IB Demystified

Examiners · Moderators · Mentors

Physics

Higher Level

Paper 1A — Mock Examination

Mock Exam 3

Calculator required

Time allowed: **1 hour 20 minutes**

Maximum mark: **40 marks**

Candidate information

Candidate name: .....

Session number: .....

Date: .....

Topic emphasis: mechanics, relativity, thermal physics, waves, fields, quantum and nuclear physics

Instructions to candidates

- Write your session number in the box on the cover.
- Do not open this examination paper until you are told to do so.
- Answer **all** questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer grid provided on page 3.
- A calculator **is** required for this paper.
- A clean copy of the **physics data booklet** is required for this paper.
- Each question is worth one mark. No marks are deducted for incorrect answers, so you should attempt every question.
- The maximum mark for this paper is **[40 marks]**.

Where necessary, take the magnitude of the gravitational field strength at the Earth's surface to be $g = 9.81\ \text{N}\,\text{kg}^{-1}$ and the speed of sound in air to be $340\ \text{m}\,\text{s}^{-1}$. Values of all other constants are given in the data booklet.

Only one response per question will be marked. If you change an answer, make sure the response you do not want is completely erased or crossed out.

Answer grid

Shade or circle one letter for each question.

Q	A	B	C	D		Q	A	B	C	D
1	○	○	○	○		21	○	○	○	○
2	○	○	○	○		22	○	○	○	○
3	○	○	○	○		23	○	○	○	○
4	○	○	○	○		24	○	○	○	○
5	○	○	○	○		25	○	○	○	○
6	○	○	○	○		26	○	○	○	○
7	○	○	○	○		27	○	○	○	○
8	○	○	○	○		28	○	○	○	○
9	○	○	○	○		29	○	○	○	○
10	○	○	○	○		30	○	○	○	○
11	○	○	○	○		31	○	○	○	○
12	○	○	○	○		32	○	○	○	○
13	○	○	○	○		33	○	○	○	○
14	○	○	○	○		34	○	○	○	○
15	○	○	○	○		35	○	○	○	○
16	○	○	○	○		36	○	○	○	○
17	○	○	○	○		37	○	○	○	○
18	○	○	○	○		38	○	○	○	○
19	○	○	○	○		39	○	○	○	○
20	○	○	○	○		40	○	○	○	○

Total	/ 40

1. A ball is thrown vertically upwards from the ground with a speed of 20 $\mathrm{m\,s^{-1}}$. Air resistance is negligible. How long after being thrown does the ball return to the ground?

A. 2.0 s

B. 4.1 s

C. 8.2 s

D. 20 s

[1]

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2. A boat is steered due north and moves at 4.0 $\mathrm{m\,s^{-1}}$ relative to the water of a river. The river flows due east at 3.0 $\mathrm{m\,s^{-1}}$ relative to the bank. What is the speed of the boat relative to the bank?

A. 1.0 $\mathrm{m\,s^{-1}}$

B. 3.5 $\mathrm{m\,s^{-1}}$

C. 5.0 $\mathrm{m\,s^{-1}}$

D. 7.0 $\mathrm{m\,s^{-1}}$

[1]

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3. A person of mass 70 kg stands on a bathroom scale in a lift. The lift accelerates vertically upwards at 2.0 $\mathrm{m\,s^{-2}}$. What is the reading on the scale?

A. 140 N

B. 550 N

C. 690 N

D. 830 N

[1]

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4. A resultant force of 5.0 N acts for 4.0 s on a body of mass 10 kg that is initially at rest. What is the speed of the body at the end of this time?

A. 0.50 $\mathrm{m\,s^{-1}}$

B. 2.0 $\mathrm{m\,s^{-1}}$

C. 5.0 $\mathrm{m\,s^{-1}}$

D. 20 $\mathrm{m\,s^{-1}}$

[1]

5. A ball of mass 0.50 kg is released from rest at a height of 2.0 m above the ground and rebounds to a height of 1.2 m. How much mechanical energy is lost by the ball?

A. 3.9 J

B. 5.9 J

C. 7.8 J

D. 9.8 J

[1]

6. A wheel accelerates uniformly from an angular speed of 10 rad s^{-1} to 30 rad s^{-1} in 4.0 s. Through what angle does the wheel turn during this time?

A. 10 rad

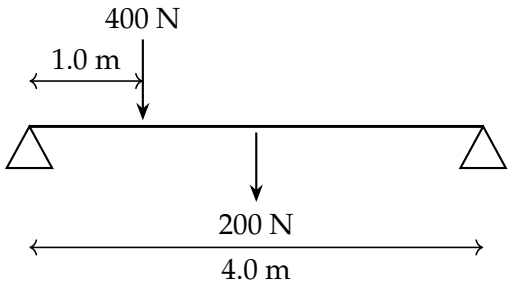
B. 20 rad

C. 40 rad

D. 80 rad

[1]

7. A uniform beam of length 4.0 m and weight 200 N rests on two supports, one at each end. A load of weight 400 N is placed 1.0 m from the left-hand support.



What is the magnitude of the force exerted by the left-hand support on the beam?

A. 200 N

B. 300 N

C. 400 N

D. 500 N

[1]

8. Two events occur at different positions but at the same time in an inertial reference frame S. What is correct about these events in an inertial reference frame S′ that moves relative to S?

A. They are simultaneous in every inertial reference frame.

B. They are simultaneous only if the clocks in S and S′ are synchronized.

C. They are not simultaneous, and the event at the greater value of x always occurs first.

D. They are not simultaneous, and which event occurs first depends on the direction of the relative motion.

[1]

9. An electron moves at a speed of $0.60c$. The rest energy of an electron is 0.511 MeV. What is the total energy of the electron?

A. 0.31 MeV

B. 0.51 MeV

C. 0.64 MeV

D. 0.85 MeV

[1]

10. A mass of 0.20 kg of water at 80 °C is mixed with 0.30 kg of water at 20 °C in an insulated container. What is the final temperature of the mixture?

A. 32 °C

B. 44 °C

C. 50 °C

D. 56 °C

[1]

11. What quantity of thermal energy is required to change 0.50 kg of water at 100 °C into steam at 100 °C? The specific latent heat of vaporization of water is 2.3×10^6 J kg^{-1}.

A. 0.11 MJ

B. 0.23 MJ

C. 0.57 MJ

D. 1.1 MJ

[1]

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12. A star behaves as a black body. Both the radius and the surface temperature of the star double. By what factor does the luminosity of the star increase?

A. 4

B. 8

C. 16

D. 64

[1]

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13. A fixed mass of an ideal gas is compressed to half its original volume at constant temperature.
What happens to the number of molecular collisions per unit area of the container wall per unit time and to the mean square speed of the molecules?

	Collisions per unit area per unit time	Mean square speed
A.	doubles	unchanged
B.	doubles	doubles
C.	unchanged	doubles
D.	unchanged	unchanged

[1]

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14. A fixed mass of an ideal gas is heated at constant volume. Which is correct?

A. The gas does work on the surroundings and its internal energy increases.

B. No work is done by the gas and its internal energy increases.

C. No work is done by the gas and its internal energy is unchanged.

D. Work is done on the gas and its temperature is unchanged.

[1]

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15. In each cycle, a heat engine absorbs 500 J of thermal energy from a hot reservoir and does 200 J of useful work. What is the efficiency of the engine?

A. 0.20

B. 0.29

C. 0.40

D. 0.60

[1]

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16. Resistors of resistance 4.0 kΩ and 8.0 kΩ are connected in series across a supply of 12 V with negligible internal resistance. What is the potential difference across the 8.0 kΩ resistor?

A. 3.0 V

B. 4.0 V

C. 6.0 V

D. 8.0 V

[1]

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17. A copper wire has a length of 2.0 m and a cross-sectional area of 0.50 mm^2. The resistivity of copper is $1.7 \times 10^{-8}\ \Omega\,m$. What is the resistance of the wire?

A. 0.068 Ω

B. 0.68 Ω

C. 6.8 Ω

D. 68 Ω

[1]

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18. A mass of 0.20 kg oscillates on a spring of spring constant 50 $\mathrm{N\,m^{-1}}$. What is the period of the oscillation?

A. 0.13 s

B. 0.40 s

C. 2.5 s

D. 7.9 s

[1]

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19. A mass oscillates with simple harmonic motion of amplitude 0.050 m on a spring of spring constant 200 $\mathrm{N\,m^{-1}}$. What is the total energy of the oscillation?

A. 0.25 J

B. 0.50 J

C. 5.0 J

D. 10 J

[1]

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20. Which property is shown by transverse waves but not by longitudinal waves?

A. They can be diffracted.

B. They transfer energy without transferring matter.

C. They can be polarized.

D. They can be refracted.

[1]

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21. The refractive index of a glass block is 1.5. What is the critical angle for light passing from the glass into air?

A. 30°

B. 42°

C. 48°

D. 60°

[1]

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22. A string of length 1.2 m is fixed at both ends. What is the wavelength of the standing wave formed when the string oscillates in its second harmonic?

A. 0.60 m

B. 0.80 m

C. 1.2 m

D. 2.4 m

[1]

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23. A stationary source emits sound of frequency 400 Hz. An observer moves directly away from the source at 20 m s^{-1}. What is the frequency of the sound received by the observer?

A. 376 Hz

B. 400 Hz

C. 424 Hz

D. 447 Hz

[1]

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24. The gravitational field strength at the surface of a spherical planet of radius R is g. What is the gravitational field strength at a distance $2R$ from the centre of the planet?

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

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

C. $2g$

D. $4g$

[1]

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25. A satellite in a circular orbit of radius r around a planet has a period T. What is the period of a satellite in a circular orbit of radius $9r$ around the same planet?

A. $3T$

B. $9T$

C. $27T$

D. $81T$

[1]

26. The mass of the Earth is 5.97×10^{24} kg and its radius is 6.37×10^{6} m. What is the gravitational potential at the surface of the Earth?

A. $-9.8 \times 10^{6}\ \text{J kg}^{-1}$

B. $-6.3 \times 10^{7}\ \text{J kg}^{-1}$

C. $-3.1 \times 10^{8}\ \text{J kg}^{-1}$

D. $-4.0 \times 10^{14}\ \text{J kg}^{-1}$

[1]

27. Two point charges of 2.0 μC and 3.0 μC are separated by a distance of 0.30 m in a vacuum. What is the magnitude of the electrostatic force between them?

A. 0.60 N

B. 6.0 N

C. 60 N

D. 600 N

[1]

28. Two parallel conducting plates are separated by 2.0 cm in a vacuum. The potential difference between the plates is 400 V. What is the magnitude of the electric field strength between the plates?

A. $8.0\ \text{V m}^{-1}$

B. $200\ \text{V m}^{-1}$

C. $2.0 \times 10^{4}\ \text{V m}^{-1}$

D. $8.0 \times 10^{4}\ \text{V m}^{-1}$

[1]

29. An electron moves at 3.0×10^6 m s^{-1} at right angles to a uniform magnetic field of strength 0.20 T. What is the magnitude of the magnetic force on the electron?

A. 9.6×10^{-14} N

B. 3.8×10^{-13} N

C. 6.0×10^{-13} N

D. 9.6×10^{-26} N

[1]

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30. A straight wire carries a conventional current due north. The wire is in a uniform magnetic field directed vertically downwards. What is the direction of the magnetic force on the wire?

A. Due west

B. Due east

C. Due north

D. Vertically upwards

[1]

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31. The magnetic flux through each turn of a coil of 100 turns decreases uniformly from 8.0 mWb to 2.0 mWb in 0.30 s. What is the magnitude of the emf induced in the coil?

A. 0.020 V

B. 0.60 V

C. 2.0 V

D. 20 V

[1]

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32. In a photoelectric experiment the stopping voltage for a particular metal and light source is 1.5 V. What is the maximum kinetic energy of the emitted photoelectrons?

A. 1.5×10^{-19} J

B. 2.4×10^{-19} J

C. 9.6×10^{-19} J

D. 2.4×10^{-18} J

[1]

33. What is the momentum of a photon of wavelength 2.0×10^{-11} m?

A. $3.3 \times 10^{-45}\ \text{kg m s}^{-1}$

B. $3.3 \times 10^{-23}\ \text{kg m s}^{-1}$

C. $6.6 \times 10^{-23}\ \text{kg m s}^{-1}$

D. $1.3 \times 10^{-14}\ \text{kg m s}^{-1}$

[1]

34. A beam of electrons is directed at a thin crystal and a pattern of rings is observed on a screen beyond the crystal. This observation is evidence for

A. the particle nature of light.

B. the existence of discrete atomic energy levels.

C. the wave nature of matter.

D. mass–energy equivalence.

[1]

35. The ionization energy of a hydrogen atom in its ground state is 13.6 eV. What is the longest wavelength of a photon that can ionize a hydrogen atom in its ground state?

A. 91 nm

B. 122 nm

C. 365 nm

D. 656 nm

[1]

36. Which type of radiation is the most penetrating, and which has the greatest ionizing power?

	Most penetrating	Greatest ionizing power
A.	alpha	gamma
B.	beta	alpha
C.	gamma	beta
D.	gamma	alpha

[1]

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37. In a nuclear reaction the total mass of the particles decreases by 0.020 u. How much energy is released in this reaction?

A. 1.9 MeV

B. 18.6 MeV

C. 186 MeV

D. 931 MeV

[1]

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38. What is the main function of the moderator in a thermal nuclear fission reactor?

A. To absorb excess neutrons so that the rate of reaction is controlled.

B. To shield the operators of the reactor from ionizing radiation.

C. To transfer thermal energy from the reactor core to the turbines.

D. To slow down neutrons so that further fission becomes more likely.

[1]

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39. A star is at a distance of 10 pc from the Earth. What is the stellar parallax angle of this star?

A. 0.010 arc-seconds

B. 0.050 arc-seconds

C. 0.075 arc-seconds

D. 0.10 arc-seconds

[1]

40. A main-sequence star with a mass similar to that of the Sun leaves the main sequence. What is the expected sequence of its later evolution?

A. It becomes a white dwarf directly, without expanding.

B. It explodes as a supernova and leaves a neutron star.

C. It collapses directly to form a black hole.

D. It becomes a red giant and then a white dwarf.

[1]

End of examination.

Total: 40 marks