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PHYSICS
STANDARD LEVEL
PAPER 1

Wednesday 11 May 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. Which of the following will reduce random errors in an experiment?

    A.   Using an instrument having a greater precision

    B.   Checking the calibration of the instrument used

    C.   Checking for zero error on the instrument used

    D.   Repeating readings

2. A body accelerates from rest with a uniform acceleration a for a time t. The uncertainty in a is 8% and the uncertainty in t is 4%. The uncertainty in the speed is

    A. 32%.

    B. 12%.

    C. 8%.

    D. 2%.

3. Which of the following lists **two** scalar quantities?

    A.   emf, momentum

    B.   emf, weight

    C.   impulse, kinetic energy

    D.   temperature, kinetic energy

4. The graph shows the variation with time t of the acceleration a of an object.
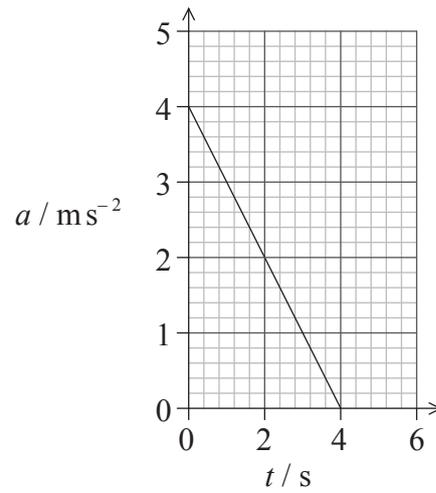
Which of the following is the change in velocity of the object in the time interval 0 to 4 s?

A. $-8\,\mathrm{ms}^{-1}$

B. $-4\,\mathrm{ms}^{-1}$

C. $+4\,\mathrm{ms}^{-1}$

D. $+8\,\mathrm{ms}^{-1}$

5. A car accelerates from rest. The acceleration increases with time. Which graph shows the variation with time t of the speed v of the car?

A.

B.

C.

D.
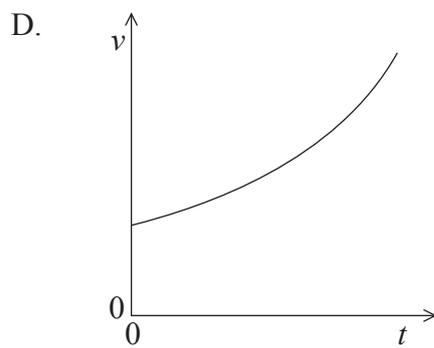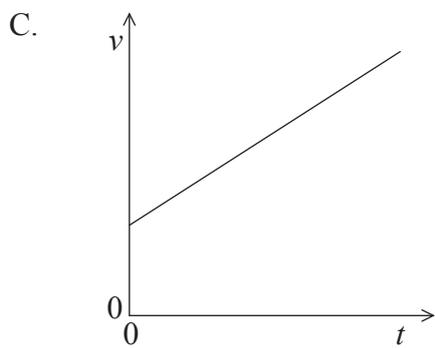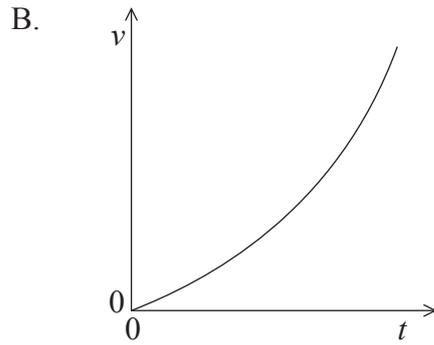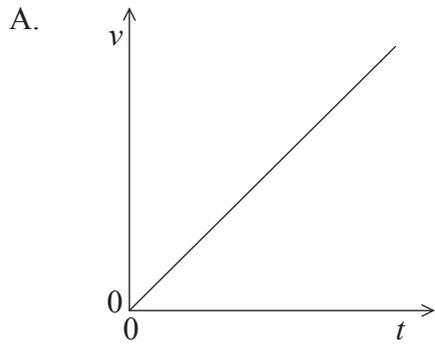
6. Which of the following is the condition for a body to be in translational equilibrium?

A. The resultant force on the body in any direction is zero.

B. The velocity of the body in any direction is zero.

C. No external force is acting on the body.

D. No work is done on the body.

7. A stone attached to a string is moving in a horizontal circle. The constant speed of the stone is v. The diagram below shows the stone in two different positions, X and Y.
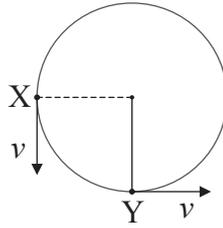
Which of the following shows the direction of the change of velocity of the stone when moving from position X to position Y?

A.

B.

C.

D.

8. The graph shows the variation with force F of the extension s of a spring.
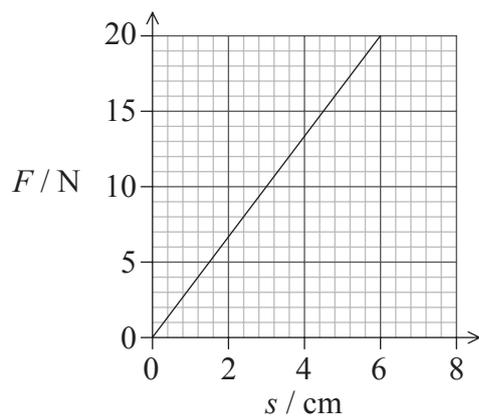
The work done in changing the extension of the spring from 3.0 cm to 6.0 cm is

A.   15 N cm.

B.   30 N cm.

C.   45 N cm.

D.   60 N cm.

9. The energy of the molecules of an ideal gas is

A.   thermal only.

B.   thermal and potential.

C.   potential and kinetic.

D.   kinetic only.

10. Oil with volume V has specific heat capacity c at temperature T. The density of oil is ρ. Which of the following is the thermal capacity of the oil?

A. $\rho c V$

B. $\dfrac{cV}{\rho}$

C. $\rho c V T$

D. $\dfrac{cV}{\rho T}$

11. The volume of an ideal gas in a container is increased at constant temperature. Which of the following statements is/are correct about the molecules of the gas?

     I.   Their average speed remains constant.

     II.   The frequency of collisions of molecules with unit area of the container wall decreases.

     III.   The force between them decreases.

A.   I only

B.   I and II only

C.   I and III only

D.   II and III only

12. A particle oscillates with simple harmonic motion with period T.

At time $t=0$, the particle has its maximum displacement. Which graph shows the variation with time t of the kinetic energy E_k of the particle?

A.

B.

C.

D.
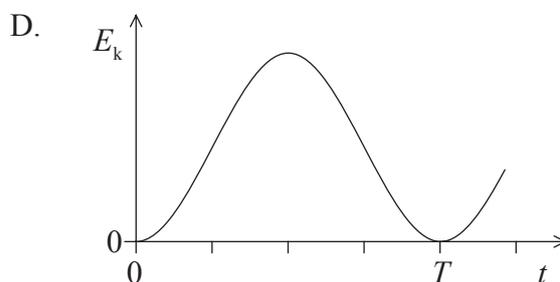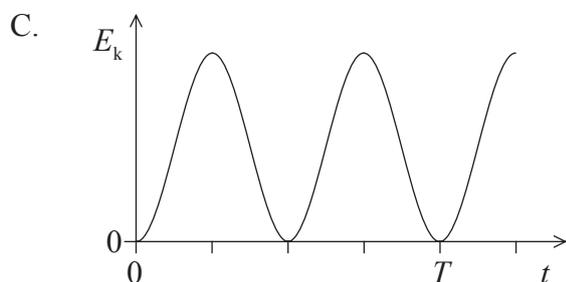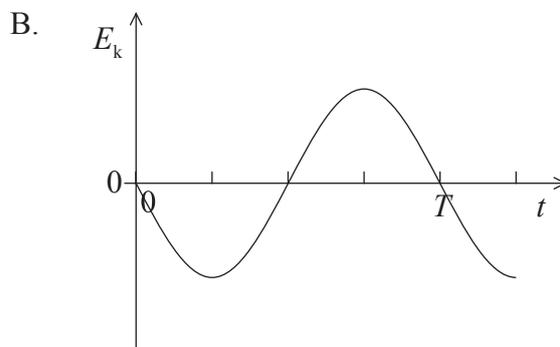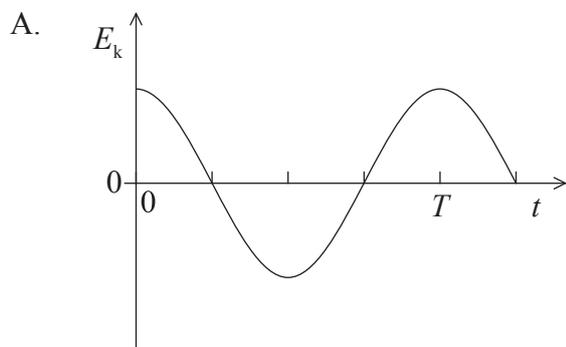
13. An object is undergoing simple harmonic motion with light damping. The natural frequency of oscillation of the object is f_0. A periodic force of frequency f is applied to the object. Which of the following graphs best shows how the amplitude a of oscillation of the object varies with f?

A.

B.

C.

D.

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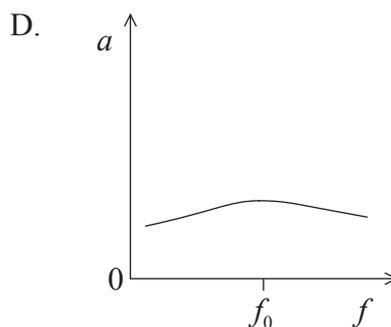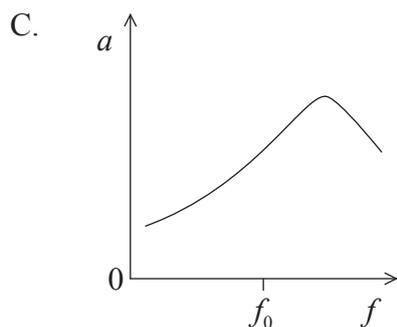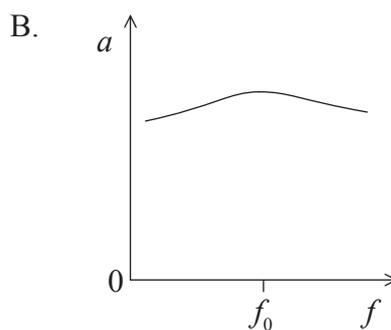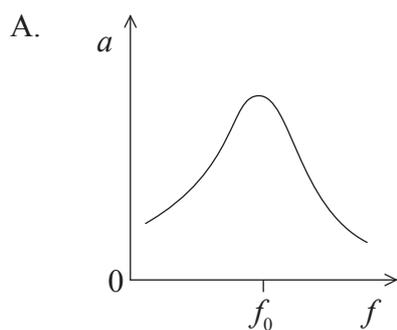
14. The graph shows measurements of the height h of sea level at different times t in the Bay of Fundy.
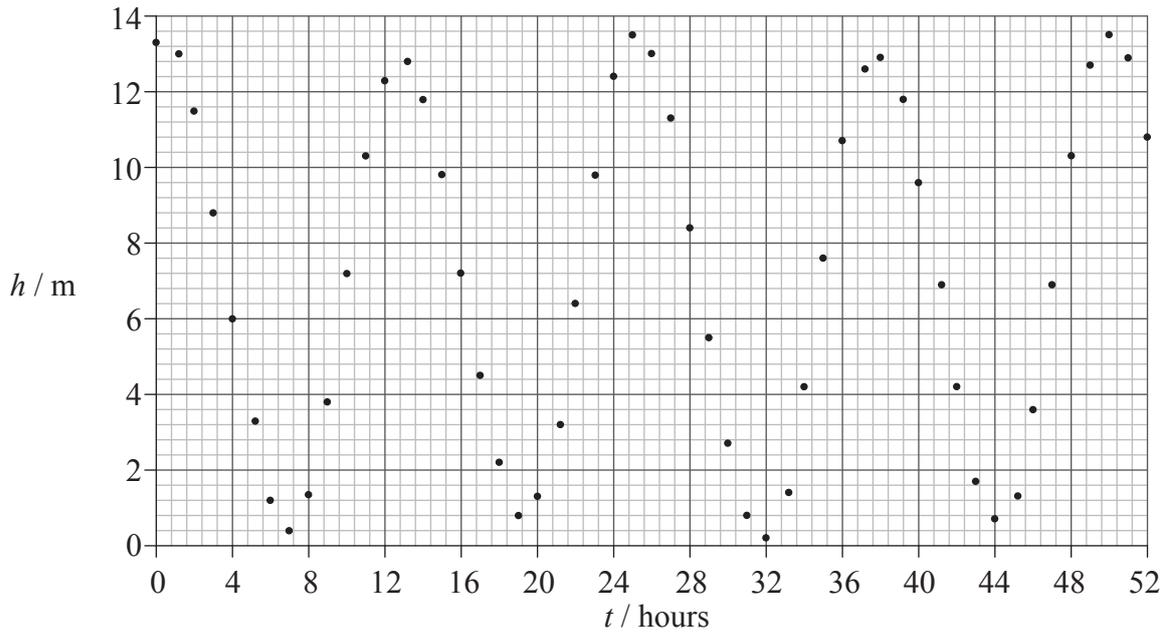
Which of the following gives the approximate amplitude and period of the tides?

	Amplitude	**Period**
A.	6.5 m	6 hours
B.	13 m	12 hours
C.	6.5 m	12 hours
D.	13 m	6 hours

15. Two waves meet at a point. The waves have a path difference of $\frac{\lambda}{4}$. The phase difference between the waves is

A. $\frac{\pi}{8}$ rad.

B. $\frac{\pi}{4}$ rad.

C. $\frac{\pi}{2}$ rad.

D. π rad.

16. Two electrodes, separated by a distance d, in a vacuum are maintained at a constant potential difference. An electron, accelerated from one electrode to the other, gains kinetic energy E_k. The distance between the electrodes is now changed to $\frac{1}{3}d$.

What is the gain in kinetic energy of an electron that is accelerated from one electrode to the other?

A. $\frac{E_k}{3}$

B. E_k

C. $3E_k$

D. $9E_k$

17. The graph shows the *I–V* characteristics of two resistors.
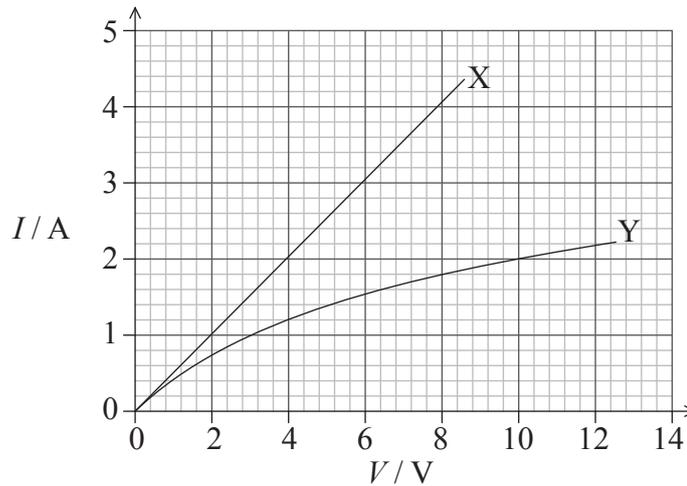
When resistors X and Y are connected in series, the current in the resistors is 2.0 A. What is the resistance of the series combination of X and Y?

A.   7.0 Ω

B.   1.3 Ω

C.   1.1 Ω

D.   0.14 Ω

18. The definition of the ampere refers to the

A.   number of electrons passing a given point per second.

B.   force between parallel current-carrying conductors.

C.   power dissipated per unit resistance.

D.   amount of charge transferred per second.

19. A spacecraft travels away from Earth in a straight line with its motors shut down. At one instant the speed of the spacecraft is $5.4\,\mathrm{km\,s^{-1}}$. After a time of $600\,\mathrm{s}$, the speed is $5.1\,\mathrm{km\,s^{-1}}$. The average gravitational field strength acting on the spacecraft during this time interval is

A. $5.0 \times 10^{-4}\,\mathrm{N\,kg^{-1}}$

B. $3.0 \times 10^{-2}\,\mathrm{N\,kg^{-1}}$

C. $5.0 \times 10^{-1}\,\mathrm{N\,kg^{-1}}$

D. $30\,\mathrm{N\,kg^{-1}}$

20. Two isolated point charges, $-7\,\mu\mathrm{C}$ and $+2\,\mu\mathrm{C}$, are at a fixed distance apart. At which point is it possible for the electric field strength to be zero?
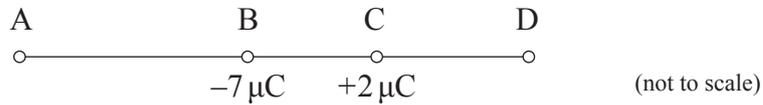
21. A long straight wire carries an electric current perpendicularly out of the paper. Which of the following represents the magnetic field pattern due to the current?
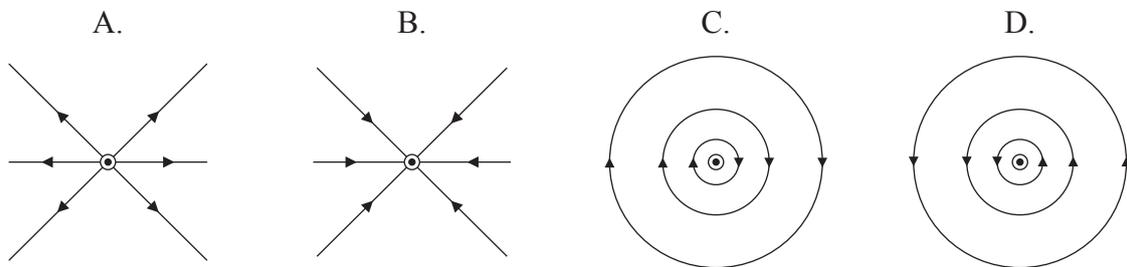
22. Which nucleons in a nucleus are involved in the Coulomb interaction and the strong short-range nuclear interaction?

	Coulomb interaction	**Strong short-range interaction**
A.	protons	protons, neutrons
B.	protons	neutrons
C.	protons	protons
D.	protons, neutrons	neutrons

23. Two samples of radioactive substances X and Y have the same initial activity. The half-life of X is T and the half-life of Y is $3T$. After a time of $3T$ the ratio

$$\frac{\text{activity of substance X}}{\text{activity of substance Y}} \text{ is}$$

A. 8.

B. 4.

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

D. $\dfrac{1}{8}$.

24. The nuclear equation below is an example of the transmutation of mercury into gold.

$$^{2}_{1}\text{H} + ^{199}_{80}\text{Hg} \rightarrow ^{197}_{79}\text{Au} + \mathbf{X}$$
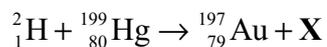
The particle **X** is a

A. gamma-ray photon.

B. helium nucleus.

C. proton.

D. neutron.

25. The Sankey diagram of a fossil-fuelled power station is shown below.
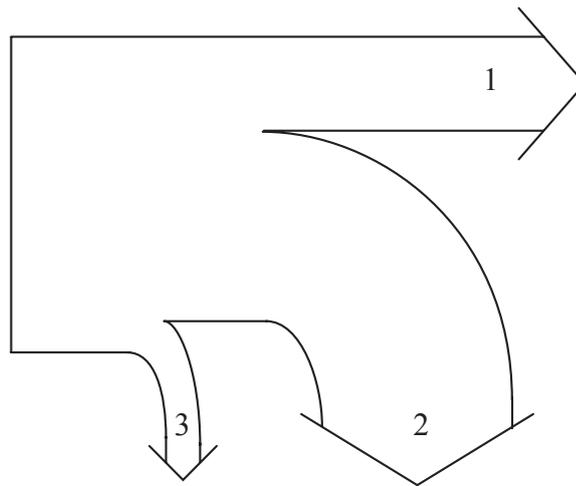
Which of the following best identifies the thermal energy removed by water and the useful electrical energy output of the station?

	Thermal energy removed	Useful electrical energy output
A.	2	1
B.	2	3
C.	3	1
D.	1	2

26. World energy resources include coal, nuclear fuel and geothermal energy. Which of the following lists these resources in order of energy use in the world?

A. nuclear, geothermal, coal

B. nuclear, coal, geothermal

C. coal, geothermal, nuclear

D. coal, nuclear, geothermal

27. Which of the following processes leads to the production of a nucleus of plutonium-239 from a nucleus of uranium-238?

    A.   Neutron capture by uranium nucleus

    B.   Radioactive decay of uranium nucleus

    C.   Electron capture by uranium nucleus

    D.   Nuclear fission of uranium nucleus

28. Water is contained in a tidal basin behind a dam. The water has a depth h at high tide and zero at low tide, as shown in the diagram.
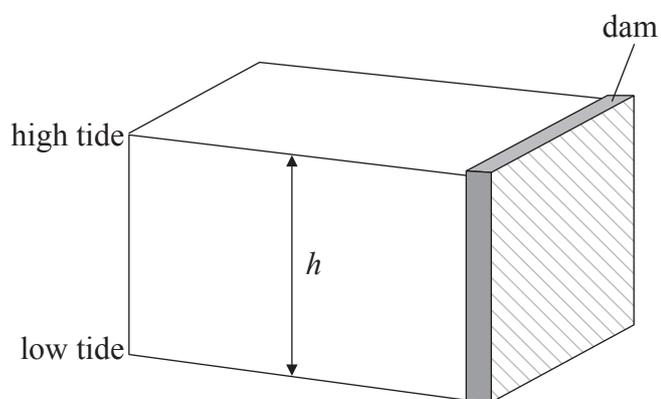
The gravitational potential energy of the water stored in the basin between a high tide and a low tide is proportional to

    A. $\sqrt{h}$.

    B. h.

    C. h^2.

    D. h^3.

Turn over

29. Surface X has a temperature T_X and emissivity ε_x. Surface Y has a temperature T_Y and emissivity ε_y. The two surfaces emit radiation at the same rate.

What is the ratio $\dfrac{T_X}{T_Y}$?

A. $\left(\dfrac{\varepsilon_y}{\varepsilon_x}\right)^{\frac{1}{4}}$

B. $\left(\dfrac{\varepsilon_x}{\varepsilon_y}\right)^{\frac{1}{4}}$

C. $\left(\dfrac{\varepsilon_y}{\varepsilon_x}\right)^{4}$

D. $\left(\dfrac{\varepsilon_x}{\varepsilon_y}\right)^{4}$

30. Large areas of rainforests are cut down and burned every year. The result of these actions is

A. reduced albedo.

B. reduced carbon fixation.

C. increased evaporation rate.

D. increased mass of atmospheric methane.