Diploma Programme
Programme du diplôme
Programa del Diploma

Physics
Standard level
Paper 1

Friday 17 May 2019 (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.
- A clean copy of the **physics data booklet** is required for this paper.
- The maximum mark for this examination paper is **[30 marks]**.

2219 – 6510

13 pages

1. A student wants to determine the angular speed ω of a rotating object. The period T is 0.50 s ±5 %. The angular speed ω is

$$\omega = \frac{2\pi}{T}$$

What is the percentage uncertainty of ω?

A. 0.2 %

B. 2.5 %

C. 5 %

D. 10 %

2. A student models the relationship between the pressure p of a gas and its temperature T as $p = x + yT$.

The units of p are pascal and the units of T are kelvin. What are the fundamental SI units of x and y?

	x	y
A.	$\mathrm{kg\,m^{-1}\,s^{-2}}$	$\mathrm{kg\,m^{-1}\,s^{-2}\,K^{-1}}$
B.	$\mathrm{kg\,m^{-1}\,s^{-2}}$	$\mathrm{K^{-1}}$
C.	K	$\mathrm{kg^{-1}\,m\,s^{-2}\,K^{-1}}$
D.	K	$\mathrm{K^{-1}}$

3. A sky diver is falling at terminal speed when she opens her parachute. What are the direction of her velocity vector and the direction of her acceleration vector before she reaches the new terminal speed?

	Direction of velocity vector	**Direction of acceleration vector**
A.	upwards	upwards
B.	upwards	downwards
C.	downwards	upwards
D.	downwards	downwards

4. A stone is thrown downwards from the edge of a cliff with a speed of $5.0\,\text{m}\,\text{s}^{-1}$. It hits the ground 2.0 s later. What is the height of the cliff?

A. 20 m

B. 30 m

C. 40 m

D. 50 m

5. A ball is thrown upwards at an angle to the horizontal. Air resistance is negligible. Which statement about the motion of the ball is correct?

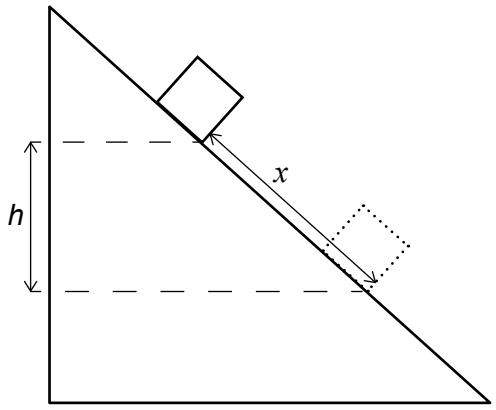
A. The acceleration of the ball changes during its flight.

B. The velocity of the ball changes during its flight.

C. The acceleration of the ball is zero at the highest point.

D. The velocity of the ball is zero at the highest point.

6. An object of mass *m* is sliding down a ramp at constant speed. During the motion it travels a distance x along the ramp and falls through a vertical distance *h*. The coefficient of dynamic friction between the ramp and the object is μ. What is the total energy transferred into thermal energy when the object travels distance x?



A. *mgh*

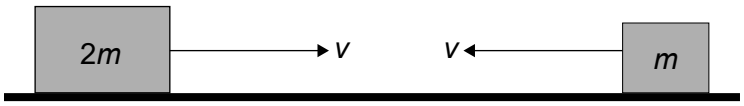
B. *mgx*

C. μmgh

D. μmgx

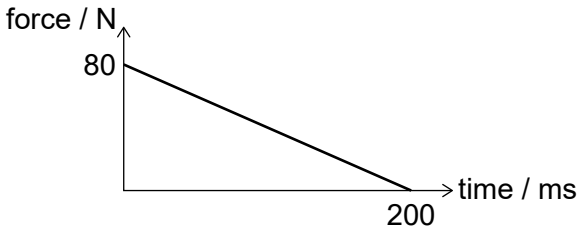
7. Two blocks of masses m and $2m$ are travelling directly towards each other. Both are moving at the same constant speed v. The blocks collide and stick together.

What is the total momentum of the system before and after the collision?



	Momentum before	Momentum after
A.	mv	mv
B.	mv	$-mv$
C.	$3mv$	$-3mv$
D.	$3mv$	$3mv$

8. The graph shows the variation with time of the resultant net force acting on an object. The object has a mass of 1 kg and is initially at rest.



What is the velocity of the object at a time of 200 ms?

A. $8\ \text{m s}^{-1}$

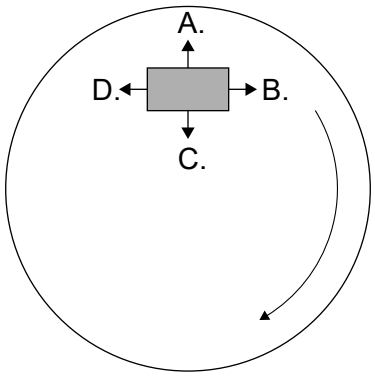
B. $16\ \text{m s}^{-1}$

C. $8\ \text{km s}^{-1}$

D. $16\ \text{km s}^{-1}$

9. A block is on the surface of a horizontal rotating disk. The block is at rest relative to the disk. The disk is rotating at constant angular velocity.

What is the correct arrow to represent the direction of the frictional force acting on the block at the instant shown?

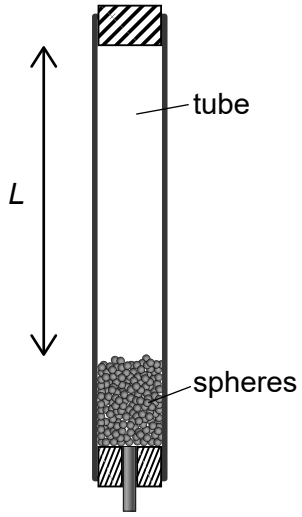


10. Energy is transferred to water in a flask at a rate *P*. The water reaches boiling point and then *P* is increased. What are the changes to the temperature of the water and to the rate of vaporization of the water after the change?

	Temperature	**Rate of vaporization**
A.	increases	unchanged
B.	increases	increases
C.	unchanged	unchanged
D.	unchanged	increases

11. An insulated tube is filled with a large number n of lead spheres, each of mass m. The tube is inverted s times so that the spheres completely fall through an average distance L each time. The temperature of the spheres is measured before and after the inversions and the resultant change in temperature is ΔT.

What is the specific heat capacity of lead?



A. $\frac{sgL}{nm\Delta T}$

B. $\frac{sgL}{\Delta T}$

C. $\frac{sgL}{n\Delta T}$

D. $\frac{gL}{m\Delta T}$

12. Boiling water is heated in a 2 kW electric kettle. The initial mass of water is 0.4 kg. Assume the specific latent heat of vaporization of water is $2\,\text{MJ}\,\text{kg}^{-1}$.

What is the time taken for all the water to vaporize?

A. 250 s

B. 400 s

C. 2500 s

D. 4000 s

13. A gas storage tank of fixed volume V contains N molecules of an ideal gas at temperature T. The pressure at kelvin temperature T is 20 MPa. $\frac{N}{4}$ molecules are removed and the temperature changed to $2T$. What is the new pressure of the gas?

A. 10 MPa

B. 15 MPa

C. 30 MPa

D. 40 MPa

14. A particle performs simple harmonic motion (shm). What is the phase difference between the displacement and the acceleration of the particle?

A. 0

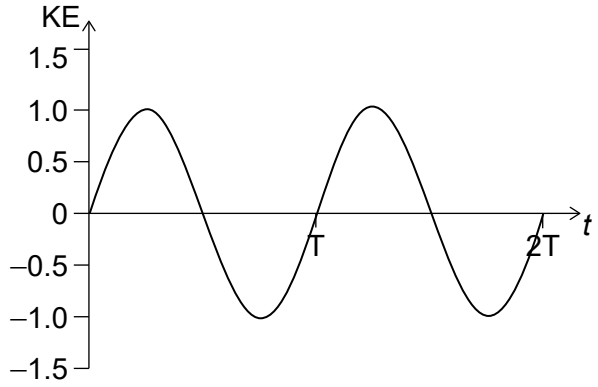
B. $\frac{\pi}{2}$

C. π

D. $\frac{3\pi}{2}$

15. Which graph shows the variation with time t of the kinetic energy (KE) of an object undergoing simple harmonic motion (shm) of period T?

A.



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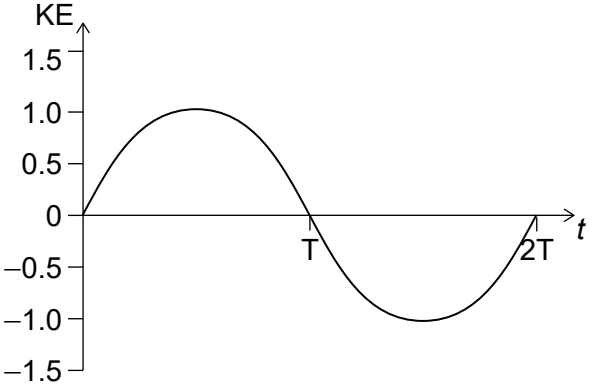
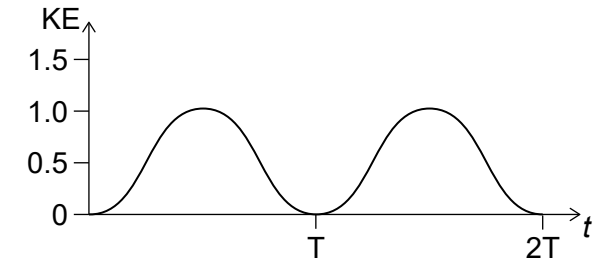
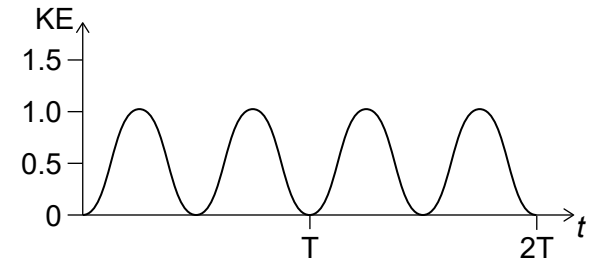


C.



D.



16. What are the changes in speed, frequency and wavelength of light as it travels from a material of low refractive index to a material of high refractive index?

	Speed	Frequency	Wavelength
A.	decreases	decreases	unchanged
B.	decreases	unchanged	unchanged
C.	unchanged	increases	decreases
D.	decreases	unchanged	decreases

17. Which of these waves cannot be polarized?

A. microwaves

B. ultrasound

C. ultraviolet

D. X rays

18. A string fixed at both ends vibrates in the first harmonic with frequency 400 Hz. The speed of sound in the string is 480 $m\,s^{-1}$. What is the length of the string?

A. 0.42 m

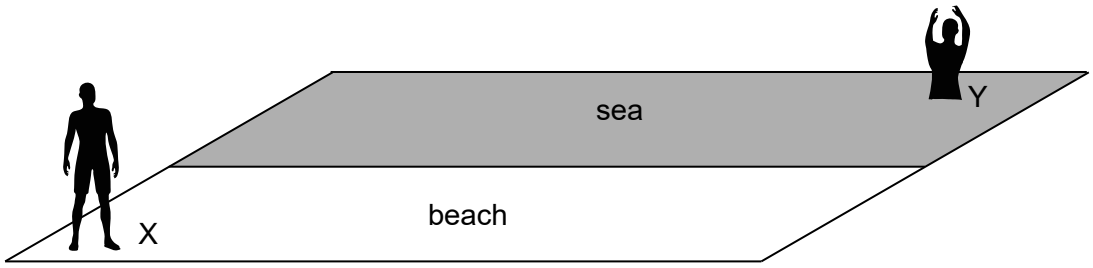
B. 0.60 m

C. 0.84 m

D. 1.2 m

19. In science, models are extensively used to study real life situations.

A person X on the beach wants to reach a person Y in the sea in the shortest possible time. The speed of person X on land is different from the speed of person X in the water. Which physical phenomenon will best model the path with the least time?



A. Conservation of momentum

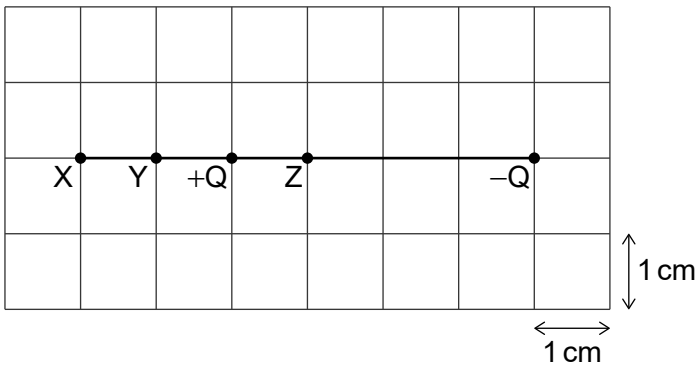
B. Diffraction

C. Flow of charge in a conductor

D. Refraction

20. Two charges, +Q and –Q, are placed as shown.

What is the magnitude of the electric field strength, in descending order, at points X, Y and Z.



A. YXZ

B. ZXY

C. ZYX

D. YZX

21. Two cells each of emf 9.0 V and internal resistance 3.0 Ω are connected in series. A 12.0 Ω resistor is connected in series to the cells. What is the current in the resistor?

A. 0.50 A

B. 0.75 A

C. 1.0 A

D. 1.5 A

22. Charge flows through a liquid. The charge flow is made up of positive and negative ions. In one second 0.10 C of negative ions flow in one direction and 0.10 C of positive ions flow in the opposite direction.

What is the magnitude of the electric current flowing through the liquid?

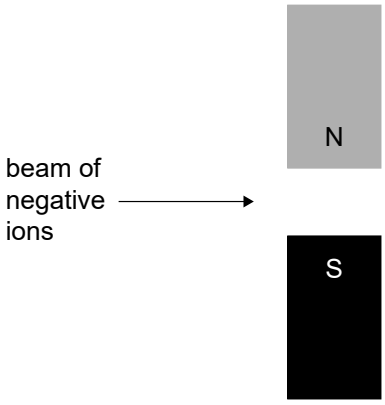
A. 0 A

B. 0.05 A

C. 0.10 A

D. 0.20 A

23. A beam of negative ions flows in the plane of the page through the magnetic field due to two bar magnets.



What is the direction in which the negative ions will be deflected?

A. Out of the page ⊙

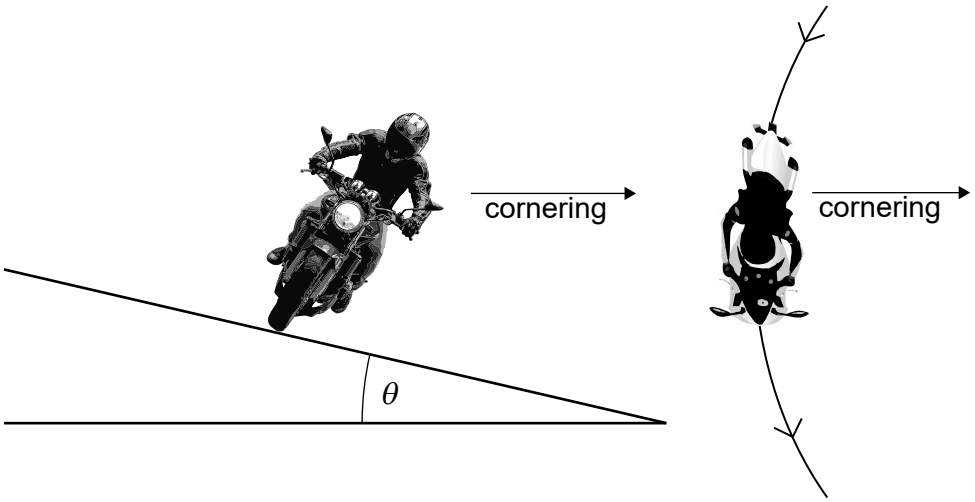
B. Into the page X

C. Up the page ↑

D. Down the page ↓

24. A motorcyclist is cornering on a curved race track.

Which combination of changes of banking angle θ and coefficient of friction μ between the tyres and road allows the motorcyclist to travel around the corner at greater speed?



	Banking angle θ	Coefficient of friction μ
A.	increase	increase
B.	increase	decrease
C.	decrease	increase
D.	decrease	decrease

25. Satellite X orbits a planet with orbital radius *R*. Satellite Y orbits the same planet with orbital radius 2*R*. Satellites X and Y have the same mass.

What is the ratio $\frac{\text{centripetal acceleration of X}}{\text{centripetal acceleration of Y}}$?

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

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

C. 2

D. 4

26. Which property of a nuclide does **not** change as a result of beta decay?

A. Nucleon number

B. Neutron number

C. Proton number

D. Charge

27. The rest mass of the helium isotope ${}^{3}_{2}\text{He}$ is m.

Which expression gives the binding energy per nucleon for ${}^{3}_{2}\text{He}$?

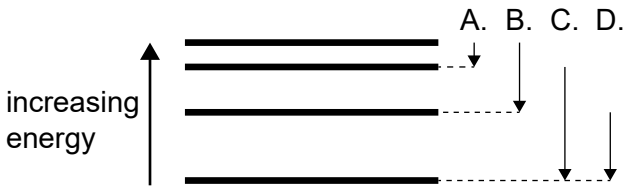
A. $\frac{\left(2m_p + m_n + m\right)c^2}{3}$

B. $\frac{\left(2m_p + m_n - m\right)c^2}{3}$

C. $\left(2m_p + m_n + m\right)c^2$

D. $\left(2m_p + m_n - m\right)c^2$

28. Which of the following atomic energy level transitions corresponds to photons of the shortest wavelength?



29. A beaker containing 1 kg of water at room temperature is heated on a 400 W hot plate. The specific heat capacity of water is $4200\,J\,kg^{-1}\,K^{-1}$.

The temperature of the water increases until it reaches a constant value. It is then removed from the hot plate.
What will be the initial rate of change of temperature?

A. $10\,K\,s^{-1}$

B. $1\,K\,s^{-1}$

C. $0.1\,K\,s^{-1}$

D. $0.01\,K\,s^{-1}$

30. Most power stations rely on a turbine and a generator to produce electrical energy. Which power station works on a different principle?

A. Nuclear

B. Solar

C. Fossil fuel

D. Wind