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PHYSICS
STANDARD LEVEL
PAPER 1

Wednesday 9 November 2011 (afternoon)

45 minutes

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. What is the order of magnitude of the estimated age of the universe in seconds?

A. 10^{12}

B. 10^{15}

C. 10^{18}

D. 10^{21}

2. The resistive force F acting on a sphere of radius r travelling with speed v through a liquid is given by the equation

$$F = 6\pi\eta rv$$

where η is a constant. What are the SI units of η?

A. $\text{kg}\,\text{m}^{-1}\text{s}^{-2}$

B. $\text{kg}\,\text{m}^{2}\text{s}^{-1}$

C. $\text{kg}\,\text{m}^{-1}\text{s}^{-1}$

D. $\text{kg}\,\text{m}^{-1}\text{s}^{-3}$

3. A small object is attached to a string and rotated in a circle of constant radius in a horizontal plane. The tension T in the string is measured for different speeds v. Which of the following plots should give a straight-line graph?

A. T against v

B. T^2 against v

C. T against v^2

D. T^2 against v^2

4. The vector diagram shows two forces acting on a point object O. The forces are in the plane of the page.
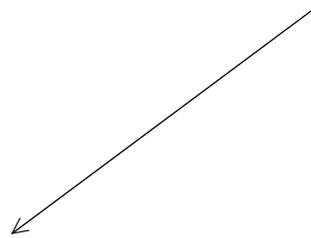
3 N

O

4 N
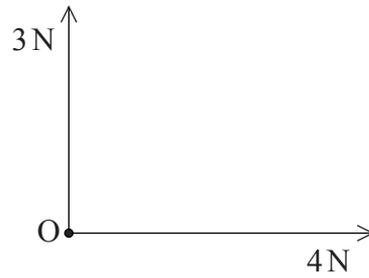
Another 5 N force is applied to O in the plane of the page. Which of the following gives the direction of this force to ensure that O is in equilibrium?
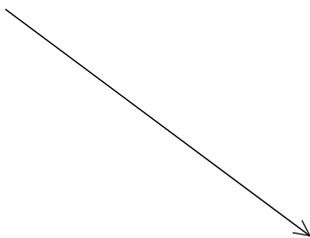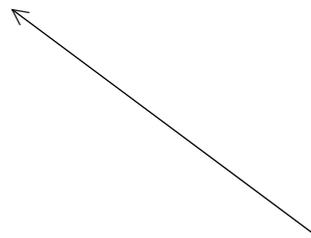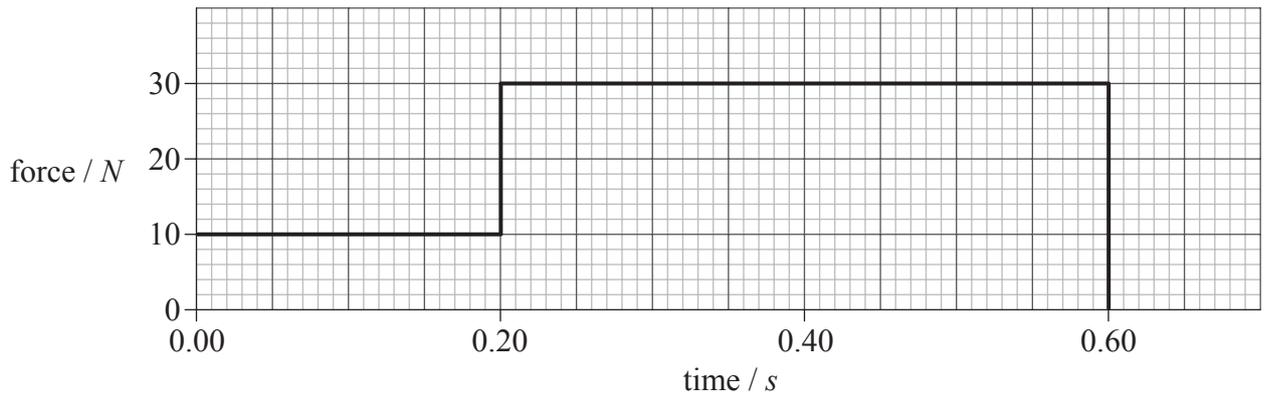
A.
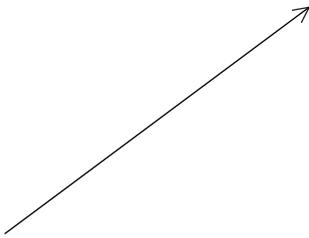
B.

C.

D.

5. The graph shows how an external force applied to an object of mass 2.0 kg varies with time. The object is initially at rest.

What is the speed of the object after 0.60 s?

A. $7.0\,\mathrm{m\,s^{-1}}$

B. $14\,\mathrm{m\,s^{-1}}$

C. $18\,\mathrm{m\,s^{-1}}$

D. $28\,\mathrm{m\,s^{-1}}$

6. A stone is thrown vertically upwards from the surface of Earth. Which of the following quantities will **not** become zero while the stone is in the air?

A. Speed

B. Velocity

C. Momentum

D. Acceleration

7. An ice-hockey puck is slid along ice in a straight line. The puck travels at a steady speed of $20\,\mathrm{m\,s^{-1}}$ and experiences no frictional force. How far does the puck travel in 2.5 s?

A. 5 m

B. 8 m

C. 25 m

D. 50 m

8.   A block of weight W slides down an inclined plane at a constant speed.
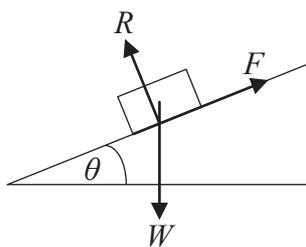

The normal reaction acting between the block and the plane is R and the frictional force between the block and the plane is F. The incline is at an angle θ to the horizontal. What is the magnitude of F?

A. $R\cos\theta$

B. $R\sin\theta$

C. $W\cos\theta$

D. $W\sin\theta$

9.   An egg dropped on the floor is likely to break. However, when it is wrapped in a cloth it is less likely to break. This is because the cloth

A.   increases the time for which the force of the ground acts on the egg.

B.   reduces the momentum of the egg.

C.   reduces the change of momentum of the egg.

D.   reduces the impulse acting on the egg.

10. A pure solid is heated at its melting point. While it is melting the

A.   mean kinetic energy of the molecules of the solid increases.

B.   mean potential energy of the molecules of the solid increases.

C.   temperature of the solid increases.

D.   temperature of the solid decreases.

11. Which of the following is equivalent to a temperature of $350\,\text{K}$?

    A. $-623\,°\text{C}$

    B. $-77\,°\text{C}$

    C. $+77\,°\text{C}$

    D. $+623\,°\text{C}$

12. A liquid-in-glass thermometer is in thermal equilibrium with some hot water. The thermometer is left in the water. The water cools to the temperature of the surroundings. Which of the following is **unlikely to be true** for the thermometer?

    A.   It is in thermal equilibrium with the water.

    B.   It is in thermal equilibrium with the surroundings.

    C.   It is at the same temperature as the water.

    D.   It has the same thermal capacity as the water.

13. The equation for the velocity of an object performing simple harmonic motion is $v = v_0 \sin \omega t$. Which of the following is a correct alternative form of the equation?

    A. $v = v_0 \sin\left(\dfrac{2\pi}{T}\right)t$

    B. $v = v_0 \sin\left(\dfrac{t}{T}\right)$

    C. $v = v_0 \sin 2\pi T t$

    D. $v = v_0 \sin\left(\dfrac{T}{2\pi}\right)t$

14. The diagram shows the variation of velocity v with time t for an object performing simple harmonic motion.
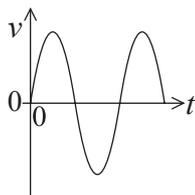

Which of the following shows how the acceleration a varies with t?

A.

B.

C.

D.
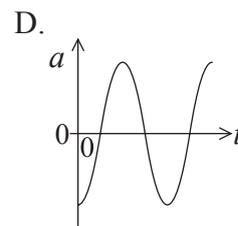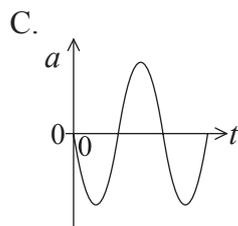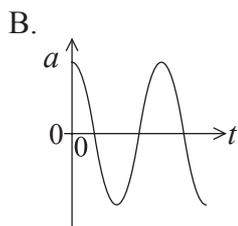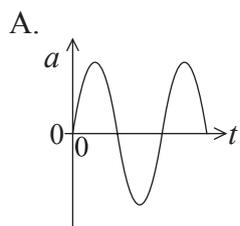
15. Which of the following gives regions of the electromagnetic spectrum in the order of **decreasing** frequency?

A.   gamma-ray, microwave, visible

B.   radio wave, infrared, microwave

C.   ultraviolet, infrared, microwave

D.   visible, gamma-ray, radio wave

Turn over

16. A cell is connected in series with a $2.0\,\Omega$ resistor and a switch. The voltmeter is connected across the cell and reads $12\,\text{V}$ when the switch is open and $8.0\,\text{V}$ when the switch is closed.

$2.0\,\Omega$
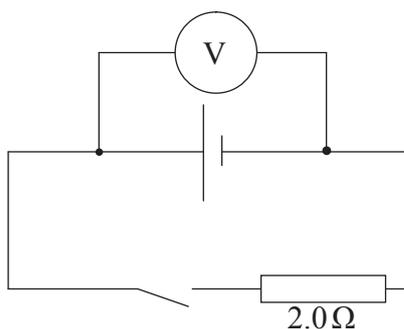
What is the internal resistance of the cell?

A. $1.0\,\Omega$

B. $2.0\,\Omega$

C. $3.0\,\Omega$

D. $4.0\,\Omega$

17. Two wires X and Y are made of the same material and have a uniform cylindrical cross-section. The wires are the same length. The radius of X is twice the radius of Y.

What is the ratio of $\dfrac{\text{resistance of Y}}{\text{resistance of X}}$?

A.   0.25

B.   0.50

C.   2.0

D.   4.0

18. An electron is accelerated through a potential difference of 100 V. Which of the following gives the correct gain in kinetic energy of the electron in both joule and electronvolt?

	Joule / J	**Electronvolt / eV**
A.	100	100
B.	1.6×10^{-17}	100
C.	100	1.6×10^{-17}
D.	1.6×10^{-17}	1.6×10^{-17}

19. Which of the following is the SI unit of gravitational field strength?

    A.   N

    B. $N\,m$

    C. $N\,kg^{-1}$

    D. $N\,m^{2}\,kg^{-2}$

20. Which of the following is the best representation of the electric field lines around a negatively charged metal sphere?

8811-6504   **Turn over**
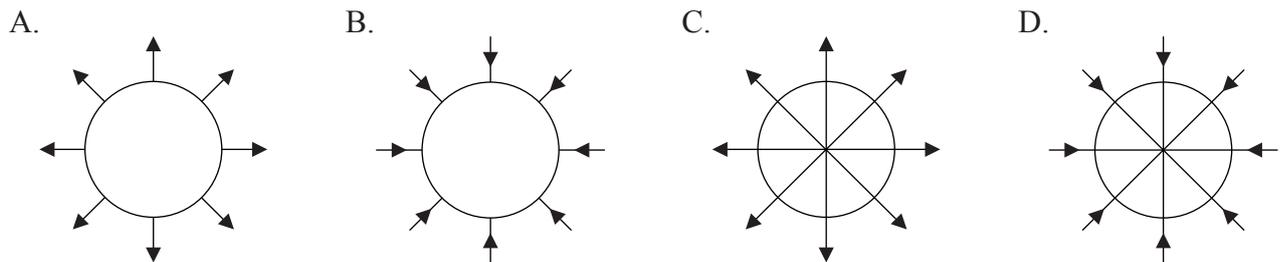
21. The diagram shows two long wires X and Y carrying identical currents in the same direction.
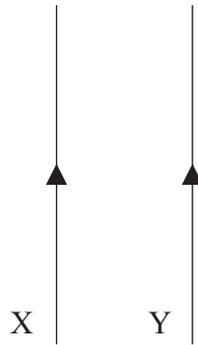
The direction of the force experienced by Y is

A.   to the left.

B.   to the right.

C.   into the plane of the page.

D.   out of the plane of the page.

22. A nucleus of the isotope plutonium-238 $\left(^{238}\text{Pu}\right)$ decays into a nucleus of uranium by emitting an alpha particle. What is the nucleon number of the uranium nucleus?

A.   234

B.   236

C.   238

D.   240

23. In Geiger and Marsden's experiments a thin gold foil was bombarded with alpha particles. It was found that

A.   all alpha particles were deflected from their original paths.

B.   no alpha particles were deflected by more than $90°$ from their original paths.

C.   a few alpha particles were deflected by more than $90°$ from their original paths.

D.   most alpha particles were deflected by more than $90°$ from their original paths.

24. Which of the following affects the rate at which a sample of a radioactive material decays?

    A.   The mass of the sample

    B.   The temperature of the sample

    C.   The volume of the sample

    D.   The pressure acting on the sample

25. What is the SI unit of energy density?

    A. $J\,s^{-1}$

    B. $J\,kg^{-1}$

    C. $J\,m^{-2}$

    D. $kg\,m^{-3}$

26. In a nuclear fission reaction neutrons are passed through a moderator. The reason for this is to reduce the

    A.   number of the neutrons.

    B.   kinetic energy of the neutrons.

    C.   the number of collisions between neutrons.

    D.   potential energy of the neutrons.

27. Wind of speed v is incident normally on a wind turbine of radius r. The maximum theoretical power output of the turbine is P. For wind of speed $2v$ incident normally on a similar turbine of radius $\frac{1}{2}r$, the maximum theoretical power will be

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

B. P.

C. $2P$.

D. $4P$.

28. Which of the following geographical features has the lowest albedo?

A. Polar ice cap

B. Desert

C. Ocean

D. White cliffs

29. The power emitted as electromagnetic radiation by the Sun is approximately 4×10^{26} W. The radius of the orbit of Mars around the Sun is approximately 2×10^{11} m. What is the best estimate for the power incident on an area of $1\,\text{m}^2$ at the radius of Mars' orbit?

A. 10^3 W

B. 10^7 W

C. 10^{11} W

D. 10^{15} W

30. Which of the following alternatives would be the most likely to increase the enhanced greenhouse effect?

    A.   Replacement of oil and coal fired power stations with natural gas fired power stations

    B.   Forests being cut down without being replanted

    C.   Greater use of combined heating and power systems

    D.   Use of motor vehicles powered by a combination of electricity and oil products