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PHYSICS
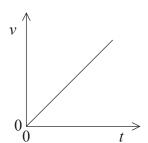**STANDARD LEVEL**
PAPER 1

Monday 8 November 2010 (afternoon)

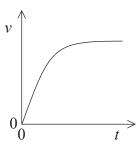45 minutes

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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. Which of the following is equivalent to the joule?

A. $N m^2$

B. $N m^{-2}$

C. $kg m s^{-2}$

D. $kg m^2 s^{-2}$

2. An object falls for a time of $0.25 s$. The acceleration of free fall is $9.81 m s^{-2}$. The displacement is calculated. Which of the following gives the correct number of significant digits for the calculated value of the displacement of the object?

A.   1

B.   2

C.   3

D.   4

3. A raindrop falling from rest at time $t=0$ reaches terminal velocity. Which graph best represents how the speed v varies with time t?
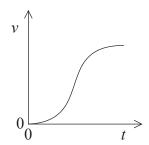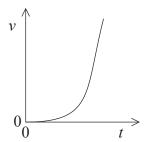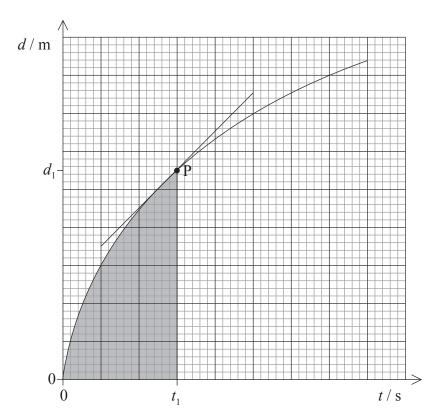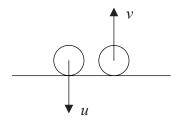
A.

B.

C.

D.

4. The graph shows how the displacement d of an object varies with time t. The tangent to the curve at time t_1 is also shown.

Which of the following gives the speed of the object at point P?

A.   the gradient at P

B.   the shaded area

C. $\dfrac{1}{\text{gradient at P}}$

D. $\dfrac{d_1}{t_1}$

Turn over

5. A ball falls vertically and bounces off the ground. Immediately before impact with the ground the speed of the ball is u. Immediately after leaving the ground the speed is v.

Which of the following expressions is the ratio of $\dfrac{\text{kinetic energy lost on collision}}{\text{kinetic energy immediately before collision}}$?
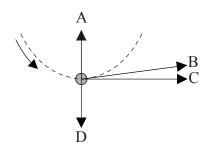
A. $\dfrac{v}{u}$

B. $1 - \dfrac{v}{u}$

C. $\left(\dfrac{v}{u}\right)^2$

D. $1 - \left(\dfrac{v}{u}\right)^2$

6. A railway engine of mass m moves along a horizontal track with uniform speed v. The total resistive force acting on the engine is F.
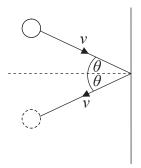

Which of the following is the power of the engine?

A. $\dfrac{F}{mv}$

B. Fv

C. $\dfrac{mv}{F}$

D. $\dfrac{v}{F}$

7. A ball is tied to a string and rotated at a uniform speed in a vertical plane. The diagram shows the ball at its lowest position. Which arrow shows the direction of the net force acting on the ball?
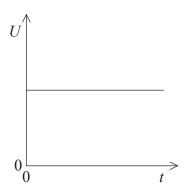

8. A gas atom strikes a wall with speed v at an angle θ to the normal to the wall. The atom rebounds at the same speed v and angle θ.
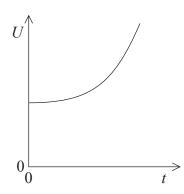

Which of the following gives the magnitude of the momentum change of the gas atom?

A.   zero

B. $2mv\sin\theta$

C. $2mv$

D. $2mv\cos\theta$

9. A system consists of an ice cube placed in a cup of water. The system is thermally insulated from its surroundings. The water is originally at 20°C. Which graph best shows the variation of total internal energy U of the system with time t?
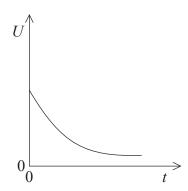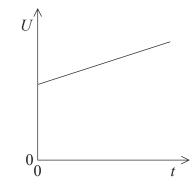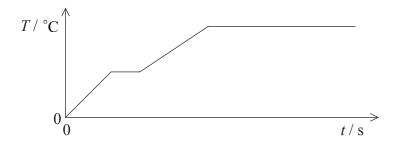
A.

B.

C.

D.

10. Thermal energy is added at a constant rate to a substance which is solid at time $t=0$. The graph shows the variation with t of the temperature T.
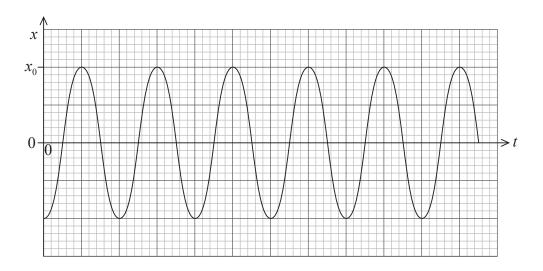

Which of the statements are correct?

    I.   The specific latent heat of fusion is greater than the specific latent heat of vaporization.

    II.   The specific heat capacity of the solid is less than the specific heat capacity of the liquid.

A.   I only

B.   I and II

C.   II only

D.   Neither I nor II

11. Which of the following is an assumption made in the kinetic model of ideal gases?

A.   Molecules have zero mass.

B.   Forces between molecules are attractive.

C.   Collisions between molecules are elastic.

D.   Molecules move at high speed.

Question 12 and Question 13 both refer to the following.

An object at the end of a spring oscillates vertically with simple harmonic motion. The graph shows the variation with time t of the displacement x. The amplitude is x_0 and the period of oscillation is T.

12. Which of the following is the correct expression for the displacement x?

A. $-x_0 \cos \dfrac{2\pi}{T} t$

B. $x_0 \cos \dfrac{2\pi}{T} t$

C. $-x_0 \sin \dfrac{2\pi}{T} t$

D. $x_0 \sin \dfrac{2\pi}{T} t$

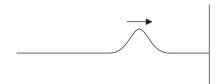**13.** Which of the following is the correct expression for the maximum acceleration of the object?

A. $\dfrac{2\pi}{T} x_0$

B. $\dfrac{2\pi}{T^2} x_0$

C. $\dfrac{4\pi^2}{T^2} x_0$

D. $\dfrac{4\pi^2}{T} x_0$

14. One end of a horizontal string is fixed to a wall. A transverse pulse moves along the string as shown.
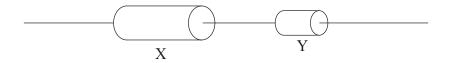
Which of the following statements are correct for the reflected pulse compared to the forward pulse?

    I.   It moves more slowly.

    II.   It has less energy.

    III.   It is inverted.

A.   I and II only

B.   I and III only

C.   II and III only

D.   I, II and III

15. Monochromatic light travels from air into water. Which of the following describes the changes in wavelength and speed?
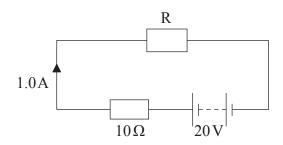
	Wavelength	Speed
A.	increases	decreases
B.	increases	increases
C.	decreases	increases
D.	decreases	decreases

16. Two resistors, made of the same material, are connected in series to a battery. The length of resistor X is twice that of resistor Y, and X has twice the cross-sectional area of Y.

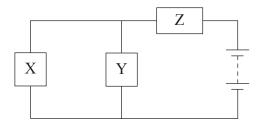Which of the following gives $\dfrac{\text{resistance of X}}{\text{resistance of Y}}$?

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

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

C. 1

D. 4

17. The circuit shows a resistor R connected in series with a battery and a resistor of resistance $10\,\Omega$. The emf of the battery is $20\,V$ and it has negligible internal resistance. The current in the circuit is $1.0\,A$.

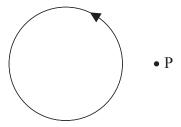Which of the following is the resistance of R?

A. $1.0\,\Omega$

B. $2.0\,\Omega$

C. $10\,\Omega$

D. $20\,\Omega$

18. Three identical resistors are connected to a battery as shown.

Which of the following is a correct statement?

A.   The current through X is greater than that through Z.

B.   The potential difference across Z is greater than that across Y.

C.   The potential difference across resistor X and Y together is the same as that across Z.

D.   The current through Z is less than the total current through X and Y.

19. A current is established in a coil of wire in the direction shown.
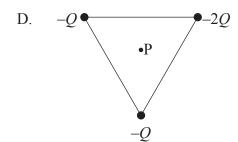

The direction of the magnetic field at point P is

A.   out of the plane of the paper.

B.   into the plane of the paper.

C.   to the left.

D.   to the right.

20. Which arrangement of three point charges at the corner of an equilateral triangle will result in a zero electric field strength at the centre of the triangle, point P?

A.

$+Q$ ● ——————— ● $+Q$

•P

$+Q$

B.

$-Q$ ● ——————— ● $-Q$

•P

$+2Q$

C.

$+Q$ ● ——————— ● $-Q$

•P

$-2Q$

D.

$-Q$ ● ——————— ● $-2Q$
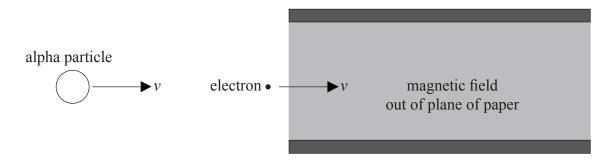
•P

$-Q$

21. The mass of a planet is twice that of Earth. Its radius is half that of the radius of Earth. The gravitational field strength at the surface of Earth is g. The gravitational field strength at the surface of the planet is

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

B. g.

C. $2g$.

D. $8g$.

22. An electron enters the vacuum between two oppositely charged plates with velocity v. The electron is followed by an alpha particle moving with the same initial velocity as the electron. A uniform magnetic field is directed out of the plane of the paper.
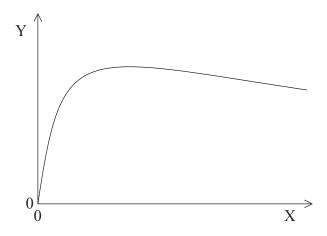

The electron's path is undeflected. The path of the alpha particle will be

A.   deflected out of the plane of the paper.

B.   undeflected.

C.   deflected upward.

D.   deflected downward.

23. The Geiger–Marsden experiment provides evidence for

A.   the existence of discrete atomic energy levels.

B.   the existence of the neutron.

C.   a dense positively charged nucleus.

D.   the stability of some nuclei.

24. A radioactive isotope has a half-life of two minutes. A sample contains sixteen grams of the isotope. How much time elapses until one gram of the isotope remains?

A.   6 minutes

B.   8 minutes

C.   10 minutes

D.   12 minutes

25. Data concerning nuclides are plotted using the axes below.

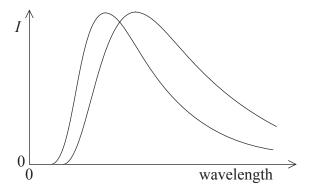What are the axis labels for this graph?

	Y	X
A.	binding energy per nucleon	number of nucleons
B.	binding energy	number of protons
C.	number of protons	binding energy per nucleon
D.	number of nucleons	binding energy

26. Which of the following is true about beta minus (β^-) decay?

A.   An antineutrino is absorbed.

B.   The charge of the daughter nuclide is less than that of the parent nuclide.

C.   An antineutrino is emitted.

D.   The mass number of the daughter nuclide is less than that of the parent nuclide.

27. A wave generator produces a power per unit length of $4.0\,kW\,m^{-1}$ for waves of amplitude A and speed v. The efficiency of the generator is constant. The power per unit length obtained from waves of amplitude $2A$ and speed $2v$ would be

A. $8.0\,kW\,m^{-1}$.

B. $16\,kW\,m^{-1}$.

C. $32\,kW\,m^{-1}$.

D. $64\,kW\,m^{-1}$.

28. The diagram shows the variation with wavelength of the power per unit wavelength I radiated from an area of $1\,m^2$ of two different bodies.
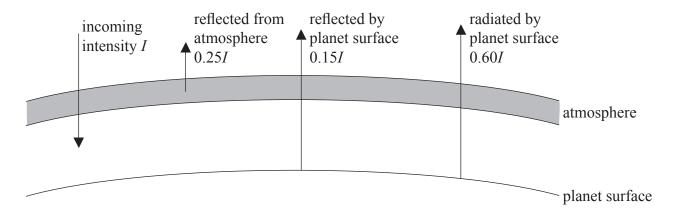

Which of the following is a correct comparison of the temperature and of the emissivity of the two bodies?

	Temperature	Emissivity
A.	same	same
B.	same	different
C.	different	same
D.	different	different

Turn over

29.   Which of the following is the most likely explanation for a rise in global sea level?

   A.   Thermal expansion of water

   B.   Melting of sea ice

   C.   Increase in rainfall

   D.   Thermal expansion of ice

30.   The diagram shows an energy balance climate model for a planet.

   The intensities of the reflected and radiated radiation are given in terms of the incident intensity *I*. Which of the following is the albedo of this planet?

   A.   0.15

   B.   0.25

   C.   0.40

   D.   0.60