



**ST ANDREW'S
CATHEDRAL
SCHOOL**
FOUNDED 1885



Candidate Session Number

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Year 12 IB Physics Standard Level

Paper 1

2021 Semester 2 Examination
Wednesday 18 August 2021

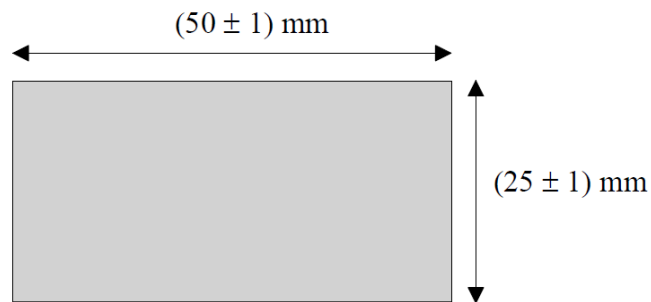
45 minutes

Instructions to candidates

- Write your session number in the boxes on the Paper 1 Answer Sheet.
- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A clean copy of the **physics data booklet** is required for this paper.
- The maximum mark for this examination paper is **[30 marks]**.

1. Repeated measurements of a quantity can reduce the effects of
 - A. both random and systematic errors.
 - B. only random errors.
 - C. only systematic errors.
 - D. neither random nor systematic errors.

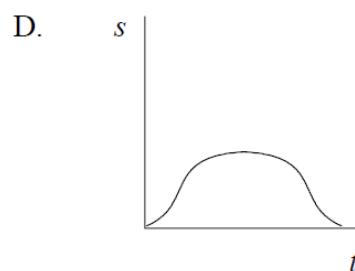
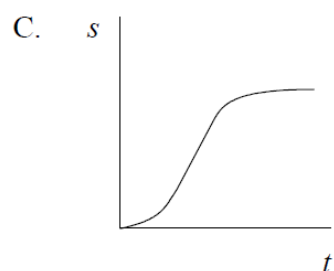
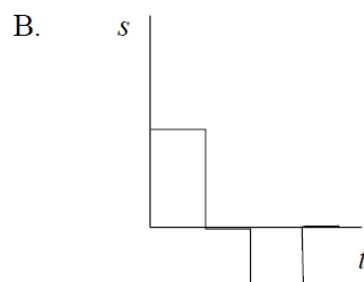
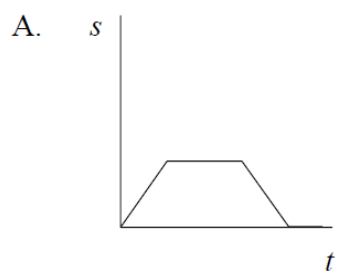
2. The lengths of the sides of a rectangular plate are measured, and the diagram shows the measured values with their uncertainties.



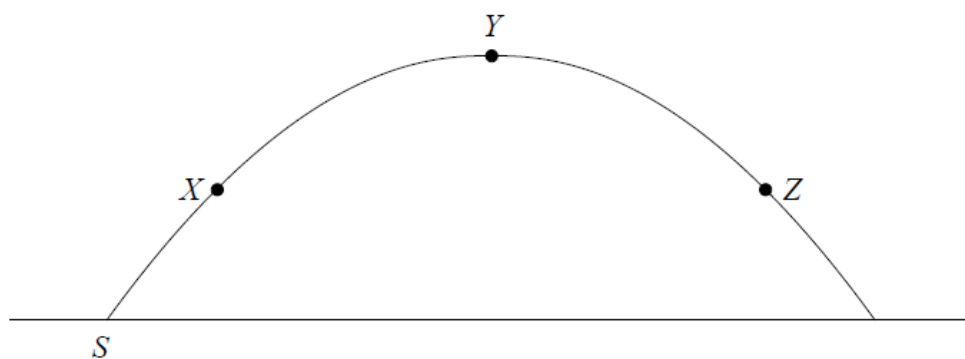
Which of the following is the best estimate of the percentage uncertainty in the calculated area of the plate?

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

3. A car travels along a straight road. It first accelerates from rest, then travels at a constant velocity, then decelerates to a stop. It then remains at rest. Which graph below best represents the displacement s of the car as a function of time t ?























4. A ball is thrown from S at an angle to the horizontal as shown in the diagram below.

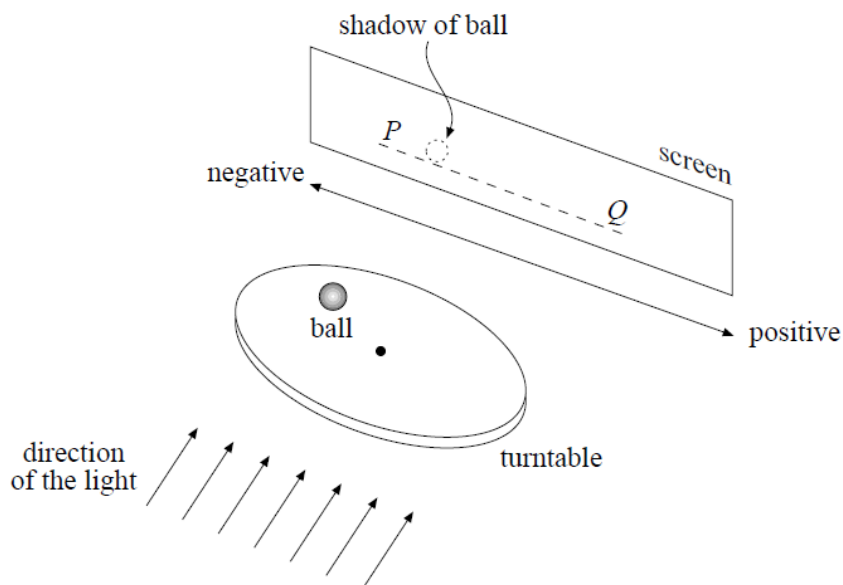


X, Y, and Z are different positions along the ball's trajectory.

Which of the following best represents the velocity and acceleration of the ball?

VELOCITY			ACCELERATION		
<i>X</i>	<i>Y</i>	<i>Z</i>	<i>X</i>	<i>Y</i>	<i>Z</i>
A. 	zero			zero	
B. 				zero	
C. 					
D. 				zero	

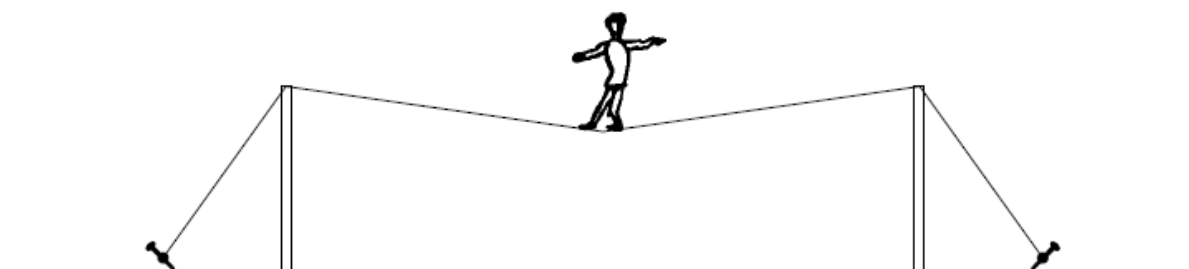
5. A ball is attached to a rotating turntable as shown in the diagram below. Light shines horizontally at the turntable. The shadow of the ball moves in simple harmonic motion in a horizontal straight line on the screen. P and Q represent the extreme positions of the shadow while the turntable is rotating. The displacement of the shadow is measured from the midpoint of PQ .



Which statement correctly describes the motion of the ball's shadow when at point P ?

- A. The displacement is negative, the velocity is zero, and the acceleration is negative.
- B. The displacement is negative, the velocity is zero, and the acceleration is positive.
- C. The displacement is negative, the velocity is maximum, and the acceleration is positive.
- D. The displacement is zero, the velocity is zero, and the acceleration is negative.

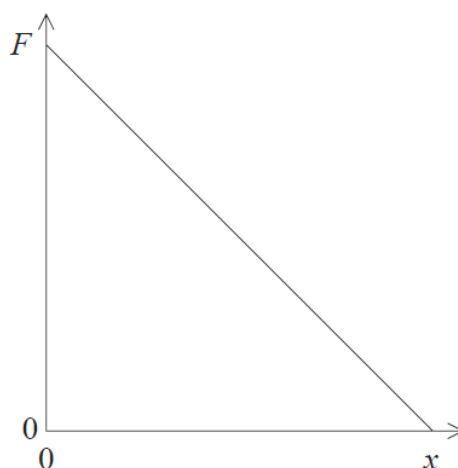
6. An acrobat is walking along a tightrope as shown in the figure below. The acrobat has weight W .



The tension in the wire between the supporting posts is

- A. Much more than W .
- B. Approximately W .
- C. Approximately $\frac{W}{2}$.
- D. Much less than $\frac{W}{2}$.

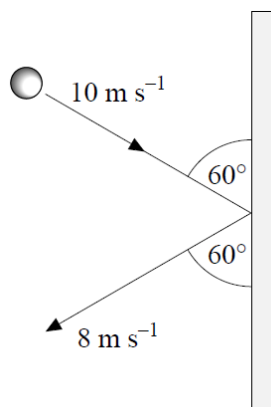
7. The graph shows the variation with distance x of the magnitude of the net force F acting on a body initially at rest.







Which of the following describes how the kinetic energy and the acceleration of the body change with distance?

	Kinetic energy	Acceleration
A.	decreases	decreases
B.	decreases	increases
C.	increases	decreases
D.	increases	increases

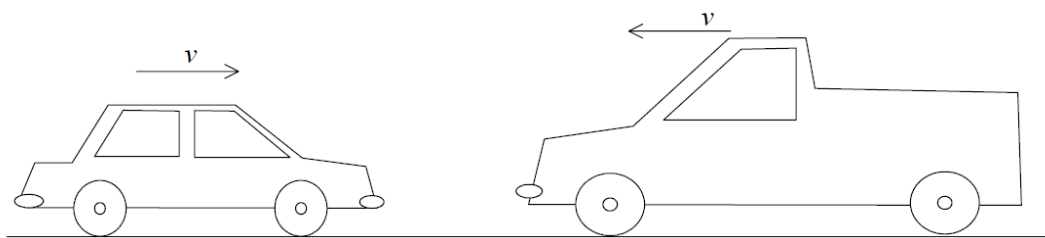
8. A ball bounces off a wall as shown in the diagram. The angles at which it strikes the wall and leaves the wall are both 60° . The initial speed of the ball is 10 m s^{-1} and the final speed is 8 m s^{-1} .



Which of the following best represents the type of collision and change in velocity of the ball?

	<i>Type of collision</i>	<i>Change in velocity</i>
A.	Inelastic	
B.	Inelastic	
C.	Elastic	
D.	Elastic	

9. A car and a truck travelling with equal speeds v in opposite directions collide head-on. The mass of the truck is greater than the mass of the car.



If the vehicles roll freely, how will the momentum changes of the vehicles compare in the collision?

- A. The car will have the greater momentum change.
 - B. The truck will have the greater momentum change.
 - C. The car and truck will have equal but opposite momentum changes.
 - D. One cannot compare momentum changes for an inelastic collision such as this.
10. A small block of metal is taken out of boiling water where it had come to thermal equilibrium at $100\text{ }^{\circ}\text{C}$ and placed into a calorimeter containing water at $0\text{ }^{\circ}\text{C}$. The mass of the block is equal to the mass of cold water. The specific heat capacity of the metal is less than that of the water.

Ignoring any transfer of thermal energy to the container, the equilibrium temperature of the block plus water will be

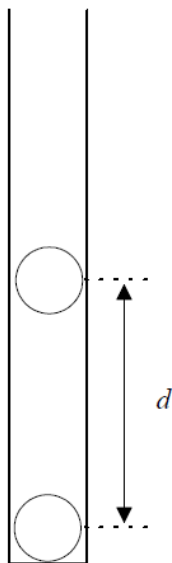
- A. less than $50\text{ }^{\circ}\text{C}$.
- B. $50\text{ }^{\circ}\text{C}$.
- C. more than $50\text{ }^{\circ}\text{C}$.
- D. $100\text{ }^{\circ}\text{C}$.

11. In order to double the average speed of the molecules in a sample of an ideal gas, the absolute temperature of the gas must
- A. halve.
 - B. increase by a factor of $\sqrt{2}$.
 - C. double.
 - D. quadruple.
12. Two identical containers A and B hold two different ideal gases at the same temperature. The number of moles of gas in each container is the same. The molar mass of the gas in container A is twice that of the gas in B. The ratio of the pressure in A to that of B will be
- A. $\frac{1}{2}$
 - B. 1
 - C. $\sqrt{2}$
 - D. 2
13. Sound travels faster in water than in air. If sound waves are generated under water a small fraction can travel into the air above the water. Which one of the following combinations is true for the sound waves as they move from water into air?

	Frequency	Wavelength
A.	Decreases	Unchanged
B.	Decreases	Decreases
C.	Unchanged	Decreases
D.	Unchanged	Unchanged

14. For an organ pipe of length L the frequency of the first harmonic is proportional to
- A. L
 - B. $\frac{1}{L}$
 - C. \sqrt{L}
 - D. $\frac{1}{\sqrt{L}}$
15. Interference phenomena can be demonstrated using light. This is evidence that
- A. light travels in a straight line.
 - B. light is a transverse wave.
 - C. light is electromagnetic in character.
 - D. light has wave characteristics.
16. A surfer is out beyond the breaking surf in a deep-water region where the ocean waves are approximately sinusoidal in shape. The crests are 20 m apart and the surfer rises a vertical distance of 4.0 m from wave trough to crest, in a time of 2.0 s. What is the speed of the waves?
- A. 1.0 m s^{-1}
 - B. 2.0 m s^{-1}
 - C. 5.0 m s^{-1}
 - D. 10.0 m s^{-1}
17. A person is walking along one side of a building and a car is driving along another side of the building. The person can hear the car approach but cannot see it. This is explained by the fact that sound waves
- A. travel more slowly than light waves.
 - B. are diffracted more at the corner of the building than light waves.
 - C. are refracted more at the corner of the building than light waves.
 - D. are longitudinal waves.

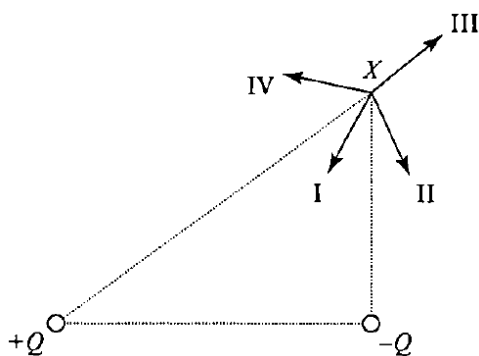
18. Two charged plastic balls in a vertical test tube are in equilibrium a distance d apart as shown.



If the charge on each ball is doubled, the distance between the balls in the test tube would become

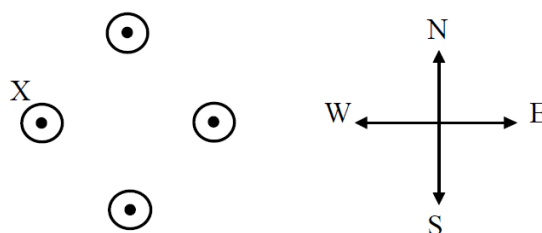
- A. $\sqrt{2}d$
- B. $2d$
- C. $4d$
- D. $8d$

19. The diagram shows two charges of magnitude $+Q$ and $-Q$. Which of the labelled arrows best shows the direction of the electric field at the point X?



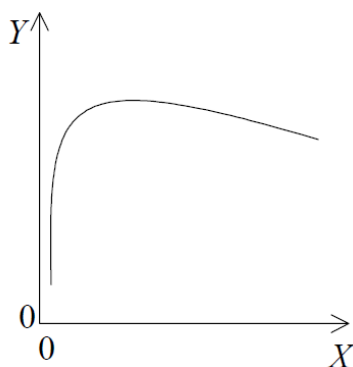
- A. I
- B. II
- C. III
- D. IV
20. To start a car with a flat battery, the battery can be connected to the battery in another car using two cables. These are called “jumper cables” and have low resistance. Suppose a good quality jumper cable has resistance R . A cheaper cable of the same length but half the cable diameter would have resistance
- A. $\frac{R}{4}$
- B. $\frac{R}{2}$
- C. $2R$
- D. $4R$

21. Four long straight parallel wires carry equal currents directed vertically out of the page. They are arranged on the corners of a square as shown in the figure below.



- The direction of the resultant magnetic force exerted on the wire labelled X is
- A. south.
 - B. north.
 - C. west.
 - D. east.
22. For a particle moving in a circle with constant speed, which one of the following statements is incorrect?
- A. There is no displacement of the particle in the direction of the force.
 - B. The force on the particle is always perpendicular to the velocity of the particle.
 - C. The velocity of the particle is constant.
 - D. The kinetic energy of the particle is constant.
23. When two identical spherical objects of radius R are touching, the gravitational force of attraction between them is F . When the gravitational force between them is $F/4$, the distance between the surfaces of the spheres is
- A. R
 - B. $2R$
 - C. $4R$
 - D. $6R$

24. The following graph is useful in predicting nuclear energy changes in fission and fusion processes.



Which one of the following correctly identifies the quantities X and Y ?

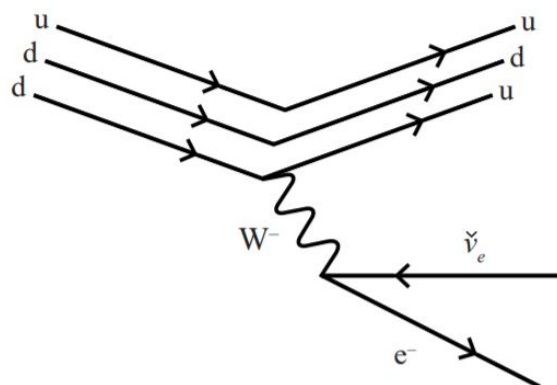
	X	Y
A.	atomic number	total binding energy
B.	mass number	total binding energy
C.	atomic number	average binding energy per nucleon
D.	mass number	average binding energy per nucleon

25. Two radioactive sources X and Y have the same initial activity. X has a half-life of 2 hours and Y a half-life of 1 hour. What is the ratio of the activities of X to Y after 4 hours?
- A. 2:1
- B. 4:1
- C. 8:1
- D. 16:1

26. In early experiments to investigate the nature of the atom a very thin gold foil was bombarded with alpha-particles. Consider the following three statements.
- I. There was no measurable deflection for most of the alpha-particles.
 - II. A large proportion of alpha-particles were deflected through angles greater than 90° .
 - III. It was deduced from this experiment that atoms have a very small, positively charged nucleus.

Which of these statements concerning this experiment is false?

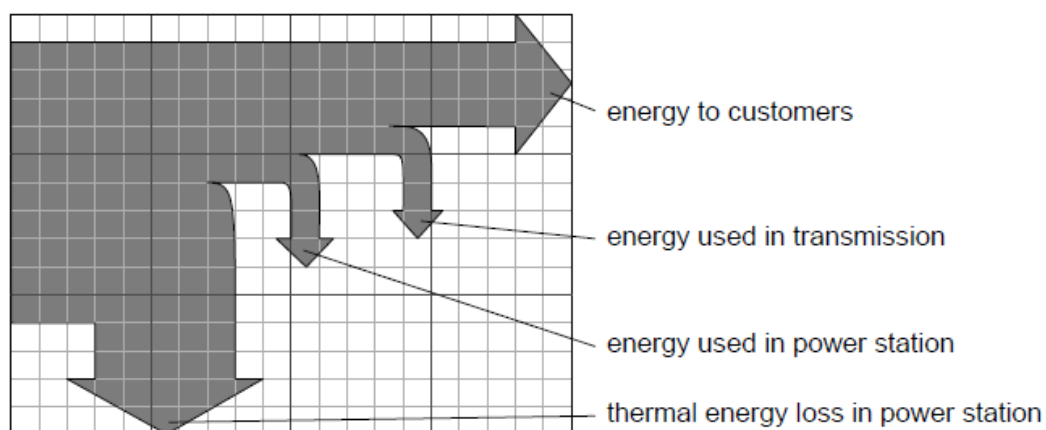
- A. I only
 - B. II only
 - C. I and II
 - D. II and III
27. The Feynman diagram below represents an interaction of particles.



Which particle interaction is represented by the diagram above?

- A. a neutron decaying into a proton
- B. a proton decaying into a neutron
- C. an electron and antineutrino interaction
- D. an electron and proton interaction

28. Which one of the following statements is *not* true about the control rods used in a nuclear reactor?
- A. They must absorb neutrons.
 - B. They must slow down neutrons to thermal speeds.
 - C. They must retain their shape at high temperatures.
 - D. The length of rod in the reactor must be variable.
29. The Sankey diagram below represents the energy flow for a coal-fired power station.



- What is the overall efficiency of the power station?
- A. 0.3
 - B. 0.4
 - C. 0.6
 - D. 0.7
30. An object is heated from $-70\text{ }^{\circ}\text{C}$ to $130\text{ }^{\circ}\text{C}$. The best estimate of the ratio of power radiated at the higher temperature to that radiated at the original temperature is
- A. $10^1:1$
 - B. $10^2:1$
 - C. $10^3:1$
 - D. $10^4:1$

