Diploma Programme
Programme du diplôme
Programa del Diploma

Physics
Standard level
Paper 1

Tuesday 31 October 2017 (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]**.

8817 – 6504

1. How many significant figures are there in the number 0.0450?

A. 2

B. 3

C. 4

D. 5

2. An object is positioned in a gravitational field. The measurement of gravitational force acting on the object has an uncertainty of 3 % and the uncertainty in the mass of the object is 9 %. What is the uncertainty in the gravitational field strength of the field?

A. 3 %

B. 6 %

C. 12 %

D. 27 %

$$g = \frac{F}{m} = \frac{3\%}{9\%}$$

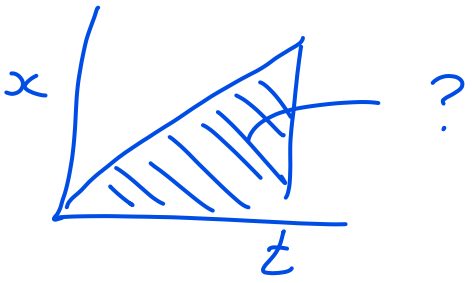
3. The variation of the displacement of an object with time is shown on a graph. What does the area under the graph represent?

A. No physical quantity

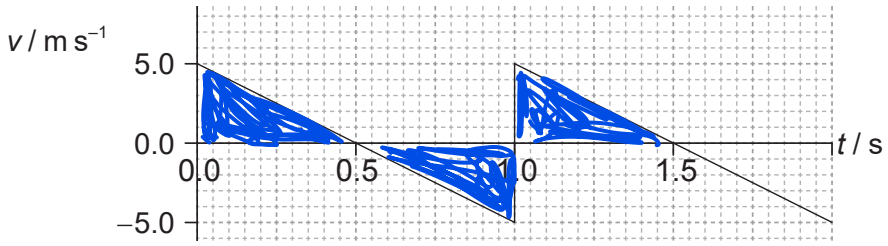
B. Velocity

C. Acceleration

D. Impulse



4. An object is thrown upwards. The graph shows the variation with time t of the velocity v of the object.



What is the total displacement at a time of 1.5 s, measured from the point of release?

A. 0 m

B. 1.25 m

C. 2.50 m

D. 3.75 m

$\frac{5 \times 0.5}{2} = \frac{5 \times 1}{2 \times 2} = \frac{5}{4} = 1.25\text{m}$

5. An object is released from a stationary hot air balloon at height h above the ground. An identical object is released at height h above the ground from another balloon that is rising at constant speed. Air resistance is negligible. What does **not** increase for the object released from the rising balloon?

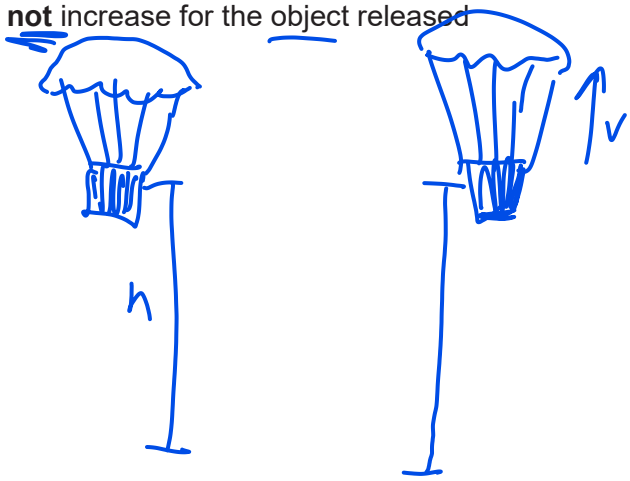
A. The distance through which it falls

B. The time taken for it to reach the ground

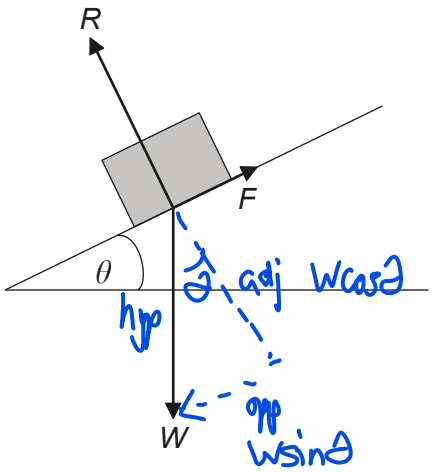
C. The speed with which it reaches the ground

D. Its acceleration

↳ same due to gravity



6. The diagram shows the forces acting on a block resting on an inclined plane. The angle θ is adjusted until the block is just at the point of sliding. R is the normal reaction, W the weight of the block and F the maximum frictional force.



not to scale

What is the maximum coefficient of static friction between the block and the plane?

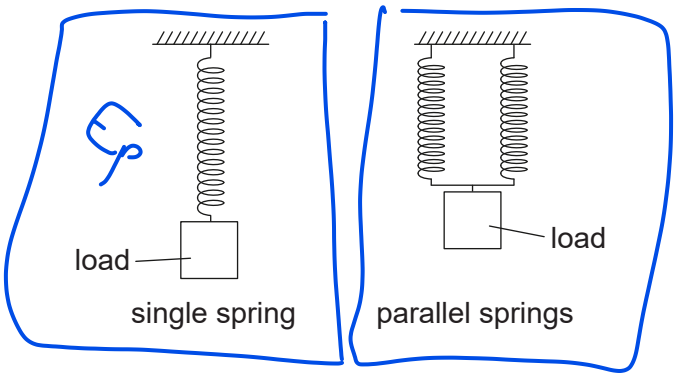
A. $\sin\theta$

B. $\cos\theta$

C. $\tan\theta$

D. $\frac{1}{\tan\theta}$

7. A system that consists of a single spring stores a total elastic potential energy E_p when a load is added to the spring. Another identical spring connected in parallel is added to the system. The same load is now applied to the parallel springs.



What is the total elastic potential energy stored in the changed system?

A. E_p

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

C. $\frac{E_p}{4}$

D. $\frac{E_p}{8}$

8. A moving system undergoes an explosion. What is correct for the momentum of the system and the kinetic energy of the system when they are compared immediately before and after the explosion?

	Momentum	Kinetic energy
A.	conserved	increased
B.	conserved	conserved
C.	increased	conserved
D.	increased	increased

9. What does the constant n represent in the equation of state for an ideal gas $pV = nRT$?

A. The number of atoms in the gas

B. The number of moles of the gas

C. The number of molecules of the gas

D. The number of particles in the gas

10. A 1.0 kW heater supplies energy to a liquid of mass 0.50 kg. The temperature of the liquid changes by 80 K in a time of 200 s. The specific heat capacity of the liquid is 4.0 kJ $kg^{-1}K^{-1}$. What is the average power lost by the liquid?

A. 0

B. 200 W

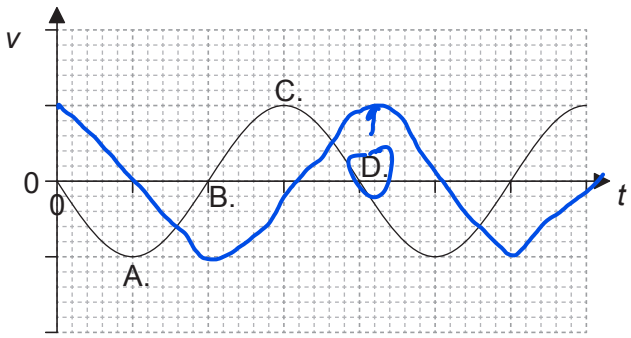
C. 800 W

D. 1600 W

11. Under what conditions of pressure and temperature does a real gas approximate to an ideal gas?

	Pressure	Temperature
A.	high	high
B.	high	low
C.	low	high
D.	low	low

12. The graph shows the variation with time t of the velocity v of an object undergoing simple harmonic motion (SHM). At which velocity does the displacement from the mean position take a maximum positive value?



13. What is the phase difference, in rad, between the centre of a compression and the centre of a rarefaction for a longitudinal travelling wave?

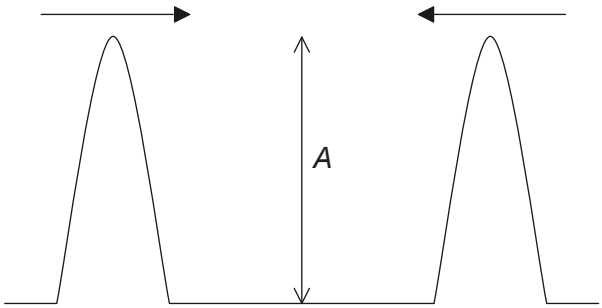
A. 0

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

C. π

D. 2π

14. Two wave pulses, each of amplitude *A*, approach each other. They then superpose before continuing in their original directions. What is the total amplitude during superposition and the amplitudes of the individual pulses after superposition?



	Total amplitude during superposition	Individual amplitudes after superposition
A.	*A*	less than *A*
B.	*A*	*A*
C.	2*A*	less than *A*
D.	2*A*	*A*

15. The refractive index for light travelling from medium X to medium Y is $\frac{4}{3}$. The refractive index for light travelling from medium Y to medium Z is $\frac{3}{5}$. What is the refractive index for light travelling from medium X to medium Z?

A. $\frac{4}{5}$

B. $\frac{15}{12}$

C. $\frac{5}{4}$

D. $\frac{29}{15}$

$\overrightarrow{XY} = \frac{4}{3}$

$\overrightarrow{YZ} = \frac{3}{5}$

$\overrightarrow{XY} \times \overrightarrow{YZ} = \overrightarrow{XZ}$

$\frac{4}{3} \times \frac{3}{5} = \frac{4}{5}$

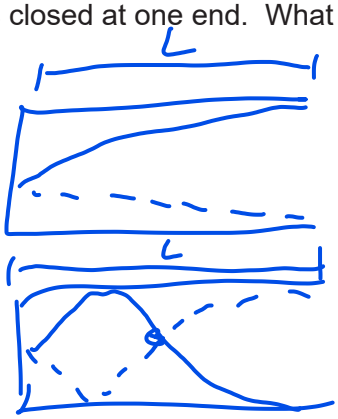
16. A pipe of fixed length is closed at one end. What is $\frac{\text{third harmonic frequency of pipe}}{\text{first harmonic frequency of pipe}}$?

A. $\frac{1}{5}$

B. $\frac{1}{3}$

C. 3

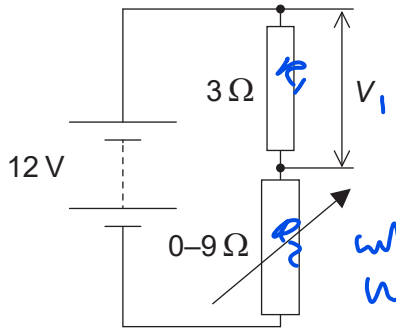
D. 5



$f_0 \quad \lambda = 4L$

$3f_0 \quad \lambda = \frac{3}{4}L$

17. In the circuit shown, the fixed resistor has a value of 3 Ω and the variable resistor can be varied between 0 Ω and 9 Ω.



when 0 Ω $V = 12\,V$ R_1

when 9 Ω $V = 3\,V$ R_1

$9\,V$ R_2

The power supply has an emf of 12 V and negligible internal resistance. What is the difference between the maximum and minimum values of voltage V_1 across the 3 Ω resistor?

A. 3 V

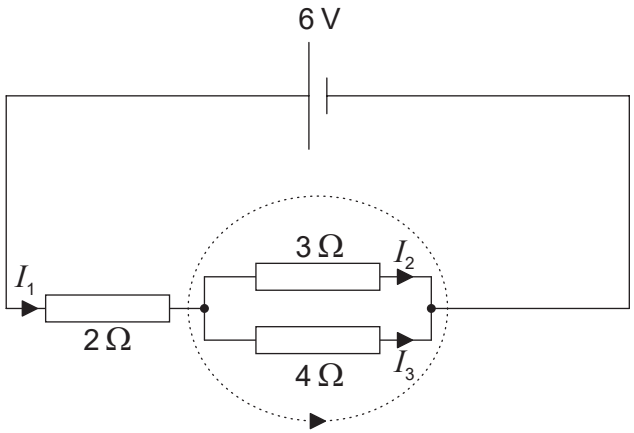
B. 6 V

C. 9 V

D. 12 V

$12V - 3V = 9V$

18. Kirchhoff's laws are applied to the circuit shown.



What is the equation for the dotted loop?

A. $0 = 3I_2 + 4I_3$

B. $0 = 4I_3 - 3I_2$

C. $6 = 2I_1 + 3I_2 + 4I_3$

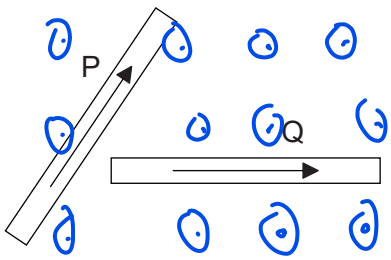
D. $6 = 3I_2 + 4I_3$

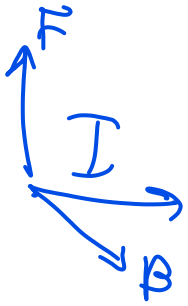
$4I_3 + (-3I_2) = 0$

19. With reference to internal energy conversion and ability to be recharged, what are the characteristics of a primary cell?

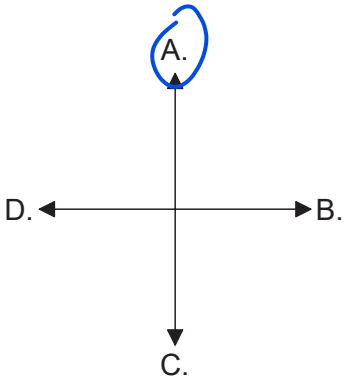
	Internal energy conversion	Ability to be recharged
A.	chemical to electrical	rechargeable
B.	chemical to electrical	not rechargeable
C.	electrical to chemical	rechargeable
D.	electrical to chemical	not rechargeable

20. The diagram shows two current-carrying wires, P and Q, that both lie in the plane of the paper. The arrows show the conventional current direction in the wires.





The electromagnetic force on Q is in the same plane as that of the wires. What is the direction of the electromagnetic force acting on Q?



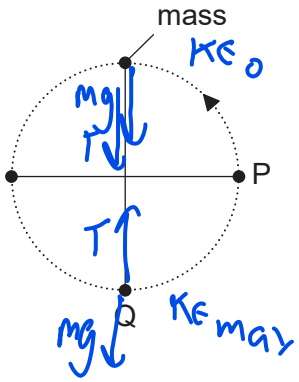
21. A mass attached to a string rotates in a gravitational field with a constant period in a vertical plane.

TOP $F_c = mg + T$

$F_c - mg = T$

BOTTOM $F_c = T - mg$

$F_c + mg = T$



How do the tension in the string and the kinetic energy of the mass compare at P and Q?

	Tension in the string	Kinetic energy of mass
A.	greater at P than Q	greater at Q than P
B.	greater at Q than P	greater at Q than P
C.	greater at P than Q	same at Q and P
D.	greater at Q than P	same at Q and P

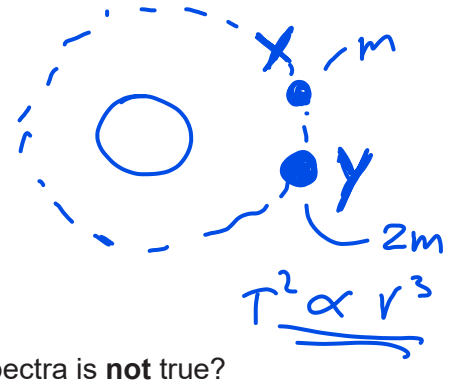
22. A satellite X of mass m orbits the Earth with a period T. What will be the orbital period of satellite Y of mass $2m$ occupying the same orbit as X?

A. $\frac{T}{2}$

B. T

C. $\sqrt{2}T$

D. $2T$



$T^2 \propto r^3$

$\frac{mv^2}{r} = \frac{GMm}{r^2}$

$\frac{4\pi^2 r}{T^2} = \frac{GMm}{r^2}$

$\frac{4\pi^2 r^3}{T^2} = GMm$

$\frac{4\pi^2 r^3}{GM} = T^2$

constant

23. Which statement about atomic spectra is **not** true?

A. They provide evidence for discrete energy levels in atoms.

B. Emission and absorption lines of equal frequency correspond to transitions between the same two energy levels.

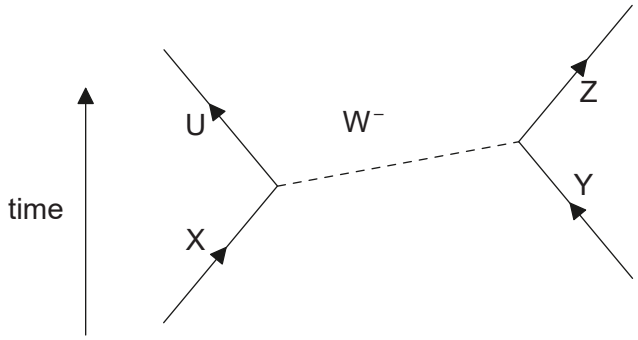
C. Absorption lines arise when electrons gain energy.

D. Emission lines always correspond to the visible part of the electromagnetic spectrum.

24. What gives the total change in nuclear mass and the change in nuclear binding energy as a result of a nuclear fusion reaction?

	Nuclear mass	Nuclear binding energy
A.	decreases	decreases
B.	decreases	increases
C.	increases	decreases
D.	increases	increases

25. The Feynman diagram shows a particle interaction involving a W^- boson.



Which particles are interacting?

A. U and Y

B. W^- boson and Y

C. X and Y

D. U and X

26. Which of the energy sources are classified as renewable and non-renewable?

	Renewable	Non-renewable
A.	Sun	wind
B.	natural gas	geothermal
C.	biomass	crude oil
D.	uranium-235	coal

27. The energy density of a substance can be calculated by multiplying its specific energy with which quantity?

A. mass

B. volume

C. $\frac{\text{mass}}{\text{volume}}$

D. $\frac{\text{volume}}{\text{mass}}$

$\frac{J}{m^3}$ $\frac{J}{kg}$ $\frac{J}{kg} \times \frac{kg}{m^3} = \frac{J}{m^3}$

28. A black body emits radiation with its greatest intensity at a wavelength of I_{max}. The surface temperature of the black body doubles without any other change occurring. What is the wavelength at which the greatest intensity of radiation is emitted?

A. I_{max}

B. $\frac{I_{max}}{2}$

C. $\frac{I_{max}}{4}$

D. $\frac{I_{max}}{16}$

$\lambda = \frac{K}{T} \Rightarrow \frac{1}{2}$ if $2T$

29. The three statements give possible reasons why an average value should be used for the solar constant.

I. The Sun's output varies during its 11 year cycle.

II. The Earth is in elliptical orbit around the Sun.

III. The plane of the Earth's spin on its axis is tilted to the plane of its orbit about the Sun.

Which are the correct reasons for using an average value for the solar constant?

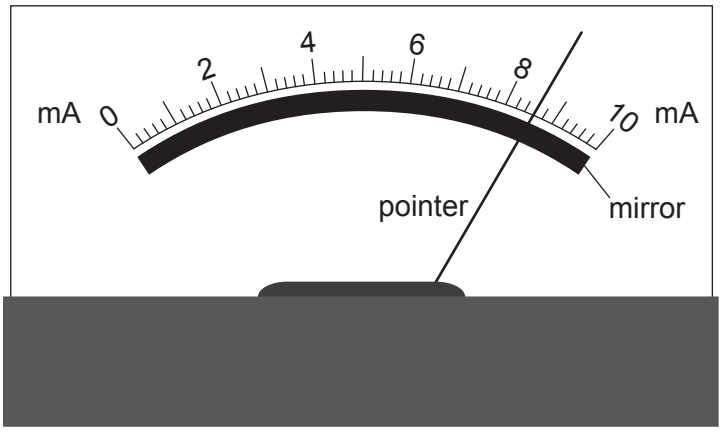
A. I and II only

B. I and III only

C. II and III only

D. I, II and III

30. The diagram shows an analogue meter with a mirror behind the pointer.



What is the main purpose of the mirror?

A. To provide extra light when reading the scale

B. To reduce the risk of parallax error when reading the scale

C. To enable the pointer to be seen from different angles

D. To magnify the image of the pointer