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PHYSICS
STANDARD LEVEL
PAPER 1

Tuesday 20 May 2008 (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.   An elephant has a life expectancy of 60 years. Which of the following gives the order of magnitude of this lifetime?

   A. 10^{11} s

   B. 10^{9} s

   C. 10^{7} s

   D. 10^{5} s

2.   The frequency f of waves of wavelength λ travelling on the surface of deep water is given by

$$f = \sqrt{\frac{g}{2\pi\lambda}}$$

   where g is the acceleration of free fall.

   Which of the following will yield a straight-line graph?

	y-axis	x-axis
A.	f^2	$\dfrac{1}{\lambda}$
B.	f^2	λ
C.	f	λ
D.	f	$\dfrac{1}{\lambda}$

3. The diagram below shows two vectors X and Y.
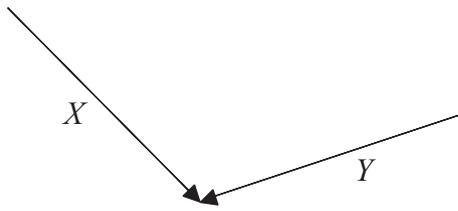
Which of the following best represents the vector $Z = X - Y$.

A.

B.

C.

D.
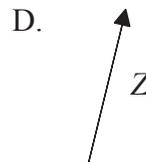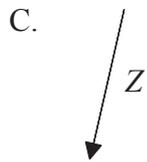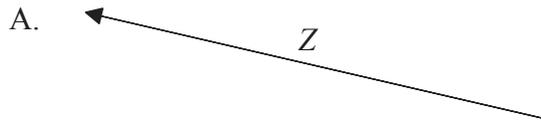
4. Which of the following graphs shows the best-fit line for the plotted points?

A.

B.

C.

D.
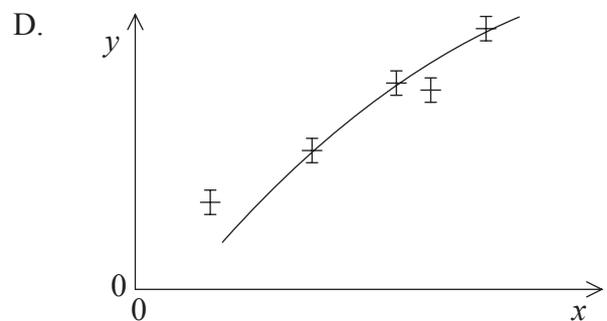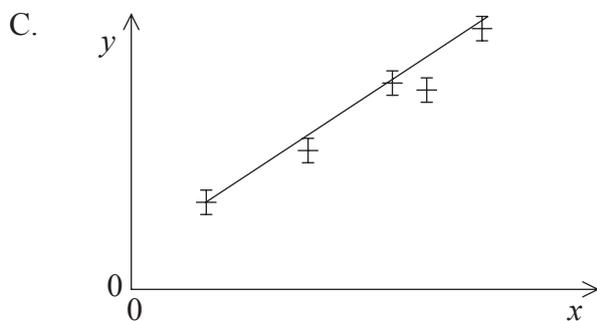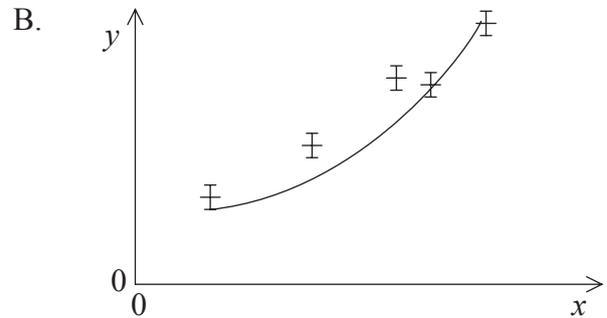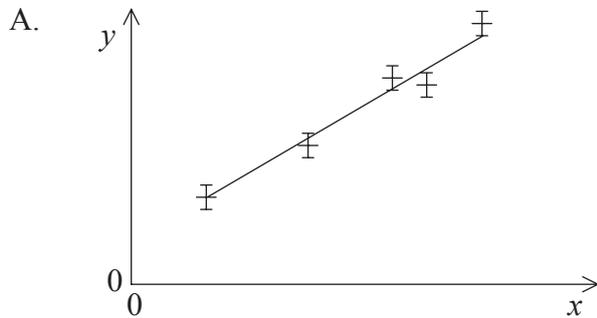
5. A car has a speed of $+15\,\mathrm{m\,s^{-1}}$ relative to the ground. It passes a cyclist travelling in the same straight-line. The speed of the car relative to the cyclist is $+12\,\mathrm{m\,s^{-1}}$.

The speed of the cyclist relative to the ground is

A. $-3.0\,\mathrm{m\,s^{-1}}$.

B. $-1.5\,\mathrm{m\,s^{-1}}$.

C. $+1.5\,\mathrm{m\,s^{-1}}$.

D. $+3.0\,\mathrm{m\,s^{-1}}$.

6. A steel sphere is dropped from rest in oil. Which of the following graphs best represents the variation with time of the speed of the sphere?

A. speed

B. speed

C. speed

D. speed
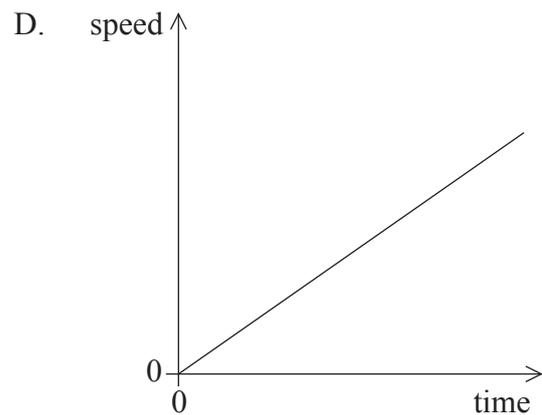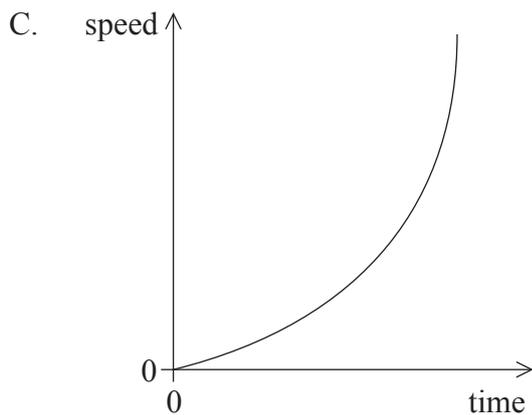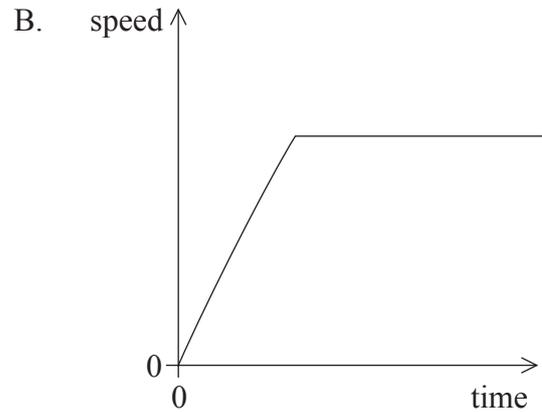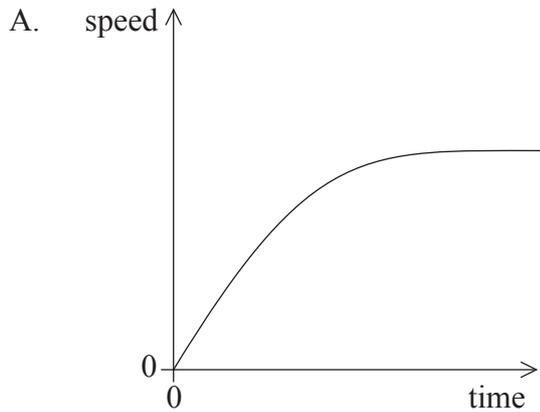
7. An electric motor has an input power of 160 W. In raising a load, 120 W of power is dissipated. The best estimate for the efficiency of the motor is

    A.   25 %.

    B.   33 %.

    C.   57 %.

    D.   75 %.

Questions 8 and 9 both refer to the following information and graph.

The graph below shows the variation with load of the length of a spring.
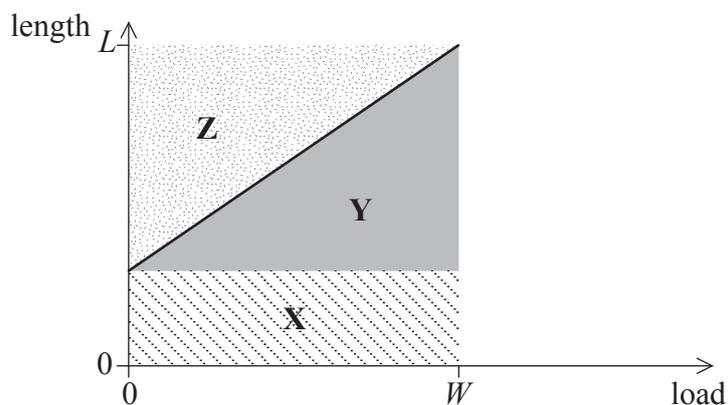
For a load W the length of the spring is L.

8.   Which of the following areas on the graph represents the energy stored in the spring when it is stretched to a length L?

A.   X

B.   Y – X

C.   Z

D.   X + Y

9.   The spring constant of the spring is given by

A.   the gradient of the graph.

B. $\dfrac{1}{\text{gradient of the graph}}$.

C. $\dfrac{W}{L}$.

D. $\dfrac{L}{W}$.

10. A fireman is holding a hosepipe so that water leaves the pipe horizontally. The hosepipe has a constant cross-sectional area. The magnitude of the force that the fireman exerts to hold the hosepipe stationary is F.

The volume of water delivered by the hose per second doubles, the force that the fireman must now exert is

A. $\sqrt{2}F$.

B. $2F$.

C. $4F$.

D. $8F$.

11. An object of mass m falls from rest in a vacuum. As the object falls it loses an amount E of gravitational potential energy. The speed of the object is then

A. $\sqrt{\dfrac{2E}{m}}$.

B. $\sqrt{\dfrac{m}{2E}}$.

C. $\dfrac{2E}{m}$.

D. $\dfrac{m}{2E}$.

Turn over

12. Two trolleys P and Q, are connected by a rubber band. They are at rest on a horizontal surface. The mass of Q is twice that of P. The trolleys are pulled apart so that the band is stretched and are then released.

The ratio $\dfrac{\text{magnitude of initial acceleration of trolley P}}{\text{magnitude of initial acceleration of trolley Q}}$ is

A. $\dfrac{1}{4}$.

B. $\dfrac{1}{2}$.

C. 1.

D. 2.

13. An object of mass M is suspended from a spring. The extension of the spring is e. The same object is suspended from an identical spring on the Moon where the acceleration of free fall is less than that on Earth. Which of the following is correct?

	Mass of the object on Moon	Extension of spring on Moon
A.	M	e
B.	less than M	less than e
C.	M	less than e
D.	less than M	e

14. An impulse I acts on a body of mass m that is initially at rest. What is the distance moved by the body in a time t after the impulse has been delivered?

A. $\dfrac{It}{m}$

B. $\dfrac{Im}{t}$

C. $\dfrac{I}{m}$

D. It

15. Which of the following will **not** affect the rate of evaporation of a liquid?

A.   The temperature of the liquid

B.   The surface area of the liquid

C.   The mass of the liquid

D.   Convection currents of air above the liquid surface

16. Gas leaks slowly out of a cylinder of constant volume. The temperature of the gas in the cylinder does not change. Which of the following is constant for the gas molecules in the cylinder?

A.   The number striking unit area of surface in unit time

B.   The number of the collisions between molecules per unit time

C.   The number per unit volume

D.   The average speed

17. The graph below shows the variation with absolute temperature T of the pressure p of one mole of an ideal gas having a volume V. R is the molar gas constant.
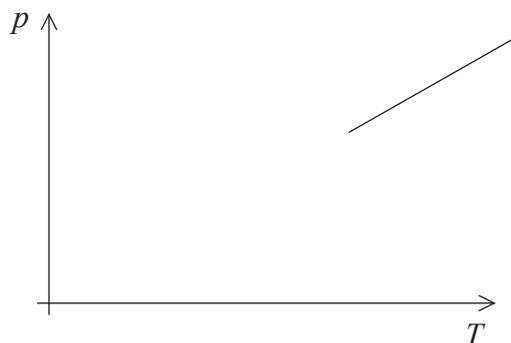
Which of the following is the best interpretation of the intercept on the temperature axis and the gradient of the graph?

	Intercept on temperature axis / K	Gradient of graph
A.	-273	$\dfrac{R}{V}$
B.	0	$\dfrac{R}{V}$
C.	0	$\dfrac{V}{R}$
D.	-273	$\dfrac{V}{R}$

18. A block of metal at a temperature of $90\,^{\circ}$C is placed in a beaker of water at a temperature of $0\,^{\circ}$C. The mass of the metal block and the mass of the water are equal. The final temperature of the water and the metal block is $9\,^{\circ}$C.

Which of the following is the best estimate of the ratio

$$\frac{\text{specific heat of water}}{\text{specific heat of metal}}?$$

A.　$\dfrac{1}{10}$

B.　$\dfrac{1}{9}$

C.　9

D.　10

19. Light travelling from water to air is incident on a boundary.
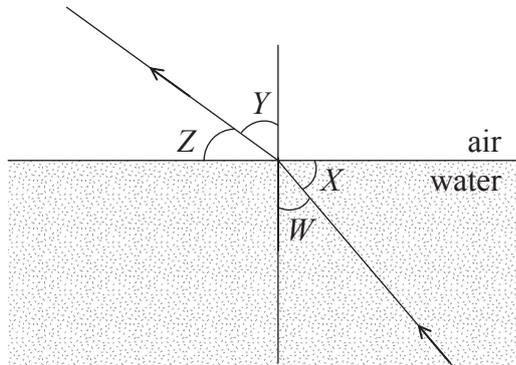
Which of the following is a correct statement of Snell's law for this situation?

A.　$\sin Z = constant \times \sin Y$

B.　$\sin W = constant \times \sin Z$

C.　$\sin X = constant \times \sin Z$

D.　$\sin W = constant \times \sin Y$

20. A standing wave is established on a string between two fixed points.
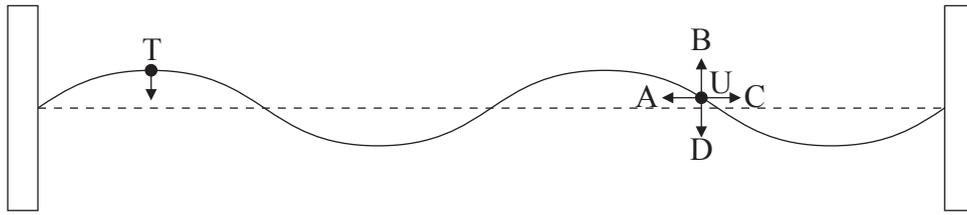
At the instant shown, point T is moving downwards. Which arrow gives the direction of movement of point U at this instant?

A.   A

B.   B

C.   C

D.   D

21. A pulse is travelling along a string attached to a wall.

pulse direction
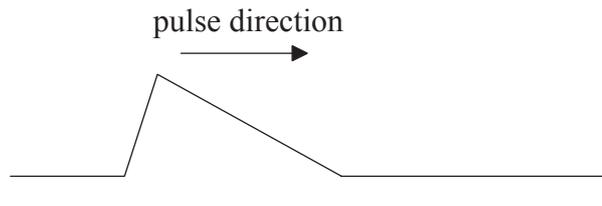
Which of the following shows the shape of the string after reflection from the wall?

A.

B.

C.

D.
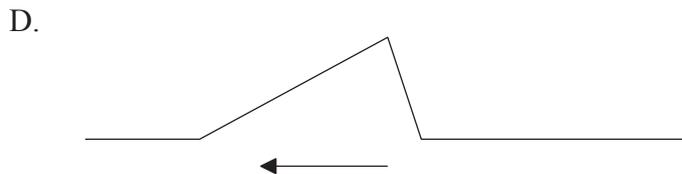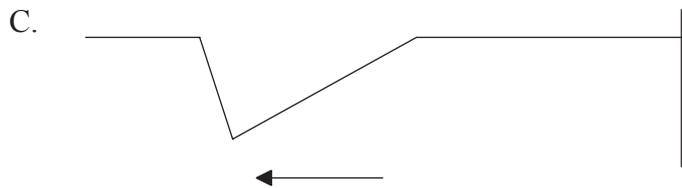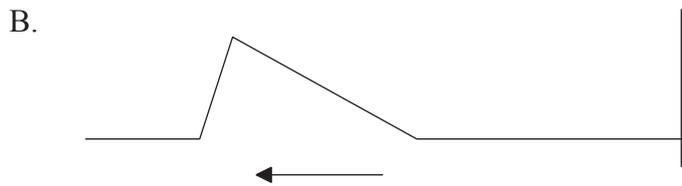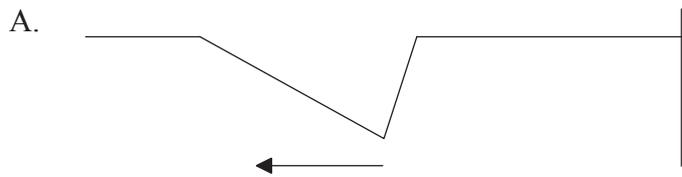
22. The diagram below shows the displacement-position graph at a particular instant for a longitudinal wave travelling along a spring.
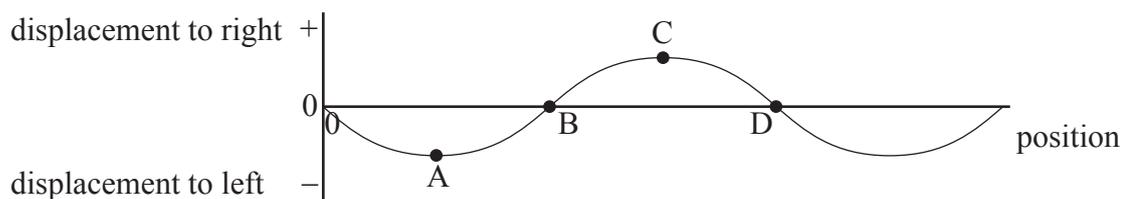
A positive displacement on the graph indicates that the coils of the spring are displaced to the right of their equilibrium position.

At which position along the spring is the displacement of two adjacent coils a maximum?

A.   A

B.   B

C.   C

D.   D

23. Which of the following is a unit for electrical resistance?

A. $W A^{-2}$

B. $A V^{-1}$

C. $V W^{-2} s$

D. $W V^{-2}$

24. The circuit contains a battery of e.m.f. 12 V and negligible resistance.
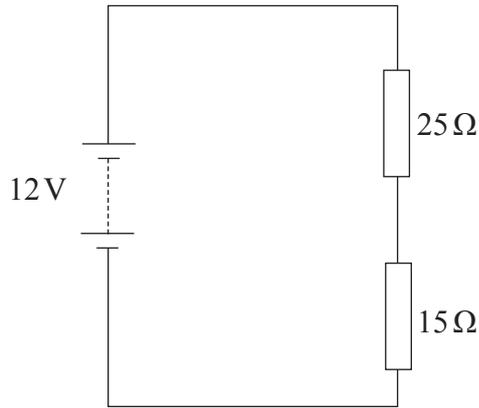
What is the potential difference across the 25 Ω resistor?

A.   3.0 V

B.   4.5 V

C.   5.0 V

D.   7.5 V

25. The diagram below shows two stationary point charges $+2Q$ and $-Q$.

At which point is the electric field strength greatest?

A.   A

B.   B

C.   C

D.   D

26. The diagram below represents four long straight wires perpendicular to the plane of the paper.
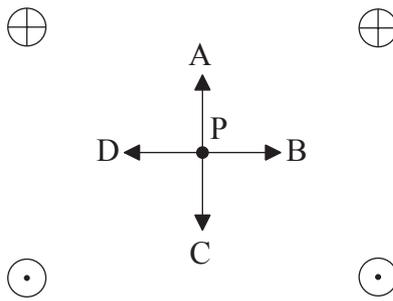
The magnitude of the direct current in each wire is the same. Wires with ⊕ have current into the plane of the paper and wires with ⊙ have current out of the plane of the paper. Point P is the same distance from each wire.

Which arrow shows the direction of the magnetic field at P?

A.   A

B.   B

C.   C

D.   D

27. Which graph best represents the relationship between the current I and the voltage V of a filament lamp.
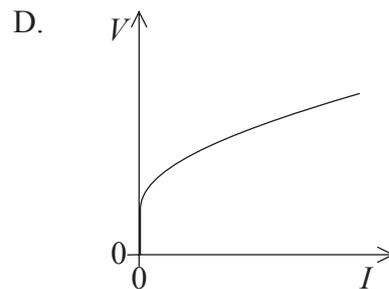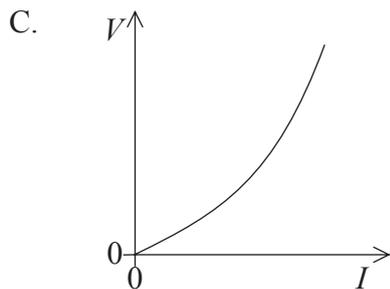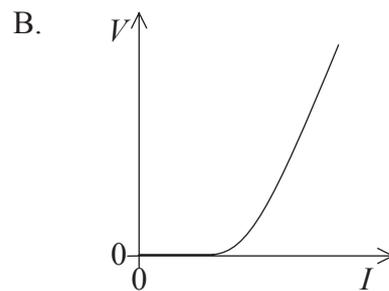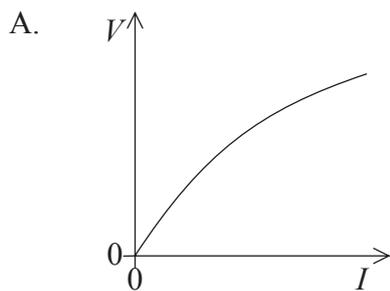
28. A nuclide X has a half-life of 10 s. On decay the stable nuclide Y is formed. Initially a sample contains only atoms of X.

After what time will 87.5% of the atoms in the sample have decayed into nuclide Y.

    A.   9.0 s

    B.   30 s

    C.   70 s

    D.   80 s

29. Which of the following best describes why alpha-particles travel only a short distance in air?

    A.   They undergo radioactive decay.

    B.   They undergo elastic collisions with air molecules.

    C.   They ionize air molecules.

    D.   They are attracted by the nuclei of air molecules.

30. A nucleus $^{90}_{38}\text{Sr}$ decays by the emission of an electron. What are the mass (nucleon) number and the atomic (proton) number of the resulting nucleus?

	Mass number	Proton number
A.	89	38
B.	90	39
C.	91	38
D.	91	39