



**PHYSICS  
STANDARD LEVEL  
PAPER 1**

Tuesday 12 May 2009 (afternoon)

45 minutes

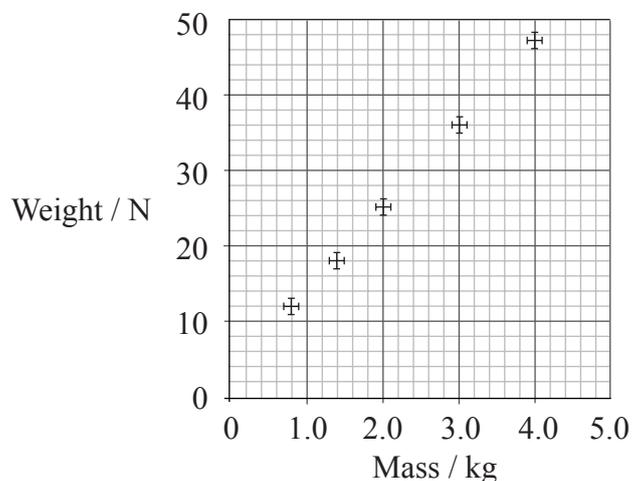
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**INSTRUCTIONS TO CANDIDATES**

- 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.



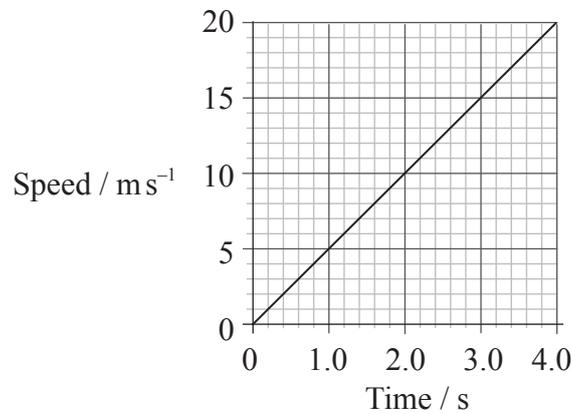
1. A volume is measured to be  $52 \text{ mm}^3$ . This volume in  $\text{m}^3$  is
  - A.  $5.2 \times 10^3 \text{ m}^3$ .
  - B.  $5.2 \times 10^1 \text{ m}^3$ .
  - C.  $5.2 \times 10^{-1} \text{ m}^3$ .
  - D.  $5.2 \times 10^{-8} \text{ m}^3$ .
  
2. The masses and weights of different objects are independently measured. The graph is a plot of weight versus mass that includes error bars.



These experimental results suggest that the

- A. measurements show a significant systematic error but small random error.
- B. measurements show a significant random error but small systematic error.
- C. measurements are precise but not accurate.
- D. weight of an object is proportional to its mass.

3. A skydiver jumped out of an airplane. On reaching a terminal speed of  $60 \text{ m s}^{-1}$ , she opened her parachute. Which of the following describes her motion after opening her parachute?
- A. She went upwards for a short time, before falling to Earth at a speed of  $60 \text{ m s}^{-1}$ .
  - B. She continued downwards at  $60 \text{ m s}^{-1}$ , but hit the ground with less force.
  - C. She continued to fall but reached a new terminal speed of less than  $60 \text{ m s}^{-1}$ .
  - D. She went upwards for a short time, before falling to Earth at a speed of less than  $60 \text{ m s}^{-1}$ .
4. The graph is a speed versus time graph for an object that is moving in a straight line.



The distance travelled by the object during the first 4.0 seconds is

- A. 80 m.
- B. 40 m.
- C. 20 m.
- D. 5 m.

5. The diagram shows a girl attempting (but failing) to lift a heavy suitcase of weight  $W$ . The magnitude of the vertical upwards pull of the girl on the suitcase is  $P$  and the magnitude of the vertical reaction of the floor on the suitcase is  $R$ .



Which equation correctly relates  $W$ ,  $P$  and  $R$ ?

- A.  $W = P + R$
- B.  $W > P + R$
- C.  $W < P + R$
- D.  $W = P = R$
6. Objects  $A$  and  $B$  collide together. They end up joined together and stationary. During the collision, a force  $+F$  is exerted on object  $A$  by object  $B$ . According to Newton's third law, there will also be a force of
- A.  $-F$  acting on object  $B$ .
- B.  $-F$  acting on object  $A$ .
- C.  $+F$  acting on object  $B$ .
- D.  $+F$  acting on object  $A$ .

7. A lift (elevator) is operated by an electric motor. It moves between the 10<sup>th</sup> floor and the 2<sup>nd</sup> floor at a constant speed. One main energy transformation during this journey is
- A. gravitational potential energy → kinetic energy.
  - B. electrical energy → kinetic energy.
  - C. kinetic energy → thermal energy.
  - D. electrical energy → thermal energy.
8. A communications satellite is moving at a constant speed in a circular orbit around Earth. At any given instant in time, the resultant force on the satellite is
- A. zero.
  - B. equal to the gravitational force on the satellite.
  - C. equal to the vector sum of the gravitational force on the satellite and the centripetal force.
  - D. equal to the force exerted by the satellite's rockets.
9. A temperature of 23 K is equivalent to a temperature of
- A. – 300 °C.
  - B. – 250 °C.
  - C. + 250 °C.
  - D. + 300 °C.

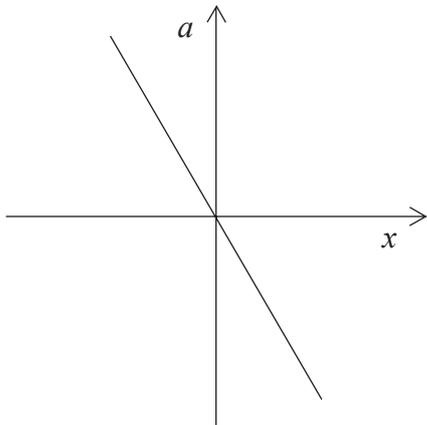
10. The ratio

$$\frac{\text{thermal capacity of a sample of copper}}{\text{specific heat capacity of copper}}$$

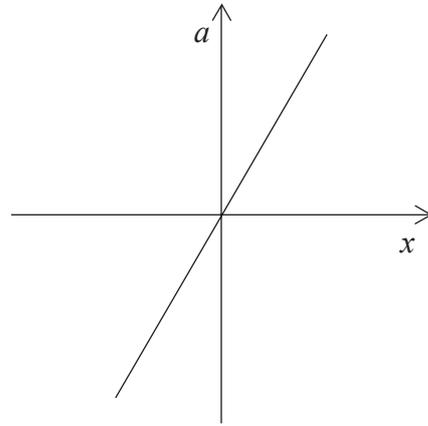
- A. does not have any unit.
  - B. has unit  $\text{J kg}^{-1} \text{K}^{-1}$ .
  - C. has unit  $\text{J kg}^{-1}$ .
  - D. has unit kg.
11. In the kinetic model of an ideal gas, it is assumed that
- A. the forces between the molecules of the gas and the container are always zero.
  - B. the intermolecular potential energy of the molecules of the gas is constant.
  - C. the kinetic energy of a given molecule of the gas is constant.
  - D. the momentum of a given molecule of the gas is constant.

12. Which graph correctly shows how the acceleration,  $a$  of a particle undergoing SHM varies with its displacement,  $x$  from its equilibrium position?

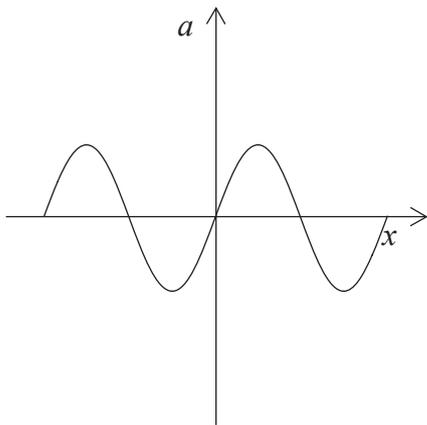
A.



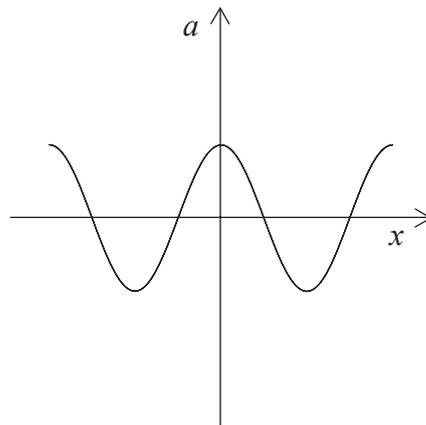
B.



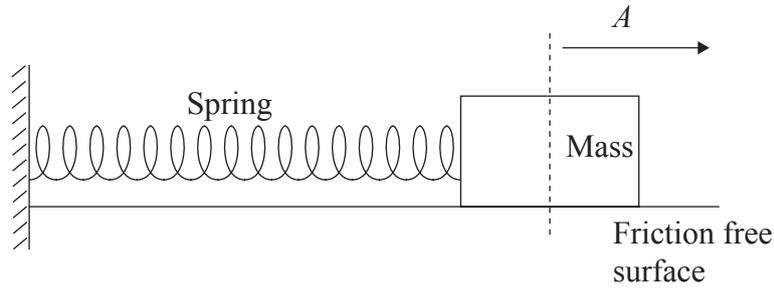
C.



D.



13. A mass on the end of a horizontal spring is displaced from its equilibrium position by a distance  $A$  and released. Its subsequent oscillations have total energy  $E$  and time period  $T$ .



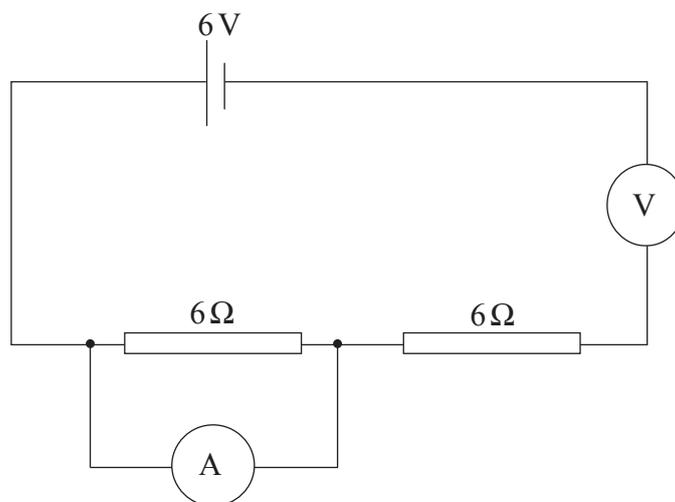
An identical mass is attached to an identical spring. The maximum displacement is  $2A$ . Assuming this spring obeys Hooke's law, which of the following gives the correct time period and total energy?

	<b>New time period</b>	<b>New energy</b>
A.	$T$	$4E$
B.	$T$	$2E$
C.	$\sqrt{2}T$	$4E$
D.	$\sqrt{2}T$	$2E$

14. In which of the following regions of the electromagnetic spectrum is radiation of wavelength 600 nm located?
- A. microwaves
  - B. radio waves
  - C. visible light
  - D. X-rays

15. What is the best estimate for the refractive index of a medium in which light travels at a speed of  $2.7 \times 10^8 \text{ ms}^{-1}$ ?
- A. 0.9
- B. 1.0
- C. 1.1
- D. 2.7
16. Two rectangular blocks,  $X$  and  $Y$ , of the same material have different dimensions but the same overall resistance. Which of the following equations is correct?
- A. resistivity of  $X \times$  length of  $X =$  resistivity of  $Y \times$  length of  $Y$
- B.  $\frac{\text{length of } X}{\text{cross sectional area of } X} = \frac{\text{length of } Y}{\text{cross sectional area of } Y}$
- C. resistivity of  $X \times$  cross sectional area of  $X =$  resistivity of  $Y \times$  cross sectional area of  $Y$
- D.  $\frac{\text{length of } X}{\text{cross sectional area of } Y} = \frac{\text{length of } Y}{\text{cross sectional area of } X}$

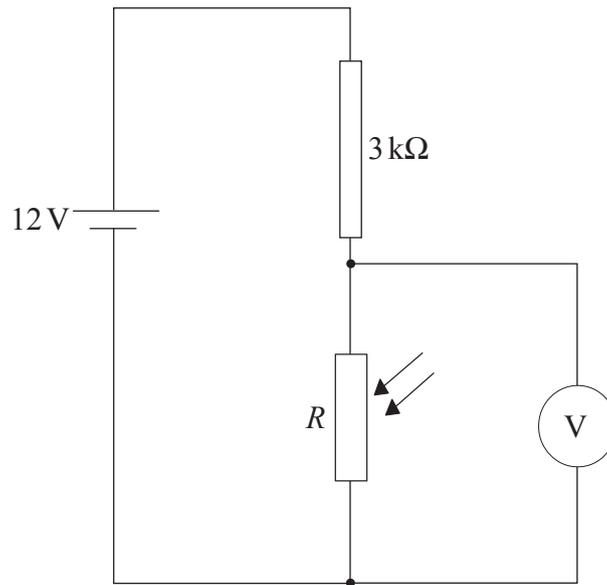
17. Two  $6\ \Omega$  resistors are connected in series with a  $6\ \text{V}$  cell. A student **incorrectly** connects an ammeter and a voltmeter as shown below.



The readings on the ammeter and on the voltmeter are

	Ammeter reading / A	Voltmeter reading / V
A.	0.0	0.0
B.	0.0	6.0
C.	1.0	0.0
D.	1.0	6.0

18. The diagram shows a potential divider circuit.

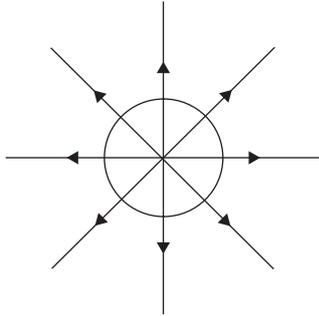


In order to increase the reading on the voltmeter the

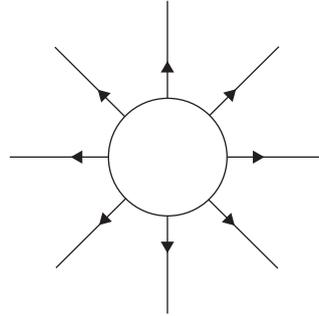
- A. temperature of  $R$  should be increased.
  - B. temperature of  $R$  should be decreased.
  - C. light intensity on  $R$  should be increased.
  - D. light intensity on  $R$  should be decreased.
19. The mass of Earth is  $M_E$ , its radius is  $R_E$  and the magnitude of the gravitational field strength at the surface of Earth is  $g$ . The universal gravitational constant is  $G$ . The ratio  $\frac{g}{G}$  is equal to
- A.  $\frac{M_E}{R_E^2}$
  - B.  $\frac{R_E^2}{M_E}$
  - C.  $M_E R_E$
  - D. 1

20. Which diagram best represents the electric field due to a negatively charged conducting sphere?

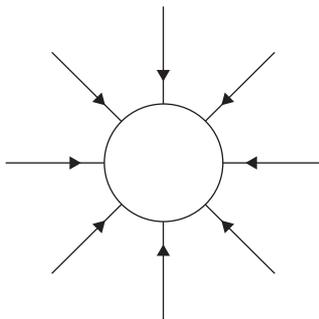
A.



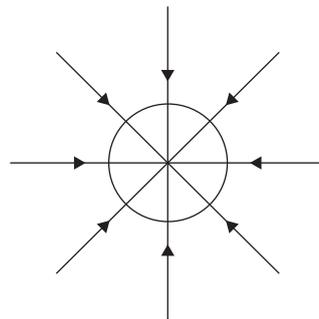
B.



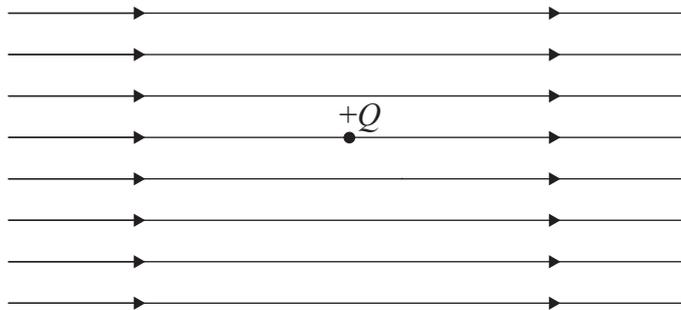
C.



D.



21. A point mass carries a positive charge  $+Q$  and is at rest in a magnetic field. The field is in the direction shown.



The magnetic force acting on the charge is

- A. from left to right in the plane of the page.
- B. from top to bottom in the plane of the page.
- C. into the plane of the page.
- D. zero.

22. The number of neutrons and the number of protons in a nucleus of an atom of the isotope of uranium  ${}^{235}_{92}\text{U}$  are

	Neutrons	Protons
A.	92	143
B.	143	92
C.	235	92
D.	92	235

23. A sample contains an amount of radioactive material with a half-life of 3.5 days. After 2 weeks the fraction of the radioactive material remaining is

- A. 94%.
- B. 25%.
- C. 6%.
- D. 0%.

24. The rest mass of a proton is  $938 \text{ MeV c}^{-2}$ . The energy of a proton at rest is

- A. 9.38 J
- B.  $9.38 \times 10^8 \times (3 \times 10^8)^2 \text{ J}$
- C.  $9.38 \times 10^8 \text{ eV}$ .
- D.  $9.38 \times 10^8 \times (3 \times 10^8)^2 \text{ eV}$

25. The efficiency of a modern natural gas power station is approximately
- A. 10%.
  - B. 50%.
  - C. 75%.
  - D. 90%.
26. The energy source that currently provides the greatest proportion of the world's total energy demand is
- A. coal.
  - B. oil.
  - C. natural gas.
  - D. uranium.
27. In a nuclear power station, uranium is used as the energy source and plutonium-239 is produced. Which of the following is true?
- A. Plutonium-239 is produced by nuclear fusion.
  - B. A moderator is used to absorb plutonium-239.
  - C. Control rods are used to slow down plutonium-239.
  - D. Plutonium-239 can be used as a fuel in another type of nuclear reactor.
28. One **disadvantage** of using photovoltaic cells to power a domestic water heater is that
- A. solar energy is a renewable source of energy.
  - B. the power radiated by the Sun varies significantly depending on the weather.
  - C. a large area of photovoltaic cells would be needed.
  - D. photovoltaic cells contain CFCs, which contribute to the greenhouse effect.

**29.** Greenhouse gases

- A. reflect infrared radiation but absorb ultraviolet radiation.
- B. reflect ultraviolet radiation but absorb infrared radiation.
- C. transmit infrared radiation but absorb ultraviolet radiation.
- D. transmit ultraviolet radiation but absorb infrared radiation.

**30.** The rate of global warming might be reduced by

- A. replacing the use of coal and oil with natural gas.
  - B. a reduction in the Earth's albedo.
  - C. a reduction in carbon fixation.
  - D. an increase in deforestation.
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