

**Physics**  
**Standard level**  
**Paper 1**

Friday 8 May 2015 (morning)

45 minutes

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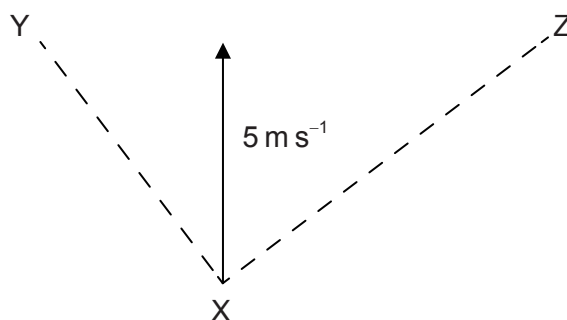
**Instructions to candidates**

- 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.
- A clean copy of the **Physics data booklet** is required for this paper.
- The maximum mark for this examination paper is **[30 marks]**.

1. Which unit is equivalent to  $\text{J kg}^{-1}$ ?

- A.  $\text{m s}^{-1}$
- B.  $\text{m s}^{-2}$
- C.  $\text{m}^2 \text{s}^{-1}$
- D.  $\text{m}^2 \text{s}^{-2}$

2. A velocity of  $5 \text{ m s}^{-1}$  can be resolved along perpendicular directions XY and XZ.



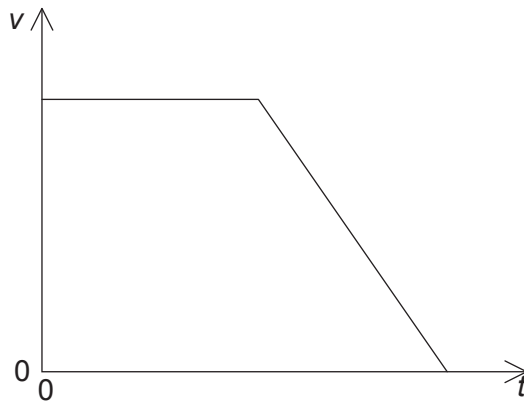
The component of the velocity in the direction XY is of magnitude  $4 \text{ m s}^{-1}$ . What is the magnitude of the component in the direction XZ?

- A.  $4 \text{ m s}^{-1}$
- B.  $3 \text{ m s}^{-1}$
- C.  $2 \text{ m s}^{-1}$
- D.  $1 \text{ m s}^{-1}$

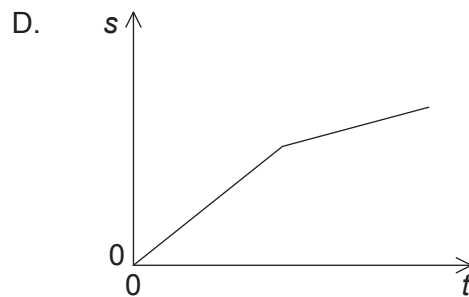
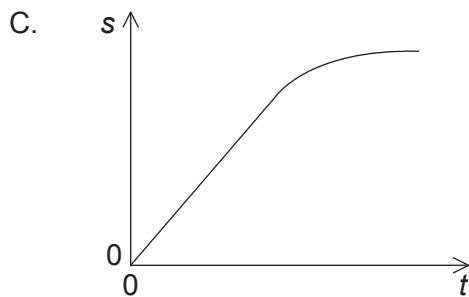
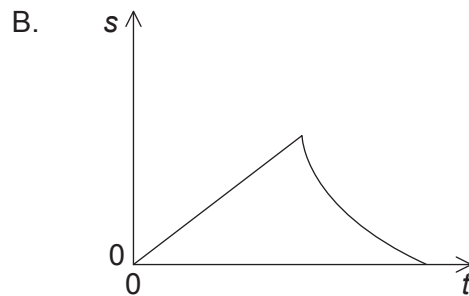
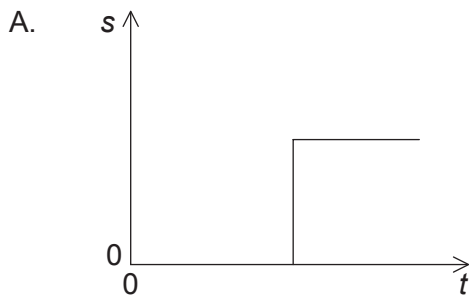
3. A tennis ball is released from rest and falls vertically through a small distance in air. What is the change in the speed of the ball and the change in the acceleration of the ball as it falls?

|    | <b>Speed of the ball</b> | <b>Acceleration of the ball</b> |
|----|--------------------------|---------------------------------|
| A. | increases                | decreases                       |
| B. | decreases                | increases                       |
| C. | increases                | increases                       |
| D. | decreases                | decreases                       |

4. The graph below shows the variation with time  $t$  of the velocity  $v$  of a car travelling in a straight line.



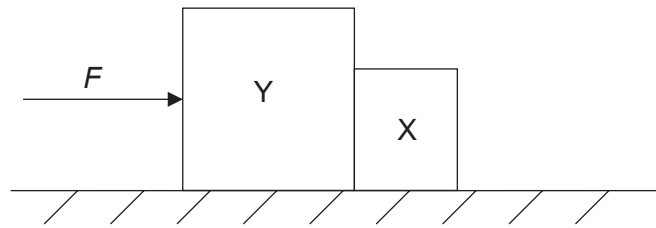
Which graph shows the variation with  $t$  of the displacement  $s$  of the car?



5. Which statement applies to an object in translational equilibrium?

- A. The object must be stationary.
- B. The object must be moving with constant acceleration.
- C. The resultant force acting on the object must be zero.
- D. There must be no external forces acting on the object.

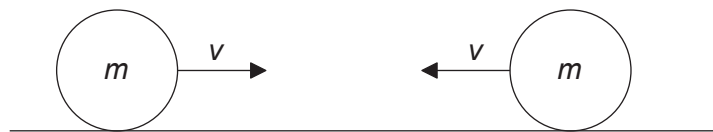
6. A constant horizontal force  $F$  is applied to a block Y. Block Y is in contact with a separate block X.



The blocks remain in contact as they accelerate along a horizontal frictionless surface. Y has a greater mass than X. Air resistance is negligible.

Which statement is correct?

- A. The force  $F$  is equal to the product of the mass of Y and the acceleration of Y.
  - B. The force that Y exerts on X is less than  $F$ .
  - C. The force that Y exerts on X is less than the force that X exerts on Y.
  - D. The force that Y exerts on X is equal to  $F$ .
7. Two identical spheres, each of mass  $m$  and speed  $v$ , travel towards each other on a frictionless surface in a vacuum.

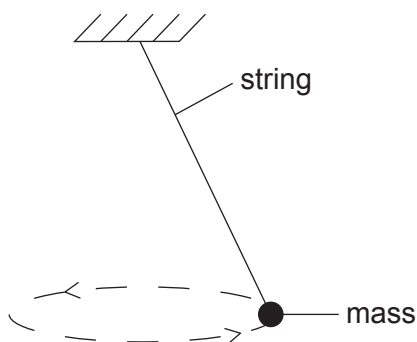


The spheres undergo a head-on elastic collision.

Which statement correctly describes the spheres after the collision?

- A. The total momentum of the spheres is  $2mv$ .
- B. Each sphere has zero momentum.
- C. The total kinetic energy of the spheres is  $mv^2$ .
- D. Each sphere has zero kinetic energy.

8. A mass is suspended by a string from a fixed point. The mass moves with constant speed along a circular path in a horizontal plane.



The resultant force acting on the mass is

- A. zero.
  - B. directed upwards along the string.
  - C. directed towards the centre of the circular path.
  - D. in the same direction as the velocity of the mass.
9. What is the definition of the *mole*?
- A. The amount of substance that has the same mass as  $6.02 \times 10^{23}$  atoms of carbon-12.
  - B. The amount of substance that contains as many nuclei as the number of nuclei in 12 g of carbon-12.
  - C. The amount of substance that has the same mass as one atom of carbon-12.
  - D. The amount of substance that contains as many elementary entities as the number of atoms in 12 g of carbon-12.

10. Molecules leave a boiling liquid to form a vapour. The vapour and the liquid have the same temperature.

What is the change of the average potential energy and the change of the average random kinetic energy of these molecules when they move from the liquid to the vapour?

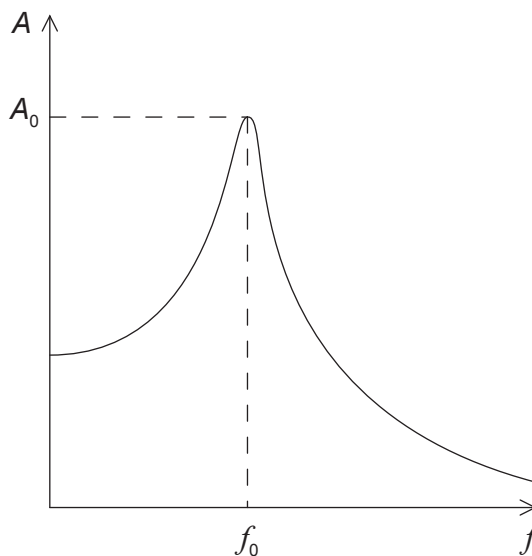
|    | Average potential energy | Average random kinetic energy |
|----|--------------------------|-------------------------------|
| A. | increases                | increases                     |
| B. | increases                | no change                     |
| C. | no change                | increases                     |
| D. | no change                | no change                     |

11. In the kinetic model of an ideal gas, which of the following is **not** assumed?
- A. The molecules collide elastically.
  - B. The kinetic energy of a given molecule is constant.
  - C. The time taken for a molecular collision is much less than the time between collisions.
  - D. The intermolecular potential energy of the molecules is zero.
12. An object performs simple harmonic motion (SHM) about a central point. The object has velocity  $v$  and acceleration  $a$  when it has displacement  $x$  from the point.

Which ratio is constant?

- A.  $\frac{x}{a}$
- B.  $\frac{x}{v}$
- C.  $\frac{x^2}{a}$
- D.  $\frac{v}{a}$

13. A periodic driving force of frequency  $f$  acts on a system which undergoes forced oscillations of amplitude  $A$ . The graph below shows the variation with  $f$  of  $A$ . The maximum amplitude  $A_0$  of the oscillations occurs at frequency  $f_0$ .

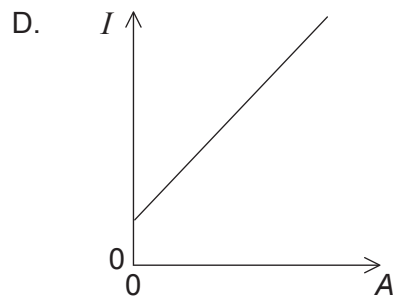
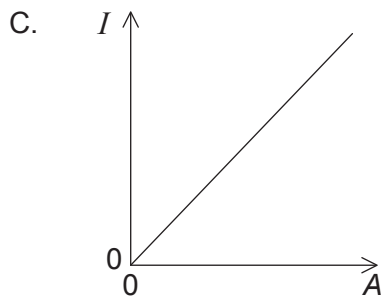
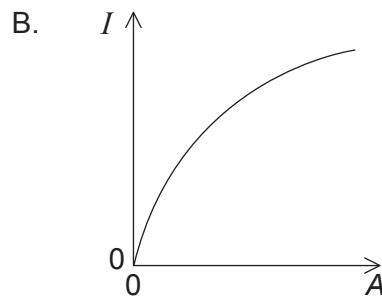
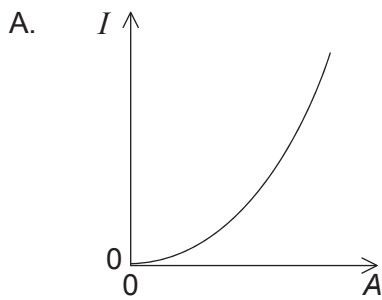


The damping of the system is now increased.

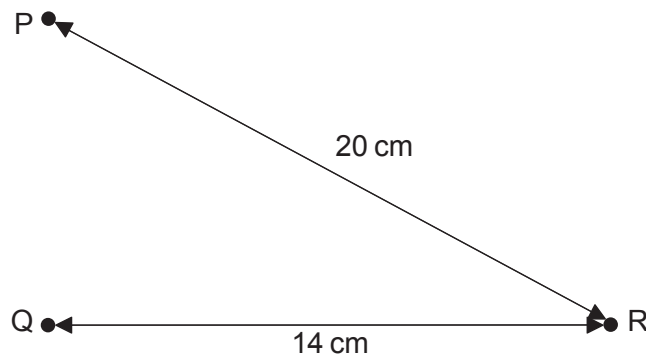
Which describes the change in  $f_0$  and the change in  $A_0$ ?

|    | $f_0$    | $A_0$    |
|----|----------|----------|
| A. | decrease | increase |
| B. | decrease | decrease |
| C. | increase | increase |
| D. | increase | decrease |

14. Which graph shows the variation with amplitude  $A$  of the intensity  $I$  for a wave?



15. Wave generators placed at position P and position Q produce water waves of wavelength 4.0 cm. Each generator, operating alone, produces a wave oscillating with amplitude  $A$  at position R. Distances PR and QR are shown in the diagram below.



Both wave generators now operate together in phase. What is the amplitude of the oscillation of the resulting wave at R?

- A. 0
- B.  $A$
- C.  $A^2$
- D.  $2A$

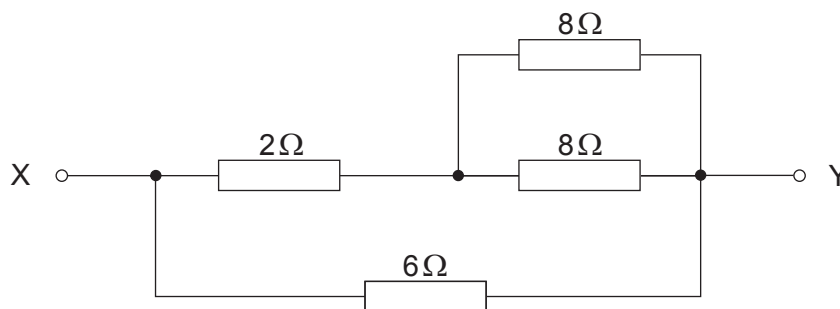


16. A wire of uniform circular cross-section is replaced in an electrical circuit. The new wire has the same length and same resistance but half the diameter of the old wire.

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.  $\frac{4}{1}$
17. A circuit is formed by connecting a resistor between the terminals of a battery of electromotive force (emf) 6 V. The battery has internal resistance. Which statement is correct when 1 C of charge flows around the complete circuit?
- A. 6 V is the potential difference across the resistor.
- B. 6 J of thermal energy is dissipated in the battery.
- C. 6 J of chemical energy is transformed in the battery.
- D. 6 J of thermal energy is dissipated in the resistor.

18. Four resistors are connected as shown.

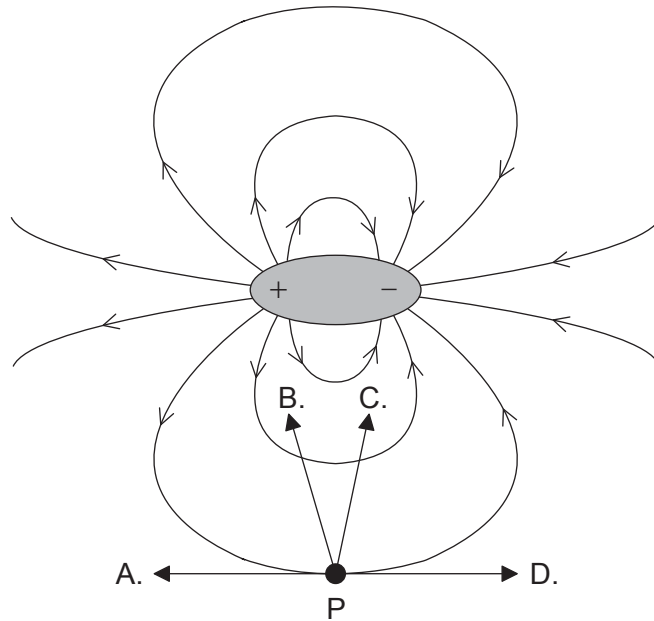


What is the total resistance between X and Y?

- A.  $3\Omega$
  - B.  $4\Omega$
  - C.  $6\Omega$
  - D.  $24\Omega$
19. Which single condition enables Newton's universal law of gravitation to be used to predict the force between the Earth and the Sun?
- A. The Earth and the Sun both have a very large radius.
  - B. The distance between the Earth and the Sun is approximately constant.
  - C. The Earth and the Sun both have a very large mass.
  - D. The Earth and the Sun behave as point masses.

20. An electric dipole consists of a positive and a negative charge separated by a fixed distance. The electric field due to the dipole is shown in the diagram below.

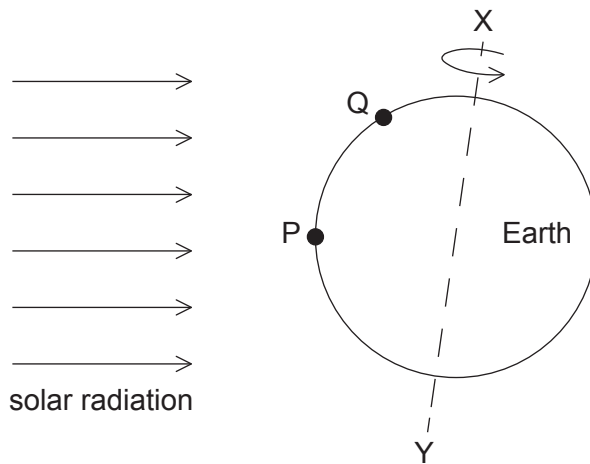
An electric force acts on an electron at point P. In which direction does this force act?



21. A particle has charge and mass. Which types of field cause a force to be exerted on the particle when it is moving in the direction of the field?
- A. Electric, gravitational and magnetic fields
  - B. Electric and magnetic fields only
  - C. Gravitational and magnetic fields only
  - D. Electric and gravitational fields only
22. Geiger and Marsden bombarded a thin gold foil with alpha particles. They observed that a small fraction of the alpha particles were deflected through angles greater than  $90^\circ$ . What does this observation suggest about the nucleus?
- A. It is at the centre of the atom.
  - B. It is surrounded by orbiting electrons.
  - C. It is made of protons and neutrons.
  - D. It is a small region of the atom and is positively charged.

23. Nucleus P decays by a sequence of emissions to form nucleus Q. One  $\alpha$  particle and two  $\beta^-$  particles are emitted during the sequence. Which statement is correct?
- A. Nucleus P has the same number of neutrons as nucleus Q.
  - B. Nucleus P is an isotope of nucleus Q.
  - C. Nucleus P has a greater charge than nucleus Q.
  - D. Nucleus P has fewer protons than nucleus Q.
24. In a nuclear fission reaction, nucleus X splits into nucleus Y and nucleus Z.
- Which of the following gives a possible order of the nuclei from lowest to highest binding energy per nucleon?
- A.  $Z \rightarrow Y \rightarrow X$
  - B.  $Z \rightarrow X \rightarrow Y$
  - C.  $Y \rightarrow X \rightarrow Z$
  - D.  $X \rightarrow Z \rightarrow Y$
25. What is the unit of energy density?
- A.  $\text{J kg}^{-1}$
  - B.  $\text{J kg}^{-1} \text{m}^3$
  - C.  $\text{J mol}^{-1}$
  - D.  $\text{J K}^{-1}$
26. In nuclear power production, what is one advantage of a nuclear fusion reactor over a nuclear fission reactor?
- A. The operating temperature of the fusion reactor is lower.
  - B. The nuclear reactants are more easily confined within the core of the fusion reactor.
  - C. The disposal of the nuclear waste products from the fusion reactor is more straightforward.
  - D. The nuclear fusion reaction is more easily sustained for long periods of time.

27. The Earth rotates about an axis XY, as shown below.



P and Q are positions on the Earth's surface that receive solar radiation from the Sun. Why is the intensity of the solar radiation incident at P significantly greater than the intensity at Q?

- A. The same amount of solar power is spread over a larger surface area at P.
  - B. The path length through the Earth's atmosphere of the solar radiation is shorter for P.
  - C. The distance travelled by the solar radiation to reach the top of the Earth's atmosphere is shorter for P.
  - D. The periodic variations in the solar power radiated from the Sun's surface have more effect at P.
28. Which type of power-production system is most suitable for responding to a sudden high increase in demand for electrical power?
- A. A wind generator
  - B. A tidal water storage hydroelectric scheme
  - C. An ocean-wave energy converter
  - D. A pump storage hydroelectric scheme

29. X and Y are spherical black bodies that radiate the same power. The temperature of X is 350 K and the temperature of Y is 700 K.

What is the ratio  $\frac{\text{radius of X}}{\text{radius of Y}}$  ?

- A. 16
  - B. 4
  - C.  $\frac{1}{4}$
  - D.  $\frac{1}{16}$
30. Which could increase the rate of global warming?
- A. Replacing fossil fuel power stations with nuclear reactors
  - B. Replacing gas-fired power stations with coal-fired power stations
  - C. Using carbon dioxide capture and storage at power stations
  - D. Replacing conventional fossil fuel power stations with combined heating and power (CHP) systems
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