INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

PHYSICS
HIGHER LEVEL
PAPER 1

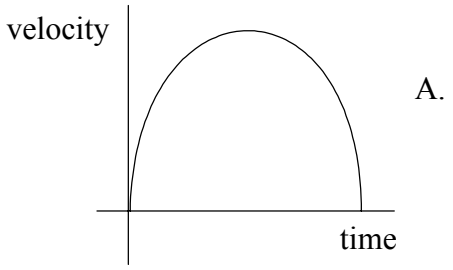
Tuesday 15 May 2001 (afternoon)

1 hour

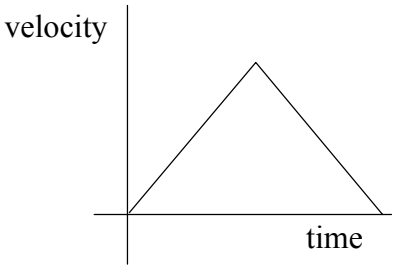
INSTRUCTIONS TO CANDIDATES

- 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.

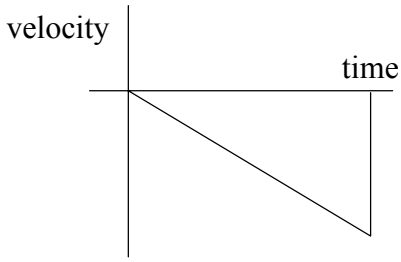
1. A projectile is launched **horizontally** from a high tower. Which **one** of the following graphs best represents the **vertical component** of the projectile's velocity from the time it is launched to the time it hits the ground? Assume negligible air resistance.



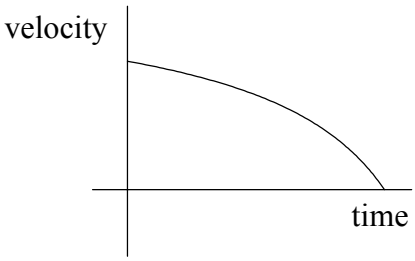
A.



B.



C.



D.

2. An astronaut drops an apple on the surface of the Moon where the acceleration due to gravity is $\frac{1}{6}$ of that on Earth. The time it takes for the apple to fall to the 'ground' compared with an apple dropped from the same height on Earth is

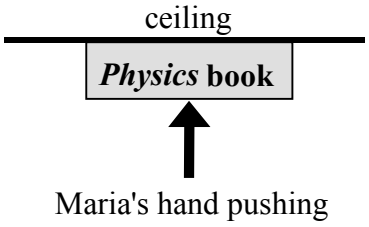
A. the same.

B. $\sqrt{6}$ times as long.

C. 6 times as long.

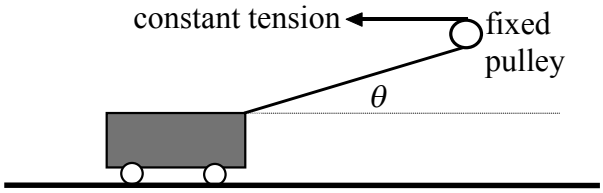
D. 36 times as long.

3. Maria pushes a book up against the horizontal ceiling of her room as shown in the figure. The book weighs 20 N and she pushes upwards with a force of 25 N. The choices below list the magnitudes of the contact forces between the ceiling and the book, and between the book and her hand. Select the correct pair.



	ceiling and the book	**book and her hand**
A.	5 N	45 N
B.	5 N	25 N
C.	25 N	5 N
D.	20 N	5 N

4. A cart is pulled along a horizontal track by a rope that passes over a fixed pulley, as shown in the figure. As the cart moves to the right, assume the tension in the rope and the frictional forces on the cart remain constant.



As the cart moves to the right, its acceleration

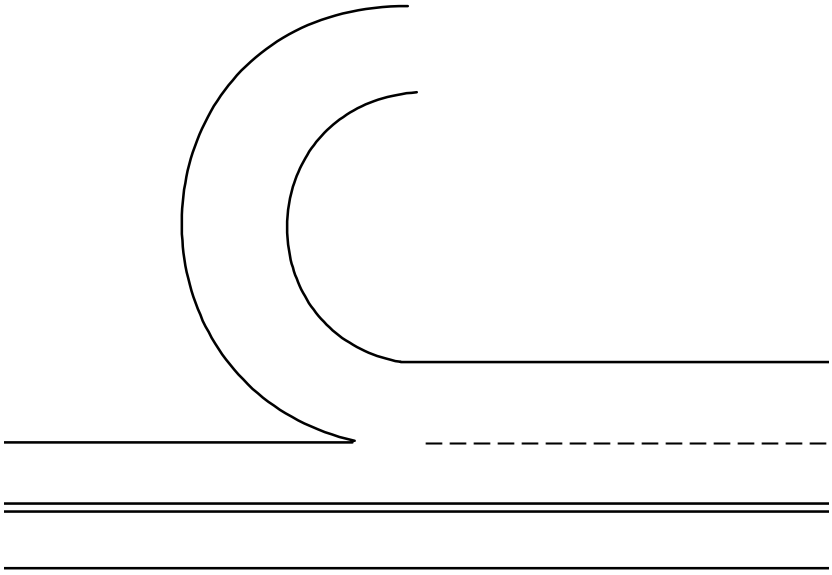
A. decreases.

B. increases.

C. remains constant.

D. is zero.

5. Many highway entrance and exit roads are circular and designed for cars moving at 50 kmh^{-1}. To design a similar road for speeds of 100 kmh^{-1} the engineers should increase the radius of the circular section by a factor of



A. $\sqrt{2}$.

B. 2 .

C. 3 .

D. 4 .

6. Two pucks move without friction across a horizontal surface such as a flat sheet of ice or an 'air table'. The momentum vectors of the two pucks before they collide are shown in **Figure 1**. On colliding, the pucks stick together. Which **one** of the vectors shown in **Figure 2** best represents the total momentum of the joined pucks after the collision?

Figure 1

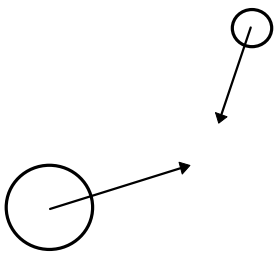
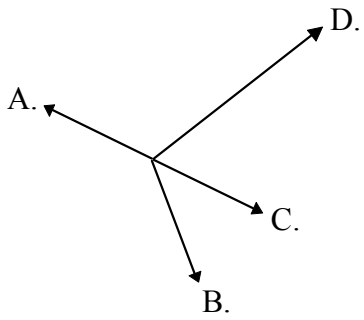
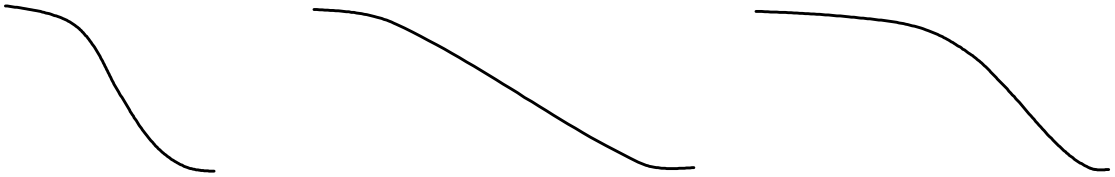


Figure 2



7. A child slides down from the top of each of the three slides shown below. All the slides start and finish at the same heights above ground level and all can be taken as frictionless.



Slide 1 Slide 2 Slide 3

Which **one** of the following is correct?

A. Slide 1 will give the greatest speed at the bottom.

B. Slide 2 will give the greatest speed at the bottom.

C. Slide 3 will give the greatest speed at the bottom.

D. All three slides will give the same speed at the bottom.

8. A mass suspended from a spring is oscillating up and down with a **small** amplitude A.
If the amplitude of the oscillation is doubled, the period will

A. halve.

B. double.

C. remain the same.

D. increase by a factor of $\sqrt{2}$.

9. Consider two planets, planet X with a radius R and mass M and planet Y with a radius $2R$ and mass $2M$. A person's weight on planet X is W. Her weight on planet Y would be

A. $2W$.

B. W.

C. $\frac{W}{2}$.

D. $\frac{W}{4}$.

10. The escape velocity from the Moon is less than the escape velocity from the Earth because the Moon

A. has a smaller mass.

B. has a smaller radius.

C. is circling the Earth.

D. has no atmosphere.

11. Select the one statement which is **false**. The moment of inertia of a body depends on

A. its mass.

B. its angular velocity.

C. its dimensions.

D. the axis of rotation.

12. The angular speed of the 'minute' hand of an analogue watch is

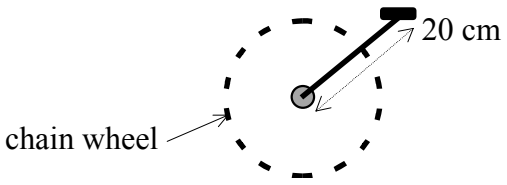
A. $\frac{\pi}{1800}$ rad/s.

B. $\frac{\pi}{60}$ rad/s.

C. $\frac{\pi}{30}$ rad/s.

D. 120π rad/s.

13. A 60 kg person riding a bicycle puts all of her weight on each pedal in turn when climbing a hill. The pedals rotate in a circle of radius 20 cm. Estimate the maximum torque that is exerted by the person.



A. 12 N m

B. 120 N m

C. 1 200 N m

D. 12 000 N m

14. A surfer is out beyond the breaking surf in a deep-water region where the ocean waves are 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?

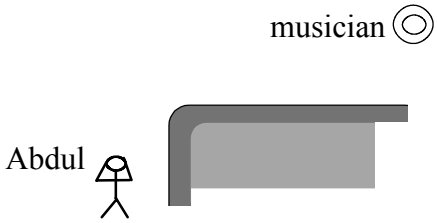
A. $1.0\ ms^{-1}$

B. $2.0\ ms^{-1}$

C. $5.0\ ms^{-1}$

D. $10.0\ ms^{-1}$

15. A street musician is playing an instrument in a large, open city square. Although Abdul cannot see the musician around the corner, he can still be heard. The main phenomenon that allows Abdul to hear the musician is



A. the Doppler effect.

B. diffraction.

C. refraction.

D. reflection.

16. Which **one** of the following is **not** an electromagnetic wave?

A. radio

B. microwaves

C. ultrasound

D. X-rays

17. Two pipes have the same length. Pipe X is open at both ends while pipe Y is closed at one end. What is the ratio of the fundamental frequency in pipe X to that in pipe Y?

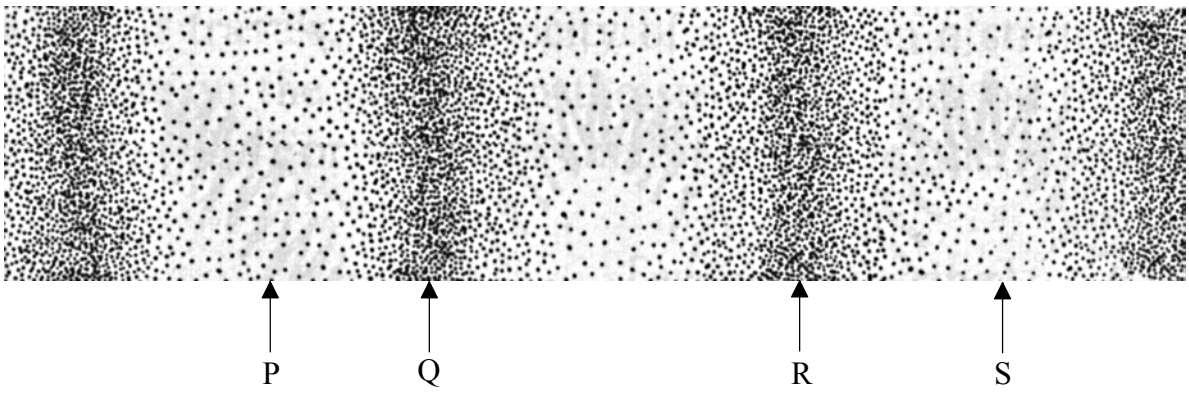
A. $\frac{1}{2}$

B. 1

C. 2

D. 3

18. A pure tone is produced by a tuning fork. The diagram below represents the air particles nearby, at a given instant of time.



The wavelength of this pure tone is equal to the distance between which of the marked positions?

A. P and Q

B. P and S

C. Q and S

D. Q and R

19. A piano tuner is making use of the phenomenon of beats in order to tune a piano. He sounds a tuning fork which produces a pure tone and at the same time strikes a key on the piano. As he tunes the piano note more closely to the tuning fork note, the beats he hears will become

A. less frequent.

B. more frequent.

C. softer.

D. louder.

20. If the refractive indices of water and a particular glass are 1.33 and 1.56 respectively, then total internal reflection at an interface between them

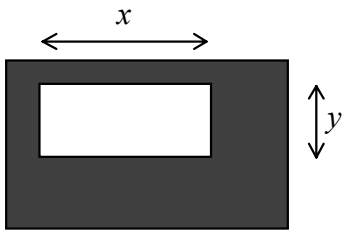
A. can never occur.

B. may occur only when the light goes from glass to water.

C. may occur only when the light goes from water to glass.

D. may occur for light going either from water to glass or from glass to water.

21. The figure shows a rectangular brass plate (dark) in which there has been cut a rectangular hole of dimensions x and y as indicated. If the plate is heated uniformly



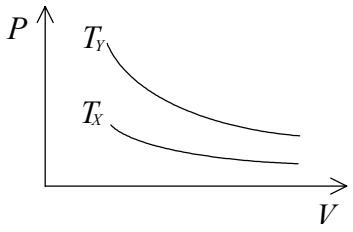
A. x will increase and y will decrease.

B. both x and y will decrease.

C. x will decrease and y will increase.

D. both x and y will increase.

22. The P-V diagram shows two isotherms for a fixed mass of ideal gas, at temperatures T_X and T_Y. Which **one** of the following is correct?



A. $T_X > T_Y$

B. $T_X < T_Y$

C. $T_X = T_Y$

D. Temperatures cannot be compared from a P-V diagram alone.

23. Let the average translational kinetic energy, at a temperature T, of helium (molar mass 4 g mol^{-1}) be K. The average translational kinetic energy, at the same temperature, of neon (molar mass 20 g mol^{-1}) would be

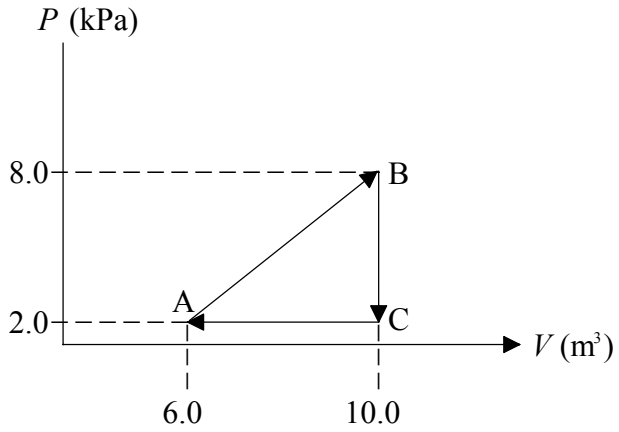
A. $5K$.

B. $\sqrt{5}K$.

C. K.

D. $\frac{1}{5}K$.

24. A gas is taken through a cyclic process A→ B → C → A as shown in the P-V diagram. The work done by the gas during one complete cycle is



A. 24 kJ.

B. 12 kJ.

C. 6 kJ.

D. 4 kJ.

25. The energy absorbed by an ideal gas during an isothermal expansion is equal to

A. the work done by the gas.

B. the work done on the gas.

C. the change in the internal energy of the gas.

D. zero.

26. When two bodies are in contact, the **direction** of thermal energy transfer depends on their

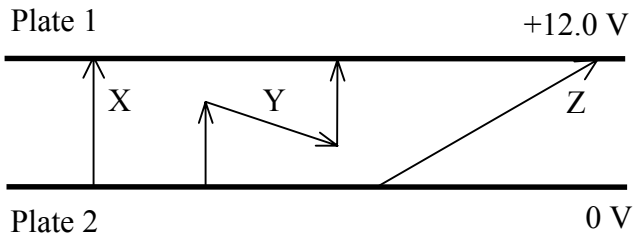
A. surface areas.

B. masses.

C. specific heat capacities.

D. temperatures.

27. A pair of charged, parallel metal plates have voltages as shown in the figure below.



The work required to move a small positive test charge from Plate 2 to Plate 1 is

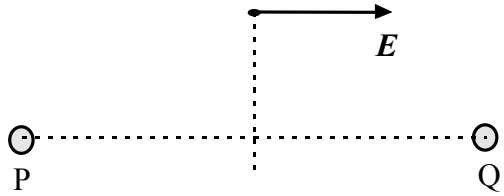
A. greatest for path X.

B. greatest for path Y.

C. greatest for path Z.

D. the same for all paths.

28. In the figure, the point charges P and Q are of equal magnitude. The direction of the electric field at a point equidistant from P and Q is indicated by the vector ***E***. The direction of the vector indicates that



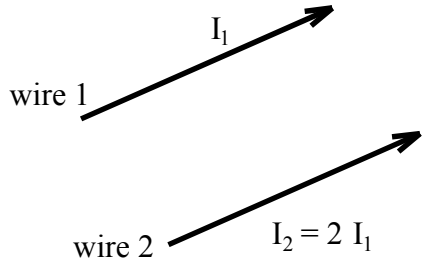
A. both P and Q are positive.

B. both P and Q are negative.

C. P is positive and Q is negative.

D. Q is positive and P is negative.

29. Two parallel wires carry currents I_1 and I_2 in the same direction as shown, and $I_2 = 2\ I_1$. The magnitude of the force on wire 1 due to the current in wire 2 is F_1. The magnitude of the force on wire 2 due to the current in wire 1 is



A. $4\,F_1$.

B. $2\,F_1$.

C. F_1.

D. $\frac{F_1}{2}$.

30. An electron and a proton travelling with the same velocity are injected into a region of uniform magnetic field at 90° to the magnetic field direction. The **initial** magnetic forces on them are

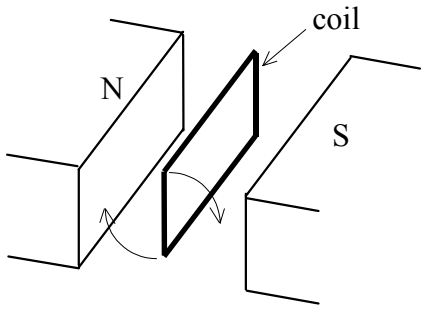
A. equal in magnitude and direction.

B. equal in magnitude and opposite in direction.

C. equal in magnitude and perpendicular to each other.

D. in opposite directions and differing in magnitude by the ratio of their masses.

31. A simple AC alternator is made by rotating a flat rectangular coil in a uniform magnetic field as shown. The maximum emf produced is V. If the frequency of rotation is doubled, the maximum emf produced is



A. V.

B. $\sqrt{2}\,V$.

C. $2\,V$.

D. $4\,V$.

32. A DC electric motor converts 75 % of the input electrical energy to mechanical energy. The remaining 25 % is

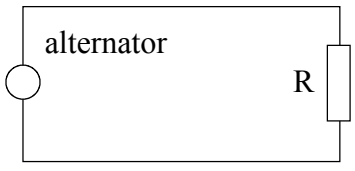
A. dissipated as thermal energy.

B. returned to the battery.

C. used to maintain the potential difference of the battery.

D. converted to electrical potential energy.

33. An alternator is connected to a resistance R as shown in the circuit below. If the rms voltage output of the alternator is doubled, the power dissipated in the resistor increases by a factor of



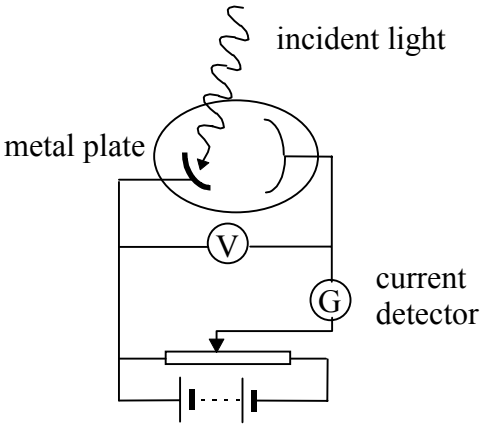
A. $\sqrt{2}$.

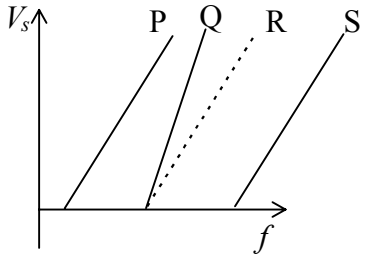
B. 2.

C. 4.

D. 1 *i.e.* it stays the same.

34. The apparatus shown below is used to measure the stopping potential V_S for photoelectrons emitted from a metal Surface. V_S is measured for different frequencies of light *f*, incident on the surface. The broken line on the graph, labelled 'R', shows the results obtained when the metal plate is zinc. The zinc plate is then replaced with another metal having a higher work function.





Which line on the graph would best represent the results obtained in this case?

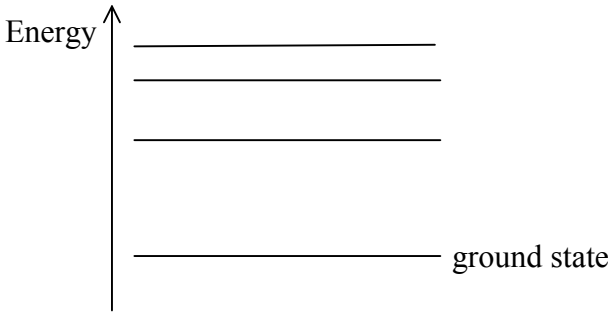
A. P

B. Q

C. R (*i.e.* no change)

D. S

35. The diagram represents the available energy levels of an atom. How many emission lines could result from electron transitions between these energy levels?



A. 3

B. 6

C. 8

D. 12

36. The accelerating voltage in a X-ray tube is increased. Consider the following three statements about this situation.

I. The intensity of the X radiation produced is increased.

II. The X radiation becomes more penetrating.

III. The short wavelength limit is reduced.

Which of the above statements are correct?

A. I and II

B. II and III

C. I and III

D. I, II and III

37. In order that an electron has a de Broglie wavelength equal to that of a proton

A. their momenta must be equal.

B. their kinetic energies must be equal.

C. their velocities must be equal.

D. the ratio of their energies must be equal to the ratio of their masses.

38. Nuclei with a Z number greater than about 20 and which are stable against radioactive decay have

A. equal numbers of neutrons and protons.

B. more neutrons than protons.

C. fewer neutrons than protons.

D. no neutrons.

39. Radioactive nuclides commonly decay via alpha (α), beta minus (β) or gamma (γ) emission. The nuclide $^{238}_{92}U$ decays to protactinium $^{234}_{91}Pa$. Which **one** of the following pairs of emissions could describe this decay?

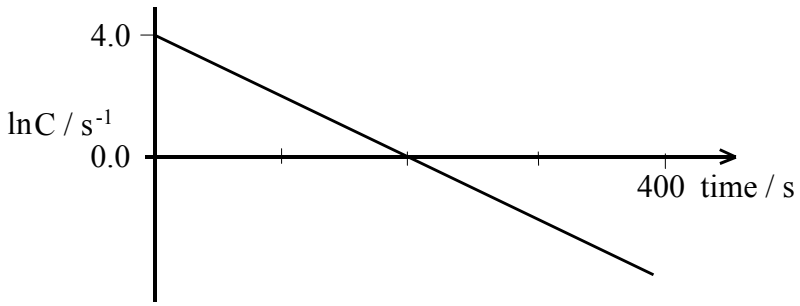
A. β followed by γ

B. β followed by β

C. α followed by β

D. α followed by γ

40. A Geiger counter is placed near a radioactive source and the count rate C, in counts per second, is recorded as a function of time. The data are corrected for background radiation and displayed in the form of a graph of $\ln C$ against time. A straight line fits the data well and this is shown below.



The decay constant of the radioactive source is

A. 1.0 s^{-1}.

B. 4.0 s^{-1}.

C. 0.04 s^{-1}.

D. 0.02 s^{-1}.