SAMPLE EXAMINATION QUESTIONS FOR THE PHYSICS GLOBAL FINAL - CATEGORY 3 (GRADES 11-12)

Q1. Which physical quantity could have units of $N\ s^2\ m^{-1}$?
A. acceleration
B. force
C. mass
D. momentum

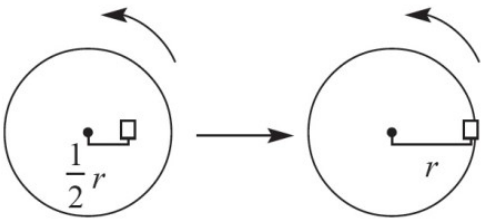
Q2. A body having uniform acceleration a increases its velocity from u to v in time t. Which expression would not give a correct value for the body's displacement during time t?
A. $ut + at^2/2$
B. $vt - at^2/2$
C. (v+u)(v-u)2a
D. (v-u)t/2

Q3. A submarine descends vertically at constant velocity. The three forces acting on the submarine are viscous drag, upthrust and weight. Which relationship between their magnitudes is correct?
A. weight < drag
B. weight = drag
C. weight < upthrust
D. weight > upthrust

Q4. A wire is stretched by applying increasing values of force *F*. For each value of force applied, the extension *x* is recorded. A force–extension graph is plotted from the data obtained. Which statement about the area under the graph **must** be correct?
A. It can be calculated as *Fx/2*.
B. It is the elastic potential energy stored in the stretched sample.
C. It is the work done in stretching the sample.
D. It would be the same for any wire of the same material.

Q5. An electromagnetic wave has a wavelength that is numerically of the same order of magnitude as the diameter of a nucleus. In which region of the electromagnetic spectrum does the wave occur?
A. gamma ray
B. X-ray
C. visible light
D. infra-red

Q6. An object is resting on a platform that rotates at a constant speed. At first, it is a distance of half the platform's radius from the center. If the object is moved to the edge of the platform, what happens to the centripetal force that it experiences? (Assume the platform continues rotating at the same speed.)

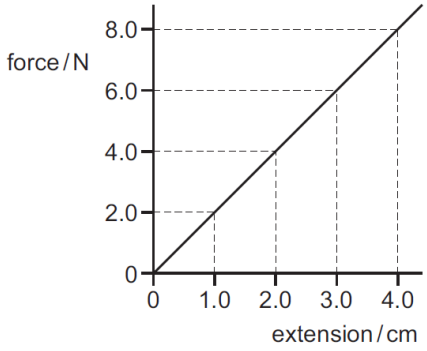


Top view

A. Increases by a factor of 4
B. Increases by a factor of 2
C. Decreases by a factor of 2
D. Decreases by a factor of 4

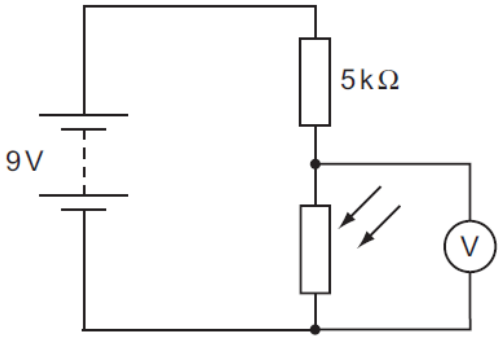
Q7. The acceleration of free fall on a planet P is 1/6 of the acceleration of free fall on Earth. The mass of a body on planet P is 30 kg. What is its weight on planet P?
A. 4.9 N
B. 49 N
C. 180 N
D. 290 N

Q8. The variation with applied force of the extension of a spring is shown in the graph. When there is no force applied to the spring, it has a length of 1.0 cm. What is the **increase** in the strain energy stored in the spring when its length is increased from 2.0 cm to 3.0 cm?



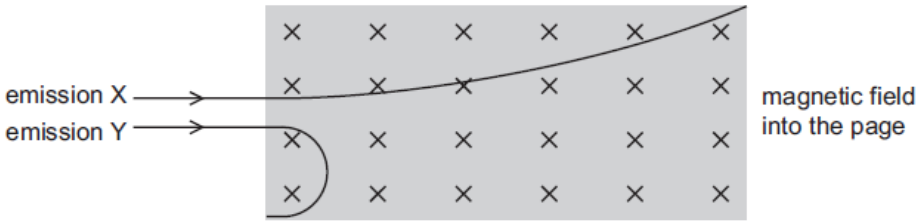
A. 0.020 J
B. 0.030 J
C. 0.040 J
D. 0.050 J

Q9. A circuit is set up with an LDR and a fixed resistor as shown. The voltmeter reads 4 V. The light intensity is increased. What is a possible voltmeter reading?



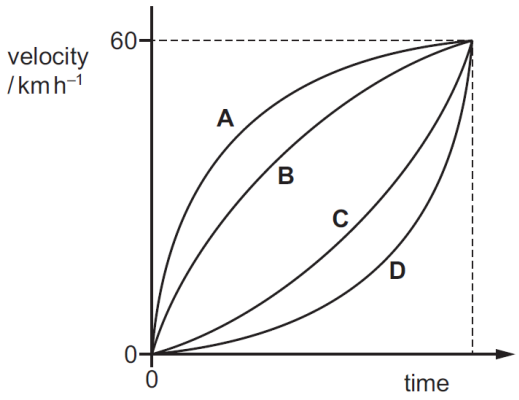
A. 3 V
B. 4 V
C. 6 V
D. 8 V

Q10. Emissions X and Y from radioactive material are passed through a magnetic field. The diagram shows the direction of the emissions, the direction of the magnetic field and the effect on the emissions. Which type of emission is X, and which type of emission is Y?



	emission X	emission Y
A	α-particles	β-particles
B	α-particles	γ-rays
C	β-particles	α-particles
D	β-particles	γ-rays

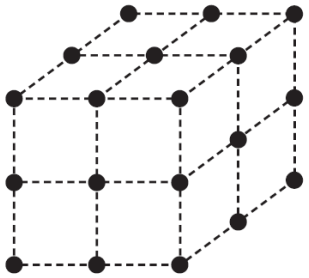
Q11. Four cars, **A**, **B**, **C** and **D**, move from rest in a straight line. The cars take the same time to accelerate to a velocity of 60 km h^{-1}. Their velocity–time graphs are shown. Which car reaches a velocity of 60 km h^{-1} in the shortest distance?



Q12. An elastic collision occurs between two bodies X and Y. The mass of body X is *m* and the mass of body Y is 4*m*. Body X travels at speed *v* before the collision and speed 3v/5 in the opposite direction after the collision. Body Y is stationary before the collision. What is the kinetic energy of body Y after the collision?

A. $8mv^2/10$
B. $34mv^2/50$
C. $16mv^2/50$
D. $mv^2/5$

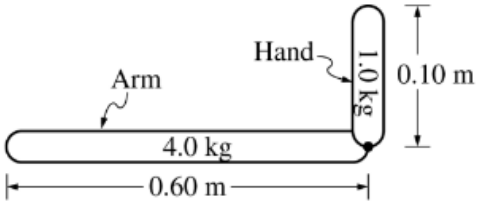
Q13. The diagram shows the arrangement of atoms in a particular crystal. Each atom is at the corner of a cube. The mass of each atom is 3.5×10^{-25} kg. The density of the crystal is 9.2×10^3 kg m^{-3}. What is the shortest distance between the centres of two adjacent atoms?



A. 3.8×10^{-29} m
B. 6.2×10^{-15} m
C. 3.4×10^{-10} m
D. 3.0×10^{-9} m

Q14. Free electrons flow along a copper wire X of radius 5.0×10^{-5} m with an average drift speed of 2.8×10^{-2} m s^{-1}. The current in the wire is 3.0 A. There is a current of 2.0 A in a copper wire Y of radius 1.0×10^{-4} m. What is the average drift speed of the free electrons in copper wire Y?
A. 4.7×10^{-3} m/s
B. 9.3×10^{-3} m/s
C. 1.1×10^{-2} m/s
D. 1.9×10^{-2} m/s

Q15. The arm is held in the horizontal position and the hand is bent at the wrist so the fingers point up, as shown in the figure.



Note: Figure not drawn to scale.

The torque exerted by the weight of the hand with respect to the shoulder is most nearly
A. 6 N m
B. 10 N m
C. 30 N m
D. 60 N m
E. 70 N m

OPEN-ENDED QUESTIONS

Q16. (a) (i) Define power.

.....

..... [1]

(ii) Mechanical power P can be calculated using the formula $P = Fv$.

Use the concept of work and the definition of power to show how this formula is derived.

[2]

(b) The engine of a lorry provides 130 kW of power to the lorry's wheels when it is travelling at a constant speed of 25 m s^{-1} along a straight horizontal road.

Show that the resistive force opposing the forward motion of the lorry is 5200 N.

[1]

(c) The lorry in (b) travels up a straight section of road that is inclined at an angle θ to the horizontal, as shown in Fig. 16.1.

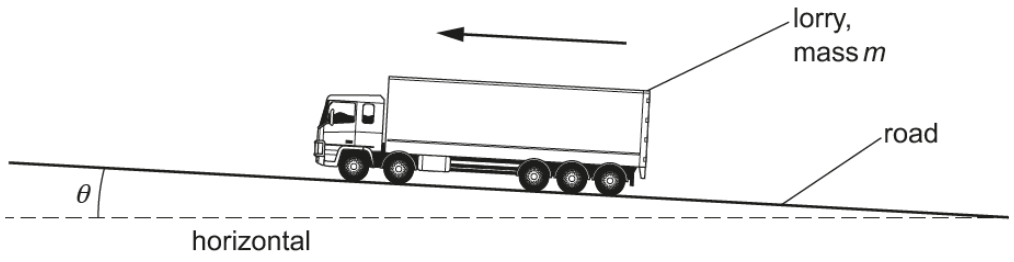


Fig. 16.1 (not to scale)

The lorry has mass m and the acceleration of free fall is g.

(i) Determine an expression, in terms of m, g and θ, for the component of the weight of the lorry that acts parallel to the surface of the road.

[1]

(ii) The total resistive force remains unchanged at 5200 N and the engine now provides greater power to maintain the speed of 25 m s^{-1}. The total mass m of the lorry is 36 000 kg. The angle θ is 1.4°.

Determine the power, in kW, now provided by the engine.

power = ... kW [3]

[Total: 8]

Q17. (a) State Ohm's law.

.....

.....

…..... [2]

(b) The variation of current I with potential difference V for a filament lamp is shown in Fig. 17.1.

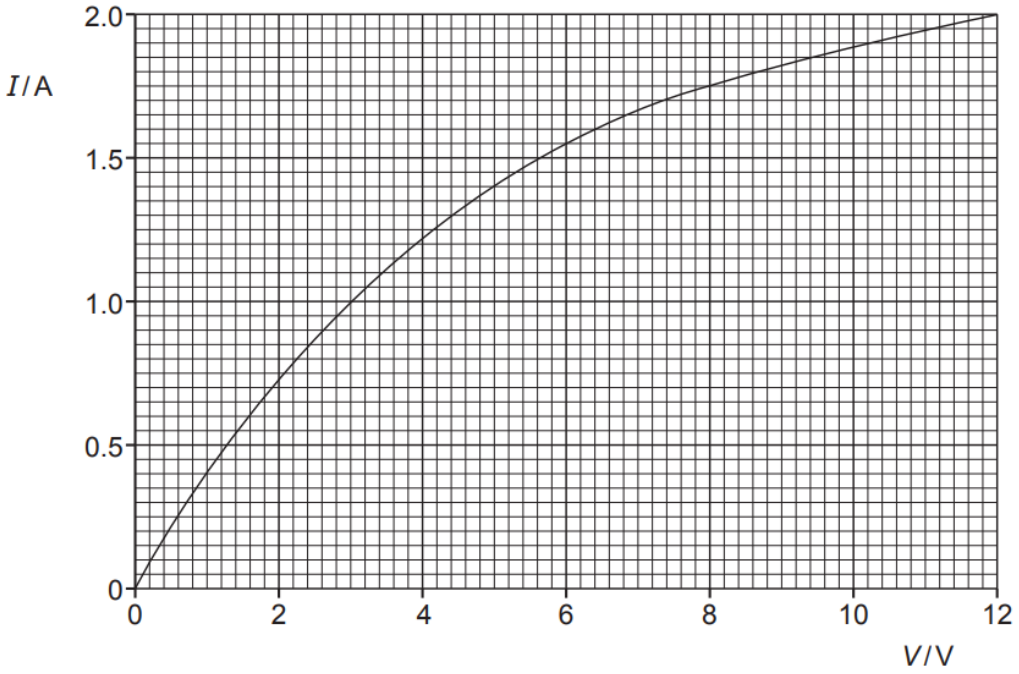


Fig. 17.1

The resistance of the filament lamp increases with potential difference.

(i) State how Fig. 17.1 shows this.

.....

..... [1]

(ii) Explain why the resistance varies in this way.

.....

..... [1]

(c) Fig. 17.2 shows a circuit with a battery of electromotive force (e.m.f.) 12.0V connected to a linear potentiometer AB and two identical filament lamps P and Q.

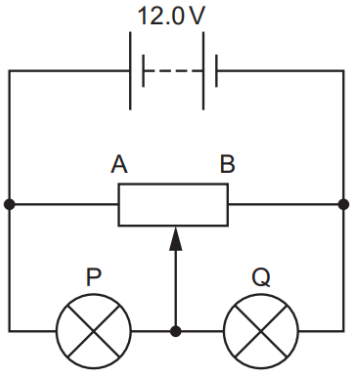


Fig. 17.2

The battery has negligible internal resistance and the lamps each have the same I–V characteristic shown in Fig. 17.1.

When the slider of the potentiometer is at its midpoint, as shown in Fig. 2, the current I in the battery is 1.78A.

Determine:

(i) the current in lamp P

current = ... A [1]

(ii) the total power dissipated in lamps P and Q

total power = ... W [2]

(iii) the resistance of the potentiometer between its ends A and B.

resistance = ... Ω [2]

(d) The slider of the potentiometer in c) is moved to end A. State and explain the effect on the brightness of lamps P and Q.

lamp P: .....

.....

lamp Q: .....

.....

[2]

[Total: 11]

Q18. (a) State the most appropriate instrument, or instruments, for the measurement of the following.

(i) the diameter of a wire of diameter about 1 mm

..... [1]

(ii) the resistance of a filament lamp

..... [1]

(iii) the peak value of an alternating voltage

..... [1]

(b) The mass of a cube of aluminium is found to be 580 g with an uncertainty in the measurement of 10 g. Each side of the cube has a length of (6.0 ± 0.1) cm.

Calculate the density of aluminium with its uncertainty. Express your answer to an appropriate number of significant figures.

density = ... ± ..... g cm^{-3} [4]

[Total: 7]

Q19. A horizontal spring is fixed at one end. A block is pushed against the other end of the spring so that the spring is compressed, as shown in Fig. 19.1.

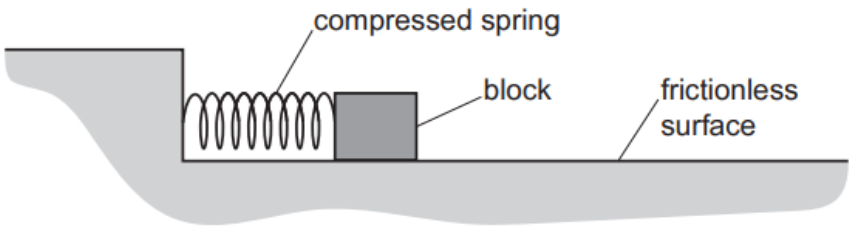


Fig. 19.1

The block is released and accelerates along a horizontal frictionless surface as the spring returns to its original length. The block leaves the end of the spring with a speed of $2.3 ms^{-1}$, as shown in Fig. 19.2.

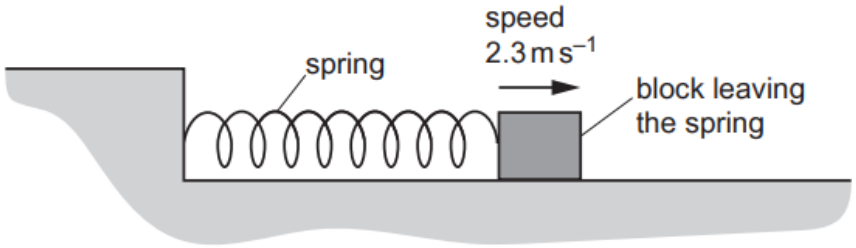


Fig. 19.2

The block has a mass of 250g and the spring has a spring constant of $420 Nm^{-1}$.

Assume that the spring always obeys Hooke's law and that all the elastic potential energy of the spring is transferred to the kinetic energy of the block.

(a) Calculate the kinetic energy of the block as it leaves the spring.

kinetic energy = ... J [2]

(b) Calculate the compression of the spring immediately before the block is released.

compression = ... m [2]

(c) After leaving the spring, the block moves along the surface until it hits a barrier at a speed of 2.3ms^{-1}. The block then rebounds at a speed of 1.5ms–1 and moves back along its original path. The block is in contact with the barrier for a time of 0.086s.

Calculate:

(i) the change in momentum of the block during the collision

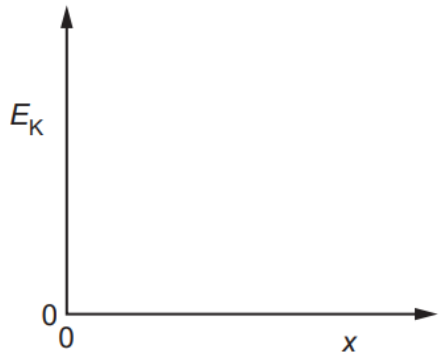
change in momentum = ... Ns [2]

(ii) the average resultant force exerted on the block during the collision.

average resultant force = ... N [1]

(d) The maximum compression x of the spring is now varied in order to vary the kinetic energy EK of the block as it leaves the spring. Assume that all the elastic potential energy in the spring is always transferred to the kinetic energy of the block.

On the diagram below, sketch a graph to show the variation with x of EK. [1]



[Total: 8]

Q20. A student carries out an experiment to determine the density of plasticine. She records the mass *m* and the volume *V* of a range of differently-sized samples. These readings are plotted on a graph as shown in Fig. 20.1.

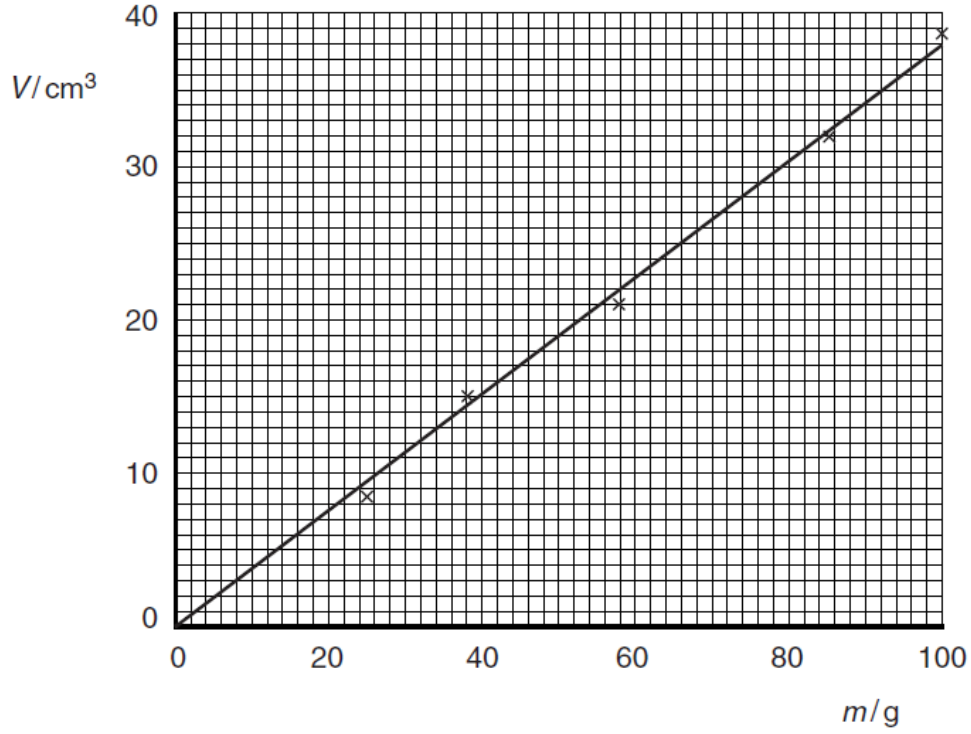


Fig. 20.1

(a) (i) Determine the gradient *G* of the line. Show clearly how you obtain the necessary information.

G = ...

(ii) Determine the density ρ of the plasticine using the equation $\rho = 1/G$

ρ = ...[5]

(b) The student could calculate the density from one set of readings. Suggest why she takes more than one set of readings and plots a graph.

.....

..... [1]

[Total: 6]