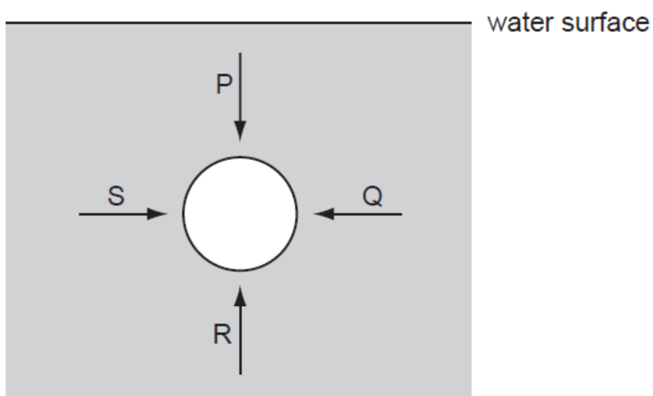
SAMPLE EXAMINATION QUESTIONS FOR THE PHYSICS GLOBAL FINAL -

Q1. Which statement about Newton's laws of motion is correct?
A. The first law follows from the second law.
B. The third law follows from the second law.
C. Conservation of energy is a consequence of the third law.
D. Conservation of linear momentum is a consequence of the first law.

Q2. Which of the following correctly defines the terms *stress*, *strain* and *Young modulus*?

	stress	**strain**	**Young modulus**
A.	force × area	extension × (original length)	stress / strain
B.	force × area	extension / (original length)	stress × strain
C.	force / area	extension / (original length)	stress / strain
D.	force / area	extension × (original length)	stress × strain

Q3. The diagram represents a sphere under water. P, Q, R, and S are forces acting on the sphere, Each force acts perpendicularly to the sphere's surface. P and R act in opposite directions vertically. Q and S act in opposite directions horizontally. Which information about the magnitudes of the forces is correct?



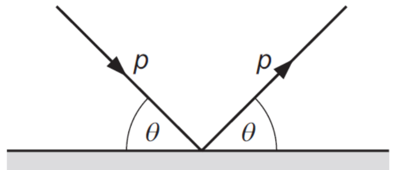
A. P < R ; S = Q
B. P > R ; S = Q
C. P = R ; S = Q
D. P = R = S = Q

Q4. Which statement about transverse or longitudinal waves is **not** correct?
A. Longitudinal waves can be used to demonstrate diffraction.
B. Longitudinal waves can travel in a vacuum.
C. Transverse waves can form stationary waves.
D. Transverse waves can transfer energy.

Q5. Which measurements are taken in order to calculate the resistivity of the metal of a piece of wire?
A. p.d., current, area, length
B. p.d., current, diameter, length

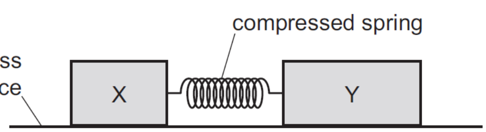
C. resistance, area, length
D. resistance, length, radius

Q6. A ball strikes a horizontal surface with momentum *p* at an angle θ to the surface, as shown.



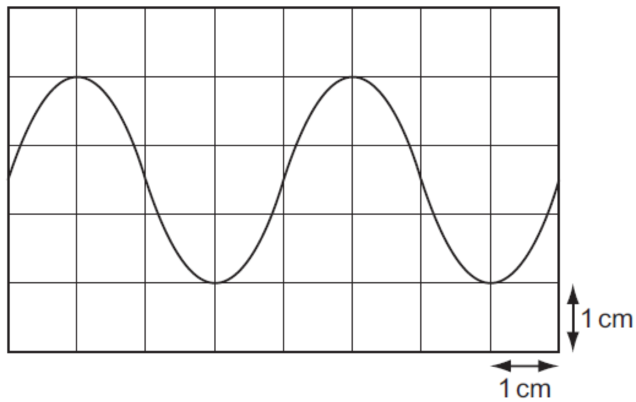
The ball rebounds with the same magnitude of momentum at an angle θ to the surface. The ball is in contact with the surface for time *t*. What is the magnitude of the average resultant force acting on the ball during the collision?
A. 0
B. 2p/t
C. (2pcosθ)/t
D. (2psinθ)/t

Q7. Two blocks, X and Y, are on a horizontal frictionless surface. The mass of block Y is greater than that of block X. Block Y has a spring attached to its end. The blocks are pushed together so that the spring is **compressed** between them and the blocks are held stationary as shown. When released, the blocks move in opposite directions.



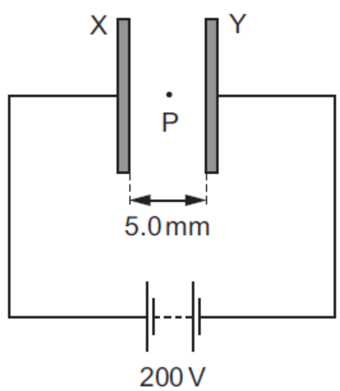
Q8. Which statement is correct?
A. After release, the kinetic energy of block X must equal the kinetic energy of block Y.
B. After release, the sum of the kinetic energies of the blocks is equal to zero.
C. The total energy of the spring and blocks immediately before release is zero.
D. The total energy of the spring and blocks is equal to the energy needed to bring the blocks together.

Q9. The diagram shows a trace of a wave on a cathode-ray oscilloscope. The vertical and horizontal gridlines have a spacing of 1.0 cm. The voltage scaling is 4 V cm^{-1} and the time scaling is 5 ms cm^{-1}. What are the amplitude and period of the wave?



	amplitude/V	period/ms
A.	1.5	4
B.	5.0	10
C.	6.0	20
D.	12.0	20

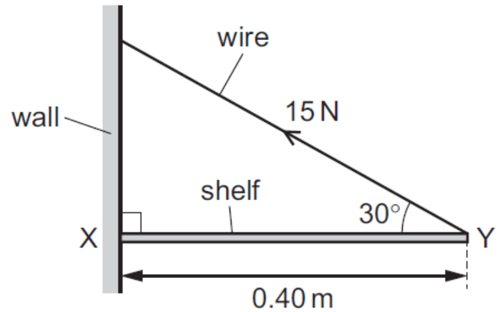
Q10. Two large parallel plates X and Y are placed a distance of 5.0 mm apart and connected to the terminals of a 200 V d.c. supply, as shown. A small oil drop at P carries one excess electron. What is the magnitude of the electrostatic force acting on the oil drop due to the electric field between the plates?



A. 6.4×10^{-15} N
B. 6.4×10^{-18} N
C. 1.6×10^{-19} N
D. 4.0×10^{-24} N

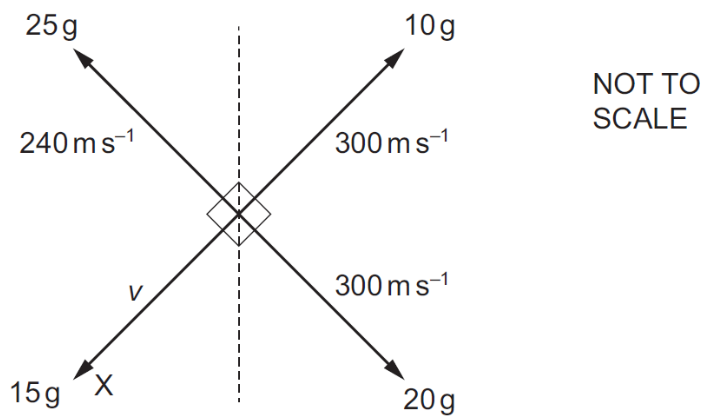
Q11. The nuclide $^{222}_{86}Rn$ decays in a sequence of stages to form the nuclide $^{206}_{82}Pb$. Four of the nuclides formed in the sequence are α-particle emitters. The others are β-particle emitters. How many nuclides formed in the decay sequence are β-particle emitters?
A. 2
B. 4
C. 8
D. 12

Q12. A shelf XY is 0.40 m long and is attached to a wall at end X. It is kept horizontal by a wire attached to Y and to the wall, as shown. The tension force in the wire is 15 N at an angle of 30° to the horizontal. What is the moment of this force about point X?



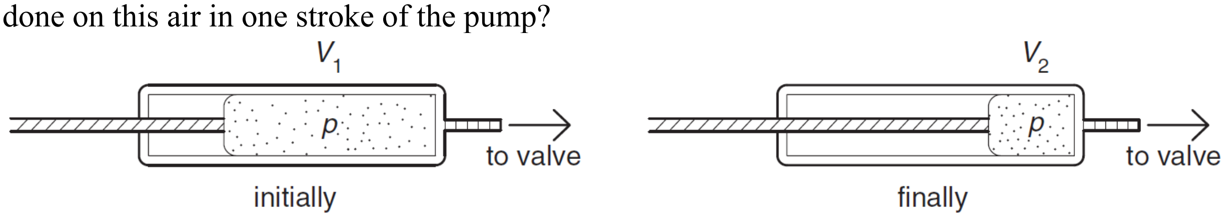
A. 3.0 N m
B. 5.2 N m
C. 6.9 N m
D. 12 N m

Q13. A stationary firework explodes into four fragments which travel in different directions in a horizontal plane. The diagram shows the velocity and mass of each fragment. What is the speed *v* of fragment X?



A. 200 m s^{-1}
B. 240 m s^{-1}
C. 300 m s^{-1}
D. 360 m s^{-1}

Q14. Air in a bicycle pump is forced through a valve at a constant pressure *p*. In one stroke of the pump the volume of air in the pump chamber is reduced from V_1 to V_2. What is the work done on this air in one stroke of the pump?



A. $p(V_1 - V_2)/2$

B. $p(V_1 + V_2)$
C. $p(V_1 - V_2)$
D. pV_1

Q15. Monochromatic light of wavelength 5.30×10^{-7} m is incident normally on a diffraction grating. The first order maximum is observed at an angle of 15.4°to the direction of the incident light. What is the angle between the first and second order diffraction maxima?
A. 7.7°
B. 15.4°
C. 16.7°
D. 32.1°

OPEN-ENDED QUESTIONS

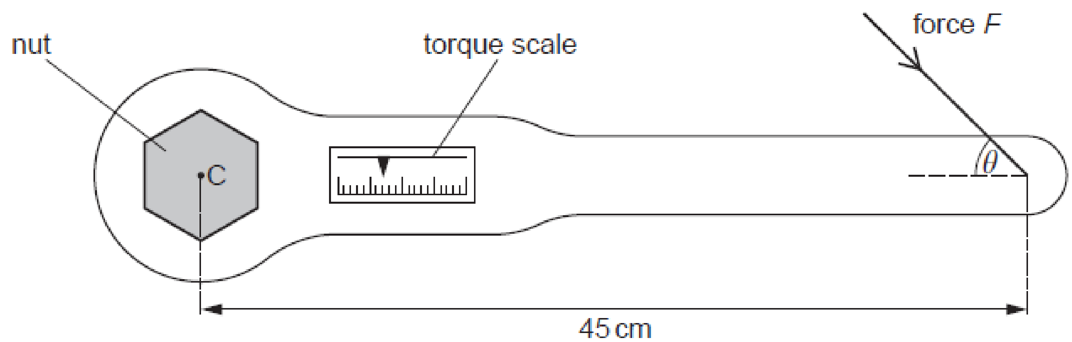
Q16. (a) Define the *torque* of a couple.

....

....

.... [2]

(b) A torque wrench is a type of spanner for tightening a nut and bolt to a particular torque, as shown below



The wrench is put on the nut and a force is applied to the handle. A scale indicates the torque applied.

The wheel nuts on a particular car must be tightened to a torque of 130 N m. This is achieved by applying a force F to the wrench at a distance of 45 cm from its centre of rotation C. This force F may be applied at any angle θ to the axis of the handle, as

shown in the figure above.

For the minimum value of F to achieve this torque,

(i) state the magnitude of the angle θ that should be used,

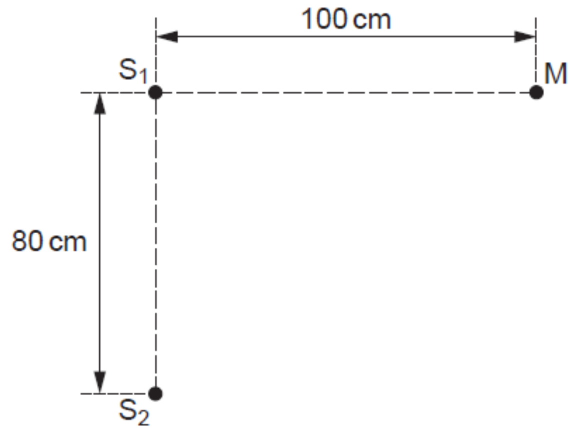
θ = ... ° [1]

(ii) calculate the magnitude of F.

F = ... N [4]

[Total: 7]

Q17. Two sources S_1 and S_2 of sound are situated 80 cm apart in air, as shown below



The frequency of vibration can be varied. The two sources always vibrate in phase but have different amplitudes of vibration.

A microphone M is situated a distance 100 cm from S_1 along a line that is normal to S_1S_2.

As the frequency of S_1 and S_2 is gradually increased, the microphone M detects maxima and minima of intensity of sound.

(a) State the two conditions that must be satisfied for the intensity of sound at M to be zero.

1. ....

....

2. ....

.... [2]

(b) The speed of sound in air is 330 m s^{-1}. The frequency of the sound from S_1 and S_2 is increased. Determine the number of minima that will be detected at M as the frequency is increased from 1.0 kHz to 4.0 kHz.

number = ... [4]

[Total: 6]

Q18. (a) Explain why, for the photoelectric effect, the existence of a threshold frequency and a very short emission time provide evidence for the particulate nature of electromagnetic radiation, as opposed to a wave theory.

....

....

....

....

....

.... [4]

(b) State and explain two relations in which the Planck constant h is the constant of proportionality.

1. ....

....

....

2. ....

....

.... [6]

[Total: 10]

Q19. (a) A sample of a radioactive isotope contains N nuclei at time t. At time $(t + \Delta t)$, it contains $(N - \Delta N)$ nuclei of the isotope.

For the period Δt, state, in terms of N, ΔN and Δt,

(i) the mean activity of the sample,

activity = ... [1]

(ii) the probability of decay of a nucleus.

probability = ... [1]

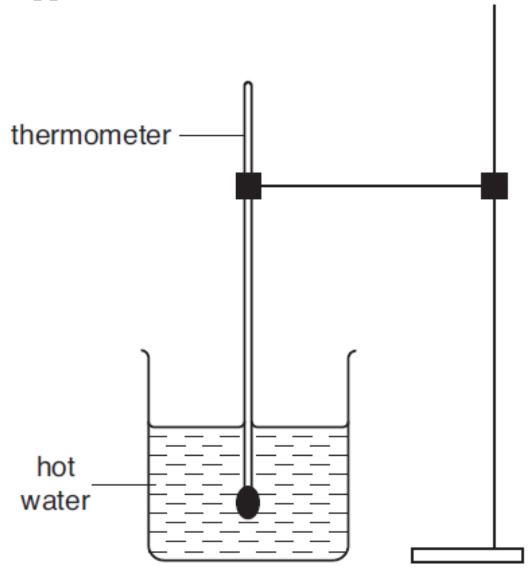
(b) A cobalt-60 source having a half-life of 5.27 years is calibrated and found to have an activity of 3.50×10^5 Bq. The uncertainty in the calibration is ±2%.

Calculate the length of time, in days, after the calibration has been made, for the stated activity of 3.50×10^5 Bq to have a maximum possible error of 10%.

time = ... days [4]

[Total: 6]

Q20. Students are investigating the cooling of water in the Physics laboratory.
The figure below shows the apparatus used:



Hot water is poured into the beaker and temperature readings are taken as the water cools.
Table 1. shows the readings taken by one student.

t / s	θ / °C
0	85
30	78
60	74
90	71
120	69
150	67
300	63

Table 1.

(a) (i) Using the information in the table, calculate the temperature change T_1 of the water in the **first** 150 s.

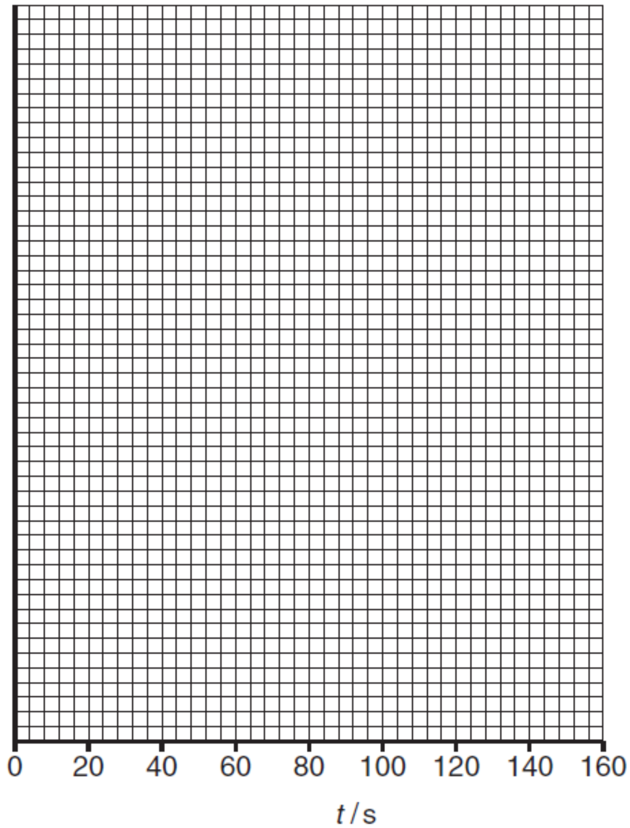
T_1 = ...

(ii) Using the information in the table, calculate the temperature change T_2 of the water in the **final** 150 s.

T_2 = ...

[4]

(b) Plot a graph of θ/°C (*y*-axis) against *t*/s (*x*-axis) for the first 150 s.



[5]

(c) During the experiment the rate of temperature change decreases.

(i) Describe briefly how the results that you have calculated in part (a) show this trend.

....

....

(ii) Describe briefly how the graph line shows this trend.

....

....

[2]

[Total: 11]