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

Year 12 IB Physics Standard Level

Paper 1

2020 Semester 2 Examination

Wednesday 26 August 2020

45 minutes

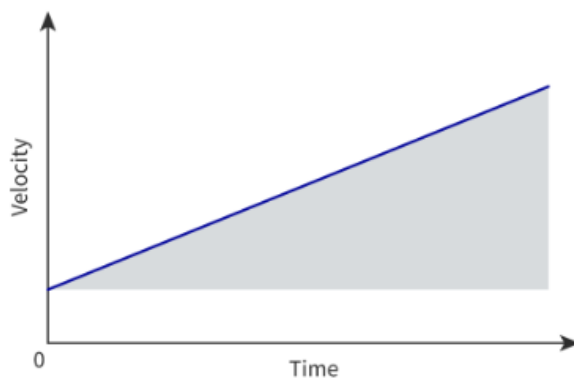
Instructions to candidates

- 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. By how many orders of magnitude is the mass of the observable universe (10^{50} kg) greater than the mass of an up quark (10^{-30} kg)?
 - A. 80
 - B. 10^{80}
 - C. 10^{20}
 - D. 20

2. Which of the following could be a unit of power?
 - A. $\text{kg m}^2 \text{s}^{-1}$
 - B. $\text{kg m}^2 \text{s}^{-2}$
 - C. $\text{kg m}^2 \text{s}^{-3}$
 - D. kg m s^{-2}

3. The following graph represents uniform acceleration.



What is the area of the shaded triangle?

s = displacement

a = acceleration

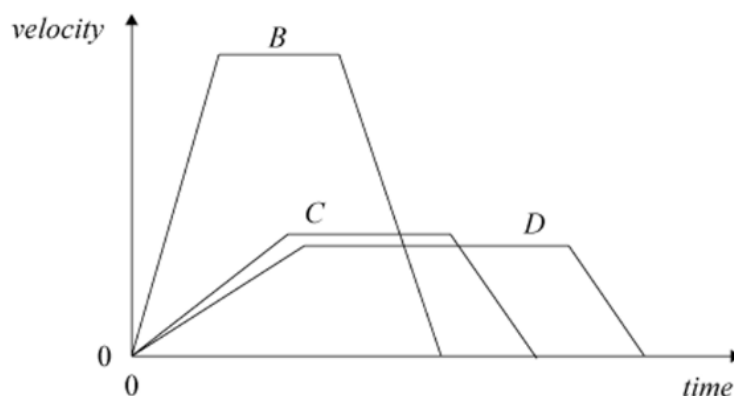
u = initial velocity

t = time

v = final velocity

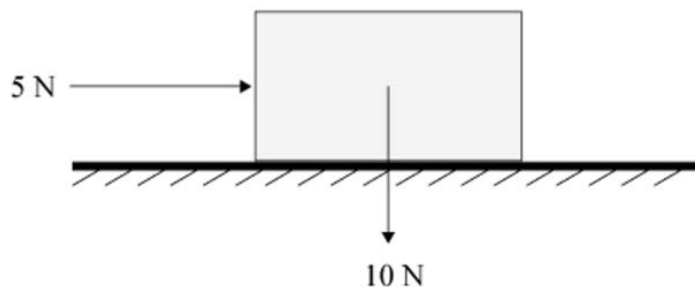
- A. $\frac{v+u}{2}$
- B. $\frac{v-u}{a}$
- C. $2 a s$
- D. $\frac{1}{2} a t^2$

4. A cyclist C, a bus B and a donkey D begin moving from the same location along a straight road according to the following graph.



What is the order, from shortest to greatest, of the distances each has travelled?

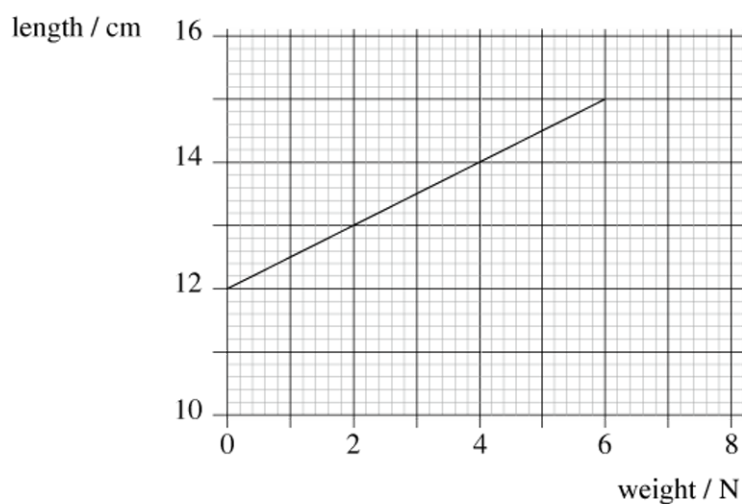
- A. Cyclist, Donkey, Bus
 - B. Bus, Cyclist, Donkey
 - C. Donkey, Cyclist, Bus
 - D. Cyclist, Bus, Donkey
5. A block of weight 10 N is moved along a surface at a constant speed of 2.0 m s^{-1} by a constant horizontal force of 5.0 N.



Which of the following is a correct statement about the coefficient of static friction between the block and the surface?

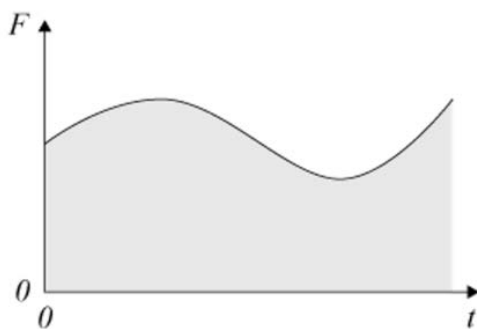
- A. It is zero.
- B. It is less than 0.5.
- C. It is equal to 0.5.
- D. It is greater than 0.5.

6. The weight attached to the end of a spring is increased gradually. The variation of the length of the spring with the weight suspended on it is shown in the graph below:



What is the spring constant of the spring?

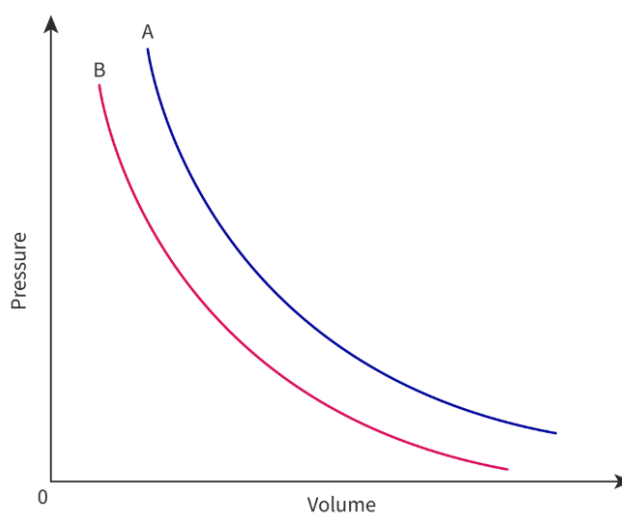
- A. 0.4 N cm^{-1}
B. 0.5 N cm^{-1}
C. 2.0 N cm^{-1}
D. 2.5 N cm^{-1}
7. The graph below shows the variation with time t of the magnitude of the net force F acting on a body moving along a straight line.



What does the shaded area of the graph represent?

- A. The change in momentum of the body.
B. The total work done by F .
C. The change in kinetic energy of the body.
D. The change in the velocity of the body.

8. A baseball is travelling horizontally when it strikes a wall with a speed u and rebounds, back the way it came, with the same speed. If the baseball has a mass m , what is the magnitude of its change in momentum?
- A. 0
- B. $\frac{1}{2}mu$
- C. mu
- D. $2mu$
9. The graph below shows the relationship between pressure and volume for two ideal gases A and B, each with a fixed mass and temperature.



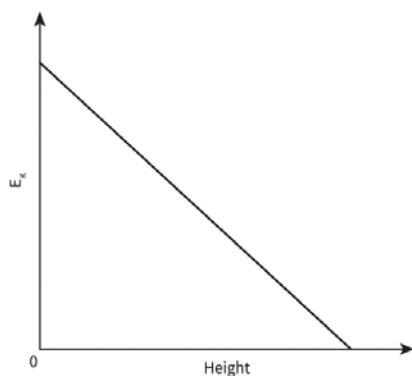
Compared with gas **A**, which of the following statements could be true of gas **B**?

1. Same mass at a lower constant temperature
2. Lower mass at a greater constant temperature
3. Greater mass at the same constant temperature
4. Same mass at a greater constant temperature

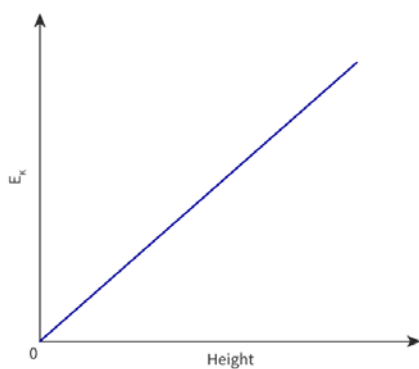
- A. 1 only
- B. 1 and 2 only
- C. 3 only
- D. 4 only

10. An object is dropped from rest and hits the ground. Which graph shows how the object's kinetic energy varies with height above the ground as it falls?

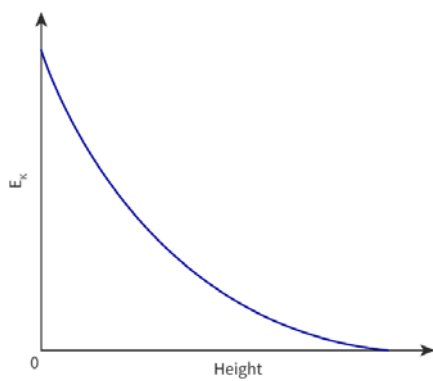
A.



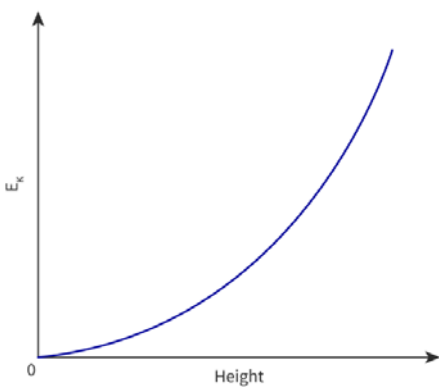
B.



C.



D.



11. A pressure (y-axis) vs temperature (x-axis) graph is sketched for n moles of an ideal gas with constant volume V . T is the absolute temperature. Which is the correct description of this graph?

	Line description	Gradient
A.	Straight line from (0,0)	$\frac{nR}{V}$
B.	Straight line from (-273,0)	$\frac{V}{nR}$
C.	Straight line from (-273,0)	$\frac{nR}{V}$
D.	Straight line from (0,0)	$\frac{V}{nR}$

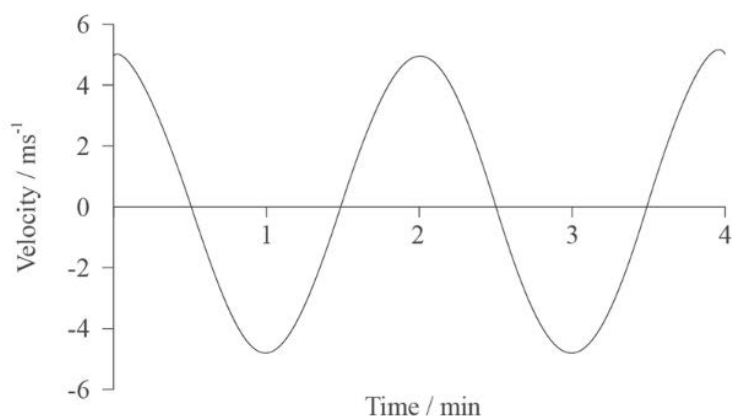
12. A solid piece of lead melts without a change in temperature. Which of the following is correct for the molecules in the liquid phase compared with the molecules in the solid phase?

	Average kinetic energy	Average potential energy
A.	Same	Same
B.	Same	Greater
C.	Greater	Same
D.	Greater	Greater

13. A pendulum is oscillating with simple harmonic motion. When the displacement of the pendulum bob with respect to the equilibrium position is positive, which of the following describes its velocity and its acceleration?

	Velocity	Acceleration
A.	Positive	Positive
B.	Positive	Negative
C.	Positive, negative or zero	Positive
D.	Positive, negative or zero	Negative

14. A body undergoes simple harmonic motion. Its velocity as a function of time is shown in the graph below.



At what times are the magnitude of the displacement and the magnitude of the acceleration of the body at their maximum values?

	Time of maximum displacement / min	Time of maximum acceleration / min
A.	0.5	0.5
B.	0.5	2.0
C.	2.0	0.5
D.	2.0	2.0

15. In an interference experiment, light of a single wavelength is made to pass through a double slit. Behind the slit is a screen on which the interference pattern can be observed.

Which of the following would increase the separation between the bright fringes on the screen?

- A. Increasing the separation between the two slits.
- B. Reducing the distance between the screen and the slits.
- C. Using light of a greater wavelength.
- D. Increasing the light intensity.

16. Light waves of frequency f travel with speed c in air and enter a medium X of refractive index 1.5.

Which of the following correctly gives the frequency and wavelength of the waves in the medium X?

	Frequency in medium X	Wavelength in medium X
A.	f	$\frac{2c}{3f}$
B.	f	$\frac{3c}{2f}$
C.	$\frac{3f}{2}$	$\frac{c}{f}$
D.	$\frac{2f}{3}$	$\frac{c}{f}$

17. Consider the following wave phenomena.

I. Reflection

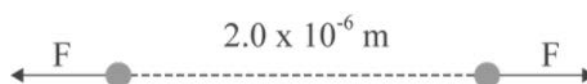
II. Refraction

III. Superposition

Which of these phenomena is responsible for the creation of a standing wave?

- A. I and II
B. I and III
C. II and III
D. I, II and III

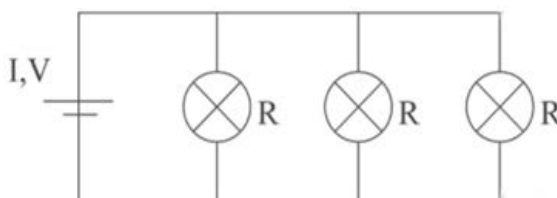
18. Two electrons initially begin 2.0×10^{-6} m apart and both experience a repulsive force F .



Each electron then moves 2.0×10^{-6} m from its original position, directly away from the other electron.

What is the new force that each electron experiences?

- A. $\frac{F}{2}$
- B. $\frac{F}{3}$
- C. $\frac{F}{4}$
- D. $\frac{F}{9}$
19. A parallel circuit is shown below, with 3 identical light bulbs of resistance R . The cell has negligible internal resistance and delivers a total current I and voltage V .



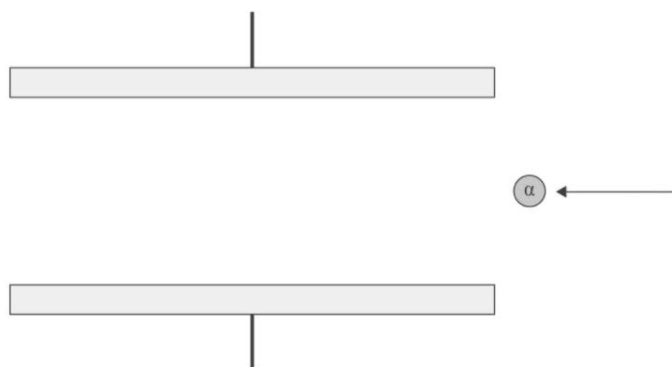
What are the correct expressions for the *total resistance* of the bulbs and the current through and voltage across *a single bulb*?

	Total Resistance	Current through a single bulb	Voltage across a single bulb
A.	$\frac{R}{3}$	$\frac{I}{3}$	V
B.	$3R$	$\frac{I}{3}$	V
C.	$3R$	I	V
D.	$\frac{R}{3}$	I	$\frac{V}{3}$

20. A wire of uniform circular cross-section is replaced in an electrical circuit. The new wire has the same length and same resistance but half the diameter of the old wire.

What is the ratio $\frac{\text{Resistivity of the new wire}}{\text{Resistivity of the old wire}}$?

- A. $\frac{1}{4}$
- B. $\frac{1}{2}$
- C. $\frac{2}{1}$
- D. $\frac{4}{1}$
21. An alpha particle He^{2+} is fired to the left between two horizontal, uncharged, metal plates. Gravity is pulling the alpha particle downwards.



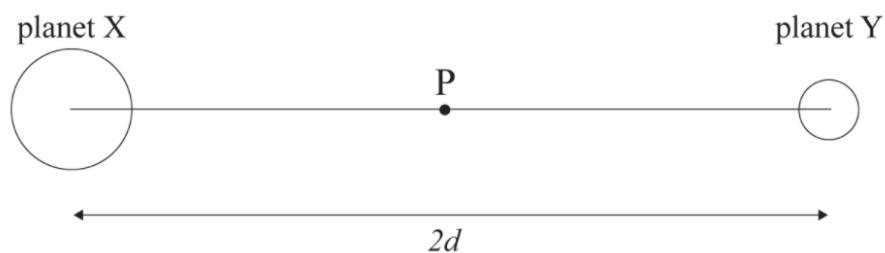
In which direction must a magnetic field be applied such that the alpha particle is undeflected?

- A. To the left
- B. To the right
- C. Out of the paper
- D. Into the paper

22. Which of the following best describes the velocity and acceleration of an object moving in circular motion with constant speed?

	Velocity	Acceleration
A.	Constant	Constant
B.	Constant	Always changing
C.	Always changing	Constant
D.	Always changing	Always changing

23. The diagram below shows two planets X and Y of masses $2M$ and M respectively. The centres of the two planets are separated by a distance $2d$. Point P is midway between the planets. The mass of each planet may be assumed to be concentrated at its centre.



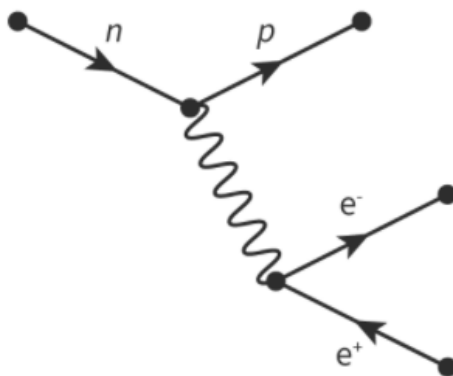
What is the magnitude of the gravitational field strength at point P?

- A. zero
- B. $\frac{GM}{d^2}$
- C. $\frac{2GM}{d^2}$
- D. $\frac{3GM}{d^2}$

24. Which of the following forces is responsible for binding protons and neutrons together in the nuclei of atoms?
- A. Gravitational force
 - B. Weak force
 - C. Strong force
 - D. Electromagnetic force
25. The binding energy per nucleon of the nucleus ${}^{12}_5\text{B}$ is 7 MeV. Approximately how much energy does it take to completely separate the nucleons of this nucleus?
- A. 7 MeV
 - B. 35 MeV
 - C. 49 MeV
 - D. 84 MeV
26. A uranium ${}^{235}_{92}\text{U}$ nucleus fissions into two smaller nuclei. How do the total mass and total binding energy change as a result?

	Total mass	Total binding energy
A.	Increases	Increases
B.	Increases	Decreases
C.	Decreases	Increases
D.	Decreases	Decreases

27. The following Feynman diagram represents a possible decay of a neutron.



- What conservation law would be violated in this interaction?
- A. Conservation of charge
 - B. Conservation of baryon number
 - C. Conservation of lepton number
 - D. Conservation of strangeness
28. What is the purpose of the moderator in a nuclear power station?
- A. To absorb neutrons
 - B. To slow down the neutrons
 - C. To transfer thermal energy from the reactor core to the coolant
 - D. To shut down the reactor in the event of an emergency
29. How do the total power radiated and wavelength of maximum intensity change when the temperature of a black body increases?

	Total power radiated	Maximum intensity wavelength
A.	Decreases	Increases
B.	Increases	Decreases
C.	Increases	Increases
D.	Decreases	Decreases

- 30.** An increase in the concentration of greenhouse gases such as carbon dioxide is believed to be the cause of global warming.

Which of the following choices correctly explains how the gases lead to global warming?

- A. Greenhouse gases absorb radiation from the Earth and re-emit it in all directions.
 - B. Greenhouse gases reflect the incoming radiation from the Sun.
 - C. Greenhouse gases absorb the radiation from the Sun and re-emit it in all directions.
 - D. Greenhouse gases reflect the radiation from the Earth.
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