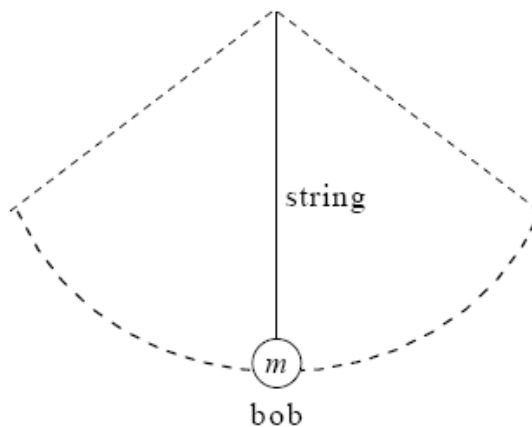


Which of the following diagrams correctly shows the force(s) acting on the Moon in the position shown above?



11. M02 H1: 9

A pendulum has a bob of mass m and swings in the arc shown below.



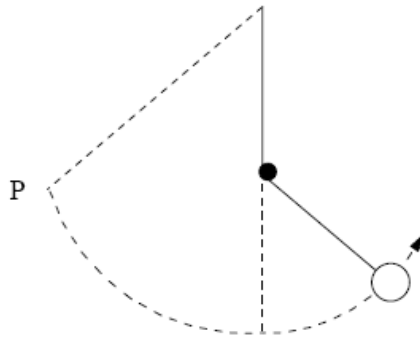
As the bob swings through the **lowest** point of its motion, the tension in the string will be

- A. zero.
- B. less than mg .
- C. equal to mg .
- D. greater than mg .

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12. M02 S1: 10

A pendulum bob is released from point P. As it swings down, the string strikes a peg and the bob swings up in a different arc on the other side as shown.

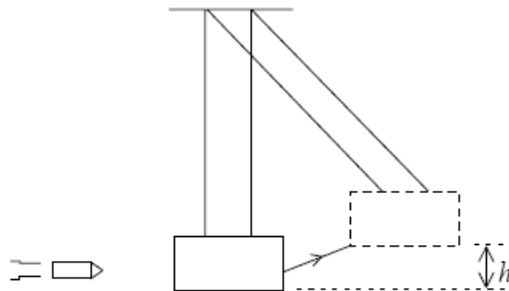


The bob will swing

- A. up to a lesser height than P.
- B. up to the same height as P.
- C. up to a greater height than P.
- D. round and round the peg.

13. M02 H1: 7

The figure shows a “ballistic pendulum” arrangement used to determine bullet speeds. A bullet is fired into a block suspended from cords and the block with the embedded bullet swings as far as the position shown below. The measured quantities are the masses of the bullet and the block and the maximum height h to which the block rises after impact.



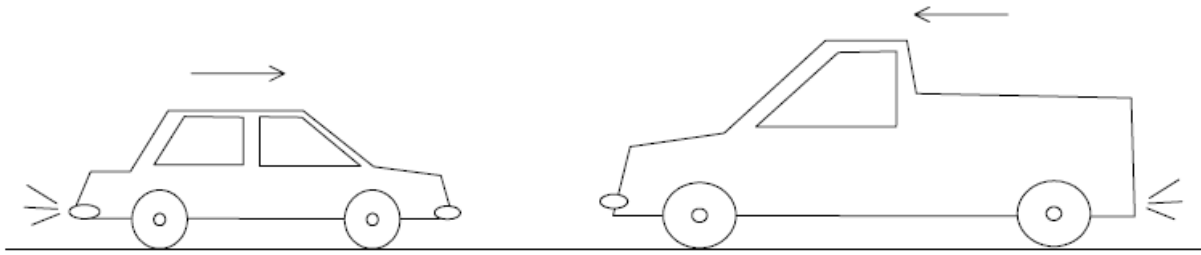
In order to calculate the **speed** with which the bullet struck the block, what principle(s) or law(s) should be applied in this situation?

- A. Newton’s first and second laws
- B. Conservation of energy only
- C. Conservation of momentum only
- D. Both conservation of energy and conservation of momentum.

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14. M02 S1: 11, H1: 11

A car collides with a more massive truck.



During the collision, each vehicle exerts a force on the other. How do the magnitudes of these forces compare?

- A. The forces cannot be compared without knowing how the initial speeds compare.
- B. The magnitudes of the forces are equal.
- C. The force exerted by the truck is the greater.
- D. The force exerted by the car is the greater.

15. M02 S1: 12

Two identical blocks connected by a light cord are on a frictionless surface. A force F is applied to one block as shown, and the system accelerates.



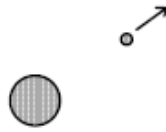
The force exerted by the cord on the second block will be

- A. zero.
- B. $\frac{1}{2}F$.
- C. F .
- D. $2F$.

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16. M02 H1: 12

A radioactive nucleus at rest decays by emitting an alpha particle.

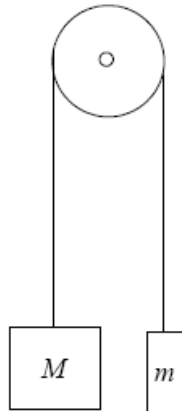


Just after emitting the alpha particle the daughter nucleus will have

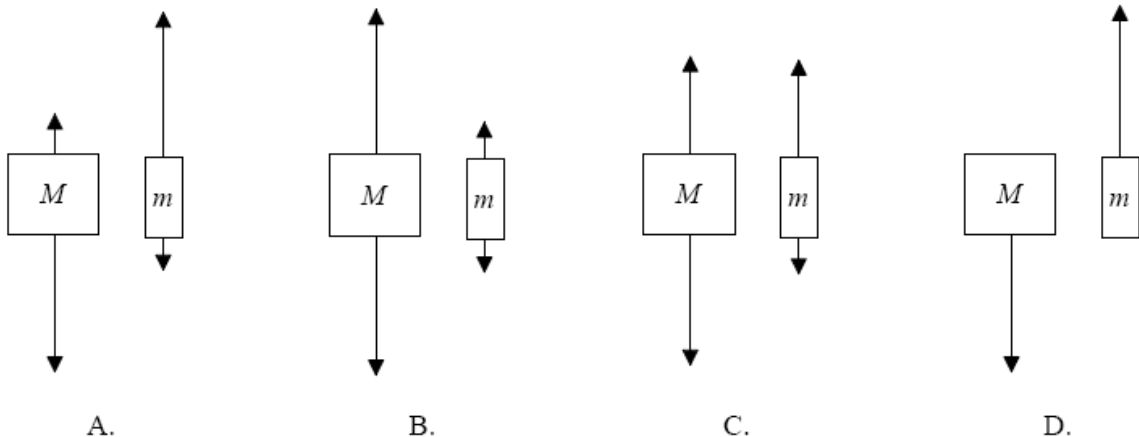
- A. zero kinetic energy and momentum.
- B. kinetic energy equal in magnitude to that of the alpha particle.
- C. momentum equal and opposite to that of the alpha particle.
- D. both energy and momentum equal in magnitude to those of the alpha particle.

17. M02 H1: 13

Two unequal masses M and m are connected by a light cord passing over a pulley of negligible mass. When released, the system accelerates.



Ignoring friction, which figure below best shows the correct free-body force diagrams for the two masses in the moving system?



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18. M02 H1: 15

Ice at 0°C is mixed with water at 0°C . Assume there is no energy exchange with the surroundings. Which of the following is correct?

- A. All the ice will melt.
- B. All the water will freeze.
- C. No ice will melt and no water will freeze.
- D. What will happen depends on the relative proportions of ice and water.

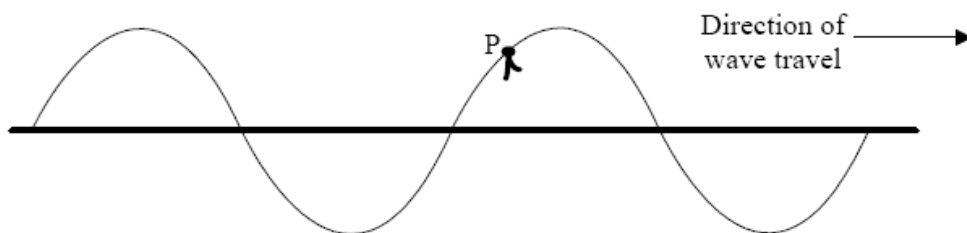
19. M02 S1: 15, H1: 18

A lead bullet is fired into an iron plate, where it deforms and stops. As a result, the temperature of the lead increases by an amount ΔT . For a lead bullet having **twice** the mass but the same speed of impact, what would be the best estimate of its temperature increase?

- A. $\frac{1}{2}\Delta T$
- B. ΔT
- C. $\sqrt{2}\Delta T$
- D. $2\Delta T$

20. M02 S1: 16

The diagram represents, at a particular instant of time, a transverse wave travelling to the right along a rope. One section of rope has been marked by tying a ribbon around it at point P.



In what direction is the ribbon moving at the instant shown in the diagram?

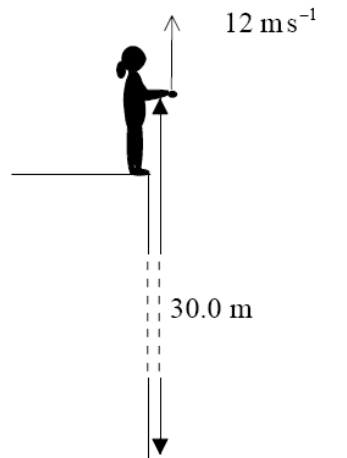
- A. 
- B. 
- C. 
- D. 

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21. M02 S2: A2. Marks: 9.

This question is about vertical motion under gravity.

A girl stands on the edge of a vertical cliff and throws a stone vertically upwards. The stone eventually lands in the sea below. The stone leaves her hand with a speed of 12 m s^{-1} at a height of 30.0 m above the sea.



Taking the acceleration due to gravity to be 10 m s^{-2} and ignoring air resistance determine

- (a) the maximum height, measured from sea-level, reached by the stone. [2]
 - (b) the time that it takes the stone to hit the sea after leaving the girl's hand. [5]
 - (c) In the space provided below sketch a graph to show how the **speed** of the stone varies with time from the moment it leaves her hand to just before it hits the sea. (*Note that this is a sketch graph; you do not need to add values to the axes.*) [2]
- (Graph on your own answering paper)

22. Marks: 6.

An electric kettle with a power of 1400 W contains 1.2 liters of water (specific heat capacity $4186 \text{ J kg}^{-1} \text{ K}^{-1}$).

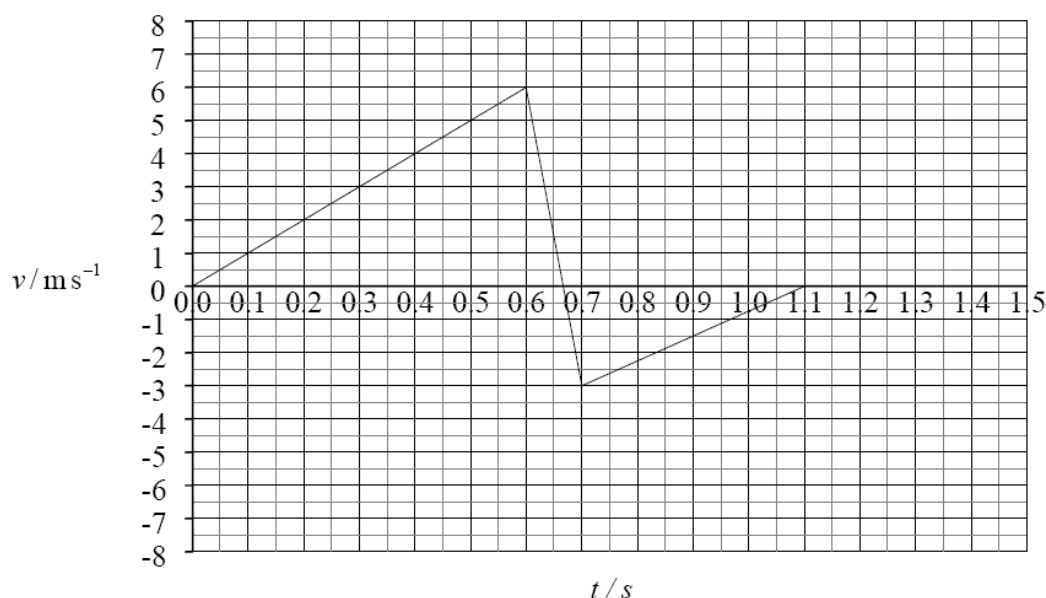
- (a) How long time will it take to bring the water to boil, starting at 20°C ? [4]
- (b) State carefully the assumptions you made in calculating (a). [2]

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23. M02 S2: B1. Marks: 25.

This question is about a bouncing ball.

A soft rubber ball of mass 0.20 kg is dropped from rest on to a flat horizontal surface and it is caught at its maximum height of rebound. A sonic data logger is used to record the velocity of the ball as a function of time. The graph below shows how the velocity of the ball varies with time t from the instant it is released to the instant that it is caught.



- (a) Mark on the graph above the time t_1 where the ball hits the surface and the time t_2 where it just loses contact with the surface. [2]
- (b) Use data from the above graph to determine
 - (i) the acceleration due to gravity. [3]
 - (ii) the height to which the ball rebounds. [3]
- (c) Use data from the graph opposite to find the change in momentum of the ball between t_1 and t_2 . [3]
- (d) Determine the magnitude of the average force that the ball exerts on the surface. [4]
- (e) Explain how the collision between the ball and the surface is consistent with the principle of momentum conservation. [2]
- (f) Is the magnitude of the force that the surface exerts on the ball greater than, smaller than or equal to the force that the ball exerts on the surface? Explain. [3]
- (g) A hard rubber ball of the same mass as the soft rubber ball is dropped from the same height as that from which the soft rubber ball was dropped.

Given that the hard rubber ball exerts a greater force on the surface than the soft rubber ball, sketch on the graph opposite how you think the velocity of the hard rubber ball will vary with time. (*Note that this is a sketch graph; you do not need to add any values.*) [5]

(Graph on your own answer paper)