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**PHYSICS  
HIGHER LEVEL  
PAPER 1**

Thursday 10 May 2012 (afternoon)

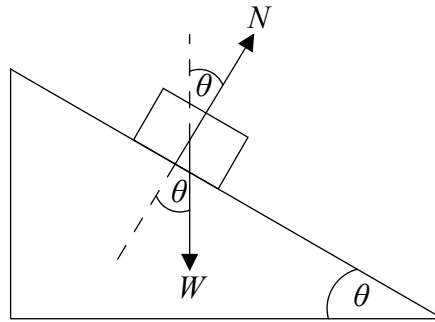
1 hour

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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.
- A clean copy of the **Physics Data Booklet** is required for this paper.
- The maximum mark for this examination paper is [40 marks].

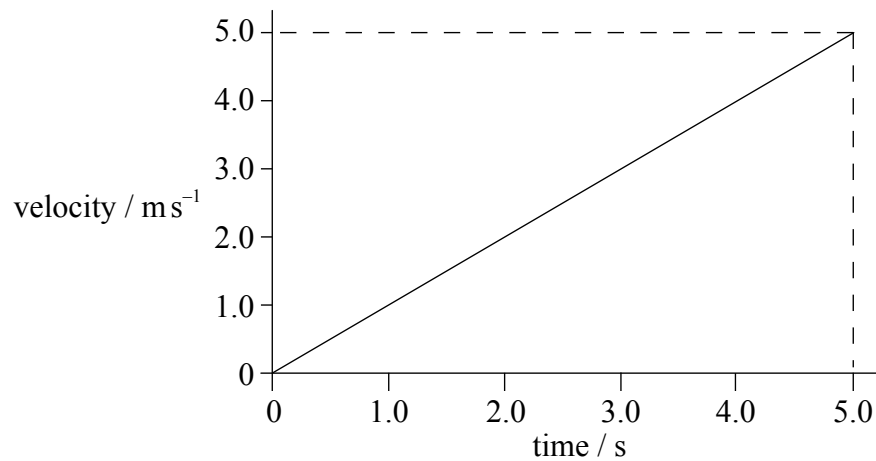
1. The diagram below shows the forces acting on a block of weight  $W$  as it slides down a slope. The angle between the slope and the horizontal is  $\theta$ , the normal reaction force on the block from the slope is  $N$  and friction is negligible.



Which of the following gives the resultant force on the block?

- A.  $W \sin \theta$
- B.  $W \cos \theta$
- C.  $N \sin \theta$
- D.  $N \cos \theta$

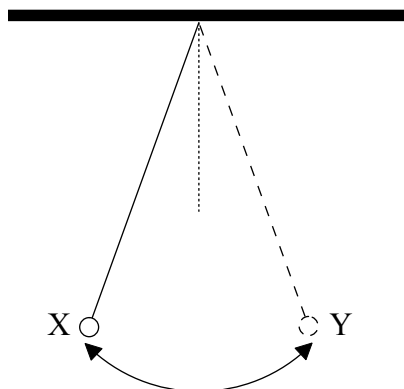
2. The velocity–time graph for an accelerating object that is travelling in a straight line is shown below.



Which of the following is the change in displacement of the object in the first 5.0 seconds?

- A. 25.0 m
  - B. 12.5 m
  - C. 5.0 m
  - D. 1.0 m
3. The momentum of an object changes by  $\Delta p$  in a time  $\Delta t$ . What is the impulse acting on the object during this change?
- A.  $\Delta p$
  - B.  $\Delta p \Delta t$
  - C.  $\frac{\Delta p}{\Delta t}$
  - D. zero

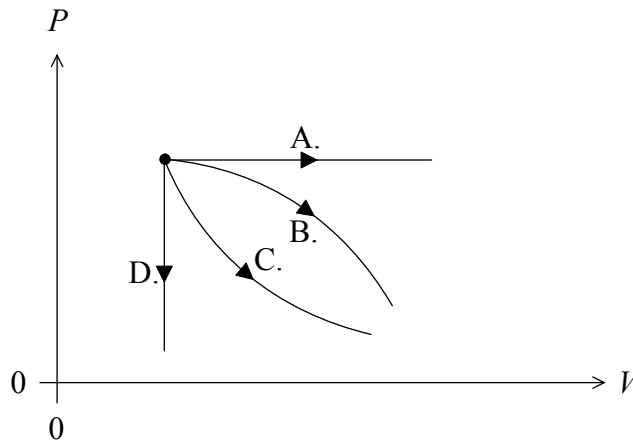
4. A pendulum swings back and forth in a circular arc between X and Y.



The pendulum bob is

- A. always in equilibrium.
  - B. only in equilibrium at X and Y.
  - C. in equilibrium as it passes through the central position.
  - D. never in equilibrium.
5. A car moves at constant speed around a horizontal circular track. The resultant force on the car is always equal to
- A. the forward force from the engine.
  - B. the sideways friction between the tyres and the track.
  - C. the weight of the car.
  - D. zero.
6. An ideal gas has an absolute temperature  $T$ . The average random kinetic energy of the molecules of the gas is
- A. independent of  $T$ .
  - B. equal to  $T$ .
  - C. proportional to  $T$ .
  - D. inversely proportional to  $T$ .

7. In the  $P$ - $V$  diagram below, which line could represent an adiabatic change for an ideal gas?



8. The entropy of a system

- A. will decrease if the system's temperature is increased.
- B. is related to the degree of disorder in the system.
- C. must always increase.
- D. is always conserved.

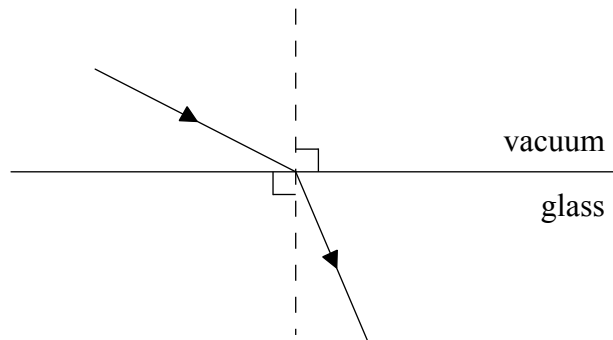
9. An object is undergoing simple harmonic motion (SHM) about a fixed point P. The magnitude of its displacement from P is  $x$ . Which of the following is correct?

	<b>Magnitude of resultant force</b>	<b>Direction of resultant force</b>
A.	proportional to $x$	towards P
B.	inversely proportional to $x$	towards P
C.	proportional to $x$	away from P
D.	inversely proportional to $x$	away from P

10. Which of the following gives the conditions for maximum amplitude in forced, but damped, oscillations?

	Driving frequency	Damping
A.	greater than natural frequency	as large as possible
B.	equal to natural frequency	as large as possible
C.	greater than natural frequency	as small as possible
D.	equal to natural frequency	as small as possible

11. A ray of light travels from a vacuum into glass as shown below.



In glass, light has speed  $v$ . In a vacuum, light has speed  $c$ . Which of the following gives the refractive index of glass?

- A.  $\frac{c}{v}$
- B.  $\frac{v}{c}$
- C.  $\frac{\sin c}{\sin v}$
- D.  $\frac{\sin v}{\sin c}$

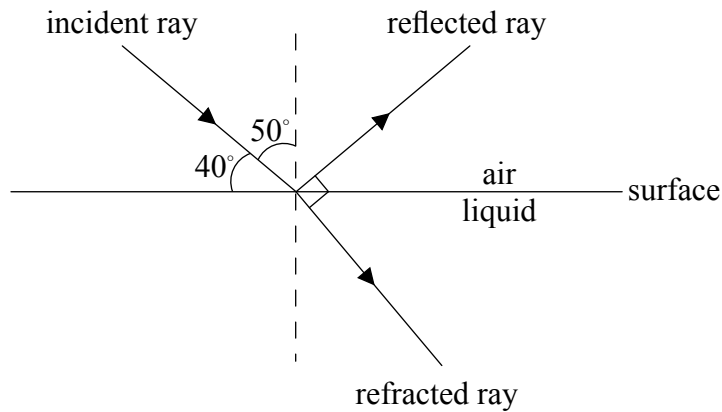
12. A transverse standing wave is established on a string. Consider the following phase differences.

- I.  $0^\circ$
- II.  $90^\circ$
- III.  $180^\circ$

Which of the following gives all the possible phase differences between the oscillations of any two particles in the standing wave?

- A. I only
  - B. I and III only
  - C. II and III only
  - D. I, II and III
13. Which of the following would be diffracted the most when incident on a slit of width 1 cm?
- A. microwaves
  - B. red light
  - C. ultraviolet
  - D. X-rays
14. Two point sources of light have an angular separation of  $\theta$ , as measured by a distant observer. The light passes through a circular aperture of radius  $r$  just before reaching the observer. Which of the following conditions must be true for the two sources to be resolved?
- A.  $\theta < 0.61 \frac{\lambda}{r}$
  - B.  $\theta < 1.22 \frac{\lambda}{r}$
  - C.  $\theta \geq 0.61 \frac{\lambda}{r}$
  - D.  $\theta \geq 1.22 \frac{\lambda}{r}$

15. A beam of unpolarized light is incident on the surface of a liquid and is partially reflected and partially refracted as shown below.



The reflected light is completely horizontally polarized. Which of the following is the refractive index of the liquid?

- A.  $\tan 40^\circ$
- B.  $\tan 50^\circ$
- C.  $\frac{\sin 40^\circ}{\sin 50^\circ}$
- D.  $\frac{\sin 40^\circ}{\cos 50^\circ}$
16. A battery of emf  $6.0\text{ V}$  is connected to a  $2.0\ \Omega$  resistor. The current in the circuit is  $2.0\text{ A}$ . The internal resistance of the battery is
- A. zero.
- B.  $1.0\ \Omega$ .
- C.  $3.0\ \Omega$ .
- D.  $4.0\ \Omega$ .



17. Which of the following gives the resistances of an ideal ammeter and an ideal voltmeter?

	Resistance of ideal ammeter	Resistance of ideal voltmeter
A.	infinite	infinite
B.	zero	infinite
C.	infinite	zero
D.	zero	zero

18. A mass at point  $X$  gives rise to a gravitational field strength  $g$  at point  $P$  as shown below.



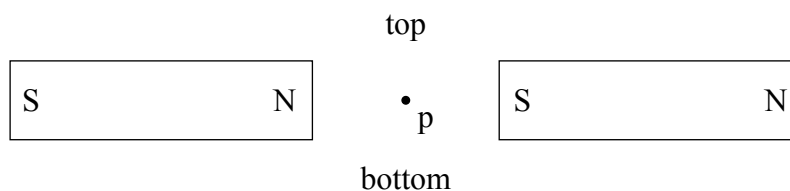
An identical mass is placed at point  $Y$  as shown below.



The resultant gravitational field strength at  $P$  is now

- A. greater than  $2g$ .
- B. between  $2g$  and  $g$ .
- C. between  $g$  and zero.
- D. zero.

19. A proton  $p$  is at rest between the poles of two horizontal magnets as shown below.

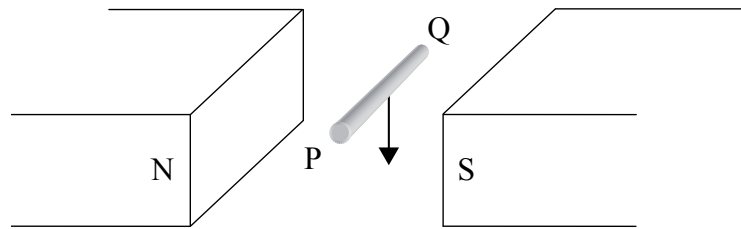


The magnetic force on the proton is

- A. from left to right.
  - B. from top to bottom.
  - C. into the plane of the paper.
  - D. zero.
20. A gun fires a bullet of mass  $m$  at a horizontal velocity of  $v$ . Air resistance on the bullet is negligible. A change in which of the following will affect the time for the bullet to hit the ground?
- A.  $m$  only
  - B.  $v$  only
  - C.  $m$  and  $v$
  - D. neither  $m$  nor  $v$
21. At the surface of a planet of radius  $r$ , the gravitational potential is  $-6.4 \times 10^7 \text{ J kg}^{-1}$ . The gravitational potential at a height of  $r$  above the surface is
- A.  $-12.8 \times 10^7 \text{ J kg}^{-1}$ .
  - B.  $-6.4 \times 10^7 \text{ J kg}^{-1}$ .
  - C.  $-3.2 \times 10^7 \text{ J kg}^{-1}$ .
  - D.  $-1.6 \times 10^7 \text{ J kg}^{-1}$ .

22. An astronaut of mass 60 kg is on board the International Space Station, which is in low orbit around the Earth. The gravitational force of attraction between the Earth and astronaut is approximately
- A. zero.
  - B. 6 N.
  - C. 60 N.
  - D. 600 N.

23. A length of copper wire PQ is moved downwards through the poles of two horizontal bar magnets as shown below.



Compared to end Q, end P will have

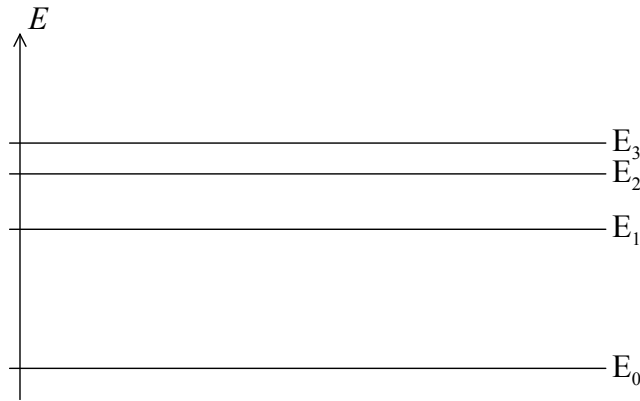
- A. fewer electrons.
  - B. more electrons.
  - C. fewer protons.
  - D. more protons.
24. The rms voltage of a sinusoidal electricity supply is 110 V. The maximum potential difference during one cycle is
- A. 220 V.
  - B. 156 V.
  - C. 110 V.
  - D. 55 V.

25. All isotopes of uranium must have the same
- A. chemical properties.
  - B. mass.
  - C. half-life.
  - D. decay constant.
26. A unit in which mass defect can be measured is
- A. MeV.
  - B.  $\text{MeV c}^{-1}$ .
  - C.  $\text{MeV c}^{-2}$ .
  - D. MeV per nucleon.
27. When compared with beta particles and gamma-ray photons, alpha particles have the greatest
- A. mass.
  - B. penetrating power.
  - C. range in air.
  - D. speed.
28. Light of a particular wavelength and intensity does not cause photoelectric emission from a clean metal surface in a vacuum. Which of the following changes to the light might cause photoelectric emission?
- A. Increase the intensity
  - B. Decrease the intensity
  - C. Increase the wavelength
  - D. Decrease the wavelength

29. Alpha particles of charge  $+2e$  and mass  $m$  are accelerated from rest through a potential difference  $V$ . Planck's constant is  $h$ . Which of the following gives the de Broglie wavelength of the alpha particles as a result of the acceleration?

- A.  $\frac{h}{mV}$
- B.  $\frac{h}{\sqrt{4mVe}}$
- C.  $\sqrt{2hmVe}$
- D.  $hmV$

30. The lowest four energy levels of a particular atom are represented in the energy level diagram below.



Planck's constant is  $h$ . What is the highest frequency in the atom's emission spectrum that is associated with these levels?

- A.  $\frac{E_3}{h}$
- B.  $\frac{E_0}{h}$
- C.  $\frac{E_3 - E_0}{h}$
- D.  $\frac{E_3 - E_2}{h}$

31. What is the momentum of an electron in the  $n=1$  state of the one-dimensional “electron in a box” model?
- A.  $\frac{h}{2l}$
  - B.  $\frac{h}{l}$
  - C.  $\frac{2l}{h}$
  - D.  $\frac{l}{h}$
32. Evidence for the existence of isotopes can come from analysis of
- A. the closest approach distance from charged particle scattering experiments.
  - B. the discrete energies of alpha particles from a given nuclide.
  - C. the range of energies of beta particles from a given nuclide.
  - D. the paths taken by ions in a Bainbridge mass spectrometer.
33. Neon-19 ( ${}^{19}_{10}\text{Ne}$ ) undergoes  $\beta^+$  decay. The other two products of this decay are
- A.  ${}^{19}_9\text{F}$  and  $\bar{\nu}$ .
  - B.  ${}^{19}_{11}\text{Na}$  and  $\bar{\nu}$ .
  - C.  ${}^{19}_9\text{F}$  and  $\nu$ .
  - D.  ${}^{19}_{11}\text{Na}$  and  $\nu$ .
34. The fraction of the world’s energy consumption provided by nuclear energy is
- A. less than 0.2%.
  - B. between 0.2% and 2%.
  - C. between 2% and 20%.
  - D. greater than 20%.

35. In a nuclear power station, in order to increase the chances of a chain reaction
- A. kinetic energy is removed from the neutrons.
  - B. kinetic energy is given to the neutrons.
  - C. some neutrons are absorbed.
  - D. extra neutrons are added.
36. A natural process that could cause an increase in global warming is
- A. an increase in the radius of the Earth's orbit around the Sun.
  - B. an increase in the absorption of carbon dioxide by sea water.
  - C. a drop in mean sea-level.
  - D. deforestation as a result of natural ecosystem changes.
37. What is the unit for the coefficient of volume expansion?
- A.  $\text{m}^3 \text{K}^{-1}$
  - B.  $\text{m}^3$
  - C. K
  - D.  $\text{K}^{-1}$
38. What is the decimal equivalent to the binary number 10111?
- A. 4
  - B. 15
  - C. 23
  - D. 46

39. Capacitance is defined as

- A.  $\frac{\text{current}}{\text{potential difference}}$
- B.  $\frac{\text{potential difference}}{\text{current}}$
- C.  $\frac{\text{charge}}{\text{potential difference}}$
- D.  $\frac{\text{potential difference}}{\text{charge}}$

40. A digital camera is used to record star images. When focused on a small region of the night sky, one area of the image was blank. In order to record images of the faint stars that do exist in that region, a possible improvement would be to increase the

- A. magnification of the camera.
  - B. total number of pixels.
  - C. quantum efficiency of the pixels.
  - D. resolution of the camera.
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